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Annex-I: “Description of Work”

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1. PROJECT SUMMARY	5
2. PROJECT OBJECTIVE(S) AND STATE OF THE ART	6
EUROPEAN QIPC RESEARCH: STATE OF THE ART AND GOALS	6
QIPC RESEARCH AT EUROPEAN LEVEL: STRUCTURE AND PERSPECTIVES	7
OBJECTIVES OF THE CA	8
3. PARTICIPANTS LIST	11
4. RELEVANCE TO THE OBJECTIVES OF FET OPEN	12
POLICY, TECHNICAL AND SCIENTIFIC OBJECTIVES	12
SOCIO-ECONOMIC OBJECTIVES	12
5. POTENTIAL IMPACT	14
5.1 CONTRIBUTIONS TO STANDARDS	16
6. PROJECT MANAGEMENT AND EXPLOITATION/DISSEMINATION PLANS	17
6.1 PROJECT MANAGEMENT	17
6.2 PLAN FOR USING AND DISSEMINATING KNOWLEDGE	19
6.3 RAISING PUBLIC PARTICIPATION AND AWARENESS	19
7. DETAILED IMPLEMENTATION PLAN – FOR WHOLE DURATION OF THE PROJECT	20
7.1 INTRODUCTION: GENERAL DESCRIPTION AND MILESTONES	20
7.2 WORK PLANNING AND TIMETABLE	36
7.3 GRAPHICAL PRESENTATION OF WORKPACKAGES	39
7.4 WORKPACKAGE LIST	40
7.5 DELIVERABLES LIST	41
7.6 WORKPACKAGE DESCRIPTIONS	46
8. PROJECT RESOURCES AND BUDGET OVERVIEW	67
8.1 EFFORTS FOR THE PROJECT	70
8.2 OVERALL BUDGET FOR THE PROJECT	74
8.3 MANAGEMENT LEVEL DESCRIPTION OF RESOURCES AND BUDGET	82
9 OTHER ISSUES	86
ETHICAL AND GENDER ISSUE	86
ETHICAL ISSUES FORM	86

APPENDIX A: CONSORTIUM DESCRIPTION	88
A.1 PARTICIPANTS AND CONSORTIUM	88
A.2 SUB-CONTRACTING	113
A.3 THIRD PARTIES	113

1. PROJECT SUMMARY

Quantum Information Processing and Communication (QIPC) is a vigorously active cross-disciplinary field drawing upon theoretical and experimental physics, computer science, engineering, mathematics, and material science. Despite its young age (the first groundbreaking proposals were published in the early- and mid 90s) this novel field is by now one of the most active in natural sciences, as witnessed by a large number of publications in such prominent journals as Nature and Science.

The importance of various research activities within QIPC has been recognized by the FET Open programme, and QIPC is overall one of the most active research fields within FET. At present the European QIPC community has reached a critical mass in all relevant subfields, but there is a clear lack of a structure unifying and coordinating all this variety of research, educational and commercial efforts at the European level. QUROPE will establish a formal and structured approach for further development of strategic vision, collaboration, and dissemination.

The emergence of a new QIPC technology will make an enormous contribution to the future of Europe – witness the effect generated by the vast growth in conventional information technology over recent decades. Rather than replacing IT, a new QIT will emerge alongside it, creating new jobs. The new technology will enable us to perform previously impossible (or utterly difficult) tasks in computing and absolutely secure communication, and therefore contribute to improving the quality of life. The exploitation of quantum effects may revolutionize information processing in the 21st century.

QUROPE will ensure a further systematic advancement of the state of the art in QIPC by converging all efforts at the European level towards building up the QIPC community, in order to develop a common strategy and vision in an orderly and democratic way and prepare the necessary input for the research programmes of the European commission.

2. PROJECT OBJECTIVE(S) AND STATE OF THE ART

EUROPEAN QIPC RESEARCH: STATE OF THE ART AND GOALS

[Source: European QIPC Strategic Report, <http://www.cordis.lu/ist/fet/qipc.htm>]

Quantum Information Processing and Communication (QIPC) is a vigorously active cross-disciplinary field drawing upon theoretical and experimental physics, computer science, engineering, mathematics, and material science. Its scope ranges from fundamental issues in quantum physics to prospective commercial exploitation by the computing and communications industries. It has the potential to revolutionize many areas of science and technology. It exploits fundamentally new modes of computation and communication, because it is based on the physical laws of quantum mechanics instead of classical physics. It holds the promise of immense computing power beyond the capabilities of any classical computer, it guarantees absolutely secure communication, and it is directly linked to emerging quantum technologies, such as, for example, quantum based sensors. European researchers have been from the outset prominent in setting the agenda of, and leading, the worldwide research efforts in quantum information science, in friendly competition with similar efforts and programs in the US, Australia, Canada, Japan and China. This includes pioneering work on the foundations of the quantum theory of computation, quantum algorithms, and the discovery of entangled state quantum cryptography, which generated a spate of new research that established a vigorously active new area of physics, computer science and cryptology. Many subsequent seminal contributions, inspired by the 1994 Shor's quantum factoring algorithm, such as ways of implementing quantum computation using ion traps, quantum dots, cavity QED, optical lattices and a number of other technologies, novel computational architectures, methods of error correction and fault tolerant quantum computation originated in Europe. A unique feature and strength of European research is the broad range of activities and expertise, linking coherently efforts from experimental realization all the way to basic theoretical questions in quantum information science and quantum physics.

The status of the QIPC field in Europe is well described by the fact that many key European researchers who are also key members of this CA proposal are listed among the 100 most cited physicists worldwide and many papers published by the CA partners are within 100 most cited papers in physics in the past 10 years.

The main advances in the field of QIPC are mainly triggered by basic research and most of them were outcomes of curiosity driven research. However a clear set of goals in the coming five to ten years, for each of its three major subfields: quantum computing, quantum communication and quantum information theory.

In **quantum computing** the goal for the next ten years is to develop a few-qubit general-purpose quantum processor including error correction, as a model system to demonstrate quantum algorithms and various quantum computing architectures, and with emphasis on potential scalability. While at present certain physical systems can be identified as prime candidates, it is essential to pursue this goal on a broad basis of competing approaches, allowing hybridization and cross fertilization between different fields (e.g., quantum optics, individual atoms and ions, as well as solid state). In addition, interfaces (with direct relevance for quantum communication) and model systems should be developed for connecting quantum computers in small networks. Parallel to these developments special purpose quantum computers with a few tens of qubits, or more, should be developed, e.g. to act as quantum simulators. The ultimate goal is to construct laboratory models of quantum computers which outperform classical computers on whatever nontrivial problem.

In **quantum communication**, the short-term goal is to develop quantum cryptography towards becoming an established technology and a commercial product. A scientific goal is to demonstrate long-distance quantum communication both in optical fiber and in free space. On the 5-10 year time scale, the goals are to gain several orders of magnitude on the secret bit rate and to demonstrate quantum repeaters. The latter will require the implementation of error correction, entanglement purification, quantum interfaces and quantum memories. Each of the mentioned four requirements constitutes a serious scientific challenge. In particular, the main challenge will be the development of a quantum memory that outperforms the simple, but insufficient, «photon in a fiber loop» technique.

Theory must on one hand continue to play a leading role in guiding and supporting experimental developments. On the other hand fundamental theoretical issues must be pursued. The most important one is the formulation of a quantum information theory, a quantum counterpart to the classical theory of information, computation and communication. This implies the search for new quantum algorithms, new computational models and architectures, as well as quantum communication and entanglement manipulation protocols. A key element is a deeper understanding of entanglement in quantum theory. This includes the understanding of decoherence (an intrinsic property of quantum systems interacting with their environment), which leads to the detrimental effects of imperfections and noise. It is necessary to find ways to overcome them, for example with quantum error correction and purification. It will lead both to a deeper understanding of quantum theory per se, but it is also in direct connection to experimental implementations. Finally, the links of quantum information theory to other branches of physics must be developed, e.g. to condensed matter physics.

To summarize, the future of the QIPC field in Europe and worldwide critically depends on the ability to identify feasible research directions and goals which, when achieved, will make quantum communication and computing a source of further inspiration for the scientific community at large and will provide clear benefits for the society. Such ability will hopefully be provided by the QUROPE CA.

QIPC RESEARCH AT EUROPEAN LEVEL: STRUCTURE AND PERSPECTIVES

QIPC has a high-risk nature and long-term outlook with visions within the scope of information and communication technologies. The potential of QIPC was quickly recognized by FET, whose pathfinder role played a crucial role for the development of QIPC in Europe. In FP5 (1999–2002) FET launched QIPC as a Proactive Initiative (PI). There were two calls for proposals and 25 projects were launched with total cost of 41 M€ and EU funding of 31 M€. In FP6 (2003–2006) QIPC continues as a FET PI. Three Integrated Projects (SCALA, QAP and EuroSQIP) succeeded in the 2004 call and are due to start in November 2005 with a contract for four years. The total EU funding is 25 M€. The proposed research goes clearly beyond the state-of-the-art, which confirms the strong European presence in QIPC and the progress made in the last years. All three consortia involve leading European scientists in their respective fields. In all projects the European dimension is a clear added value. The accent on integration across different disciplines and approaches is very strong and it is considered crucial for the further advancement of QIPC in Europe.

QIPC is also funded via the FET-Open continuous submission scheme. In FP5 ten QIPC projects with total cost of 7 M€ and EU funding of 5.6 M€ were launched. The QUIPROCONe Thematic Network successfully coordinated all QIPC projects in FP5, integrating the projects arising from the Open scheme with those supported through the proactive initiative. In FP6 seven projects are already funded via FET Open and others are expected to follow.

In 2004 there was a call for proposals for coordinated actions related to structuring the ERA (European Research Area). The project “Structuring the ERA with quantum information science and technology” or ERA-Pilot QIST was successful and started work on February 1, 2005 for two years. It has many challenging objectives with the goal to promote QIPC research in Europe and to give recommendations to European and national authorities on policy, coordination and funding.

Within QIPC–FET specific efforts were dedicated to quantum cryptography. In FP4 seed work was done by the EQCSPOT project. It led to a wider field of investigation in a number of projects of the QIPC Proactive Initiative in FP5, where they reached maturity. In FP6 this area of research was transferred to more applied parts of the IST programme. Quantum cryptography is now part of the strategic objective “Towards a global dependability and security framework”, where a large Integrated Project SECOQC is funded with about 40 partners, including several large companies, and EC funding for 11.35 M€.

Projects related to QIPC research have been successful also within the EU programme Improving Human Potential, both with Research and Training Networks (CONQUEST and ATOMCHIPS, involving 16 and 11 partners respectively) and with several Marie-Curie Individual Fellowships.

Apart from the EU programs, QIPC is also coordinated and funded on national level. An extensive list of such initiatives is not available at the moment and it is one of the goals of the project ERA-Pilot QIST. Initiatives exist in the United Kingdom, Denmark, Sweden, Austria, France, Germany, Italy, Slovakia and Poland.

However, on other research areas – especially in the United States of America – structuring of QIPC is much more advanced. An overall strategy (“towards quantum computing”) has been established, and public funding in America is now spent according to this generally accepted strategy. So Europe lags behind, not from a scientific point of view (Europe’s researchers are among the leading groups world wide), but in terms of coordinating QIPC research funding and development. In order not to lose the race in exploiting these developing technologies and in order to remain world leading in QIPC research there is an urgent need in Europe to intensify its structuring efforts within the next few years. **A common vision regarding the future of QIPC in Europe has to be developed and some strategic decisions have to be made accordingly on the level of funding and on the technology focus.** The goal of QUROPE project is to make a significant contribution in this direction.

Although breakthroughs of the type needed to make QIPC a reality cannot be expected to follow a precise timetable, it is imperative that at each point in time we have a clear understanding of the results obtained, an assessment of the strengths and weaknesses in present research, as well as a clear definition of the challenges and the objectives. The collective effort of the scientific community in this direction has resulted in a stable version of **“QIPC: strategic report on current status, visions and goals for research in Europe”**, written by the most prominent scientists in the field. The editing author is Prof. Peter Zoller from the University of Innsbruck. This was really a community effort, as it can be seen from the substantial list of contributors. It is important to note that they have donated their time and expertise without any compensation or a formal structure. This document shows that the research community has been able to organize itself and to present in a comprehensive way the major challenges, visions and goals. In April 2005 a stable version of the strategic report was published on the FET and on the ERA-Pilot QIST project web sites with the goal to initiate a broader discussion and receive feedback from the research community in order to make appropriate corrections. It was given for print as an EC publication in August. On the other hand, it is a living document and it will be regularly updated after its publication. The goal is to always reflect the current situation. The updates are currently taken care of by ERA-Pilot QIST WP1 in collaboration with the research community and FET. Considering the scope of the endeavor and the gained momentum, it is necessary to have an appropriate structured and formal framework for regularly updating and editing the document. Taking over the responsibility of the Roadmap would be one of the major priorities of the present project.

OBJECTIVES OF THE CA

The above analysis shows that the field of QIPC has matured in the last ten years. There is critical mass in Europe in all of the main sub-fields. It is clear that QIPC research has gained an important European dimension which is crucial for its further development. It is, however, necessary to expand and strengthen activities at the European level. From this it follows directly that the goals of the QUROPE CA are to be:

- **Unify, structure and strengthen the QIPC scientific community in Europe** through developing interdisciplinary collaborations, supporting links and facilitating the flow of information about QIPC activities and initiatives among all European QIPC groups. In this respect, the project will actively work with the community and request its direct input through various channels like meetings, e-mail distribution lists, and web-based tools. Studies will be performed on the collected feedback at regular intervals and the resulting information will be used to improve the efficiency of the whole system and to create and express equilibrium and unity across the QIPC community.
- **Develop a common strategy, vision and goals at the scientific level**, that can serve as a guideline for future efforts, while at the same time remaining open to new emerging ideas and approaches. This effort will be based on the QIPC Strategic Report already developed by a committee led by P. Zoller. Most of the members of the ‘roadmap’ committee are partners or affiliated members in the present proposal. As stated above, the strategic report is a living document and it will be regularly expanded and updated. The goal is to make it a

reference document for the competitive and sustained development of QIPC research in Europe. Expert groups will be set up based on this committee to oversee regular updates of the document, building on one hand on the experience of the team who maintained it in ERA-Pilot, and on the other hand on a constant feedback collection from the whole community. A large consensus will be sought to provide input towards the EC in the preparation of upcoming Programmes (in primis FP7) through reports, position papers and other documents.

- **Congregate and co-ordinate all QIPC projects/actions at EU level**, including all FET projects from the QIPC cluster as described in the previous section, but also SECOQC, the two Research & Training Networks CONQUEST and ATOMCHIPS and several Marie Curie fellowships. A common information system, in the form of an extensive web site, will be developed. It will contain links to most major QIPC sites in the world, reflect all main activities in Europe (and if possible in the world), have a web forum (where people can give opinions and suggestions on specific issues), post job advertisements, post CVs of scientists looking for a job, give highlights on or reference to recently published papers or important scientific results, courses or educational material on-line, and serve as a data exchange and communication system for the QIPC community. The CA and its Governing Board will actively shape the scope of the major QIPC annual meetings in Europe in order to steer them along the main strategic directions.
- **Support integration and cross-fertilization across disciplines and subfields**, e.g., between different QIPC realizations, approaches, and technologies such for example quantum communication on one hand and quantum information processor realizations on the other hand, different possible approaches in the development of a quantum processor (e.g., solid state and quantum optics), quantum information theory (e.g., quantum algorithms) and quantum communication or computation, in order to achieve concrete results.
- **Extend investigations towards emerging new areas, topics and applications**, with activities directed also to establishing collaboration with adjacent fields of research. This and the previous objectives will be implemented via concrete coordination activities like meetings, workshops and a major yearly European QIPC event as a forum giving the opportunity for interactions between the members of the projects and for cross-fertilisation and exchange and dissemination of good practice.
- **Encourage promising young researchers in the different QIPC fields** via interchange of students and researchers and short Schools (with emphasis on cross-disciplinary exchange) providing expertise transfer, and aiming at attracting young scientists into the field.
- **Increase the general public awareness and visibility of QIPC in Europe** through a broad range of dissemination actions, both authoring and encouraging publications for a general readership, articles in the specialized press, popular science press, general press – and by making use of the CA website.
- **Establish international cooperation**: beside carrying out activities for the inclusion of new EU member states, the CA will make contacts, negotiate, establish a formal framework towards some kind of international collaboration with the other players like the US, Canada, Australia, Japan, China and Singapore, with the eventual goal of developing a common internationally accepted QIPC roadmap, for instance combining the EU QIPC Strategic Report and the US QIST Roadmap.

These objectives reflect a well-defined vision: to establish a widely recognized common strategy for the development of QIPC in Europe for the years to come, through **an intensified and structured dialogue with and within the community**. All actions in the Workplan are planned around this concept. A series of mechanisms is foreseen to implement this leading idea – for instance, the possibility to propose events or actions to the Governing Board via competitive calls, the possibility to add new partners, a web forum for discussion of relevant issues and the collection of feedback from the community. The goal of all these measures is to achieve **flexibility, openness and the ability to respond to specific and possibly unforeseen needs**, in order to prevent the CA from evolving into some sort of closed and self-referential structure.

The **authority** of this CA is insured by the fact that the Legal Partner and affiliated members of the CA represent the entire QIPC community to the best of our current knowledge. This inherently **bottom-up approach is complementary to that of the currently running ERA-Pilot QIST project**, which is essentially an intergovernmental initiative aiming at collecting information about QIPC funding in Europe, analyzing it and formulating suggestions and recommendations to national and European funding agencies. ERA-Pilot has by nature a top-down approach and relates to non-scientific issues, its main role being that of facilitating collaboration between national initiatives. Conversely, the CA will be active in making decisions and representing the whole scientific community at EU level and towards funding agencies and the Commission itself, in an institutionalized structured framework. As a consequence, the workpackages focus on tasks that are not contained in ERA-Pilot – with the notable exception of the development of the “QIPC Strategic Report” already developed by a committee lead by P. Zoller and involving several partners of the present Consortium. This document is currently maintained and regularly updated by a team from the ERA-Pilot QIST project, which is also involved in the present proposal and will carry on the work in the framework of the present CA. Some overlap in time between the two projects (ERA-Pilot ends in February 2007 whereas the CA, if successful, could start by the summer of 2006) will provide for a smooth transition, while the present project will ensure continuity to this very important community effort.

There are several reasons justifying the need for this CA. In fact, a long series of successful events (the projects funded under the FP5 QIPC Proactive Initiative, the Integrated Projects about to start in FP6, the development of the “QIPC Strategic Report” to name a few) has led to this development. The research community has gained critical mass, is very active and has ambitious goals and plans to continue and to expand activities. **At this point, a further systematic advance of the state of the art requires all efforts at European level to converge for establishing a formal and well structured approach for further development and collaboration, in order to develop a common strategy and vision in an orderly and democratic way.** Such an official institutionalized representation of the research community is also required to achieve extensive integration of the new member and associated states and to establish a formal framework for international collaboration. There is also a need for integrating different sub-fields and approaches, for seeking connections with industry, and for doing extensive dissemination work in the society. The coordinating effort of the present Project will build a community structure capable of meeting all these needs.

3. PARTICIPANTS LIST

Part role	Part id	Legal name	Short legal name	Country	Date enter	Date exit
CO	P1	University of Copenhagen	KU	DK	1	36
CR	P2	Austrian Academy of Sciences	OEAW	AT	1	36
CR	P3	Universität Wien	UNIVIE	AT	1	36
CR	P4	Université Libre de Bruxelles	ULB	BE	1	36
CR	P5	Univerzita Palackého v Olomouci	UP	CK	1	36
CR	P6	University of Aarhus	AAR	DK	1	36
CR	P7	University of Jyväskylä	JyU	SF	1	36
CR	P8	Universite Paris-Sud XI	UPS	FR	1	36
CR	P9	Commissariat a l'Energie Atomique	CEA	FR	1	36
CR	P10	Centre National de la Recherche Scientifique	CNRS	FR	1	36
CR	P11	Universität Bonn	UBONN	DE	1	36
CR	P12	Technische Universität Carolo-Wilhelmina zu Braunschweig	BRS	DE	1	36
CR	P13	Universität Stuttgart, 3. Physikalisches Institut	USTUTT	DE	1	36
CR	P14	Max-Planck Gesellschaft zur Foerderung Wisseschaften E. V.	MPG	DE	1	36
CR	P15	Weizmann Institute of Science	Weizmann	IL	1	36
CR	P16	Università degli Studi di Camerino	Unicam	IT	1	36
CR	P17	Fondazione ISI	ISI	IT	1	36
CR	P18	Scuola Normale Superiore	SNS	IT	1	36
CR	P19	Dipartimento di Fisica, Università di Roma "La Sapienza"	ROM	IT	1	36
CR	P20	Fondazione Bruno Kessler	FBK	IT	1	36
CR	P21	Stichting Centrum voor Wiskunde en Informatica	CWI	NE	1	36
CR	P22	Delft University of Technology	TU Delft	NE	1	36
CR	P23	University of Gdansk	UG	PL	1	36
CR	P24	Insitut de Ciencies Fotoniques	ICFO	ES	1	36
CR	P25	Institute of Physics of the Slovak Academy of Sciences	IPSAS	SK	1	36
CR	P26	Chalmers Tekniska Hoegskola Aktiebolog	Chalmers	SE	1	36
CR	P27	Kungl Tekniska Högskolan	KTH	SE	1	36
CR	P28	University of Basel	UniBas	CH	1	36
CR	P29	University of Geneva, Group of Applied Physics	GAP	CH	1	36
CR	P30	ETH Zürich, Quantum Photonics Group	ETHZ	CH	1	36
CR	P31	University of Bristol	UoB	UK	1	36
CR	P32	The Chancellor, Masters and Scholars – University of Cambridge	UCAM-DAMTP	UK	1	36
CR	P33	Imperial College of Science, Technology and Medicine	ICSTM	UK	1	36
CR	P34	The Chancellors Masters and Scholars of the University of Oxford	UOXF.DU	UK	1	36
CR	P35	Universität Ulm	ULM	DE	12	36

In the table above partners P5 — P19, P21, P22, P23, P26, P27, P30, P31, P33, P34 represents partners at zero cost. Their role in the CA is nevertheless crucial since they ensure that the whole European QIPC community is represented in QUROPE in a balanced way in terms of fields of

research, projects and geographical areas, while acting, at the same time, as local nodes for QUROPE memberships, therefore ensuring the capillary dissemination of the CA initiatives and/or results.

4. RELEVANCE TO THE OBJECTIVES OF FET OPEN

POLICY, TECHNICAL AND SCIENTIFIC OBJECTIVES

Quantum Information Processing and Communication is a FET Proactive Initiative in FP 5 and FP 6, covers a significant number of projects funded under the FET Open scheme, and is overall one of the most active research field of FET.

A Coordination Action for the whole area would **substantially promote and enhance the FET effort**. QUROPE would in fact add coherence and link appropriate sub-areas and/or projects, support and develop new opportunities as they arise, bring relevant new researchers and groups into the area, raise public awareness of the field, expand QIPC towards existing R & D and industry. Moreover all these activities will be aimed at **elaborating a common strategy, vision and goals, and in this way tracing the road ahead at the European level**. Through its bottom-up approach, the CA will become an institutionalized representation of the QIPC research community, equipping the latter with a feedback channel that will be used for addressing the decision and policy makers with the community true needs, thus giving to the European Commission concrete and invaluable input to shape the future goals and priority areas of QIPC research in FP7 and subsequently FP8.

The European QIPC community has reached a critical mass in all relevant subfields, and there is a need to establish a formal and well structured approach for further development and collaboration, as well as convergence of all the efforts. The CA support to enhance the QIPC-structuring and co-ordination measures is an essential point in order to exploit new opportunities at the interface between blue sky research, targeted basic research and applied research, between science and technology, between research policy and industry. All the big players in European QIPC research are in fact contributing to the present project. This will enable it to deliver the missing ingredient in this arena – building, structuring and unifying a community, by integrating the diverse research activities into a common strategic vision, giving a direction for future evolution at the scientific level, promoting integration across disciplines, fields, between different realizations, approaches and technologies, **in order to achieve concrete objectives and to expand to new areas, topics, applications**.

The CA will also ensure continuation in expanding/updating the databases (QIPC groups, national funding agencies, QIPC activities and actors) that the currently running ERA-Pilot QIST is painstakingly collecting. This will help FET in maintaining an up to date **knowledge of the expertise of European QIPC scientific community**, optimizing at the same time the efficiency of project funding both at the national as well as at the EU level.

The interdisciplinary and international nature of all European wide consortium members will also contribute considerably to the education of **young researchers** in all QIPC subject areas and in all the European countries involved. Moreover the CA will expand its bounds towards the integration of the ten new European members. Many young scientists will be involved through the CA: interaction, collaboration and the understanding of concepts and techniques will be required, between disciplines/subject areas, the fundamental and the applied, the conceptual and the practical. QUROPE objectives to enhance research, development, links with existing R&D and industry (through the provision of funding and/or organisation) should be particularly appropriate for shaping young researchers into the future generation of leading scientists.

SOCIO-ECONOMIC OBJECTIVES

The emergence of a new Quantum Information Technology (QIT) will make an enormous contribution to the future of Europe – witness the effect generated by the vast growth in conventional information and communication technology over recent decades. Rather than displacing IT, a new QIT will emerge alongside it, creating new jobs. The new technology will enable us to perform previously impossible (or utterly difficult) tasks, and therefore contribute generally to improving the quality of life.

Already at this early stage QIPC R&D has contributed to the most secure way of communication between two parties, and the QIPC community (through the European project SECOQC) is working on

a tool based on quantum technologies that will enable citizens, companies and institutions to exchange critical information with guaranteed security, thus creating significant advantages for the European economy

In addition to the direct contribution to economic development which would arise from a new QIT, it should also be noted that there is a high potential for spin-offs and hybrid technologies, such as combinations of conventional and quantum IT, etc. Investigations of these possibilities are part and parcel of the whole QIPC programme, and as such are already thoroughly addressed.

5. POTENTIAL IMPACT

QIPC is a new scientific field which opens unconventional perspectives for information processing. Quantum physics has revolutionized science in the 20th century. The exploitation of quantum effects may revolutionize information processing in the 21st century. There is a major world-wide effort to advance research in QIPC, which has led to a deeper and broader understanding of information theory, of computer science and of the fundamental laws of the quantum world. It has the potential to lead to new technologies and the conception of devices able to perform tasks which could not be accomplished before and may radically change the way we communicate and compute.

The importance of the emergence of completely new areas of technology for the future European information society can hardly be overestimated - witness the effect generated by the vast growth in conventional information and communications technology over recent decades.

At present it is difficult to quantify the possible future economic impact of Quantum Information Processing and Communication (QIPC) technology. This is hardly surprising, since the same held so for conventional IT at such an early stage of its development. Nevertheless, given the huge growth in usage of conventional IT over the last few decades (with the corresponding huge growth in industry), it is justifiable to be optimistic about QIPC technology, assuming that the fundamental scientific hurdles can continue to be successfully overcome. Downstream, the economic impact is likely to depend on many other issues, such as cost and availability of materials needed, environmental impact of materials and fabrication processes; ease of manufacture for the proposed technology; power requirements; size of circuitry to name only the more obvious. However, before turning to these issues, it is important for science and industry together to identify and address all the underlying fundamental research and development issues. This is the current state of play, and a CA project in the area of QIPC (in conjunction with all the on-going QIPC research in Europe) will lead forward from here.

Obviously, during the QUROPE lifetime it is unlikely to achieve the end products of an entirely new technology because QIPC is a relatively new and still-developing research field. Nevertheless, QIPC has by now demonstrated that it is an exciting mid-to-long term endeavour, with the potential for spawning a new Quantum Information Technology (QIT), and it is to the pursue of this ultimate goal that the present CA will contribute.

It is known already that new technology for information processing and communication based on the laws of quantum physics will be capable of performing some tasks that cannot be achieved with conventional IT (which is based on classical physics). Examples are the factoring of large composite integers (a problem on which many current public-key cryptosystems are based), efficient simulation of quantum systems (which would greatly benefit many research areas such as chemistry, material sciences and so on) and guaranteed secure cryptographic key distribution (something that has already been taken up by industry). Although working quantum cryptosystems exist and some very simple examples of (quantum) processing have been demonstrated (most notably the factoring of $15=5*3$), QIPC systems are still very much in their infancy. Much research and development still needs to be done, to turn these into real technology for the future information society. **The potential impact of the CA will be in coordinating a path towards this technology via framing and supporting interdisciplinary links, such as theory – experiment, solid state – quantum optics, algorithms – implementations, etc.**

Through the realisation of its objectives, **a CA for QIPC will develop a common European strategy and will implement it** by providing overall coherence and support to the QIPC community, unifying and linking appropriate sub-areas or projects, supporting and developing new opportunities as they arise, bringing relevant new researchers and groups into the area (including from new member and associate states), and linking to industry. It will also provide a communication backbone between members and a dissemination route to the wider scientific and technological community and beyond, furnishing at the same time an invaluable contribution to the path to future QIT. Moreover, the interdisciplinary and international nature of a European wide consortium of CA members will also contribute considerably to the education of young researchers, in all the subject areas which comprise QIPC and in all the European countries involved. Many young scientists will be involved in the events organised by the project: interaction, collaboration and the understanding of concepts and techniques will be required, between disciplines/subject areas, between the fundamental and the applied, and between theory and experiment.

At present, Europe as a whole is fortunate to possess a large number of the world's top class QIPC and QIPC-related researchers/research groups, so it should be noticed that the initial consortium of members is of top quality, even when measured by worldwide standards. The Governing Board of the CA includes some of the most influential names in the field worldwide and certainly the best ones in Europe. **Moreover each of the legal partners acts as a node, a local QIPC centre for a group of researchers (Affiliated Members) and will provide a link to the project. These Affiliated researchers are included in the exploitation and dissemination plans that ensure the maximal potential impact of the CA beyond the Legal Participants in the action. Their list will be continuously updated. The potential impact on the general public beyond the participants in the action will be ensured by the planned public outreach campaign..** In addition, the CA provides enough flexibility to allow for the addition of new partners to respond in an effective way to the specific needs of a rapidly growing and expanding field. It is vital that the former leads are maintained and new ones are sought for. If not, the risk will be that the economic and employment benefits of a future Quantum Information Technology may well fall mostly outside Europe.

ADDED VALUE IN CARRYING OUT THE WORK AT A EUROPEAN LEVEL

It is clear that QIPC research has gained an important European dimension, which will be central for its further development. Actions and activities initiated through the FET Proactive Initiative in FP5 and FP6, served the twofold purpose of aiming **to build a European identity and to express a unified image of the QIPC research in Europe, as well as keeping Europe at the leading edge of QIPC worldwide.** Moreover, the early spearheading of this high-risk R&D effort by the EC has aided in the creation of a number of national investments in QIPC with this research area now reaching a more mature stage of medium/high risk.

Coordination between national and EC programs will have decisive influence on the progress of QIPC research in Europe. The work towards a common European strategy and goals is in progress. It will create to new opportunities both for research and for technological development. This implies in turn the needs to expand and strengthen activities and funding on European level. Strong and visionary leadership of high quality is also important: only by stronger coordination between national efforts among each other and with the EC program, we can keep or reach critical mass in various sub-fields.

In these respects the continuation of the work of the ERA-Pilot QIST Workpackage 1 through the QUROPE Workpackage 2 is crucial: updated databases will continue to be available for access by the policy players in the European countries and will supply them with an overview of QIST; at the same time, the common vision developed and disseminated through the QIPC Strategic Report will continue to harmonise the efforts within single countries, bring in new thrust for targeted basic research, and give possibilities for the subsequent rise of a 'quantum industry'.

The CA will also serve as a mean of sharing experience and knowledge, ensuring at the same time that neither efforts nor funding will be duplicated; in addition, it will provide a mean through which the European QIPC research community gives input to the EC in the process of preparation of the Seventh Framework Program (and beyond), and through which extensive dissemination work outside the QIPC community (which will carry much more weight and coherence if performed at the European level) will be performed to help raising public awareness of what the future IT might look like.

Finally, the CA representing the whole European QIPC community, will have the unique opportunity to establish for the first time some sort of international common platform, since the field has reached maturity not only at the European level but also worldwide. This will be done through making contacts, establishing specific needs for collaboration and negotiating a formal framework, through the promotion of science policy meetings and round tables with top international experts within QIPC, something that obviously cannot be done at a level other than the European one.

5.1 CONTRIBUTIONS TO STANDARDS

The roadmap-type document “Quantum Information Processing and Communication: strategic report on current status, visions and goals for research in Europe” (<http://www.cordis.lu/ist/fet/qipc.htm>), already developed by members of this Project, will be maintained and regularly updated as part of the workplan of the CA. This document is intended to develop a common European strategy. It is not only an overview of existing activities in the field, but also a concerted effort from the community to provide visions and goals for future directions and developments. In this sense, it will contribute in a broad sense to setting the standard in this highly strategic field of research. Gradually, as the technology matures, this document is intended to give initial guidelines for the development of future standards. In a more specific sense, several of the quantum-based sensor technologies, and in particular quantum metrology, as described in the document itself, have the potential to improve by orders of magnitude the limits of current precision measurements, and are therefore directly relevant to the establishment of international standards for fundamental physical quantities.

6. PROJECT MANAGEMENT AND EXPLOITATION/DISSEMINATION PLANS

6.1 PROJECT MANAGEMENT

This section describes the general top-down organization structure of QUROPE.

The consortium represents a pyramid with a layered structure. It is coordinated and managed by the Coordinator and the Executive Secretary, governed by the 19 member Governing Board, and involves 34 Legal Partners (Austria – 2, Belgium -1, Czech Republic -1, Denmark -2, Finland -1, France – 3, Germany – 4, Israel -1, Italy -5, The Netherlands - 2, Poland -1, Spain -1, Slovakia -1, Sweden -2, Switzerland -3, and United Kingdom – 4), who serve as nodes for other members of the community called here Affiliated Members (additional 44 institutions).

The project coordinator, Prof. E. Polzik, has demonstrated significant coordination and scientific management experience as Director of the Danish National Quantum Optics Center (operational since 2001. annual budget 2.100.000 Euros, 35 researchers and graduate students). The coordinator will:

- be responsible for the overall legal, financial, contractual, ethical and administrative management
- coordinate and supervise the work of the WPs, especially when collaboration between them is needed
- supervise the project scheduling
- apply corrective actions when necessary
- produce management reports with the highlights of the project progress
- organize the meetings of the GB
- insure the information flow from the partners to the GB and vice versa
- coordinate knowledge management
- oversee science and society issues
- obtain audit certificates by each of the financed participants
- collaborate with the FET QIPC proactive initiative (projects and EC officials) in order to insure a coherent development of the initiative as a whole, the development and implementation of a common European strategy, etc.
- maintain the consortium agreement

The executive secretary, Prof. T. Calarco, has demonstrated experience of research management as the Roadmap work package leader of the ERA-pilot project. He will work closely with the project coordinator to assist him in the above mentioned tasks, and will deal with a series of tasks related to communication and information flow, both internally and externally: between workpackages, between the Commission and the partners, between the Governing Board and the whole consortium.

Several post-docs/scientific secretaries will be hired to help Work Package Leaders to implement the decisions/actions on a day-to-day basis, i.e. do the mailings, manage respective parts of the web site, receive and analyze input from the community, organize events, collect input from senior scientists and perform the actual writing of documents under specified supervision, etc. The Executive Secretary will coordinate the work of this secretarial unit.

The Governing Board (GB): The GB will decide on all strategic issues and actions to be taken, in special cases by vote. It is formed from the scientists with highest authority in QIPC worldwide: Professors R. Blatt (Innsbruck), H. Buhrman (Amsterdam), V. Buzek (Bratislava), N. Cerf (Brussels), I. Cirac (Munich), A. Ekert (Cambridge), N. Gisin (Geneva), P. Grangier (Paris), Sir P. Knight (London), M. Lewenstein (Barcelona), D. Loss (Basel), H. Mooij (Delft), E. Polzik (Copenhagen), G. Rempe (Munich), I. Walmsley (Oxford), R. Werner (Braunschweig), A. Zeilinger (Vienna), P. Zoller (Innsbruck), and T. Calarco (Ulm) – Executive Secretary. The research profiles of the GB members are shown in the

Consortium description. Meetings of the GB will be held twice a year in connection to other major events or take decisions remotely according to a specified procedure. Whenever considered necessary and when possible, top international experts from the worldwide QIPC community will be invited to the GB meetings in order to discuss the global status of the QIPC field.

The Governing Board will discuss and decide all major issues of the project as a whole, particularly it will:

- decide to steer in a specific direction the common strategy and vision
- rectify the work-plan of the project when necessary and appoint the people responsible for a particular action
- allocate or re-allocate funding
- decide on the applications of new legal partners
- perform top-level quality control on the actions undertaken and give recommendations for future actions
- approve personnel changes when necessary
- decide on corrective actions when necessary
- invite top international experts to the GB meetings when necessary

The GB decisions and the entire work-plan will be implemented by the respective work-packages. The work-package leaders, who are all members of the GB, will manage and follow-up the work until its completion. They are responsible for the production and quality control of WP deliverables and may delegate parts of this responsibility to other WP participants. The WP leaders will report periodically to the GB.

It should be stressed that in addition to the post-docs/scientific secretaries for which we request funding from the European Commission, many senior scientists involved in the project (and in some cases, their assistants), will be paid for the time they contribute to the CA by their host institutions (as it is accepted in academia). With the limited funding available for the CA this will allow to reach critical mass in terms of the time and effort necessary for the success of the CA. The additional effort in man months paid by the host institutions is shown as an additional Project Effort and also explained in each Work Package deliverable.

The project coordinator with the executive secretary will elaborate quantitative criteria on how the project measures its own success, which will be approved by the GB. They can be internal self assessment of the project work with criteria which are adapted to the specifics of each WP, based on the reports of the WP leaders and the work plan deliverables. It is also necessary to introduce other specific criteria and quality control mechanisms. For example surveys on the level of consensus reached in support of the project outcomes, from the organization of conferences to the development of strategic reports and position papers. Such mechanisms can be used also externally, e.g. a questionnaire to be filled in by all participants at a given event reflecting their level of satisfaction and suggestions for improvement. The coordinator will ensure that the criteria are applied and analyzed in an objective and impartial way, will draw the necessary conclusions and will report them to the GB.

A contingency plan will be put in place and the coordinator will insure its implementation. Considering that this is not a research project, unforeseen situations can occur mainly because of the wrong performance of a partner. If such a situation occurs, the coordinator will react immediately, evaluate the situation and propose alternatives in a report to be discussed by the GB. The GB will make decisions accordingly. A conflict resolution mechanism will be also put in place. In case of conflict between two or more legal partners, the coordinator must be immediately informed. He will initiate a one-month negotiation phase, and will appoint a GB member as negotiator to help resolve the conflict. If negotiations fail and no solution is found within the one month period, the conflict is discussed by the GB (either at a meeting or remotely). The GB will make a decision on how to solve the problem and the coordinator will implement it.

Management of knowledge and Intellectual Property Rights (IPR): Since the major deliverables of the project are all of a public nature and no own research as such is carried out by the CA, IPR is not

a major issue. However, it, will be reflected in the Consortium Agreement. Intellectual property rights concern mainly WP4 (electronic portal) and are also covered in the description of this WP.

A consortium agreement will be negotiated among the partners signing the contract before the project starts. It will also include detailed conflict resolution procedures.

6.2 PLAN FOR USING AND DISSEMINATING KNOWLEDGE

A large part of QUROPE will be directed towards the dissemination objective, and in particular

- **WP 2** will maintain and enlarge the QIPC Strategic Report (also producing any further required position document), which will be central in planning the future and addressing the present state of the art of the field
- **WP 3** is specifically designed for raising the public awareness and visibility of the whole QIPC field
- **WP 4** is devoted to information broadcast through the developed electronic information infrastructure and feedback channel
- **WP 5** focuses on defining and supporting strategic meetings within QIPC community
- **WP 6** is aimed at attracting and training of the next generation of broadly educated QIPC researchers
- **WP 7** is expressly set up for the dialogue with industry and existing R & D areas
- **WP 8** aims at disseminating the EU vision and flavor worldwide and to foster the birth of a novel international coordination programme

The CA results will be also disseminated through traditional routes:

- at a technical level, publication of work by the CA members in major (European) scientific journals and presentation at international conferences etc.;
- at a wider level, publication of articles in popular journals/magazines and presentation of popular/review talks at appropriate audiences (WP 3), including a documentary movie “Quantum Information” targeted at broad audiences.

The EU is looking for input for the coming Seventh Framework Program (FP7). The CA will play a crucial fundamental role in this with respect to those aspects connected with QIPC, through the feedback and consultation to EC and in particular through the QIPC Strategic Report (work package WP 2), and via the more popular collection of article in the Scientific American style (WP2/WP3).. The latter will constitute the most effective tool for a successful exploitation of the CA results.

6.3 RAISING PUBLIC PARTICIPATION AND AWARENESS

During the last 5-6 years there were quite a few events and activities in Europe in QIPC as can be seen from the tables on conferences and schools (pages 27 and 29) and from the brief overview of the FET Proactive initiative. FET has made a major effort to concert these activities, to create some structure and to plan ahead. Also some important work was done for dissemination. Since QIPC research in Europe has expanded and its multidisciplinary character has been significantly increased, there is a strong need for a CA project in cooperation with FET to bring more structure, to elaborate a common vision and strategy and to implement it in an optimal way.

QUROPE is going to engage the wide audience and to spread awareness and knowledge beyond the research community via the dedicated WP3 (Public outreach). The tasks 3.3 3.5 and 3.6 of the latter concerning the documentary film production and popular brochures are directly aimed at this goal. Synergy with education comes from the fact that most of the Partners are higher education institutions. Engagement of undergraduate and graduate students is envisioned in the WP6 - training activities. Synergy with the high school audience will be promoted by disseminating good practice via posting of high school related lectures and other activities planned within WP3.

7. DETAILED IMPLEMENTATION PLAN – FOR WHOLE DURATION OF THE PROJECT

7.1 INTRODUCTION: GENERAL DESCRIPTION AND MILESTONES

The work to accomplish the aforementioned objectives, specifically to develop a common European strategy for research in QIPC and its implementation will be organized in an articulated set of eight workpackages aimed to different yet correlated tasks:

- **(WP1) Management and Coordination of the project.** WP1 task is to guarantee the success of the project through the efficient and effective coordination and management (legal, financial and administrative), towards achieving of all of the agreed objectives. The Governing Board and the Coordinator will be responsible for taking strategic decisions within the QIPC field and for control and updating of the CA work plan. The management team of the project with the Coordinator and the Executive Secretary with his team will assure that the project impact is optimized by addressing in a transparent appropriate and equilibrated way all sub-fields and geographical areas. It will ensure coordination with other projects of the QIPC FET cluster and coordination of the work of the entire QIPC community towards implementation of the common vision and strategy developed by this CA. WP1 will cover the administration and distribution of funding to other WP leaders to support the achievement of its goals. Furthermore this WP will be responsible for the risk management and dealing with unforeseen problems (e.g., missed deliverables or milestones, EC needs of specific and not initially planned documents, etc.), and for annual updates of the workplan and its modification according to the community input.

Coordination Activities

- **(WP2) Develop a common vision, strategy and goals.** WP2 is designed to develop a common European vision, strategy and goals. This will be done through a set of actions. It will formally take over the development and regular updates of the European QIPC Strategic Report. Other reports and position papers are also within the scope of work. The goal is to provide input for the preparation of the upcoming 7th Framework Program, and of other strategy/policy documents which could help the EC to shape the research programme in the field of IST. The organization of working Expert groups in various sub-fields, their interaction and integration is also an important part of the work.
- **(WP3) Public outreach: increasing the public visibility and awareness of the field.** WP3 aims at increasing the impact on the society via improved public visibility and awareness of the field, through specific initiatives such as articles in specialized/popular science/general press, promotion, a dedicated documentary movie, etc. It will collect and provide material for the public part of the project web site. It will also regularly produce specific publications to reflect and promote QIPC research in Europe, possibly in cooperation with the three FP6 Integrated Projects and the EC (FET QIPC Proactive Initiative).
- **(WP4) Electronic Information Infrastructure and Information Exchange (with a feedback channel).** WP4 will establish and maintain an Electronic Information Infrastructure to support the efficient service of all the CA objectives. The centerpiece will be a comprehensive website constituting (i) the project portal through which all the relevant information will be distributed, exchanged and disseminated, and (ii) the feedback channel that the QIPC community will use to provide direct input;
- **(WP5) Structuring and integrating the community: Scientific meetings and dissemination activities.** WP5 main objective will be to promote multidisciplinary research and integration of approaches as well as expansion to new fields and applications through the organization of 2 major interdisciplinary international QIPC conferences (one in 2007 and one in 2009), and a smaller QIPC workshop in 2008;

- **(WP6) Young scientists and Training Activities.** WP6 aims to shape and promote the next generation of QIPC research, fostering schools for young researchers and networks with special emphasis on cross-disciplinary exchange of young scientists;
- **(WP7) Collaboration with related well-established R&D and with industry.** WP7 plans to create links with well-established R&D communities (e.g., telecommunications, computer science) as well as with industry, in order to establish a long-term collaboration and to facilitate the take up by industry. The goal is to facilitate and accelerate the development of QIPC and related technologies.
- **(WP8) International contacts between researchers communities in Europe and overseas.** The aims of WP8 are sustained international contacts between the QIPC researcher community in Europe, and research communities overseas (US and Canada, Asia, Australia, and others). Specifically, within WP8 we want to strengthen the European QIPC community by establishing new contacts and scientific exchanges, increasing the global connectedness of European researchers, promoting European research in QIPC in the USA, Asia, etc., in order to increase its visibility, and attracting the most excellent non-European researchers in QIPC to research centers in Europe.

Each WP aims at implementing by appropriate means the common European strategy and vision developed by the project.

(WP1) MANAGEMENT AND COORDINATION

WP Leader: E. Polzik (P1/KU)

This Workpackage will ensure that the work plan of the project is implemented correctly in a timely manner and that all the objectives of the project are achieved (see also section B5). The Coordinator and the Executive Secretary, with the support of specialized personnel hired through the CA, will be responsible for the following management activities:

- represent the project (and the whole QIPC community) at the European Commission level
- deliver information from the Commission to the Partners
- monitor the work of each WP
- coordinate and mediate tasks involving two or more work packages
- coordinate integration of new members
- insure information flow, coordination and cooperation with the other active projects of the FET QIPC cluster
- carry out accounting, auditing and budget management
- Prepare input documents for the Governing Board meeting, such as:
 - proposals for new members
 - proposals for conferences and schools
 - progress reports
 - suggestions for solution of conflict situations
- call for and conduct the meetings of Governing Board
- implement the decisions of the Governing Board into a revised Work Plan when necessary

The Governing Board responsibilities include (see also section B5):

- 1) Take decisions on major issues within the CA, such as:
 - a) Assessment of the performance of individual WPs
 - b) Take necessary steps towards optimal performance of WPs
 - c) Approve the Conferences and Schools coordinated by the CA
 - d) Approve the personal changes in the CA structure and admittance of new members
- 2) Coordinate and approve the major position articles on major scientific issues of QIPC (.e.g. for the European Commission and, if necessary, national governments)
- 3) Approve and endorse the list of most important research achievements within QIPC in Europe based on the reports of Expert Groups
- 4) Prepare proposals on the QIPC Young Investigator Award - QUROPE Prize for the GB decision

Moreover, the Executive Secretary, building on the experience in managing the QIPC strategic report, will

- use internally developed web tools for communication, document management and data exchange, at the various levels of the Governing Board and the whole Consortium
- manage the collective editing process (mainly at the internal level) of documents produced by the CA, like so-called “position papers” et similar
- make each of the above available to appropriately defined partners, groups, institutions, inside and outside of the CA, towards the QIPC community and the general public

There will be a proposal mechanism for a certain limited number of activities in certain WPs (for instance summer schools, tutorials, meeting of young scientists, a conference on a particular subject, a prize, etc.). Proposals could be made by people internal or external to the project: e.g. a scientist who is not in the project would like to propose an event that could be of benefit to the whole community. The GB will consider the proposals and make decisions accordingly. The implementation of the event and the relevant budget go to people from the consortium. A fraction of the budget will be reserved for activities approved via this proposal mechanism.

This WP will deliver every year a report which will make a brief overview of all the actions and activities undertaken during the year. It will make an evaluation of the strengths and weaknesses. It will also evaluate the current needs and gaps on the basis of which will propose new actions and activities. The report is to be discussed by the Governing Board. It will decide on adjustments and if necessary changes to the work plan each year.

(WP2) DEVELOP A COMMON VISION, STRATEGY AND GOALS

WP Leaders: T. Calarco (P35/ULM), P. Zoller (P2/OEAW)

The main goal of this WP is to complement and gradually (as it ends) take over from the currently running ERA-Pilot QIST project the task of regularly updating the existing ERA-Pilot ‘living’ documents: the ‘QIPC Strategic Report’ and the ‘Quantum Information Classification Scheme’. The ERA-Pilot project will end by the 28/02/2007, with the QUROPE proposed starting date of 01/09/2006. The overlap period together with the fact that the WP will be run by the same team running the ERA-Pilot WP1 (the actual ERA-Pilot workpackage that takes care of the aforementioned documents), will ensure the necessary continuity and smooth transitional phase. Notice that the overlap between the ERA-Pilot WP1 and the WP2 of the present CA is the only one between the two projects, which has the added advantage that the WP2 work will be carried on until 28/02/2007 on the resources already allocated to the leading institutions under the ERA-Pilot budget, at no cost for the CA.

Given the entanglement between this WP and the ERA-Pilot QIST WP1, some brief background information is required in order to describe its content and make a strong case for its presence in the

CA. It is important to note that the only overlap between the two projects is WP1 of ERA-Pilot and WP2 of the proposed CA. There are no other overlaps in the activities of the two projects.

At the 5th European QIPC Workshop (September 2004 in Rome) a special session was organized by FET, titled “Perspectives for QIPC in the Seventh Framework Programme”. The main point was that input from the scientific community to the European Commission would be needed for the preparation of the Seventh Framework Programme. There was a general discussion on the actions to be taken with the aim to promote QIPC research in Europe, strengthen its image in a coherent way, unify the research community by elaborating a common European strategy and goals, and, especially, provide the necessary input to the European Commission, reaching in an appropriate way decision makers. It was then decided (i) to write a strategic report including an assessment of current results and an outlook on future efforts, and (ii) to expand the strategic report with a detailed technical assessment, to draw up a summary of long and medium term goals, and to express visions and challenges for QIPC in Europe. P. Zoller was nominated as the editing author and the coordinator of the committee in charge. Work on the document started immediately afterwards, on a completely voluntary basis and without any formal framework, involving an expert committee of roughly 40 European QIPC top scientists.

A follow-up discussion took place during the conference day of the QIPC cluster review, 14-16 February 2005 in Innsbruck. On the 10th of May, the QIPC strategic document reached a stable version that was published in electronic form at the IST-FET website (<http://www.cordis.lu/ist/fet/qipc-sr.htm>). In August it was submitted for print as an official publication of the European Commission and as a regular scientific paper in the European Physics Journal D. In the future it will continue to be updated regularly as a “living document” in the context of the project ERA-Pilot QIST (in particular by the ERA-Pilot WP1, led by T. Calarco and R. Fazio from CNR-INFM and which is employing a post-doc, D. Binosi). In addition to the strategic report, ERA-Pilot WP1 is developing a commonly accepted Quantum Information Classification Scheme (QICS) that provides an overview of the QIPC subfields. The expertise of European QIPC groups is being classified according to this scheme.

The way to arrive to this widely accepted position documents has been not an easy one and spans at least five years (but the idea of a QIPC roadmap-like document can be found in seed in many EC funded projects dating back to the nineties). Moreover this important milestone has finally allowed the EC to bridge the gap with the US where a QIST roadmap-like document has been published and maintained (with yearly updates) since 2002.

This WP will formally take over the development and regular updates of the European QIPC roadmap. It will also provide input for the preparation of FP7 and for the development of strategy and policy documents of the European Commission: reports, position papers, etc.

The WP will setup Expert Groups contributing to the roadmap development. These groups have never before existed in a formal/structured way and it is a novelty that QUROPE aims to introduce, building on the experience of the informal groups that have emerged during the initial drafting of the QIPC Strategic Report. The structure and goals of the Expert groups is as follows

- Three Expert Groups will be identified, which will cover all of the existing areas of QIST: quantum communication (fiber-based; free-space; quantum interfaces and memories), quantum computing (trapped ions; atoms and cavity QED; semiconductor quantum dots; superconducting circuits; linear optics quantum computation; impurity spins in solids; new implementations), theoretical quantum information science (entanglement theory; quantum algorithms and communication protocols; quantum computer models and architectures).
- Initially the members of the Expert Groups will be chosen among the contributors to the QIPC Strategic Report. These members will then expand the group according to their needs involving key scientists of their respective area, which may then become contributors of the roadmap.
- Expert Groups will contribute to the updating the QIPC Strategic Report through web-based tools for document sharing (internally developed by the WP). Moreover, annual meetings where the state-of-the art and goals of the field will be revised and updated, will be scheduled at an international conference organized by the CA.

- Expert Groups will have the additional aim of providing the CA website with reference/pointers to the most recent hot topic publications, breakthrough papers, etc. The development of these Expert Groups and their collaboration will contribute to the integration and cross-fertilization among QIPC sub-fields.

(WP3) PUBLIC OUTREACH: INCREASING THE PUBLIC VISIBILITY AND AWARENESS OF THE FIELD

WP Leader: A. Zeilinger (P2/OEAW, P3/UNIVIE)

Further WP members: E. Polzik (P1/KU), P. Knight (P33/ICSTM)

The main goal of this WP is to increase both public visibility and public awareness on the European research effort in QIPC. This will be achieved by a concerted effort of all QUROPE members, coordinated by the WP leader and the other WP members. The WP members will coordinate all members of QUROPE to:

- collect recently published articles about QIPC in the media (specialized and popular-science press/media)
- disseminate the collected information via web-postings, newsletters or brochures adapted for different target groups (schools, media, general public, policy makers, etc...)
- produce a documentary film on the topic of QIPC
- organize press conferences and press releases, participate in different “public understanding of Science”-events and initiate other concentrated efforts around the QUROPE meetings to make it more open and more eligible to the public
- publish folders, brochures and other texts intended for the general public and distributed in collaboration with the European Commission
- increase the publication of articles on QIPC in the popular science press and in the general press
- increase general media coverage of QUROPE issues and activities
- publish a special edition of collected articles related to QUROPE issues and activities, focusing on a general public readership
- develop ideas to make the field become attractive to young people (like high school lectures, booklets, guided-lab-tours for teachers and pupils, documentary school films...)

The WP aims towards sustained public awareness to ensure a broader acceptance of science and better education of the general public. The main approach to reach the objectives of the WP is to collect and disseminate media relevant to the public and related to QUROPE. A strong collaboration with WP 2 is suggested, which includes the utilization of the developed database(s) (see WP2) for the purposes of WP3.

Specific emphasis will be given to activities increasing young people’s interest in QIPC and finding talented young scientists.

The collected media database will also prove as a helpful indicator for the scientific excellence of European research in comparison with other international competitors.

All these efforts will be concerted and in collaboration with the FET Proactive initiative in QIPC and in accordance with the common European strategy developed by QUROPE and the FET QIPC cluster.

(WP4) ELECTRONIC INFORMATION INFRASTRUCTURE AND INFORMATION EXCHANGE (WITH A FEEDBACK CHANNEL)

WP Leader: E. Polzik (P1/KU) and D. Binosi (P20/FBK)

The main dissemination route for the results of the proposed CA will be electronic information exchange and sharing through a comprehensive website. However, this website will not only amount to a ‘passive’ mean of communication between the CA and the QIPC community, but will also provide a feedback channel that the latter can use to trigger lively discussions and influence ‘on the fly’ future

actions taken by the CA, as well as enhance the communication between the CA members (document sharing, etc.)

This WP will closely relate to all other WPs, for which it provides the facilities to publicise their activities and record and archive their work.

The website will be composed by at least the following sections

- **General pages:** These pages will be the introductory ones, which explains in details the purpose and scope of the QUROPE proposal. They will also holds yellow pages containing relevant details about the project coordinator, legal partners and affiliated members, and detailed description on how the community can profit from and interact with QUROPE.
- **Web based learning center:** These pages will be aimed at providing pedagogic material on the basic aspects of QIPC as well as on its most important applications. The tutorial pages will be prepared with the contribution of WP3 (responsible of raising the public awareness of the field), all interested community members, and possibly sponsoring a series of lectures by some of the founders of the field (as has been already successfully done within the previous Thematic Network QUIPROCONE).
- **QIPC News:** This section will report about the latest breakthroughs and developments relevant to QIPC. The CA members as well as the whole (international) QIPC community will be encouraged to contribute relevant articles, references to journal/archive papers, pointers/hyperlinks to newspaper/magazine articles, etc. Also, there will be a periodically updated section dedicated to highlights on or references to recently published papers or important scientific results (even if not directly related to the CA activities, of course) provided by the WP2 established Expert Groups.
- **QIPC Conferences and Schools:** This section will post calls for proposals for conferences and schools organized by the CA (input from WP5 and WP6), links to the meeting and schools already approved and being organized, as well as the meeting and schools already organized by the CA.
- **QIPC Strategic Report:** These pages will host the QIPC Strategic Reports and all of its subsequent updates. They will be equipped with a special discussion forum for receiving the community feedback and addressing it to the relevant Expert Groups established by WP2, and equipped with custom web based tools for document editing and sharing (developed also by WP2). In the period of overlap between QUROPE and the ERA-Pilot, ther will be a duplication of information, ensuring a smooth transition from the latter to the former (with a task -4.2 – especially designed for transferring all the information collected by ERA-Pilot during its life-time).
- **Events diary:** This section will be used to post all available details/links on QIPC conferences meetings, workshops, schools, events, etc. (possibly not only European but worldwide). The CA members as well as the (international) QIPC community will be encouraged to submit relevant event information for inclusion.
- **CA Reports:** All activities funded through QUROPE will require the submission of short reports upon completion, that will be linked to this section of the website. Basic templates for applications, refereeing and reports (together with detailed explanations for their completion and submission) will also be available through these pages.
- **QIPC links:** A directory of links to other QIPC relevant resources: contain links to most major QIPC sites in the world and will reflect all main activities in Europe (and, if possible, worldwide).
- **Feedback channel:** The feedback channel will be implemented through a web discussion forum where people can freely post opinions and comments either on specific issues put forward directly by the CA (e.g., call for suggestions on the strategic reports and/or classification scheme) or initiate themselves specific threads (e.g., on specific research topics). The collected information, which in principle can provide input for all WPs, will be periodically analyzed, addressed to the relevant WP, and used accordingly.

- **QUROPE outcomes:** This section contains all interesting material produced in any activity funded by the CA (including possibly all the talks given at any QUROPE funded conference).
- **Jobs:** a list of worldwide jobs offers with all relevant information will be made available in this section. This facility will therefore help the European QIPC groups to fill positions and studentships (such as those funded by the EC QIPC programme) and helps EC-based researchers and students. It will also be possible for researchers looking for jobs to post their CVs. In this way the CA will provide a repository of personnel expertise which QIPC groups can use to directly contact the most appropriate person to fill their vacancies.
- **Spin-offs and targeted industry:** This section will host a page dedicated to potential QIPC spin-offs (and vice versa, i.e., spin-offs from other fields potentially relevant for QIPC), posting results, links to the relevant literature and monitoring their status/advances. It will also host the QIPC related material targeted specifically to industry (provided by WP7)
- **Newsletter:** This section of the website will post the electronic form of the brochures that will be periodically published by WP3
- **Databases:** this section (that could be publicly available or password restricted, depending on the policy chosen) will integrate and maintain all the databases which are being collected by the ERA-Pilot (European QIPC groups, national funding agencies, QIST activities and actors), and will host the new ones collected by other QUROPE WPs (e.g., WP7 and WP8). Also mailing lists will be kept and updated.
- **Password protected areas:** these pages will be used for internal purposes and equipped with web based tools for communication, document management and data exchange.

It should be noticed that the outlined structure is preliminary since we expect some unanticipated relevant features will grow from suggestions and perceived community needs collected through the feedback channel. The website will be made flexible enough to accommodate further facilities as necessary through the lifetime of the CA

Finally, given the dynamic nature of the website, with such a big flow of information sharing and posting, Intellectual Property rights will be a main issue. We plan to cope with that through the following means:

- A general text about the terms and conditions for the information posted on the QUROPE website. This text might be different for sections of the website available to the general public and password protected ones.
- For articles and publications printed elsewhere and which are posted on the web site (for example in the Expert Group highlights), the authors will need to request the permission of the original publisher, whose name and copyright will be mentioned.
- As far as the information related to original knowledge generated by the project, (most notably by WP2 through its strategic report and any other position documents it might produce), the project partners will be asked to agree on some (yet to be defined) general terms on how this knowledge should be managed. These terms will then be posted on the relevant web pages.
- Finally for all the remaining information, (provided by the community individuals through the 'feedback channel', internal reports, databases, CVs, etc.) different copyright agreements will be elaborated and posted in the relevant pages

The next two work packages (WP5 and WP6) concern coordination and support of conferences, workshops, and schools within the CA. The following general conditions apply to ALL meetings supported by the CA.

Given that the goal of the CA is to coordinate and structure strategic meetings within the QIPC field, the eligible meeting expenses covered by the CA will be in accordance with the budget breakdown indicated in this TA and limited to:

- partial conference cost (including cost of the location, lecture halls, travel and expenses of organizers, invited speakers, participation costs of young researchers etc.);
- infrastructure;
- secretary and/or post-doc to help in organisation of the event;
- travel and expenses (and possibly a honorarium in case of schools) of keynote speakers;
- costs of proceedings.

The CA will not fund individual trips of researchers. Considering the limited funds of the CA and the ambitious programme, we intend to seek close collaboration with the other projects within the QIPC cluster. The success of this collaboration is ensured by the presence of the key players of QIPC Integrated Projects in the CA

(WP5) STRUCTURING AND INTEGRATING THE COMMUNITY: SCIENTIFIC MEETINGS AND DISSEMINATION ACTIVITIES

WP Leaders: A. Imamoğlu (P30/ETHZ) and M. Lewenstein (P24/ICFO)

Members of the Scientific Meetings Management Committee (SMMC): R. Blatt (P2/OEAW), A. Imamoğlu (P30/ETHZ) and M. Lewenstein (P24/ICFO), G. Rempe (P14/MPG), H. Burhman (P21/CWI), I. Walmsley (P34/UOXF.DU)

The main objective of this work package is to promote multidisciplinary research and integration of approaches in QIPC, as well as expansion to new fields and applications, throughout the European Union. This will be achieved through the organization and coordination of two major interdisciplinary QIPC conferences (in 2007 and 2009), and a smaller QIPC workshop (2008).

The exchange of scientific and technological innovation is the key means of advancing the field at a rapid pace. Within the context of specific research projects, such as the IPs, this activity is well catered for. However, an important characteristic of QIPC is that it is essentially multidisciplinary. This has several consequences that suggest a CA can play a significant role in optimizing the impact of EU funding in this area:

- Strongly interdisciplinary research requires development of common language and concepts before novel ideas can propagate across fields and germinate.
- Individual disciplines represented within EU projects are tightly focussed and are not geared directly toward broad cross-disciplinary activities.

The CA can address these issues by providing a framework in which research projects can interact and ideas from one area can cross-fertilize current activities in another, as well as stimulate new ones. This is absolutely fundamental for achieving the main goals of CA, i.e. among others elaborate a common vision and strategy, set research priorities, structure the community, expand its geographical areas and attract new communities, exploit applications etc.

In this regard the role and importance of meetings for stimulating new research is widely recognized. Past EU activities in this area, including both research projects and training networks, have shown this approach can be tremendously successful.

The European Community has already established a series of internationally known meetings on QIPC – the eponymous conference meets annually around Europe, and attracts speakers and papers from around the world. This is a solid base on which to build a continuing community and is an ideal activity for the CA to help coordinate. We intend to elevate this activity to a new level by running a major interdisciplinary biennial QIPC conference in 2007 and 2009 for 200-250 participants. It is likely that the IPs will play a leading role in organizing this conference in the future, since they have specific budgets and mandates for this: the CA will assist making these meetings as broadly interdisciplinary and international (both within and without the EU) as possible. The QIPC meetings in Europe have had,

and continue to have, an essential role in maintaining the very high level of research in this area internationally.

Date	Location	Activity name
2007/2008	Brussels (Belgium)	Solvay-QIPC workshop
2006	Venice (Italy)	QIPC
2006	Paris (France)	QIPC
2005	Wien (Austria)	QUPON
2004	Rome (Italy)	European QIPC Workshop
2003	Oxford (United Kingdom)	European QIPC Workshop
2002	Dublin (Ireland)	European QIPC Workshop

Table 1: Incomplete list of major QIPC meetings in Europe, past, present and (known) future

We envision that the CA will encourage in WP5 the growth of a broad-based EU expertise in QIPC by the following means:

- Showcasing the EU research effort in QIPC by coordinating with the IPs and other EU QIPC projects two biennial major international QIPC conference in Europe on all aspects of the subject (in 2007 and 2009). The Conference Committee and the Governing Board will ensure that these meeting serve the common goals of the CA: unifying and structuring the research activities. The funding of this conference will be decided through an open call. We already expect a very strong proposal for the QIPC 2007 conference from the Barcelona group (A. Acin, L. Torner).
- Organizing a QIPC workshop in 2008.

The major role of the CA, through this workpackage, will be thus to help in structuring the community, in expanding it in terms of scientific breadth and participation, and to contribute in a significant way to the development of a common strategy and vision. The Governing Board will make decisions with these goals in mind.

The aim of this workpackage is to assist in the coordination and financial support (within the limits eligible expenses given just above the WP5 description) of the aforementioned cross-disciplinary scientific meetings and other dissemination activities in QIPC in Europe. The main role of the WP5 within the CA will be to increase the scope, impact and quality of these events In particular it will:

- provide international forums for exchange of scientific results;
- assist in the identification and recruitment of key international speakers for the major conferences; this will in particular relate this WP5 to the WP8;
- help in formulating common themes across different disciplines involved in QIPC;
- assist cross-fertilization of concepts and technologies across different subfields of QIPC;
- build a pan-European QIPC research community;
- in relation to WP7 increase the industrial liason by assisting in supporting invited lecturers from companies and firms to the meetings;
- increase the participation of the new countries by attracting young people from those countries to the meetings through the QUROPE web site.

To this end a call for proposals for the QIPC conferences and other meetings will be made annually. The proposals will be reviewed by the Scientific Meetings Management Committee (SMMC), who will also assess priorities to the successful proposals. The SMMC of the WP will then make a proposal on funding allocations subject to approval by the Governing Board.

Given the budget limitation for running conferences, WP5 will seek for other sources of support by establishing contacts and coordinating with the corresponding workpackages present in the running ERA-Pilot QIST and the 3 Integrated Projects (SCALA, QAP and EuroSQIP) for using the Commission resources already allocated to them for the purpose of organizing conferences and meetings.

Although the CA already has the above indications of intent for meetings, the main process for new activities will be driven from the bottom up, via a solicitation from the QIPC community. Below (after the WP6 description) we describe the procedures that will be followed in the context of the call for proposals, their evaluation, and administration. Our expectation is that we will receive a small number of proposals (approximately 2) per 1 year period, and that one of these will be funded.

Every year the WP leader will prepare an Annual Report on the results obtained in this workpackage. The Annual Report will contain a critical analysis of whether the workpackage attains its objectives. On the basis of the Annual Report, modifications to the procedure followed for the call can be made. These modifications require a unanimous decision of the Governing Board.

(WP6) YOUNG SCIENTISTS AND TRAINING ACTIVITIES

WP Leaders: N. Cerf, S. Massar (P3/ULB) and M. Ziman (P25/IPSAS)

Aside from traditional scientific conferences, the importance of summer schools and other training activities for Ph.D. students and young Post-Docs is widely recognized. The multidisciplinary character of modern research indeed requires that the training of young researchers takes place in contact with the international research arena, outside their original laboratory and university. It is essential that they acquire as broad a view as possible of their field and its actors, which is an indispensable prerequisite on the way to European research integration.

The goal of WP6 will be to coordinate and support financially (within the limits of eligible costs described just above WP5) various training activities in QIPC in Europe, in particular Summer/Winter schools. In this way, WP6 will contribute, through close collaboration with the other workpackages, to the development of a common strategy and vision for QIPC in Europe.

The need for training activities is particularly true in QIPC, which is characterised by its relatively young age and a very strong multidisciplinary nature. Indeed, it is essential that the Ph.D. student or young researcher in this discipline becomes familiar both with the different experimental avenues that are being explored for the implementation of quantum computers, which include quantum optics, atomic physics, solid state physics, etc., and with the theoretical bases of quantum information sciences, which range from quantum algorithms and quantum cryptography to the theory of quantum entanglement. In addition, even the specific subfields of QIPC, such as the theory of quantum entanglement or the atomic physics implementations, have themselves already so many ramifications that the young researcher working in these subfields will benefit from specific training activities.

This situation was recognized very early in the history of QIPC. This is illustrated in Table 1, which contains an (incomplete) list of QIPC training activities which have been organised in Europe in the past. The number of activities – and their diversity – is particularly striking, considering the size of the QIPC community. It clearly indicates that training activities have probably contributed to the same extent as the major scientific conferences to the remarkable past progresses in QIPC. These activities have ranged from major summer schools, lasting a month, to shorter summer schools and 2-day training sessions appended to conferences. A very original and particularly successful training activity which is worth mentioning is the series of “informal quantum information gatherings” that took place in London (September 2002), Garching (December 2003), and Paris (July 2005), aiming at bringing young researchers together in an informal environment for a discussion on new perspectives in QIPC, both in experiments and theory. Note that most of these training activities have been resolutely international. The present WP will support future training activities in Europe, such as those already planned in Benasque (Spain) in Summer 2006 and 2007 (organisers: I. Cirac and E. Ekert). Other locations where training activities are traditionally organised are Les Houches (France) and Cargèse (France), but many other places are also possible, see table 2.

It is generally believed that the importance of training activities in QIPC in Europe has had, and continues to have, an essential role in maintaining the very high level of research in this field in Europe.

Date	Location	Activity name
2007	Benasque (Spain)	Quantum Information
2006	Benasque (Spain)	Scalable Quantum Computers
2006	Bad Honnef (Germany)	Strong Coupling of Light and Matter
29/08-30/09/2005	Dresden (Germany)	Quantum Information
31/08-05/09/2005	Belfast (Ireland)	Quantum Information Theory & Technology
July 2005	Paris (France)	Informal Quantum Information Gathering
11-17 July 2005	Valkonya (Hungary)	Quantum Information
5-10 June 2005	Sheringham (United Kingdom)	Quantum Information Processing I R C Summer School
20-26 May 2005	Vienna (Austria)	Quantum Physics of Nature (The first 2 days of the conference were devoted to tutorials)
16-28 August 2004	Cargèse (France)	Quantum Logic and Communication
13-17 September 2004	Herrsching (Germany)	International Workshop on Solid State Based Quantum Information Processing (Included a 2 day Summer School)
December 02-05, 2003	Garching (Germany)	Informal Quantum Information Gathering
July 20-August 2, 2003	Wittenberg (Germany)	Fundamentals of Quantum Information Processing
June 30 – July 25, 2003	Les Houches (France)	Quantum Entanglement and Information Processing
September, 2002	London (United Kingdom)	Informal Quantum Information Gathering
May 29-31, 2002	Innsbruck (Austria)	Short Course on Quantum Information Science
07-13 April 2001	Cargèse (France)	Cryptographie Quantique
March 19-30 2001	Les Houches (France)	Quantum Entanglement and Quantum Information

Table 2: Incomplete list of training activities in QIPC in Europe, past, present and future

It has helped young scientists to carry out very high level research, and has surely contributed to help them obtain a permanent position in research institutions, and gradually become themselves leading scientists in QIPC.

This positive trend is set to continue as several training activities are already being planned for the next years. In addition, all 3 IP's in QIPC which will start in autumn 2005 have provisions to support training activities in the context of the individual projects. In IP QAP, a specific task led by Prof. N. Gisin (University of Geneva) is devoted to training activities, while the IP's SCALA and EuroSQIP each have workpackages partially devoted to training activities. Close contact will be maintained between WP6 and these IP's. For example, the young scientists attending the WP6 training activities who are affiliated with a partner institution of an IP may be supported directly by this IP. This will be decided on a case-by-case basis.

Besides this support originating directly from the IP's, the organization of training activities in Europe will largely benefit from the additional resources and integrated management of this Coordination Action. Indeed, by coordinating the training activities at a European level, the present workpackage will contribute significantly towards the development of a common strategy and vision for QIPC in Europe. On the one hand it is essential that training activities be included in any global strategy for QIPC in Europe. On the other hand it is essential that young scientists are aware of, and participate actively in, this common strategy and vision. One can ensure the later by having one or more lectures at schools devoted to the European strategy and vision for QIPC.

WP6 will be carried out in close collaboration with the other WP's. Specific connections with other WP's include:

- Given the anticipated strengthening of the QIPC community resulting from the newly entered EU member states, a particular emphasis will therefore be given in WP6 to assist young scientists coming from the newly entered EU member states in acquiring experience outside their home institution. The preferred method to achieve this will be to support a number of fellowships that will be allocated to young scientists at the occasion of the organized training activities.
- If possible, training activities will be organised so that students from outside Europe can also participate, and that some of the lectures are given by prominent scientists from outside Europe. This will ensure that the European students are aware of the world wide research in QIPC.
- Given the growing interest of industry in QIPC and the future importance of industrial investment in QIPC, we will also try to ensure that scientists working in industrial R&D participate in the training activities, for instance by being invited either to attend the event or to give lectures. The best way to ensure this will be developed in collaboration with WP7.
- In the past, some major conferences included tutorials for younger researchers. We will encourage this, and such tutorials will be established through a close collaboration with WP5. In addition we note that in order to simplify administration the procedure to apply for financial support is practically identical in WP's 5 and 6.
- A call for proposals for training activities in QIPC in Europe will be issued by WP6, with a deadline every 6 months. Publicity for this call for proposals and for the accepted proposals will be made via the CA web page, in collaboration with WP4.

Every 6 months, the proposals for training activities that have been received will be screened by the present WP leaders and then reviewed by the Governing Board, which will also decide how the available funds will be shared between the successful proposals. The selection procedure will ensure:

- the scientific excellence of the activities;
- the pedagogical excellence of the activities;
- that the different subfields of QIPC are adequately covered, with a preference given to interdisciplinary activities;
- that the activities are adequately spread out over the different countries of Europe;
- that an adequate support is provided to young scientists, with a preference to those coming from the newly entered EU member states;
- that women have at least equal access, and if possible easier access, than men to these activities.

In addition, WP6 will encourage and support financially the publication of proceedings of the major summer schools, so as to increase their impact.

The procedures that will be followed in the context of these calls for proposals, the evaluation of the proposals, and the administration of the training activities are described below. We have also worked out the proposal and report forms (not included here for the sake of space). Our expectation is that we will receive a reasonable number of proposals (approximately 2 or 3) per 6 month period.

In order to encourage dissemination of good practice QUROPE will establish the QIPC Young Investigator Award. The biannual Award will be given to a researcher under the age of 35, for the best research recently published or presented at one of the biannual QIPC major conferences. The input candidates for the Award will be nominated by the CA partners with special input from Expert Groups highlighting major results of the year. The candidates will be screened by the WP6 leaders and by the CA coordinator and presented for final decision to the Governing Board meeting. The 3000€ Prize will be awarded at every major QUROPE biannual conference.

Every 12 months, the WP leaders will also prepare a WP6 Report on the results obtained. The Report will contain a critical analysis of whether the workpackage did attain its objectives. On the basis of this report, corrective actions will possibly be taken. These modifications of the procedure will require an approval of the GB.

Common procedures for the Calls, Evaluation, and Decisions on the Conferences (WP5) and Training Activities (WP6) supported by the CA.

Open calls for Proposals for Conferences (Training activities) in QIPC in Europe will be issued at least at the end of month 3 of the project, with a deadline every 6 months. The proposals will be evaluated and the successful training activities will be administrated according to the following procedure:

- 1) Publicity for the calls for proposals for major QIPC conferences, QIPC workshop, and training activities will be ensured by the following measures:
 - a) The present procedure for calls and proposal forms will be posted on the CA web site as soon as possible after the start of the project, and in any case no later than month 3.
 - b) The call for proposals for training activities will be sent, using the mailing list established by ERA-Pilot QIST and WP2, to all groups active in QIPC in Europe. This will be done as soon as possible after the start of the project, and in any case no later than month 3.
 - c) Public announcements summarizing this call for proposal will be made at major conferences and other activities where most scientists active in QIPC are present.
 - d) The results of the bi-annual evaluations as well as the reports on the supported activities will be posted on the CA web site.
- 2) Deadlines for receipt of the applications will be the last day of month 6, and month 18 of the project (considering a total project duration of 3 years). The proposals (the necessary forms have been created and will be posted on the web site of the CA) will be submitted by postal mail to the WP leaders.
- 3) Evaluation of the proposals will be according to the following steps, so to ensure fair and objective decisions
 - a) Every 12 months, the proposals that have been submitted will be listed and pre-evaluated by the WP leaders (and the SMMC in case of conferences) considering the above-listed criteria. The proposals will have to include suggestions for Conference Chair(s), Local Organizing Committee, and a list of suggested Program Committee Members. The Program Committee should include a number of scientists with balanced expertise from the main QIPC sub-fields. A recommendation will then be issued by the WP leaders to the attention of the Governing Board.

- b) The Governing Board will evaluate the proposals received during the preceding 12 months on the basis of the recommendation by the WP leaders. As the aim of WP5 (WP6) is to coordinate conferences (training activities) in Europe, and since the WP leaders will have an overall view of the funded activities, they may provide the GB with recommendations based on specific information (for instance concerning previously funded projects). The final decision is however due to the GB. The GB considers all the proposals from local organizers for the given year and makes a decision. If necessary the GB gives recommendations on the selected proposal on how to improve it, including suggestions for additional members of the Program Committee.
 - c) The CA will not fund conferences (training activities) that involve only a single EU country, nor does it fund training activities that fall within the scope of a single EU project.
 - d) According to the overall strategy of the CA, proposals with an interdisciplinary character covering all facets of QIPC at the highest international level will be prioritized.
 - e) Satellite meetings to the QIPC meeting may be proposed, and will be decided upon by the Organizing and Program Committees of the winning proposal.
 - f) A special session (max. 4 hours) organized by FET Proactive Initiative in cooperation with QUROPE will be incorporated in each of the 3 conferences. The issues discussed at this meeting may include: organization, strategy and planning of the work of the QIPC proactive initiative and the projects in the QIPC cluster, management and organizational issues of QUROPE, discussion on the updates of the roadmap, discussion on any other document that is to be written by QUROPE, discussion on collaboration/coordination with national or international QIPC initiatives, discussion on issues either scientific or strategic that are of particular importance at the time of the conference, brief presentations of the main IPs or other QIPC projects, invited speakers of strategic or political importance.
- 4) Reimbursement of costs incurred during the activity will take place in 2 steps. An advanced payment will be made by the WP leader institution to the successful applicant after the funding of the proposed training activity has been decided by the GB. This advanced payment will represent 50 % of the approved preliminary budget, possibly amended by the GB. The final reimbursement will only take place after reception of a report on the activity, and only on the basis of original justifications. An invoice, issued by the organizing institution and summarizing the costs listed by categories (travels, accommodation, young scientist fellowships, lecturer honorarium, proceedings, etc.) will be acceptable if it is certified by the organizing institution. The reimbursement of costs will be according to the rules of the Work Package leader institution. The institution reserves itself the right to refuse to reimburse any costs which are not according to its internal rules. Eligible costs include, but are not limited to, travel and accommodation of lecturers, lecturer honorarium, young scientist fellowships, editing and printing of proceedings, organisational and secretariat costs.
 - 5) Modification of the Call for Proposals for Conferences (Training Activities) in QIPC and associated documents can be made at any moment by the decision of the Governing Board. In any case, the success of this workpackage will be evaluated on an annual basis, using the Annual Report as a feedback. Corrective actions will then be taken by the Governing Board.
 - 6) The exception to this rule concerns only the major interdisciplinary QIPC conference in 2007, since due to the time pressure the decision in this case will to be boosted up. In this case the Governing Board will evaluate the applications not later than the month 1.

(WP7) COLLABORATION WITH RELATED WELL-ESTABLISHED R&D AND WITH INDUSTRY

WP Leader: N. Gisin (P29/GAP)

The building of collaborations between well-established R&D (e.g. the optical computing community) as well as the enhancement of developmental and industrial interchange represent the scope of this WP.

There is already some industrial involvement with QIPC, even at this stage, with a number of IT and telecommunications companies having small-scale research activities and links with the major academic research centres (and therefore have indirect involvement with the CA or a strong link to it). However, these industry-based activities are likely to remain investigative and small-scale until two basic questions have been answered:

- 1) What is the best route forward for quantum information processing hardware?
- 2) Where are the markets for QIPC technology? In other words, what can QIPC technology be used for which will make it sell? Either, what new “algorithms” can it run, or how can the associated by-products be exploited?

These vital questions are currently being addressed, through EC-wide and individual member national research initiatives. As progress continues, the next step towards technology is to establish stronger links with European industry. The WP planned enhancement of industry involvement at this investigative research stage will help speed up this process, enhance existing industrial activity and pave the way for future exploitation from R&D to industry.

Another important avenue that needs to be promoted is possible benefits associated with spin-offs or by-products (as opposed to actual quantum information technology) such as the controlled manipulation of quantum systems. Such systems serve as precision standards and as detectors in applications that provide the highest possible precision. Examples range from gravitational detectors using atom interferometry, to atomic clocks using laser-cooled ions or atoms. There are existing start-up companies such as idQuantique SA and MagiQ companies that are taking advantage of both fundamental advances, through quantum cryptography, as well as the associated by-products like detectors for improved spectroscopy and quantum random number generators that can be used in classical cryptography schemes or even in gaming or finance modeling arenas.

We aim to improve the already active dialogue with these start-ups and use this as a model to motivate other industry partners. There will certainly be a wide range of benefits from the developments in QIPC research, and one of the missions of this WP is to identify emerging technologies and potential new spin-offs, as well as monitor the progress of the existing ones, thus providing a link for the different scientific communities involved to exchange ideas, experience and expertise.

The WP will also try to establish an early dialogue towards technology transfer and will provide patent guidelines for researchers and possibly a patent service.

(WP8) INTERNATIONAL CONTACTS BETWEEN RESEARCHERS COMMUNITIES IN EUROPE AND OVERSEAS

WP Leaders: G. Burkard, D. Loss (P28/UniBas), A. Ekert (P32/UCAM-DAMTP)

The aims of the WP8 are sustained international contacts between the QIPC researcher community in Europe (QUROPE) and research communities overseas (US and Canada, Asia, Australia, and others). Specifically, within WP8 we want to strengthen the European QIPC community (QUROPE) by

- establishing new contacts and scientific exchange,
- increasing the global connectedness of European researchers,
- promoting European research in QIPC in the USA, Asia, etc., in order to increase its visibility,
- and attracting the most excellent non-European researchers in QIPC to research centers in Europe.

The partners involved in this WP have well developed structural connections with leading international QIPC Centers, such as NSEC at Harvard University (Nanoscale Science and Engineering Center), the Center for Spintronics and Quantum Computation at the University of California at Santa Barbara. They have been involved in setting up a number of the European, American and some Asian programmes in quantum information science. They have been advising such international organizations as, ARDA technology expert panel on Roadmap in Quantum Computation, The Perimeter Institute, The Canadian Institute for Advanced Research, quantum information science groups in Singapore (at the National University of Singapore), the Science Council of Japan and several Japanese companies on quantum information technology and in Taiwan. WP8 will extensively use these links to achieve the objectives of the CA.

The work planned within WP8 involves two different tasks. From the one hand, the main WP8 objective will be to ignite the structuring of an international coordination programme between the EU QIPC research community and other communities (in the same area) overseas, most notably the ones in the US, Canada, Asia, and Australia. This will be achieved through a set of bilateral high profile meetings with only few relevant participants (the CA governing board and EU officers) and their correspondent for the other party involved. The QUROPE governing board members will act as “ambassadors” of Europe in QIPC who maintain “diplomatic relations” with researchers and funding agencies overseas. In particular the possibility of setting up bilateral research projects with shared resources (e.g., with the EU funding the European scientists involved, and the partner country funding its own researchers) will be promoted. In discussing this initiatives we will take advantage of the experience that the EU has matured inside FEAST (Forum for European-Australian Science and Technology cooperation, see <http://www.feast.org>), an organisation established in 2001 for highlighting, promoting, and facilitating research collaboration between the European and Australian research communities. There is no dedicated funding for these high profile meetings within QUROPE, hence the meetings are subject to the independent funding availability.

On the other hand, WP8 will made the first concerted effort to reverse (in the QIPC field) the so-called “brain drain” phenomenon, i.e., the flow of talented European QIPC researchers to other countries overseas (most notably the U.S.). A public relations campaign will be organized to attract excellent students and young talented researchers from outside Europe to European QIPC research institutions; this initiative will be supported by a comprehensive job database published and maintained on the QUROPE main site, and that will advertise the most attractive QIPC jobs available within the QUROPE partners and affiliated members.

7.2 WORK PLANNING AND TIMETABLE

Task	Title	Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
	(WP1) Management and Coordination.												
1.1	Administration and support	[Bar]											
1.2	Coordination with existing FET QIPC projects	[Bar]											
1.3	Internal exchange of information	[Bar]											
1.4	Governing Board meetings and decisions	[Bar]											
1.5	Quality control	[Bar]											
1.6	Risk management	[Bar]											
	(WP2) Develop a common vision, strategy and goals												
2.1	Online communication tool	[Bar]											
2.2	Quantum Information Classification Scheme	[Bar]											
2.3	QIPC Database	[Bar]											
2.4	European QIPC Strategic Report	[Bar]											
	(WP3) Public outreach: increasing the public visibility and awareness of the field												
3.1	Publication and collection of articles in special and popular press; promotion of general media coverage of QUROPE issues	[Bar]											
3.2	Posting of the articles on the website	[Bar]											
3.3	Documentary film	[Bar]											
3.4	General promotion of QUROPE issues and activities	[Bar]											
3.5	Publication of a special edition of collected articles aimed at a general public readership	[Bar]											
3.6	Publication of folders and brochures intended for the general public	[Bar]											

Task	Title	Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
	(WP8) International contacts between researchers communities in Europe and overseas												
8.1	Structuring an international coordination programme												
8.2	Recruitment and job market												

7.3 GRAPHICAL PRESENTATION OF WORKPACKAGES

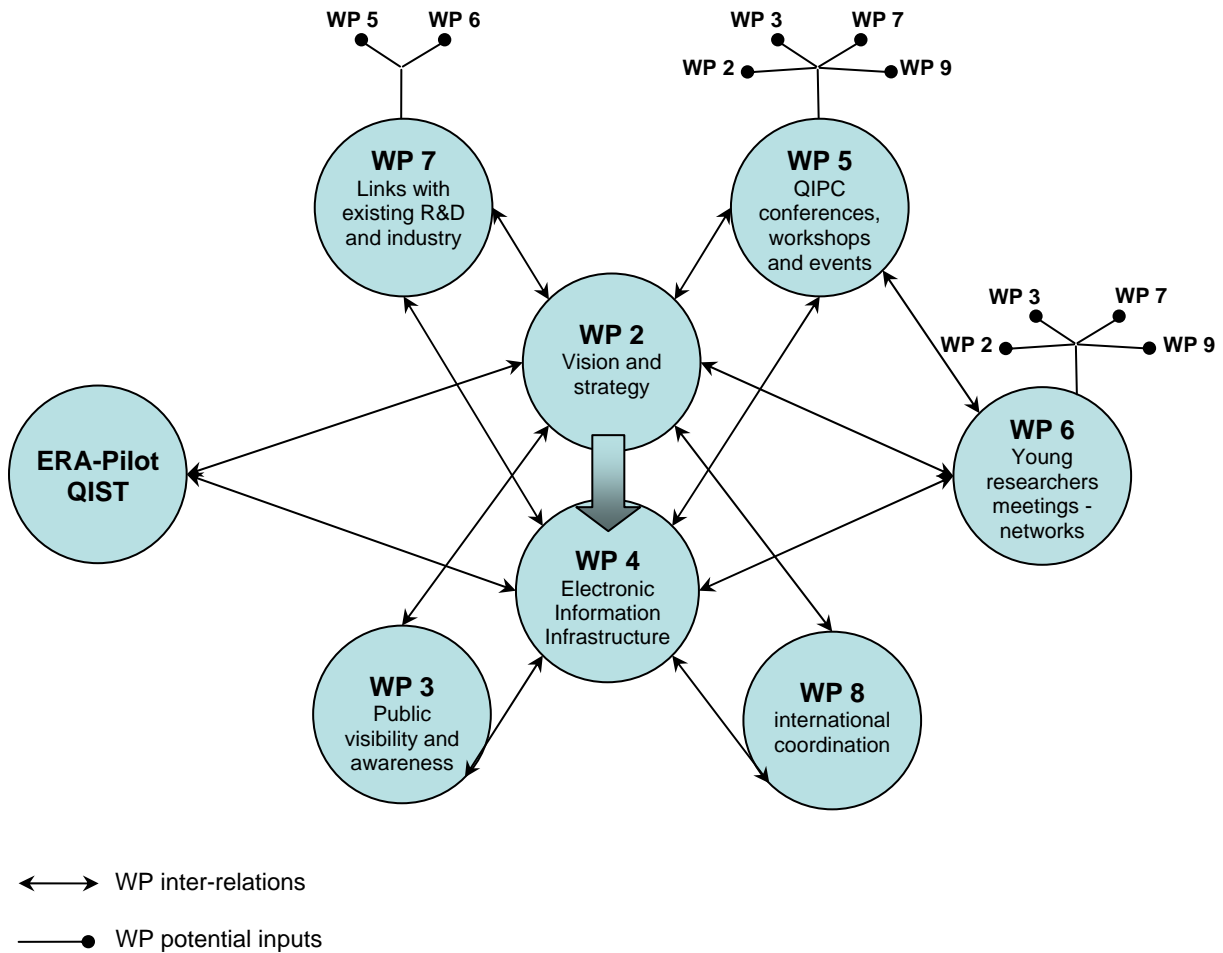


Figure 1: Graphical representation of workpackage inter-relationships and potential inputs. In order to avoid cluttering WP1 is not shown. The latter will run in the background coordinating all other workpackages and providing cooperation with the ERA-Pilot.

7.4 WORKPACKAGE LIST

Wp n°	Workpackage title	Lead contractor n°	Person month	Start month	End month	Deliverable n°
WP1	Management and coordination	P1	52	0	36	D1.1-D1.7
WP2	Develop a common vision, strategy and goals	P2-P20-P35	40	0	36	D2.1-D2.11
WP3	Public outreach: increasing the public visibility and awareness of the field	P2-P3-P1-P33	58	0	36	D3.1-D3.14
WP4	Electronic Information Infrastructure and Information Exchange (with a feedback channel)	P1-P20	25	0	36	D4.1-D4.8
WP5	Structuring and integrating the community: Scientific meetings and dissemination activities	P30-P24	35	0	36	D5.1-D5.13
WP6	Young scientists and training activities	P4	30	0	36	D6.1-D6.7
WP7	Collaboration with related well-established R&D and with industry	P29	10	0	36	D7.1-D7.5
WP8	International contacts between researchers communities in Europe and overseas	P28-P32	10	0	36	D8.1-D8.4
	TOTAL		260			

7.5 DELIVERABLES LIST

Deliverable n°	Deliverable title	Delivery date	Nature ¹	Dissemination level ²
D1.1	Internet-based communication platform	4	O	PP
D1.2	Risk management structure	6	O	PP
D1.3	1 st year progress report and workplan update	12	R	PP
D1.4	Mid-term QIPC community survey	18	O	PP
D1.5	2 nd year progress report and workplan update	24	R	PP
D1.6	Final QIPC community survey	36	O	PP
D1.7	Final progress report	36	R	PP
D2.1	Web based communication tool	4	O	PP
D2.2	Establishment of Expert Group panels	4	R	PU
D2.3	Update of the QI Classification Scheme from ERA-Pilot	12	O	PP
D2.4	Update of the QIPC Database from ERA-Pilot	12	R	PU
D2.5	Update of the QIPC Strategic Report from ERA-Pilot	12	R	PU
D2.6	Mid-term release of the QI Classification Scheme	24	O	PP
D2.7	Mid-term release of the QIPC Database	24	R	PU
D2.8	Mid-term release of the QIPC Strategic Report	24	R	PU
D2.9	QI Classification Scheme final version	36	O	PP
D2.10	QIPC Database final version	36	R	PU
D2.11	QIPC Strategic Report final version	36	R	PU

¹ R=Report, P=Prototype, D=Demonstrator, O=Other

² PU=Public, PP=Restricted to other programme participants (including the Commission Services), RE=Restricted to a group specified by the consortium (including the Commission Services),CO=Confidential, only for members of the consortium (including the Commission Services).

Deliverable n°	Deliverable title	Delivery date	Nature	Dissemination level
D3.1	Research & development of project manuscript for the film Quantum Information	6	O	PU
D3.2	1 st Annual media report on QUROPE	12	R	PU
D3.3	1 st Annual promotion report of events and PR	12	R	PU
D3.4	Editing and post production of the film Quantum Information	12	O	PU
D3.5	Publication of annual folder 1, for general distribution	12	O	PU
D3.6	Completed film demonstration	18	O	PU
D3.7	2 nd Annual media report on QUROPE	24	R	PU
D3.8	2 nd Annual promotion report of events and PR	24	R	PU
D3.9	Publication of annual folder 2, for general distribution	24	O	PU
D3.10	3 rd Annual media report on QUROPE	36	R	PU
D3.11	3 rd Annual promotion report of events and PR	36	R	PU
D3.12	Presentation of media database	36	O	PU
D3.13	Publication of a special edition of collection of articles aimed at a general public readership	36	O	PU
D3.14	Publication of annual folder 3, for general distribution	36	O	PU
D4.1	Operational website	3		PU
D4.2	Feedback channel	5		PU
D4.3	Enhanced web features	8		PU
D4.4	Full integration of ERA-Pilot	12		PU/PP
D4.5	Full website integration of all QUROPE WPs	12		PU
D4.6	Mid-term website update	24		PU

Deliverable n°	Deliverable title	Delivery date	Nature	Dissemination level
D4.7	Final website update	36		PU
D4.8	Final version of the website	36		PU
D5.1	GB decision for the major QIPC conference in 2007 and establishment of the referee list	1	O	PU
D5.2	Publication on the CA website of the Call for Proposals for Meeting and Dissemination Activities in QIPC and associated documents	3	O	PU
D5.3	Support and organisation of the major biannual QIPC conference 2007	12	O	PU
D5.4	Financial Report for year 1 of WP5	12	R	PP
D5.5	Annual report and Strategic Summary for year 1 of WP5	12	R	PP
D5.6	Evaluation of the proposals for 2008	18	O	PU
D5.7	Support and organization of the 2008 QIPC workshop	24	O	PU
D5.8	Financial Report for year 2 of WP5	24	R	PP
D5.9	Annual report and Strategic Summary for year 2 of WP5	24	R	PP
D5.10	Evaluation of proposals for 2009	30	O	PU
D5.11	Support and organisation of the major biannual QIPC conference 2009	36	O	PU
D5.12	Financial Report for year 3 of WP5	36	R	PP
D5.13	Annual report and Strategic Summary for year 3 of WP5	36	R	PP

Deliverable n°	Deliverable title	Delivery date	Nature	Dissemination level
D6.1	Publication on the CA website of the call for proposals for training activities in QIPC in Europe and associated documents	3	O	PU
D6.2	Strategic Report on training activities for year 1	12	R	RE
D6.3	Call, evaluation and award of the 2007 QIPC Young Award Prize	18	O	PU
D6.4	Coordination and financial support of training activities during months 0-18	18	O	PU
D6.5	Strategic Report on training activities for year 2	24	R	RE
D6.6	Call, evaluation and award of the 2009 QIPC Young Award Prize	36	O	PU
D6.7	Coordination and financial support of training activities during months 18-36	36	O	PU
D6.8	Strategic Report on training activities for year 3	36	R	RE
D7.1	Database of potentially interested industries and emerging technologies	12	O	PP
D7.2	Creation of a regular information distribution service for industry concerning QIPC research in Europe	24	O	PP
D7.3	Final update of dedicated database	36	O	PP
D7.4	Special session targeting industry at one of the major QIPC conferences	36	O	PU

Deliverable n°	Deliverable title	Delivery date	Nature	Dissemination level
D7.5	Development and update of a wish-list/shopping list for QIPC-industry technology transfer	36	R	PP
D8.1	Job database and job PR program online	6	O	PU
D8.2	First high level bilateral meeting	12	O	RE
D8.3	Second high level bilateral meeting	24	O	RE
D8.4	Third high level bilateral meeting	36	O	PU

7.6 WORKPACKAGE DESCRIPTIONS

(WP1) MANAGEMENT AND COORDINATION

Workpackage number	WP1	Start date or starting event		0
Participant id		P1	GB Members ³	
Person-months (total)	Coordination ⁴	28		
	Management ⁵	6	18	
Person-months (requested EC contribution)	Coordination	27		
	Management	6	0	

Objectives

This WP objective is to secure an effective progress of the project towards its various goals, under the unifying vision to build a common strategy for QIPC in Europe in the mid- to long-term future.

Description of work

The work of WP1 has been organized according to the following task structure.

Task 1.1: Administration and support

This Task has to fulfil all administrative requirements (accounting, reporting, etc.) and to give the leaders of the other workpackages support to fulfil their own tasks. It will also be responsible for financial issues (e.g. yearly cost-claims, transfer of funding, organization of financial audits). This task has no formal deliverable, as its output will consist in the collection, compilation and transmission of cost statements and audit reports.

Task 1.2: Coordination with existing FET QIPC projects

This task includes the responsibility to organize the collaboration with the projects of the QIPC cluster, by coordinating with their own initiatives, where appropriate in the framework of specific CA workpackages (e.g. conferences). The outcome of this coordination activity will be reported in the yearly progress report (see D1.3, D1.5 and D.17).

Task 1.3: Internal exchange of information

To secure communication between the participants an internet-based communication platform will be established that allows the distributed work on common documents and the virtual discussion of relevant topics. This will include directing and facilitating in an appropriate way the flow of information between workpackages, between the Commission and the partners, between the Governing Board and the whole consortium.

*D1.1 Internet-based communication platform
(month 4, 2 person-month)*

³ Governing Board (GB) members are contributing 1 person month (for management activities) each. As detailed in the B5 section, the GB has the following composition: R. Blatt (P2/OEAW), H. Buhman (P21/CWI), V. Buzek (P25/IPSAS), N. Cerf (P4/ULB), I. Cirac (P14/MPG), A. Ekert (P32/UCAM_DAMTP), N. Gisin (P29/GAP), P. Grangier (P10/CNRS), Sir P. Knight (P33/ICSTM), M. Lewenstein (P24/ICFO), D. Loss (P28/UniBas), H. Mooij (P22/TU-Delft), E. Polzik (P1/KU), G. Rempe (P14/MPG), I. Walmsley (P34/UOXF.DU), R. Werner (P12/BRS), A. Zeilinger (P3/UNIVIE), P. Zoller (P2/OEAW), and T. Calarco (P35/ULM).

⁴ Person-months allocated for coordination activities

⁵ Person-months allocated for management activities (and as such not counted when distributing person-months over deliverables)

Task 1.4: Governing Board meetings and decisions

WP1 will prepare and organize meetings of the GB. In order to make the oversight of the Governing Board on the activities of the whole CA as complete and effective as possible, this task will provide to GB members all relevant information in such a way as to appropriately prepare decisions, including adjustments to the work plan, and follow up with their implementation.

*D1.3 1st year progress report and workplan update
(month 12, 6 person month)*

*D1.5 2nd year progress report and workplan update
(month 24, 6 person-month)*

*D1.7 Final progress report
(month 36, 6 person-month)*

Task 1.5: Quality control

This task will gather information on the level of attainment of the CA objectives, on one hand by monitoring progress of the various workpackages towards their goals, and on the other hand by surveying the level of satisfaction by the community about its outcomes (both internally, from project partners and affiliated, and externally, from European QIPC groups at large).

*D1.4 Mid-term QIPC community survey
(month 18, 3 person-month)*

*D1.6 Final QIPC community survey
(month 36, 3 person-month)*

Task 1.6: Risk management

In this task a mechanism will be put in place, including responsible persons within the GB, to deal with unforeseen developments during the course of the project life.

*D1.2 Risk management structure
(month 6, 2 person-month)*

Deliverables

D 1.1	Internet-based communication platform	4
D 1.2	Risk management structure	6
D 1.3	1 st year progress report and workplan update	12
D 1.4	Mid-term QIPC community survey	18
D 1.5	2 nd year progress report and workplan update	24
D 1.6	Final QIPC community survey	36
D 1.7	Final progress report	36

Milestones and expected result

- M 1.1 1st year Governing Board meeting and workplan revision
M 1.2 2nd year Governing Board meeting and workplan revision
M 1.3 End of the project

Expected result: Efficient management and coordination based on pyramidal structure ensuring openness on the one hand and authority on the other hand, will result in successful completion of the CA. Thus the main goal of the structuring and development of a common vision and strategy for QIPC in Europe will be achieved.

(WP2) DEVELOP A COMMON VISION, STRATEGY AND GOALS

Workpackage number	WP2	Start date or starting event			0		
Participant id		P2	P20	P35			
Person-months (total)		8	29	3			
Person-months (requested EC contribution)		0	29	0			

Objectives

This WP aims at carrying out a complete survey of QIPC research in Europe, collecting information on ongoing activities, elaborating a comprehensive strategic vision of current directions and future goals, reaching a broad consensus in the scientific community about it, expressing it in a series of documents serving different purposes, and maintaining and regularly updating each one of them.

Description of work

This WP will formally take over the development and regular updates of the existing ERA-Pilot 'living' documents: the 'QIPC Strategic Report' and the 'Quantum Information Classification Scheme', providing and developing also the necessary web-based tools for the document editing/sharing, based on the work already being performed for the ERA-Pilot WP1 website (<http://gist.ect.it>)

The WP will consist of 4 strictly interrelated Tasks: the Quantum Information Classification Scheme will enable to structure an easily searchable index of all QIPC research activities to be described and categorized in the QIPC Database, and this will serve as the basis for the regular updates of the QIPC Strategic Report, keeping track of the rapid development of the field and tracing it back to a global vision. All of the required data collection, sharing and editing activities will be straightforwardly performed on line with the aid of the specifically developed web tool.

The WP will setup Expert Groups (in the three broad sub-fields: quantum communication, quantum computing and theoretical quantum information science) contributing to the development of the QIPC Strategic Report.

Task 2.1: Online communication tool

Based on the software being developed by the same partners within the ERA-Pilot project, a comprehensive system for data collection and exchange and for online editing will be made available to serve all different tasks in this WP.

*D2.1 Web-based communication tool
(month 4, 1 person-months)*

After the initial delivery, the tool will be maintained throughout the whole duration of the project (with an additional personnel cost of 3 person-months).

Task 2.2: Quantum Information Classification Scheme (QICS)

The Quantum Information Classification Scheme, a structured and indexed list of all sub-topics within the field of QIPC modelled on the PACS Scheme, will be regularly updated based on a survey of new publications and on input requested from the community through the website, to take account of newly emerging topics and ideas.

*D2.3 Update of the QI Classification Scheme from ERA-Pilot
(month 12, 3 person-month)*

*D2.6 Mid term release of the QI Classification Scheme
(month 24, 3 person-month)*

*D2.9 QI Classification Scheme final version
(month 36, 3 person-month)*

Task 2.3: QIPC Database

This task will carry on an analysis of the scientific community and maintain a database that contains: a list of European QIST-groups; a classification of QIST-groups according to the scheme of Task 1.2; the size of the groups; the geographical allocation of groups, knowledge, and expertise; an overview of existing collaborations between single groups and membership in projects. The database will be periodically updated with calls for renewing registration and providing information, and it will be made available in a searchable form to all members of the Consortium, and it will be used for several tasks within the project – for instance as a basis for consultation of groups on issues relevant to the elaboration of the common European QIPC vision and strategy.

*D2.4 Update of the QIPC Database from ERA-Pilot
(month 12, 3 person-month)*

*D2.7 Mid-term release of the QIPC Database
(month 24, 3 person-month)*

*D2.10 QIPC Database final version
(month 36, 3 person-month)*

Task 2.4: European QIPC Strategic Report

With the help of the specifically appointed Expert Groups, this task will periodically update the Strategic Report recently published by the European Commission with the support of the ERA-Pilot QIST project, that will express the common strategy, vision and goals of the QIPC community for the years to come. This will be based on the Expert Groups' judgement of the state of the art and of recent advances in the field, as gathered from relevant publications and from the QIPC Database updated under Task 1.3, as well as on input from the community, collected through the web tool developed and maintained under Task 1.1.

At every yearly update of the Report, this Task will produce a short Strategic Summary which will serve as a milestone to highlight to the CA the breakthroughs and/or development occurred in the QIPC scientific community, and the new directions that might have been opened/explored.

*D2.2 Establishment of Expert Group panels
(month 4, 1 person month)*

*D2.5 Update of the QIPC Strategic Report from ERA-Pilot
(month 12, 6 person-month)*

*D2.8 Mid term release of the QIPC Strategic Report
(month 24, 7 person-month)*

*D2.11 QIPC Strategic Report final version
(month 36, 7 person-month)*

Deliverables

D2.1	Web-based communication tool	4
D2.2	Establishment of Expert Group panels	4
D2.3	Update of the QI Classification Scheme from ERA-Pilot	12
D2.4	Update of the QIPC Database from ERA-Pilot	12
D2.5	Update of the QIPC Strategic Report. from ERA-Pilot	12
D2.6	Mid-term release of the QI Classification Scheme	24
D2.7	Mid-term release of the QIPC Database	24
D2.8	Mid-term release of the QIPC Strategic Report	24
D2.9	QI Classification Scheme final version	36
D2.10	QIPC Database final version	36
D2.11	QIPC Strategic Report final version	36

Milestones and expected result

- M2.1 First year's Strategic Summary
- M2.2 Second year's Strategic Summary
- M2.3 Third year's Strategic Summary

Expected result: a broad consensus around a vision on the future of QIPC research in Europe, and a widely accepted strategy for its implementation.

(WP3) PUBLIC OUTREACH: INCREASING THE PUBLIC VISIBILITY AND AWARENESS OF THE FIELD

Workpackage number	WP3	Start date or starting event				0	
Participant id		P1	P2	P3	P33		
Person-months (total)		16	21	16	5		
Person-months (requested EC contribution)		1	5	5	0		

Objectives

This WP aims to increase the public visibility and public awareness of the field of QIPC. The WP leader will coordinate the other WP members and members of QUROPE to actively disseminate and promote issues relevant to the public and related to QUROPE. Specifically, the WP aims at increasing general media coverage of QUROPE issues by strengthening media activities of the QUROPE consortium members and active publication of articles in the popular science press and in the general press.

Specific emphasis will be given to activities increasing the interest of young people in quantum physics and finding talented young scientists.

The WP aims towards sustained awareness to ensure a broader acceptance of science and better education of the general public. The collected media contributions will also prove a helpful indicator for the scientific excellence of European research compared to other international competitors.

Description of work

The WP Leader will coordinate the other WP members and members of QUROPE for the following tasks:

Task 3.1: Collection of articles in special and popular press

The WP leader will encourage the consortium to actively publish QUROPE-related issues in the popular science press and in the general press and to increase their media activities. The WP leader will collect the resulting media contributions and in addition actively search current media for public

coverage of work related to QUROPE. All QUROPE members are asked to participate in this action by reporting their own public coverage on a regular basis. Information will be collected in a database. If possible, the database developed during WP 2 could be used for that purpose (would simplify the interface to the Web). The ongoing work in this WP will be summarized in annual media reports.

These detailed reports will be accompanied by a summary of the successes and activities in the field, including the activities of the three Integrated Projects in the field and the general strategies and activities of the European Commission. This part of the report will be produced as a separate, contained publication that may be used for wide distribution and promotion of QIPC research in Europe with reference to the project web site will accompany the detailed reports.

*D3.2 1st Annual media report on QUROPE
(month 12, 4 person-months)*

*D3.7 2nd Annual media report on QUROPE
(month 24, 4 person-months)*

*D3.10 3rd Annual media report on QUROPE
(month 36, 4 person-months)*

Task 3.2: Posting of the articles on the website

There will be three different sections in the website:

- Articles of topical interest of the QUROPE members
- Other articles of the QUROPE members
- Articles of other Quantum research groups

It is suggested to post and/or distribute short Newsletters via Web and/or e-mail; approximately 3 times per year.

*D3.12 Presentation of media database
(month 36, 2 person-month)*

Task 3.3: Documentary films

There is an agreement with the known documentary movie director Lars Becker-Larsen from Denmark [“The Copenhagen Interpretation” (2004); “Theory of Everything” (1998); “The lesson of Quantum physics” (1991)] about collaboration and partial funding of a documentary film on Quantum Information by the CA. In the spring of 2005 research & filming was performed by the L. Becker-Larsen at QUPON conference in Vienna. By the end of 2005 the promotional DVD has been produced and fundraising has started.

It is proposed that director L. Becker-Larsen serves as sub-contractor for the CA. He is allocated the budget of 60.000€ towards production of the film. The rest of necessary funding will be provided by the Danish Film Institute and other sources.

The WP leader will explore other possibilities of producing other films on the topics related to QUROPE.

*D3.1 Research & development of project manuscript for the film Quantum Information
(month 6, 5 person-month)*

*D3.4 Editing and postproduction of the film Quantum Information
(month 12, 5 person-month)*

*D3.6 Completed film demonstration
(month 18, 5 person-month)*

Task 3.4: Promotion

The WP leader will collect and disseminate suggestions of the other WP leaders and QUROPE members for

- The promotion of the aims and contents of QUROPE during meetings and conferences by press conferences and/or press releases
- Participation in other events that try to increase the public understanding of science

- The development of ideas to get into contact with schools and make the field of QUROPE more attractive for both pupils and teachers
- The development of ideas to increase the public awareness and creating products for public dissemination, such as booklets, popular lectures etc.

*D3.3 1st Annual promotion report of events and PR
(month 12, 4 person-months)*

*D3.8 2nd Annual promotion report of events and PR
(month 24, 4 person-months)*

*D3.11 3rd Annual promotion report of events and PR
(month 36, 4 person-months)*

Task 3.5: Publication of a special edition of collection of articles aimed at a general public readership

The WP leader will undertake the coordination for publishing a special edition of collection of articles on QIPC issues, written in “Scientific American” style, aimed at a general public, similar to the publication done in 2005 by the FET Proactive Initiative in QIPC and to be published as an EC book. The 2005 publication contained 30 articles by 58 of the most prominent European scientists.

The aim is

- To provide the interested public with deeper insights into QUROPE related issues and outlook
- To increase the public awareness of the field and its potential for the future
- To reach in an appropriate way decision makers in research (policy, academia, industry)

*D3.13 Publication of a special edition of collection of articles aimed at a general public readership
(month 36, 5 person-month)*

Task 3.6: Publication of folders and brochures intended for the general public

The WP leader will coordinate the publication of several folders and brochures for wide distribution and intended for the general public. In addition to any brochures or folders on concrete scientific results in the three Integrated Projects in the field, an annual folder will provide an overview over the activities and successes in the field. Reference to the website will open the possibility for further information to the interested reader. The aims of these folders and brochures are

- To provide the interested public with an overview over QUROPE related issues and scientific results in the field
- To increase the public awareness of the field
- To inform interested readers of possibilities for further information (websites, other publications)

WP3 is allocated 60.000€ towards publication costs.

*D3.5 Publication of annual folder 1, for general distribution
(month 12, 4 person-months)*

*D3.9 Publication of annual folder 2, for general distribution
(month 24, 4 person-months)*

*D3.14 Publication of annual folder 3, for general distribution
(month 36, 4 person-months)*

Deliverables

D3.1	Research & development of project manuscript for the film Quantum Information	6
D3.2	1 st Annual media report on QUROPE	12
D3.3	1 st Annual promotion report of events and PR	12

D3.4	Editing and post production of the film Quantum Information	12
D3.5	Publication of annual folder 1, for general distribution	12
D3.6	Completed film demonstration	18
D3.7	2 nd Annual media report on QUROPE	24
D3.8	2 nd Annual promotion report of events and PR	24
D3.9	Publication of annual folder 2, for general distribution	24
D3.10	3 rd Annual media report on QUROPE	36
D3.11	3 rd Annual promotion report of events and PR	36
D3.12	Presentation of media database	36
D3.13	Publication of a special edition of collection of articles aimed at a general public readership	36
D3.14	Publication of annual folder 3, for general distribution	36

Milestones and expected result

- M3.1 First year's Evaluation of PR-activities
M3.2 Second year's Evaluation of PR activities
M3.3 Third year's Evaluation of PR activities

Expected result: a broad public visibility of QIPC research in Europe and a strong impetus on a new generation of teachers, young students and potential researchers.

(WP4) ELECTRONIC INFORMATION INFRASTRUCTURE AND INFORMATION EXCHANGE (WITH A FEEDBACK CHANNEL)

Workpackage number	WP4	Start date or starting event				0
Participant id		P1	P20			
Person-months (total)		13	12			
Person-months (requested EC contribution)		11	12			

Objectives

This WP will establish and maintain an Electronic Information Infrastructure to support the efficient service of all the QUROPE objectives. The WP activity will be centered around the development, publication and maintenance of a comprehensive website, through which the bulk of the information concerning the Coordination Action will be actually elaborated, distributed, exchanged and finally disseminated. The objectives of this WP are therefore to:

- Enhance the communications between different QUROPE WPs and provide a mechanism for the distribution of information between them
- Provide a facility to archive any knowledge generated during the QUROPE life-time
- Endow QUROPE with a bidirectional flow of information to and from the entire QIPC community

Description of work

As much of the QUROPE functions as possible will be achieved through elaboration, distribution, exchange and presentation of information electronically. This WP will respond to this requirement through the development and maintenance of an appropriate infrastructure in the form of a comprehensive website (the detailed description of which has been provided in section B6a). The WP will constantly communicate with all others QUROPE WPs, in such a way of developing the tools they need as well as maintaining a continuous and up to date flow of information of the CA initiatives towards the QIPC community. Moreover, the aforementioned flow will be bidirectional, since a feedback channel will be established for the community to influence the future actions and directions QUROPE might take.

Finally, a specific WP task will seek for integration in QUROPE of the already existing information (databases, position documents etc.) that has been collected through the life-time of the currently running ERA-Pilot QIST.

Task 4.1: Website development

This task is the main one of this WP, and will be running for all the life-time of the Coordination Action. In fact, after the initial delivery of the website, this task will continuously enhance it, developing and accommodating new tools that will grow either from explicit request of the different QUROPE WPs, or from suggestions and perceived community needs.

D4.1 Operational website

(month 3, 6 person-months)

D4.1.1 General pages (P1)

D4.1.2 QIPC news (P20)

D4.1.3 Events Diary (P1)

D4.1.4 CA Reports (P1)

D4.1.5 QIPC links (P1)

D4.1.6 QUROPE Newsletter (P1)

D4.2 Feedback channel (P20)

(month 5, 3 person-months)

D4.3 Enhanced web features

(month 8, 7 person-months)

D4.3.1 Web based learning center (P1)

D4.3.2 QIPC Strategic Report (P20)

D4.3.3 QUROPE Outcomes (P1)

D4.3.4 Jobs (P1)

D4.3.5 Spin-off (P1)

D4.3.6 Databases (P20)

D4.3.4 Password Protected areas (P20)

Task 4.2: Integration of ERA-Pilot

This task will run for the limited period of 6 months starting right after the expiration of the ERA-Pilot QIST, and is designed to incorporate and integrate in QUROPE the bulk of information that has been collected and elaborated by the ERA-Pilot. It will ensure that no valuable data (databases, position documents, etc.) produced during the life-time of the ERA-Pilot by all of its WPs will be lost, and help WP2 in finalizing its taking over of the responsibilities of the ERA-Pilot WP1.

D4.4 Full integration of ERA-Pilot (P20)

(month 12, 3 person-month)

Task 4.3: Website maintenance

This task will be responsible for the maintenance of the delivered website, and as such its deliverable it will have periodic delivery dates. From the one hand, it will take care of the correct running of all the developed tools (feedback channel, 'living documents' editing tools, etc.); on the other hand it will ensure that the bidirectional flow of information between the QUROPE WPs and the QIPC

community is kept and updated by periodically analyzing the input coming from the feedback channel and address it to the relevant QUROPE WPs when appropriate.

*D4.5 Full website integration of all QUROPE WPs
(month 12, 3/2 person-month)*

*D4.6 Mid-term website update
(month 24, 3/2 person-month)*

*D4.7 Final website update
(month 36, 3/2 person-month)*

*D4.8 Final version of the website
(month 36, 3/2 person-month)*

Deliverables

D4.1	Operational website	3
D4.2	Feedback channel	5
D4.3	Enhanced web features	8
D4.4	Full integration of ERA-Pilot	12
D4.5	Full website integration of all QUROPE WPs	12
D4.6	Mid-term website update	24
D4.7	Final website update	36
D4.8	Final version of the website	36

Milestones and expected result

M4.1 First version of the website in place 3 months after the starting date

M4.2 Final version of the website including first version of all the planned tools (for details see WP 4 description in section B6a) in place 6 months after the starting date

M4.3 Fully fledged website with final version of all the planned tools in place 10 months after the starting date.

Expected result: ensure the success of the all of the QUROPE objectives that rely on the Electronic Information Infrastructure as the key dissemination vehicle.

(WP5) STRUCTURING AND INTEGRATING THE COMMUNITY: SCIENTIFIC MEETINGS AND DISSEMINATION ACTIVITIES

Workpackage number	WP5	Start date or starting event			0
Participant id		P24	P30	SMMC ⁶	Other Members ⁷
Person-months (total)		10	7	4	14
Person-months (requested EC contribution)		4	0	0	7

Objectives

The aim of this workpackage is to steer, coordinate and support financially cross-disciplinary scientific meetings in QIPC in Europe. In particular it will:

- Provide international forums for exchange of scientific results
- Help in formulating common themes across different disciplines involved in QIPC
- Assist cross-fertilization of concepts and technologies across different subfields of QIPC
- Build a pan-European QIPC research community

In particular, the Scientific Meetings Management Committee (SMMC), will facilitate the organization of a major biannual scientific meeting, in coordination with all EU projects represented in the CA, and others. This will be located in Europe and provide broad international and interdisciplinary visibility for the field. In the forthcoming years, the CA will be responsible, in collaboration with IPs for planning, structuring and supporting the biennale QIPC conference (2007 and 2009). In 2008, a smaller QIPC workshop will be also organized.

The CA will assist where needed in planning and coordinating organizational structures for the meetings, including suggesting invited speakers and highlighting new research activities. Given also the limited budget for conferences, WP5 will seek for other sources of support by establishing contacts and coordinating with the corresponding workpackages present in the running ERA-Pilot QIST and the 3 Integrated Projects (SCALA, QAP and EuroSQIP) for using the Commission resources already allocated to them for the purpose of organizing conferences and meetings.

Description of work

This workpackage is to plan, structure and coordinate major cross disciplinary scientific meeting activities in QIPC in Europe. To successfully carry out this task, it will consist of 4 interrelated Tasks, accompanied by associated deliverables. The man months shown include the effort for which funding is sought from the EC, as well as the effort funded by other sources (partner institutions, IPs)

⁶ SMMC stands for Scientific Meetings Management Committee (see WP5 description for details) and it is composed by the following people/partners: R. Blatt (P2/OEAW), A. Imamoğlu (P30/ETHZ) and M. Lewenstein (P24/ICFO), G. Rempe (P14/MPG), H. Burhman (P21/CWT), I. Walmsley (P34/UOXF.DU).

⁷ Other members refer to the yet unspecified members and partners who will be granted the support of the CA to run one of the QUROPE supported meetings. These members will be identified according to the open call procedures outlined in detail in the text of WP5, and the funding of these mm will come directly from the allocated budget for conferences/schools.

Task 5.1: Call for proposals

A wide participation in coordinating meetings will be ensured by:

- A Call for Proposals for Meeting and Dissemination Activities in QIPC will be posted on the web site of the CA as soon as possible after the start of the project, and in any case no later than month 3; the list of referees who will evaluate the proposals (see Task 5.2) will also be posted on the web site by month 3.
- Public announcements summarizing the call for proposals at major conferences in the field

*D5.2 Publication on the CA web site of the Call for Proposals for Meetings and Dissemination Activities in QIPC and associated documents,
(month 3, 2 person-months)*

Task 5.2: Evaluation of proposals

In order to ensure fair and objective decisions concerning which proposals to fund, and at what level, the following steps will be taken:

- During the first 2 months of the project, a list of referees will be established using as input the database of the ERA-Pilot QIST. The referees will be chosen for their scientific reputation, but also so as to cover in a representative way the different subfields of quantum information, the different countries of Europe, and the involvement/non involvement in EU projects. The referees will be contacted to obtain their consent. Their names will be posted on the CA website when online.
- Each proposal will be screened by the SMMC and will be evaluated by two referees, following the guidelines posted on the web site. The referees will also make recommendations concerning how the available funds are to be divided among the successful proposals.

*D5.1 GB decision for the 2007 conference and establishment of the referees list
(month 1, 3person-month)*

*D5.6 Evaluation of proposals for 2008
(month 18, 3person-month)*

*D5.10 Evaluation of proposals for 2009
(month 30, 3 person-month)*

Task 5.3: Support of meetings and reimbursement of costs

The CA will allocate certain number of man months of administrative support to the partner or member hosting a meeting that it helps to organize. As customary in Academia, the host will be also expected to allocate a number of man months funded from its own resources. The effort shown below for the deliverables of this task is the total effort. The CA funded costs incurred during the funded activities will be reimbursed by the workpackage leader only after reception of a report on the activity (the necessary forms have been created and will be posted on the web site of the CA), and only on the basis of original justifications. The reimbursement of costs will be according to the internal rules of the WP leader institution.

In particular, for the biannual major QIPC conferences the allocated budget from the CA will be limited to 65k€. Since the conference is planned to involve 200-250 participants, the major portion will have to be funded from other cluster resources. QUROPE contribution will be used to ensure the highest level, the interdisciplinary and independent character of the meeting, with

- 25k€ allocated for invited speakers and organizers
- 22k€ allocated for venue
- 18k€ for 7/2 person-month for support to conference organizers

For the smaller QIPC workshop run in 2008 the allocated budget will be of 20k€ and will be split in a similar fashion.

*D5.3 Support and organization of the major biannual QIPC conference 2007
(month 12, 5 person-month)*

D5.4 Financial Report for year 1 of WP5

- (month 12, 2 person-month)*
D5.7 *Support and organization of the 2008 QIPC workshop*
(month 24, 2 person-month)
D5.8 *Financial Report for year 2 of WP5*
(month 24, 2 person-month)
D5.11 *Support and organization of the major biannual QIPC conference 2009*
(month 36, 5 person-month)
D5.12 *Financial Report for year 3 of WP5*
(month 36, 2 person-month)

Task 5.4: Annual Reports on WP5

At the ends of years 1, 2, 3 the workpackage leader will prepare an Annual Report on the results of the workpackage. It will be partially based on the reports on funded activities (see Task 5.3). The Annual Report will analyse critically whether WP5 meets its objectives. If necessary it will propose modifications to the Call for Proposals for Meeting and Dissemination Activities in QIPC.

- D5.5 *Annual report and Strategic Summary for year 1 of WP 5*
(month 12, 2 person-months)
D5.9 *Annual report and Strategic Summary for year 2 of WP 5*
(month 24, 2 person-months)
D5.13 *Annual report and Strategic Summary for year 3 of WP 5*
(month 36, 2 person-months)

Deliverables

D5.1	GB decision for the 2007 QIPC conference and establishment of the referee list	1
D5.2	Publication on the CA website of the call for proposals for meeting and dissemination activities in QIPC and associated documents	3
D5.3	Support and organisation of the major biannual QIPC conference 2007	12
D5.4	Financial Report for year 1 of WP5	12
D5.5	Annual report and Strategic Summary for year 1 of WP5	12
D5.6	Evaluation of the proposals for 2008	18
D5.7	Support and organization of the 2008 QIPC workshop	24
D5.8	Financial Report for year 2 of WP5	24
D5.9	Annual report and Strategic Summary for year 2 of WP5	24
D5.10	Evaluation of the proposals for 2009	30
D5.11	Support and organisation of the major biannual QIPC conference 2009	36
D5.12	Financial Report for year 3 of WP5	36
D5.13	Annual report and Strategic Summary for year 3 of WP5	36

Milestones and expected result

M5.1 Annual Report and Strategic Summary for year 1 of WP5

M5.2 Annual Report and Strategic Summary for year 2 of WP5

M5.3 Annual Report and Strategic Summary for year 3 of WP5

Expected result: Structuring and uniting the QIPC community via planning and coordination of scientific meetings and dissemination activities in QIPC in Europe. Contributing to the development of the vision for the future of QIPC as a result of such activities.

(WP6) YOUNG SCIENTISTS AND TRAINING ACTIVITIES

Workpackage number	WP6	Start date or starting event			0
Participant id		P4	P25	Other Members ⁸	
Person-months (total)		10	8	12	
Person-months (requested EC contribution)		4	4	6	

Objectives

The aim of this workpackage is to coordinate and support financially the organisation of training activities in QIPC in Europe. In particular it will strive to ensure:

- The scientific excellence of the activities
- The pedagogical excellence of the activities
- That the different subfields of QIPC are adequately covered, with a preference given to interdisciplinary activities
- That the activities are adequately spread out over the different countries of Europe
- That an adequate support is provided to young scientists, with a preference to those coming from the newly entered EU member states
- That women have at least equal access, and if possible easier access, than men to these activities.

Description of work

WP6 will be led by N. Cerf and S. Massar from partner P4 (ULB) and M. Ziman from partner P25 (IPSAS). All decision concerning WP6 will be made collectively by the two workpackage leaders.

In order to coordinate and support financially the organisation of training activities in QIPC in Europe, this workpackage is divided into 4 interconnected Tasks, accompanied each by associated deliverables.

⁸ Other members refer to the yet unspecified members and partners who will be granted the support of the CA to run one of the QUROPE supported meetings. These members will be identified according to the open call procedures outlined in detail in the text of WP5, and the funding of these mm will come directly from the allocated budget for conferences/schools.

Task 6.1: Publicity

In order to successfully carry out this workpackage, it is necessary that information about the funding of training activities and about the rules for applying be easily available and widely distributed. To this end the following steps will be taken:

- The Call for Proposals for Training Activities in QIPC in Europe and associated documents will be posted on the CA web site as soon as possible after the start of the project, and in any case no later than month 3.
- Public announcements summarizing the Call for Proposals for Training Activities in QIPC in Europe will be made at major conferences in the field

D6.1 Publication on the CA website of the Call for Proposals for Training Activities in QIPC in Europe and associated documents

(month 3, 2 person-months)

Task 6.2: Evaluation of proposals

In order to ensure fair and objective decisions concerning which proposals to fund, and at what level, the following evaluation procedure will be followed:

- Every 6 months (starting at month 6), the proposals that have been submitted will be screened and pre-evaluated by the WP leaders, following the guidelines defined by the Governing Board. High level scientists may also possibly be consulted as referees at this stage. A recommendation will then be issued by the WP leaders to the attention of the Governing Board, which will make the final decision.
- The proposals will then be reviewed by the Governing Board, using the evaluation document from the WP leaders as a starting basis. The GB will also decide how the available funds will be shared between the successful proposals. As the aim of WP6 is to coordinate training activities in Europe, and since the WP leaders will have an overall view of the funded activities, they may provide the GB with recommendations based on specific information (for instance concerning previously funded projects). The final decision is however due to the GB.

Task 6.3: Reimbursement of costs

The CA will allocate certain number of man months of administrative support to the partner or member hosting a training activity that it helps to organize. As customary in Academia, the host will be also expected to allocate a number of man months funded from its own resources. The effort shown below for the deliverables of this task is the total effort. The costs incurred during the funded training activities will be reimbursed by the Université Libre de Bruxelles only after reception of a report on the activity, and only on the basis of original justifications. The reimbursement of costs will be according to the internal rules of the Université Libre de Bruxelles. The Université Libre de Bruxelles reserves itself the right to refuse to reimburse any costs which are not according to its internal rules.

The planned budget for each one of the two schools organized by QUROPE will be limited to 40k€. Eligible costs that can be covered by this amount include, but are not limited to, travel and accommodation of lecturers, lecturer honorarium, young scientist fellowships, editing and printing of proceedings, organisational and secretariat costs.

D6.4 Coordination and financial support of training activities during months 0-18
(month 18, 7 person-month)

D6.7 Coordination and financial support of training activities during months 18-36
(month 36, 7 person-month)

Task 6.4: Annual Reports on WP6

At the end of years 1, 2, and 3, the WP leaders will prepare an Annual Report on the results achieved within WP6. The Annual Report will be based on the actually performed work of proposal evaluation and cost reimbursement during the past year (see Tasks 6.2 and 6.3), as well as on the reports that will be returned by the organizers of past activities (the necessary forms have been created and will be posted on the web site of the CA). The Annual Report will analyse critically whether WP6 has met its objectives. If necessary, it will propose corrective actions and modifications to the Call for Proposals for Training Activities in QIPC in Europe and associated documents.

*D6.2 Strategic Report on training activities for year 1
(month 12, 2 person-months)*

*D6.5 Strategic Report on training activities for year 2
(month 24, 2 person-months)*

*D6.8 Strategic Report on training activities for year 3
(month 36, 2 person-months)*

Task 6.5: QIPC Young Award Prize

In order to encourage dissemination of good practice QUROPE will establish the QIPC Young Investigator Award. The biannual Award will be given to a researcher under the age of 35, for the best research recently published or presented at one of the biannual QIPC major conferences. The input candidates for the Award will be nominated by the CA partners with special input from Expert Groups highlighting major results of the year. The candidates will be screened by the WP6 leaders and by the CA coordinator and presented for final decision to the Governing Board meeting. The 3000€ Prize will be awarded at every major QUROPE biannual conference (a possible exception, due to time pressure is the 2007 award, that it might be shifted to 2008 and delivered at the small QIPC meeting organized by WP5 in that year).

*D6.3 Call, evaluation and award of the 2007 QIPC Young Award Prize
(month 18, 4 person-months)*

*D6.6 Call, evaluation and award of the 2009 QIPC Young Award Prize
(month 36, 4 person-months)*

Deliverables

D6.1	Publication on the CA website of the call for proposals for training activities in QIPC in Europe and associated documents	3
D6.2	Strategic Report on training activities for year 1	12
D6.3	Call, evaluation and award of the 2007 QIPC Young Award Prize	18
D6.4	Coordination and financial support of training activities during months 0-18	18
D6.5	Strategic Report on training activities for year 2	24
D6.6	Call, evaluation and award of the 2009 QIPC Young Award Prize	36
D6.7	Coordination and financial support of training activities during months 18-36	36
D6.8	Strategic Report on training activities for year 3	36

Milestones and expected result

M6.1	Strategic Report for year 1 of WP6. The Report will identify the achievements of the first 12 months and specify changes in the work plan for the next period
M6.2	Strategic Report for year 2 of WP6. The Report will identify the achievements of the second 12 months and specify changes in the work plan for the next period
M6.3	Strategic Report for year 3 of WP6. The report will summarize the achievements of training activities and make recommendations for the future QIPC training programme
Expected result: Structuring the QIPC community and shaping its future via coordination and financial support of training activities in QIPC in Europe.	

(WP7) COLLABORATION WITH RELATED WELL-ESTABLISHED R&D AND WITH INDUSTRY

Workpackage number	WP7	Start date or starting event				0
Participant id	P29					
Person-months (total)	10					
Person-months (requested EC contribution)	7					

Objectives

This WP aims at initiating a steady information transfer and establishing a collaboration between the QIPC community and both large and small European industries, as well as major international companies. First, a database of interested industries will be created and regularly up-dated. Next, a format for fluid information transfer between all communities will be developed. This should facilitate an early dialogue towards technology transfer. Subsequently, our goal is to develop a wish-list/shopping list for QIPC-industry technology transfer.

Description of work

Today, many large companies and SMEs have put QIPC in their list of technologies to be monitored. These include many different kinds of companies, from telecom and electronics industries to large banks and companies active in security, etc. Furthermore, several spin-off companies venture into the field. This WP aims at facilitating such monitoring. Efficient information transfer, in both directions, is the one of the primary objectives of WP7.

All of the four identified tasks described below, will require close collaboration with all the other WPs of this CA. In particular continuous information exchange with WP2, on the road map, will be secured with a view to possible integration of industry in the QIPC roadmap in the future as the QIPC-industry relationship matures. In collaboration with WP3 promotional material targeted specifically to industry can be published. In collaboration with WP4, a special section of the public web site can be developed to target industry.

Finally, it is envisaged that the appointed postdoc will perform a major part of the daily activities of this WP with respect to liaising with industrial groups and potential partners within and external to the QIPC community, for the term of the project. The coordinator is expected to also contribute with respect to identifying potential technology and industry partners and promoting the QIPC community through industrial contact.

Task 7.1: Database of industries interested in QIPC

This task consists in initiating a database of industries with interest in QIPC. Within Europe, the aim is to be as exhaustive as possible. On the international level, some major companies will be approached. This list will be publicly available and continuously up-dated.

*D7.1 Database of potentially interested industries and emerging technologies
(month 12, 2 person-months)*

*D7.3 Final update of dedicated database
(month 36, 2 person-months)*

Task 7.2: Tools for efficient communication with industries

This second task consists in developing the tools for efficient communication with these industries. Most likely this will be achieved by short e-mails, with information about up-dated web sites (e.g. with the European roadmap) and with news on workshops and conferences. These first two tasks could take advantage of the development of the electronic Information Infrastructure of WP4.

*D7.2 Creation and update of a regular information distribution service for industry concerning QIPC research in Europe
(month 24, 2 person-month)*

Task 7.3: Creation of synergies

This task will aim at involving industry people in the CA meetings as well as workshops and conferences, so as to increase synergies. This could initially be a 2-3 hour meeting/special session integrated into one of the CA events organised through WP5. This should help the CA to focus on the most relevant issues, considered from an industrial perspective. It should also help the interested industrial partners to understand the technical and scientific challenges within QIPC.

*D7.4 Special session targeting industry at one of the major QIPC conferences
(month 36, 2 person-months)*

Task 7.4: Wish and shopping list

The last task of this WP will consist in developing “shopping lists” for both the QIPC community and industrial partners, building on their mutual understanding of their respective domains. This should provide significant motivation for exploring the interest in a specialised workshop on the industrial issues of QIPC. At the start of this CA, such an event might be premature, however, the goal is to be ready whenever the need for such a specific workshop develops.

*D7.5 Development and update of a wish-list/shopping list for QIPC-industry technology transfer
(month 36, 2 person-months)*

Deliverables

D7.1	Database of potentially interested industries and emerging technologies	12
D7.2	Creation and update of a regular information distribution service for industry concerning QIPC research in Europe	24
D7.3	Final update of dedicated database	36
D7.4	Special session targeting industry at one of the major QIPC conferences	36
D7.5	Development and update of a wish-list/shopping list for QIPC industry technology transfer	36

Milestones and expected result

M7.1	First year's summary of industrial interests
M7.2	First three visits to industry partners for information exchange
M7.3	Second year's summary of industrial interests relevant to QIPC
M7.4	Third year's summary of industrial interests, relevant QIPC technology, QIPC-industry interchange and future perspectives for quantum technology transfer with industry.
Expected result: Establishment of an early dialogue between researchers and industries in view of technology transfer.	

(WP8) INTERNATIONAL CONTACTS BETWEEN RESEARCHERS COMMUNITIES IN EUROPE AND OVERSEAS

Workpackage number	WP8	Start date or starting event				0
Participant id		P28	P32			
Person-months (total)		6	4			
Person-months (requested EC contribution)		4	2			

Objectives

The aim of the WP8 is the organization of strong and sustained international contacts between the researcher community in the field of QIPC in Europe and those overseas (US, Canada, Asia, Australia, and others) in order to foster an international coordination programme, to increase the global visibility of European QIPC and its connectedness in the global research network, and to attract the best researchers in QIPC to research institutions in Europe.

Description of work

The work within WP8 is planned in two main tasks:

- 8.1. Structuring an international coordination programme
- 8.2. Recruitment and job market

Task 8.1. Structuring an international coordination programme

We will coordinate three high-level scientific/political meetings (end of first, second, and third year of the CA) between the QUROPE governing board and EU officers, and the correspondent representatives of overseas countries (US, Canada, Australia and Asia). The objective of these meetings will be to boost the connections between the European QIPC community and the overseas ones, by igniting the structuring of an international coordination programme. In particular, the possibility of establishing bilateral projects for which man power and funding will be shared by the participating countries (the EU and the another overseas partner) will be discussed. The experience that the EU has matured inside FEAST (Forum for European-Australian Science and Technology cooperation, see <http://www.feast.org>), an organisation established in 2001 for highlighting, promoting, and facilitating research collaboration between the European and Australian research communities., will be used as a precious resource for establishing stable and worthwhile relationships

The conference organization will be supported by an administrator.

*D8.2 First high level bilateral meeting
(month 12, 5/2 person-months)*

*D8.3 Second high level bilateral meeting
(month 24, 5/2 person-months)*

*D8.4 Third high level bilateral meeting
(month 36, 5/2 person-months)*

Task 8.2. Recruitment and job market

The phenomenon of the so-called “brain drain”, i.e., the flow of talented European researchers to the U.S. has been a long-standing concern for European research institutions. Currently, it appears that the U.S. loses attractiveness (due to more stringent visa regulations and other factors). “When it comes to competing for the best brains, the USA can clearly boast a long-standing lead. But America’s supremacy is on the wane—for reasons of its own making. [...] Asia and Europe seek to benefit from America’s flagging attractiveness.” (Humboldt kosmos 85/2005, p.8, biannual publication of the German Alexander von Humboldt foundation). We think that now is a good time to work for a reversal of the brain drain, specifically in the field of QIPC, by attracting the most excellent researchers from the U.S. and Asia to Europe. This requires a concerted effort that will be made within WP8.

A job database will be set up within the first 6 months of the program. The database will be available on the central QUROPE website, maintained by the partners within WP4, while the WP8 partners will be responsible for the corresponding web contents. The QC2 Basel and the University of Cambridge will use their international relations to gain access to the necessary information.

A public relations campaign will be organized to attract talented researchers from outside Europe to European research institutions in QIPC. This will involve a survey of European institutions, leading to a brochure that will be mailed to target institutions overseas. Additionally, a webpage and a centralized and simple electronic application process will be set up. The WP8 leaders (QC2 Basel and University of Cambridge) have the required connections to institutions in the US, Canada, India, Russia, Japan, China, Korea, Singapore, Australia, Brazil, and other countries to be able to advertise this campaign.

These activities within the WP8 will be supported by administrative staff.

*D8.1 Job database and job PR program online
(month 6, 5/2 person-months)*

Deliverables

D8.1	Job database and job PR program online	6
D8.2	First high level bilateral meeting	12
D8.3	Second high level bilateral meeting	24
D8.4	Third high level bilateral meeting	36

Milestones and expected result

M8.1 Coordination action operational, First bilateral strategic review

M8.2 Second bilateral strategic review

M8.3 Third bilateral strategic review, coordination action completed

Expected result:

- Structuring of an international coordination programme started
- Increase of Europe's visibility worldwide in QIPC research
- Intensified research collaboration between Europe and overseas
- Increase of excellent non-European researchers joining European QIPC research groups

8. PROJECT RESOURCES AND BUDGET OVERVIEW

The Consortium congregates all main players in the field of QIPC in Europe, with members from all of the currently running FET projects, from the Integrated Project SECOQC, from two RTN networks and from the ERA-Pilot QIST Project. WP1 of the latter project comprises a team of researchers that have already gained invaluable experience in coordinating research groups in view of developing a strategic vision for the “QIPC Strategic report”. This experience is of direct relevance to the objectives of the present proposal. As a matter of fact, the best of the European QIPC competence is included in this consortium.

The consortium has a pyramid structure consisting of the Coordinator and Executive Secretary, the Governing Board (19 members), the Legal Partners (33 institutions) and Affiliated Members (at the moment around 40 groups). The Governing Board includes the most known and respected European scientists in the field. Its members come from nine EU countries, and are team leaders with highest achievements in all major areas of the QIPC research: quantum information theory and algorithms and experimental implementations of QIPC with atoms, light and solid state devices. Members of the Governing Board include scientists who are listed among the top 100 most cited physicists worldwide. **The CA is looking for integration across disciplines, cross-fertilization, etc. The consortium structure reflects that.**

The consortium Legal Partners and members affiliated with them form the broad basis of the pyramid. They represent the QIPC community in a balanced way in terms of fields of research, projects and geographical areas. Due to a large number of groups (more than 100) working on various aspects of QIPC in physics, computer science and chemistry, a manageable project could not possibly have all of them as Legal Partners. Therefore, in order to keep the project open, and secondly, to have a broad support from the community and represent the community, all members are organized around a limited number of Legal Partners who will sign the Contract. Each of the 34 Legal Partners forms a ‘node’ around it, a group of scientists working on similar topics and/or in the same geographical area. Legal Partners provide the flow of information to and from their respective affiliated members. The Legal Partners and their affiliated members (see below) include the majority of top-notch groups in the QIPC field, thus insuring that research actions coordinated by the CA are at the absolute forefront of the current state-of-the-art.

Affiliated members: These are research groups in QIPC around Europe that are not legal partners, but nevertheless would like to participate in the activities of the project and in the information flow assured by it. They are grouped around a given legal partner according to the criteria of geographical vicinity. In the consortium agreement and the web site of the project there will be a general text for terms and conditions defining the relations between the affiliated members and the respective legal partner assigned to them. The list of Affiliated members will be continuously updated and enlarged. This structure is to enhance the impact of the CA over the largest number of scientists who can profit from the project and at the same time keeping the project consortium to a reasonable size.

The legal partner serves as a ‘link’ to the project for its affiliated members. Both Partners and Affiliated Members will be eligible to take advantage of the CA by proposing and running QIPC meetings and summer schools, by contributing to the strategy and vision development via Expert Groups and Roadmap, and by being involved in the common information system. There will be a standard agreement between the legal partner and the group of scientists he represents. This agreement is the same for all nodes and will be posted on the CA project web site. All scientists in the node agree to this status described in the agreement, though this description does not have a legal value with the EC.

It should be stressed that the structure of the CA is designed for best coordination and interaction between active QIPC FET projects with the goal for integration and cross-fertilization. Coordinators and main players from all Integrated Projects, as well as key members of ERA-Pilot QIST, SECOQC and other relevant projects are Partners and Government Board members of the CA. In Table I of the next page, we give an overview of the involvement in FET funded QIPC projects of QUROPE coordinator, legal partners, and affiliated members to their respective nodes. A brief profile of each QUROPE participant can be found in Appendix I.

Part.-id	FP5 1 st Call	FP5 2 nd Call	FP5 Open	FP6 1 st Call	FP6 Open	ERA-Pilot	Impr.H. Pot.
P1	SAWPHOTON (C), QUICOV			QAP	SECOQC, COVAQIAL	✓	
P2	QUBITS	CECQDM, QGATES, PROSECCO	QUIPROCONE	QAP, SCALA	OLAQUI	✓	
P3	QUCOMM	RAMBOQ	QUIPROCONE		SECOQC	✓	
M3a							
P4	EQUIP	RESQ (C)	QUIPROCONE	SCALA			ATOMCHIPS
P5	QUICOV				SECOQC, COVAQIAL		
P6	QUICOV, EQUIP, QAIP	REQCHARDWARE, ESQUIRE, PROSECCO	QUIPROCONE	SCALA	SECOQC		
P7	SQUBIT1	SQUBIT2, QUPRODIS					
M7a	EQUIP	SQUBIT2	QUIPROCONE		RSFQUBIT		
M7b							
P8	QAIP	ACQP, RESQ, QGATES	QUIPROCONE				
M8a		EDIQP (C)	QUIPROCONE	EUROSQIP			ATOMCHIPS
P9	SQUBIT1	ESQUIRE, SQUBIT2	QUIPROCONE	EUROSQIP	RSFQUBIT		
M9a	NSP-SI			QAP			
P10	QUICOV, S4P (C), QUANTIM, ACQUIRE, QUBITS, NSP-SI (C), SQID	REQCHARDWARE, ESQUIRE, ACQP, RESQ, QGATES	QUIPROCONE	SCALA (C), QAP	COVAQIAL, SECOQC	✓	CONQUEST, ATOMCHIPS
M10a							
M10b	QUICOV, QUANTIM (C)	QGATES		SCALA			CONQUEST
M10c							
M10d							
P11		QGATES	QUIPROCONE	SCALA			
M11a		EDIQP, ACQP	QUIPROCONE	SCALA			ATOMCHIPS
M11b	ACQUIRE, EQUIP	ACQP, QUPRODIS	QUIPROCONE				ATOMCHIPS
M11c			QUELE	SCALA	COVAQIAL, QUELE, OLAQUI		
M11d		QGATES		QAP			
P12	EQUIP	QUPRODIS	QUIPROCONE				
M12a				SCALA			
M12b	EQUIP (C)	ACQP, QUPRODIS	QUIPROCONE	QAP	QUELE		
M12c		SQUBIT2		EUROSQIP			ATOMCHIPS
P13		QIPDDF-ROSES		QAP			
M13a	QIPD-DF	CECQDM (C), QIPDDF-ROSES	QUIPROCONE				
M13b				EUROSQIP			
M13c	Q-ACTA, SQUBIT1	PROSECCO, SQUBIT2	QUIPROCONE	EUROSQIP	SECOQC, RSFQUBIT		
P14	NSP-SI (C), ACQUIRE, EQUIP, QUBITS	ACQP, QUPRODIS, RESQ, QIPDDF-ROSES, QGATES, TOPQIP	QUIPROCONE	SCALA	COVAQIAL	✓	ATOMCHIPS, CONQUEST
M14a							
M14b	QUICOV (C)	ESQUIRE, RAMBOQ		QAP	RSFQUBIT, SECOQC, COVAQIAL		
M14c	QCOMM, QUBITS	QUPRODIS, RAMBOQ	QUIPROCONE	QAP, EUROSQIP			
M14d	QUBITS	ESQUIRE, RAMBOQ, QUPRODIS	QUIPROCONE	QAP, EUROSQIP	SECOQC		
P15	ATESTI, ACQUIRE, QAIP	ACQP		SCALA			
M15a				QAP			

Part.-id	FP5 1 st Call	FP5 2 nd Call	FP5 Open	FP6 1 st Call	FP6 Open	ERA-Pilot	Impr.H. Pot.
P16			QUIPROCONE, QUELE (C)	SCALA	QUELE (C)		
M16a				EUROSQIP			
P17	Q-ACTA, SQID (C), SQUBIT1	TOPQIP (C)	QUIPROCONE				
M17a							
M17b	ATESIT, EQUIP	QUPRODIS	QUIPROCONE		SECOQC		
M17c							
P18	SAWPHOTON	SQUBIT2	QUIPROCONE	EUROSQIP	SECOQC	✓	
M18a		SQUBIT2	QUIPROCONE	EUROSQIP			
M18b					OLAQUI (C)		
P19	ATESIT (C)		QUIPROCONE				
P20	ACQUIRE	ACQP	QUIPROCONE	SCALA			
M20a							ATOMCHIPS
P21	QAIP (C)	RESQ	QUIPROCONE	QAP			
P22	SQUBIT1	SQUBIT2		EUROSQIP			
M22a	ATESIT						
P23	EQUIP	QUPRODIS, RESQ		SCALA			
M23a				SCALA			
M23b				QAP			
M23c		QUPRODIS	QUIPROCONE	SCALA			
M23d		QUPRODIS		SCALA			
P24	EQUIP	QUPRODIS		QAP, SCALA			
M24a	EQUIP			QAP			
M24b	MAGQIP (C)	QUPRODIS	QUIPROCONE				
P25	EQUIP, QUBITS	QUPRODIS, QGATES	QUIPROCONE	QAP		✓	CONQUEST (C), INTAS (C)
P26	SQUBIT1	SQUBIT2 (C)	QUIPROCONE	EUROSQIP	RSFQUBIT		
P27	QUCOMM (C), S4P, SQUBIT1	SQUBIT2	QUIPROCONE	QAP			
M27a		REQCHARDWARE, ESQUIRE	QUIPROCONE	QAP			
P28				EUROSQIP			
P29	QUCOMM, EQUIP	RAMBOQ, RESQ	QUIPROCONE		SECOQC		
M29a			QUIPROCONE	QAP	SECOQC		
P30					OLAQUI		
P31	ATESIT, EQUIP, QAIP	RAMBOQ, RESQ	QUIPROCONE	QAP	SECOQC		
P32	SAWPHOTON, QIPD-DF, SIQUIP (C)	RAMBOQ, RESQ, QIPDDF-ROSES, PROSECCO, TOPQIP	QUIPROCONE	SCALA	SECOQC		
P33	EQUIP, QUBITS (C)	QUPRODIS, QGATES, TOPQIP	QUIPROCONE	QAP, SCALA			ATOMCHIPS
M33a		QUPRODIS		QAP			
M33b			QUIPROCONE				
P34	QUCOMM, EQUIP, QAIP, QUBITS	QGATES	QUIPROCONE	SCALA	OLAQUI	✓	
P35	QUBITS	QGATES					CONQUEST

Table I: Participation in FET QIPC projects of QUROPE coordinator (C), legal partners (P) and affiliated members (M).

8.1 EFFORTS FOR THE PROJECT

	KU		OEAW		FBK		UNIVIE		ICSTM		ICFO		ETHZ		SMMC ⁹		OTHER MEMBERS ¹⁰		ULB		GAP		ULM	
	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req
Coordination activities¹¹	28	27																						
(WP1) Management and Coordination																								
(WP2) Develop a common vision, strategy and goals			8	0	22	21																	10	8
(WP3) Public outreach: increasing the public visibility and awareness of the field	16	1	21	5			16	5	5	0														
(WP4) Electronic Information Infrastructure and Information Exchange (with a feedback channel)	13	11			12	12																		
(WP5) Structuring and integrating the community: Scientific meetings and dissemination activities											10	4	7	0	4	0	14	7						
(WP6) Young scientists and Training Activities																	12	6	10	4				
(WP7) Collaboration with																						10	7	

⁹ SMMC stands for Scientific Meetings Management Committee (see WP5 description for details) and it is composed by the following people/partners: R. Blatt (P2/OEAW), A. Imamoğlu (P30/ETHZ) and M. Lewenstein (P24/ICFO), G. Rempe (P14/MPG), H. Burhman (P21/CWI), I. Walmsley (P34/UOXF.DU)

¹⁰ Other members refer to the yet unspecified members and partners who will be granted the support of the CA to run one of the QUROPE supported meetings and training activities. These members will be identified according to the open call procedures outlined in detail in the text of WP5 and WP6, and the funding of these mm will come directly from the allocated budget for conferences/schools.

¹¹ For each activity we report the total amount of person month per participant used for that activity (Tot) and the person month per participant requested as EC contribution (Req)

related well-established R&D and with industry																								
(WP8) International contacts between researchers communities in Europe and overseas																								
TOTAL COORDINATION	57	39	29	5	34	33	16	5	5	0	10	4	7	0	4	0	26	13	10	4	10	7	10	8


	IPSAS		UNIBAS		UCAM-DAMTP		CNRS		MPG		BRS		CWI		TU-DELFT		UOXF.DU		TOTAL PARTNERS ¹²			
	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req		
Coordination activities																						
(WP1) Management and Coordination																					28	27
(WP2) Develop a common vision, strategy and goals																					40	29
(WP3) Public outreach: increasing the public visibility and awareness of the field																					58	11
(WP4) Electronic Information Infrastructure and Information Exchange (with a feedback channel)																					25	23
(WP5) Structuring and integrating the community: Scientific meetings and dissemination activities																					35	11
(WP6) Young scientists and Training Activities	8	4																			30	14
(WP7) Collaboration with related well-established R&D and with industry																					10	7
(WP8) International contacts between researchers communities in Europe and overseas			6	4	4	2															10	6
TOTAL COORDINATION	8	4	6	4	4	2															236	128

¹² The total is calculated over the two tables reporting coordination activities.

	KU		OEAW		ULM		UNIVIE		ICSTM		ICFO		ETHZ		SMMC		OTHER MEMBERS		ULB		GAP	
Management activities	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req
(WP1) Management and Coordination	6	6	2	0	1	0	1	0	1	0	1	0							1	0	1	0
TOTAL MANAGEMENT	6	6	2	0	1	0	1	0	1	0	1	0							1	0	1	0

	IPSAS		UNIBAS		UCAM-DAMTP		CNRS		MPG		BRS		CWI		TU-DELFT		UOXF.DU		TOTAL PARTNERS	
Management activities	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req	Tot	Req
(WP1) Management and Coordination	1	0	1	0	1	0	1	0	2	0	1	0	1	0	1	0	1	0	24	6
TOTAL MANAGEMENT	1	0	1	0	1	0	1	0	2	0	1	0	1	0	1	0	1	0	24	6

8.2 OVERALL BUDGET FOR THE PROJECT

Contract Preparation Forms									
		EUROPEAN COMMISSION		Coordination Action			A3.1		
		6th Framework Programme on Research, Technological Development and Demonstration							
Please use as many copies of form A3.1 as necessary for the number of partners									
Proposal Number			033622		Proposal Acronym		EUROPE		
Financial information - whole duration of the project									
Partici pant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+ (3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
1	UNIVERSITY OF COPENHAGE	AC	Eligible costs	Direct Costs (a)	221.667,00		31.700,00	253.367,00	
				of which subcontracting	60.000,00			60.000,00	
				Indirect costs (b)	32.333,00		6.300,00	38.633,00	
				Total eligible costs (a)+(b)	254.000,00	,00	38.000,00	292.000,00	
				Requested EC contribution	254.000,00		38.000,00	292.000,00	
2	OEAW	FC	Eligible costs	Direct Costs (a)	20.833,00		2.000,00	22.833,00	
				of which subcontracting				,00	
				Indirect costs (b)	43.119,00			43.119,00	
				Total eligible costs (a)+(b)	63.952,00	,00	2.000,00	65.952,00	
				Requested EC contribution	25.000,00		2.000,00	27.000,00	
3	UNI WIEN	AC	Eligible costs	Direct Costs (a)	70.833,00		2.000,00	72.833,00	
				of which subcontracting				,00	
				Indirect costs (b)	14.167,00			14.167,00	
				Total eligible costs (a)+(b)	85.000,00	,00	2.000,00	87.000,00	
				Requested EC contribution	85.000,00		2.000,00	87.000,00	
4	ULB	AC	Eligible costs	Direct Costs (a)	90.000,00		2.000,00	92.000,00	
				of which subcontracting				,00	
				Indirect costs (b)	18.000,00			18.000,00	
				Total eligible costs (a)+(b)	108.000,00	,00	2.000,00	110.000,00	
				Requested EC contribution	108.000,00		2.000,00	110.000,00	
5	UP	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
6	AAR	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	

Contract Preparation Forms



EUROPEAN COMMISSION
6th Framework Programme on
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Coordination Action

A3.1

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Proposal Number	033622	Proposal Acronym	EUROPE
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Financial information - whole duration of the project									
Partici pant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+ (3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
7	JYU	AC	Eligible costs	<i>Direct Costs (a)</i>				.00	
				<i>of which subcontracting</i>				.00	
				<i>Indirect costs (b)</i>				.00	
				<i>Total eligible costs (a)+(b)</i>	.00	.00	.00	.00	
			<i>Requested EC contribution</i>				.00		
8	UPS	FCF	Eligible costs	<i>Direct Costs (a)</i>				.00	
				<i>of which subcontracting</i>				.00	
				<i>Indirect costs (b)</i>				.00	
				<i>Total eligible costs (a)+(b)</i>	.00	.00	.00	.00	
			<i>Requested EC contribution</i>				.00		
9	CEA	FC	Eligible costs	<i>Direct Costs (a)</i>				.00	
				<i>of which subcontracting</i>				.00	
				<i>Indirect costs (b)</i>				.00	
				<i>Total eligible costs (a)+(b)</i>	.00	.00	.00	.00	
			<i>Requested EC contribution</i>				.00		
10	CNRS	FCF	Eligible costs	<i>Direct Costs (a)</i>			.00	.00	
				<i>of which subcontracting</i>				.00	
				<i>Indirect costs (b)</i>				.00	
				<i>Total eligible costs (a)+(b)</i>	.00	.00	.00	.00	
			<i>Requested EC contribution</i>				.00		
11	UNIBONN	AC	Eligible costs	<i>Direct Costs (a)</i>				.00	
				<i>of which subcontracting</i>				.00	
				<i>Indirect costs (b)</i>				.00	
				<i>Total eligible costs (a)+(b)</i>	.00	.00	.00	.00	
			<i>Requested EC contribution</i>				.00		
12	TUBS	AC	Eligible costs	<i>Direct Costs (a)</i>			.00	.00	
				<i>of which subcontracting</i>				.00	
				<i>Indirect costs (b)</i>				.00	
				<i>Total eligible costs (a)+(b)</i>	.00	.00	.00	.00	
			<i>Requested EC contribution</i>				.00		

Contract Preparation Forms



Coordination Action


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Proposal Number	033622	Proposal Acronym	QUROPE
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Financial information - whole duration of the project									
Participatant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
13	USTUTT	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
14	MPQ	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
15	Weizmann	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
16	UNICAM	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
17	ISI	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
18	SNS	AC	Eligible costs	Direct Costs (a)				,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	

Contract Preparation Forms



EUROPEAN COMMISSION
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A3.1

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Proposal Number	033622	Proposal Acronym	QUROPE
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Financial information - whole duration of the project									
Particip ant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities			Total (4)=(1)+(2)+ (3)	Total receipts
					Coordination activities (1)	Training activities (2)	Consortium Management activities (3)		
19	UOR	FC	Eligible costs	Direct Costs (a)				.00	
				of which subcontracting				.00	
				Indirect costs (b)				.00	
				Total eligible costs (a)+(b)	.00	.00	.00	.00	
			Requested EC contribution				.00		
20	FBK	FC	Eligible costs	Direct Costs (a)	136,667.00		2,000.00	138,667.00	
				of which subcontracting				.00	
				Indirect costs (b)	27,333.00			27,333.00	
				Total eligible costs (a)+(b)	164,000.00	.00	2,000.00	166,000.00	
			Requested EC contribution	164,000.00		2,000.00	166,000.00		
21	CWI	FC	Eligible costs	Direct Costs (a)			.00	.00	
				of which subcontracting				.00	
				Indirect costs (b)				.00	
				Total eligible costs (a)+(b)	.00	.00	.00	.00	
			Requested EC contribution				.00		
22	TUD	FC	Eligible costs	Direct Costs (a)			.00	.00	
				of which subcontracting				.00	
				Indirect costs (b)				.00	
				Total eligible costs (a)+(b)	.00	.00	.00	.00	
			Requested EC contribution				.00		
23	GDA	AC	Eligible costs	Direct Costs (a)				.00	
				of which subcontracting				.00	
				Indirect costs (b)				.00	
				Total eligible costs (a)+(b)	.00	.00	.00	.00	
			Requested EC contribution				.00		
24	ICFO	AC	Eligible costs	Direct Costs (a)	141,667.00		2,000.00	143,667.00	
				of which subcontracting				.00	
				Indirect costs (b)	28,333.00			28,333.00	
				Total eligible costs (a)+(b)	170,000.00	.00	2,000.00	172,000.00	
			Requested EC contribution	170,000.00		2,000.00	172,000.00		

Contract Preparation Forms



EUROPEAN COMMISSION
6th Framework Programme on
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Coordination Action

A3.1

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Proposal Number	033622	Proposal Acronym	EUROPE
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Financial information - whole duration of the project									
Participatant n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts	
				Coordination activities (1)	Training activities (2)	Consortium Management activities (3)			
25	FYZIKALNY USTAV - SLOVENSKE AKADEMIE VI	AC	Eligible costs	Direct Costs (a)	16.667,00		2.000,00	18.667,00	0,00
				<i>of which subcontracting</i>				,00	
				Indirect costs (b)	3.333,00			3.333,00	
				Total eligible costs (a)+(b)	20.000,00	,00	2.000,00	22.000,00	
				Requested EC contribution	20.000,00		2.000,00	22.000,00	
26	CHALMERS	AC	Eligible costs	Direct Costs (a)				,00	0,00
				<i>of which subcontracting</i>				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
27	KTH	AC	Eligible costs	Direct Costs (a)				,00	0,00
				<i>of which subcontracting</i>				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
28	UNI BASEL	AC	Eligible costs	Direct Costs (a)	16.667,00		2.000,00	18.667,00	0,00
				<i>of which subcontracting</i>				,00	
				Indirect costs (b)	3.333,00			3.333,00	
				Total eligible costs (a)+(b)	20.000,00	,00	2.000,00	22.000,00	
				Requested EC contribution	20.000,00		2.000,00	22.000,00	
29	UNIGE	AC	Eligible costs	Direct Costs (a)	29.167,00		2.000,00	31.167,00	0,00
				<i>of which subcontracting</i>				,00	
				Indirect costs (b)	5.833,00			5.833,00	
				Total eligible costs (a)+(b)	35.000,00	,00	2.000,00	37.000,00	
				Requested EC contribution	35.000,00		2.000,00	37.000,00	
30	ETHZ	AC	Eligible costs	Direct Costs (a)	,00			,00	0,00
				<i>of which subcontracting</i>				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	

Contract Preparation Forms



EUROPEAN COMMISSION
6th Framework Programme on
Research, Technological
Development and Demonstration

Coordination Action

A3.1

Please use as many copies of form A3.1 as necessary for the number of partners

Proposal Number	033622	Proposal Acronym	EUROPE
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Financial information - whole duration of the project									
Participat n°	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities			Total (4)=(1)+(2)+(3)	Total receipts	
				Coordination activities (1)	Training activities (2)	Consortium Management activities (3)			
31	UOB	AC	Eligible costs	Direct Costs (a)					,00
				of which subcontracting					,00
				Indirect costs (b)					,00
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
32	UCAM-DAMTRAC	AC	Eligible costs	Direct Costs (a)	8.333,00		2.000,00	10.333,00	
				of which subcontracting				,00	
				Indirect costs (b)	1.667,00			1.667,00	
				Total eligible costs (a)+(b)	10.000,00	,00	2.000,00	12.000,00	
				Requested EC contribution	10.000,00		2.000,00	12.000,00	
33	IMPERIAL	AC	Eligible costs	Direct Costs (a)	,00		,00	,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
34	UOXF.DU	AC	Eligible costs	Direct Costs (a)			,00	,00	
				of which subcontracting				,00	
				Indirect costs (b)				,00	
				Total eligible costs (a)+(b)	,00	,00	,00	,00	
				Requested EC contribution				,00	
35	ULM	AC	Eligible costs	Direct Costs (a)	42.917,00		1.500,00	44.417,00	
				of which subcontracting				,00	
				Indirect costs (b)	8.583,00			8.583,00	
				Total eligible costs (a)+(b)	51.500,00	,00	1.500,00	53.000,00	
				Requested EC contribution	51.500,00		1.500,00	53.000,00	
TOTAL			Eligible costs	981.452,00	,00	57.500,00	1.038.952,00	,00	
			Requested EC contribution	942.500,00	,00	57.500,00	1.000.000,00		

Contract Preparation Forms



Coordination Action

A3.2

Proposal Number	033622	Proposal Acronym	EUROPE
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Estimated breakdown of the EC contribution per reporting period				
Reporting Periods	Start month	End month	Estimated Grant to the Budget	
			Total	In which first six months
Reporting Period 1	1	12	350.000,00	,00
Reporting Period 2	13	24	300.000,00	180.000,00
Reporting Period 3	25	36	350.000,00	210.000,00
Reporting Period 4			,00	,00
Reporting Period 5			,00	,00
Reporting Period 6			,00	,00
Reporting Period 7			,00	,00

8.3 MANAGEMENT LEVEL DESCRIPTION OF RESOURCES AND BUDGET

RESOURCES NEEDED TO CARRY OUT THE PROJECT.

From the financial point of view, there are two distinct kinds of partners within the QUROPE consortium:

- Funded partners
- Zero costs partners

Funded partners are those organizations that are responsible for workpackages coordination, thus ensuring that each of the latter achieve a “critical mass” of workers contributing either by ideas, critiques or plain hard work to their various goals. To this purpose funded partners will have to hire additional personnel, and/or engage existing one for managing the work to be carried out within the individual groups, for organizing meetings and symposia, for writing documents, for supplying information, and for communication and awareness activities.

Zero cost partners have no budget of their own: Their role in the CA is nevertheless crucial since they ensure that the whole European QIPC community is represented in QUROPE in a balanced way in terms of fields of research, projects and geographical areas, while acting, at the same time, as local nodes for QUROPE memberships, therefore ensuring the capillary dissemination of the CA initiatives and/or results. Furthermore, almost half (8/19) of the Governing Board members belongs to zero costs partners, and two zero costs partners (ETHZ and ICSTM) are in fact workpackage co-leaders (of WP5 and WP3, respectively).

Funded partners are:

- University of Copenhagen – KU (P1, Denmark)
- Austrian Academy of Sciences – OEAW (P2, Austria)
- Universität Wien – UNIVIE (P3, Austria)
- Université Libre de Bruxelles – ULB (P4, Belgium)
- Fondazione Bruno Kessler – FBK (P20, Italy)
- Institut de Ciències Fotoniques – ICFO (P24, Spain)
- Institute of Physics of the Slovak Academy of Sciences – IPSAS (P25, Slovakia)
- University of Basel – UniBas (P28, Switzerland)
- University of Geneva, Group of Applied Optics – GAP (P29, Switzerland)
- The Chancellor, Masters and Scholars – University of Cambridge – UCAM-DAMTP (P32, United Kingdom)
- Universität Ulm – ULM (P35, Germany)

KU will apply for 292k€. KU is the QUROPE coordinator, and therefore will lead WP1 (“Management and Coordination”). Within this WP the direct personnel cost will be 165k€ (33 person month). Additional cost of WP1 will be travels (2.5k€) and financial audits (2k€). KU will also participate (together with OEAW and UNIVIE) in WP3 (“Public outreach: Increasing the public visibility and awareness of the field”) and (together with FBK) in WP4 [“Electronic Information Infrastructure and Information Exchange (with a feedback channel)”]. For the former WP, the direct costs for personnel is 5k€ (1 person month) while additional costs include 60k€ for the production of the documentary film Quantum Information (see D3.1 and D3.4 and Appendix A2). Finally, as far as WP4 is concerned, the direct personnel costs will be 55k€ (11 person month) with additional costs including travels (2.5k€).

OEAW will apply for 27k€. OEAW will be the co-leader (together with ULM) of the WP2 (“Develop a common vision, strategy and goals”) and (together with KU and OEAW) WP3 (“Public outreach: Increasing the public visibility and awareness of the field”). For WP2 no direct costs are claimed, while for WP3 direct personnel costs will be 25k€ (5 person month) with additional costs of 2k€ for auditing purposes.

UNIVIE will apply for 87k€. UNIVIE will be the co-leader (together with KU and OEAW) of WP3 (“Public outreach: Increasing the public visibility and awareness of the field”). Direct personnel costs will be 25k€ (5 person month), while additional costs include 60k€ for media publishing (see D3.5, D3.9, D3.13 and D3.14) and 2k€ for auditing.

ULB will apply for 110k€. ULB will be the co-leader (together with IPSAS) of WP6 (“Young scientists and Training Activities”). The amount of money claimed includes 20k€ for personnel (4 person month), and additional costs of 80k€ (for funding 2 QIPC schools, as detailed in the WP description), 8k€ for the two QIPC Young Investigator Award. Finally 2k€ are devoted to auditing purposes.

FBK will apply for 166k€. FBK will be the co-leader (together with KU) of WP4 [“Electronic Information Infrastructure and Information Exchange (with a feedback channel)”. It will also participate in the realization of tasks within WP2. The cost will cover personnel for 157k€ (33 person month) and 7k€ for traveling while 2k€ will be dedicated to audit activities.

ICFO will apply for 172k€. ICFO will be the co-leader (together with the zero cost partner ETHZ) of WP5 (“Structuring and integrating the community: Scientific meetings and dissemination activities”). Of the cost claimed, 20k€ are for personnel (4 person month), while the sum of 150k€ is for financing the 2 major biannual QIPC conferences (2007 and 2009, 65k€ each) and the smaller QIPC workshop (2008, 20k€) according to the breakdown given in the WP description. 2k€ are reserved for auditing.

IPSAS will apply for 22k€. IPSAS will be the co-leader (together with ULB) of WP6 “Young scientists and Training Activities”). The amount of money claimed includes 20k€ for personnel (4 person month), and 2k€ are devoted to auditing purposes.

UniBas will apply for 22k€. UniBas will be the co-leader (together with UCAM-DAMTP) of WP8 (“International contacts between researchers communities in Europe and overseas”). Of the sum claimed, 20k€ are for personnel (4 person month) and 2k€ for auditing purposes.

GAP will apply for 37k€. GAP will be leading WP7 (“Collaborations with related well-established R&D and with industry”). Direct personnel cost will be 35k€ (7 person month), with the remaining 2k€ for auditing.

UCAM-DAMTP will apply for 12k€. UCAM-DAMTP will be the co-leader (together with UniBas) of WP8 (“International contacts between researchers communities in Europe and overseas”). Of the sum claimed, 10k€ are for personnel (2 person month) and 2k€ for auditing purposes.

ULM will apply for 53k€. ULM will be the co-leader (together with OEAW) of WP2 (“Develop a common vision, strategy and goals”). Direct personnel cost will be 37.5k€ (8 person month), 10k€ are for traveling, 4k€ are for miscellanea expenses, and 1.5k€ are reserved for auditing.

If any changes to the current budget (as indicated in the present TA including breakdown per partner, work packages or categories) are considered, they need to be discussed in advance with the project officer and at the closest project review.

MOBILISATION OF THE CRITICAL MASS OF RESOURCES

The amount of person month for which legal partners apply as requested Commission contribution is of 128 (for coordination activities) and 6 (for management activities). For the successful realization of all the objectives of QUROPE the consortium has estimated respectively 236 and 26 person month.

Therefore, in terms of personnel resources, the person months contribution of each legal partner funded by QUROPE is comparable with the financed one. In particular contractors using the additional cost reporting model will contribute to the CA by an amount of personnel which is always comparable with the eligible costs funded by the Commission contribution, as detailed in the tables shown in Section 8.1. Moreover, all the needed infrastructure, including the computer ones used during the project (in particular the servers needed by WP4 for developing and publishing the Electronic Information Infrastructure and the CA feedback channel) will be also provided by the QUROPE participants. On top of this, it has already be noticed that almost half of the Governing Board members belongs to zero costs partners, that two of these zero costs partners are actually WP co-leaders, and, finally, that all this kind of partners will take an active role for acting as local nodes for QUROPE memberships, and ensuring the capillary dissemination of the CA initiatives and/or results.

Consequently, in a broad and general sense, any of the legal partners will contribute financially and support the work of the QUROPE coordination action, ensuring at the same time the achievement of the “critical mass” necessary for its success.

INTEGRATION OF THE RESOURCES TO FORM A COHERENT PROJECT

The integration of the resources coming from QUROPE with those mobilised at the level of each legal partner will be very natural and immediate, guaranteeing the coherent realisation of the project. At the same time the QUROPE structure will enhance various collaborations and exchanges between the different workpackages (see the graphical diagram in Section 7.3), endowing them with a concrete matrix into which their advances and results are embedded and communicated to the entire QIPC community. It should be also noticed that this matrix will be extended also the three currently running IPs (QAP, SCALA and EUROSQIP) and the ERA-Pilot QIST project, with which QUROPE will coordinate for the realization of objectives like the funding of conferences and workshops.

This approach is consistent with the project organization which from the one hand maximizes the resources put in by the legal partners, and on the other hand maximizes the internal communications in order to spread out quickly the results and initiatives (which might be even coming from the community feedback) at the level of the CA consortium and the whole QIPC community.

9 OTHER ISSUES

ETHICAL AND GENDER ISSUE

QUROPE plans to work on gender issues in science and specifically in the field of QIPC. This will be done within the framework of several WPs. Historically there is a strong gender imbalance in the related to the field of QIPC sciences like physics, mathematics, computer science and engineering, which transfers directly to QIPC. There are very few female young scientists at doctoral or post-doctoral level. The situation worsens when considering positions at permanent researcher or professor level. For example there are only 4 female contributors (out of a total of 58) to the publication “QIPC in Europe”. This is a collection of 30 articles in Scientific American style which reflect the current research developments in different sub-fields of QIPC. This publication was coordinated and edited by FET and the collaboration of female scientists was encouraged. This is unfortunately a realistic reflection of the current situation. Therefore it is necessary to work on integrating young female scientists into this field by the following actions:

- include female scientists in the strategic report working groups – WP2
- include relevant information in promotional and dissemination materials – WP3
- have a special information section on the project web site – WP4
- facilitate their job search via the web site – WP4
- request feedback from female scientists about specific activities or events that could be organized by the project – WP4
- facilitate their participation in Schools and Conferences – WP5 and WP6

The female professor who is the leader of the Partner 7 group will be naturally involved in these actions.

ETHICAL ISSUES FORM

Does your proposed research raise sensitive ethical questions related to:	Yes	No
Human beings		✓
Human biological samples		✓
Personal data (whether identified by name or not)		✓
Genetic information		✓
Animals		✓

We moreover confirm that the proposed research does not involve:

- Research activity aimed at human cloning for reproductive purposes,
- Research activity intended to modify the genetic heritage of human beings which could make such changes heritable
- Research activity intended to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer;
- Research involving the use of human embryos or embryonic stem cells with the exception of banked or isolated human embryonic stem cells in culture

Confirmation: the proposed research involves none of the issues listed above	Yes	No
	✓	

APPENDIX A: CONSORTIUM DESCRIPTION

A.1 PARTICIPANTS AND CONSORTIUM

Below we provide a brief profile of all participants to QUROPE. We also provide hyperlinks to their respective websites (when available). Participants are numbered according to the following conventions: the coordinator will be indicated by a capital C, legal partners by a capital P followed by a number, and affiliated members to a legal partner by a capital M followed by the number of the partner to which they are affiliated to and, finally, a letter.

P1. University of Copenhagen (KU) – Denmark

<http://www.nbi.ku.dk>
<http://www.nbi.ku.dk/page24813.htm>

The Coordinator of the QUROPE, Professor Eugene Polzik is Director of one of the major European Centers for Quantum Information, the Danish National Quantum Optics Center – QUANTOP (operational since 2001. annual budget 2.100.000 Euros, involves around 35 researchers and graduate students). The Center is located at the Niels Bohr Institute of University of Copenhagen, the birth place of modern quantum physics, which provides the backbone for the QIPC research. QUANTOP unites most of QIPC research in Denmark.. Besides University of Copenhagen it includes the Partner at the University of Aarhus. E. Polzik leads the quantum optics laboratory (15 researchers and students). The highlights of research include experimental entanglement of atomic objects (Nature, 2001), quantum memory for light (Nature, 2004), and quantum teleportation (Science, 1998). Another senior member of the group at NBI is Assoc. Prof. J. H. Muller who conducts quantum memory research with ultra-cold atoms. Theoretical Quantum Information group is led by Assoc. Prof. A. Sorensen (co-author of the Sorensen-Molmer proposal for quantum computing) and deals with such issues as quantum repeaters and atomic ensemble and solid state implementations of quantum communication and computing. The groups have been involved in such European funded projects as CAUAC, QUICOV, COVAQIAL, and QAP.

P2. Austrian Academy of Sciences (OEAW) – Austria

<http://www.oeaw.ac.at>
<http://www.iqoqi.at/>

The Austrian groups of R. Blatt, H. Briegel, R. Grimm and P. Zoller (Innsbruck), and A. Zeilinger (Vienna) are world leaders in the field of QIPC. Partly as a result of the successes of these Austrian groups, several Centres of Excellence for Quantum Optics and Quantum Information have been established around the globe. In combining the activities of the various Austrian groups as well as consolidating their foundations, the new Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences ensures their long term competitiveness on a world stage.

The recently founded Institute for Quantum Optics and Quantum Information will

- provide the framework for collaborative research;
- allow projects with a higher risk to be pursued which currently are not possible at the university;
- provide the framework for long-term projects which are currently not possible;
- permit the development of quantum technology together with industry;
- foster the synergy between the groups in Vienna and Innsbruck;
- be the institution for internationally funded research projects;
- invite internationally renowned scientists for extended periods;
- have young, foreign scientists as guests for a number of years;
- offer young outstanding scientists the possibility of developing their own unique research style.

The Institute is located in Innsbruck with a branch also in Vienna. The combined Institute is, however, responsible for the collaborative activities of all groups in Vienna and Innsbruck. The new Institute will ensure Austria's forefront role in the future of quantum information.

P3. Universität Wien (UNIVIE) – Austria

<http://www.univie.ac.at>
<http://www.quantum.at>

The research group around Prof. A. Zeilinger and M. Arndt is one of the world's leading research groups in experimental quantum physics research. Major research achievements include among many other successes the first realization of the teleportation of a qubit, the observation of quantum interference for the most massive and complex objects worldwide to date and the first implementation of entangled-state quantum cryptography. Another success was the group's experimental realization of free-space distribution of entanglement, over distances of 600 m across the Danube and, only recently, of several kilometres across the city of Vienna, and the experimental realization of a novel quantum computing scheme, the one-way quantum computer.

The group has between 30 and 35 members. Young scientists from a range of countries including currently Austria, France, Germany, Italy, Japan, Spain, Switzerland, Thailand and Tibet, are working theoretically and mostly experimentally in diverse areas of quantum research. Active exchange exists with other quantum physics groups worldwide. Strong synergies with partner P2 exist. The common goals of both groups are outlined in the description of the former.

M3a. Technische Universität Wien

<http://www.tuwien.ac.at/>

The Technische Universität Wien group headed by Prof. Schmiedmayer has extensive expertise in coherent manipulation of small thermal and quantum degenerate atomic samples. They have pioneered, first in Innsbruck (1994-2000) and then in Heidelberg (2000-2005) the development of microscopic atom optics, the Atom Chip and the physics of microscopic / mesoscopic cold atomic samples and their quantum manipulation. Recent breakthroughs include the development of the Atom Chip (Adv. At. Mol. Opt. Phys., 2002), the demonstration of ultra smooth atom chip potentials and the development of an atom based magnetic field sensor (Nature, 2005), the coherent quantum phase preserving manipulation of the external motion of low dimensional mesoscopic samples of atoms on atom chips, and the demonstration of an atom chip based atom interferometer (Nature Phys., 2005). Prof. Schmiedmayer was the coordinator of 2 IST collaborations focusing on atom chip based quantum information processing (ACQUIRE and ACQP), and recently organized an international conference on Atom surface interactions (CAMS) (Apr. 2005). The Group participates in many EU and national and transnational collaborations and projects.

P4. Université Libre de Bruxelles (ULB) – Belgium

<http://www.ulb.be>
<http://quic.ulb.ac.be>
<http://www.ulb.ac.be/sciences/liq/>
<http://www.ulb.ac.be/polytech/soa>

The Université Libre de Bruxelles was founded in 1834 and consists of 18 Faculties and Schools distributed over 8 campuses and an academic hospital. The faculty body and staff total up 5,000 persons and the University has acquired a leading position in the world's academic community. It has many distinguished alumni, including three Nobel Prize winners, several Francqui Prize winners, and a Fields Medal. Three groups are currently engaged in research on quantum information theory at the Université Libre de Bruxelles, one at the Ecole Polytechnique (Prof. N. Cerf and Prof. P. Emplit), and another at the Physics Department (Dr. S. Massar). They have initiated a long-term collaborative research project aimed at building a strong pole of expertise in quantum information and computation at the Université Libre de Bruxelles. They participated in the ESF programme entitled "Quantum Information Theory and Quantum Computation", in the FP5 project EQUIP, are coordinating the FET projects RESQ

(FP5) and COVAQIAL (FP6), and have important roles in the FP6 Integrated Projects SECOQC and QAP.

P5. Univerzita Palackého v Olomouci (UP) – Czech Republic

<http://www.upol.cz>
<http://optics.upol.cz>

The research in the field of quantum information processing at Palacky University is carried out at the Department of Optics and at Joint Laboratory of Optics. A recently established theoretical quantum information processing group lead by Dr. J. Fiurasek and Dr. T. Opatrny focuses on the development of optical implementations of protocols for quantum information processing with both discrete variables (single photons) and continuous variables (squeezed and coherent light and also atomic ensembles). The group consists of nine people including three Ph.D. students. Another theoretical group lead by Prof. Z. Hradil concentrates on the problems of quantum state reconstruction, estimation, and discrimination. This group currently contains four members including one Ph.D. student. Finally, The experimental team is lead by Dr. O. Haderka with experiments covering the generation of correlated and entangled pairs of photons by means of parametric down conversion and their application in quantum information processing as well as the measurement of the quantum statistical properties of light. The experimental group consists of six members including three Ph.D. students.

P6. University of Aarhus (AAR) – Denmark

<http://www.au.dk>
<http://www.phys.au.dk/quantop/theory.shtm>

At the University of Aarhus, QIPC research is carried out in several groups. 4 permanent staff members have their main research in QIPC, and another 3-4 have significant overlap with QIPC. 4 post docs and 6-10 Ph.D. students are engaged in QIPC research. In the Computer Science Department, substantial research is carried out on quantum communication, and high-level courses are offered for all students at the Faculty of Science. In the Physics and Astronomy Department, trapped ion experiments, degenerate gas experiments and theoretical quantum optics and quantum information research takes place within the local branch of the Danish National Research Foundation Center for Quantum Optics. A joint quantum communication experimental activity is currently being planned between physics and computer science. Interaction with NMR and femto-second laser groups in the Chemistry Department have recently led to QIPC related joint meetings and seminars and to a few joint research projects.

P7. University of Jyväskylä (JyU) – Finland

<http://www.jyu.fi>
<http://www.chem.jyu.fi/nanoscience/>

The research in the field of quantum information at the University of Jyväskylä is performed within two groups which are part of the NanoScience Center/Department of Physics, the Nanoelectronics group (Prof. P. Törmä) and the Quantum Engineering group (Acad. Res. G. S. Paraoanu). The first group focuses on theoretical aspects of quantum information processing with cold atoms and on quantum network theory, while the second group is doing experimental and theoretical research on transport processes in single-electron transistors and quantum coherence in superconducting circuits (Josephson-effect qubits and resonators).

M7a. Helsinki University of Technology

<http://ltd.tkk.fi/>

The Low Temperature Laboratory of Helsinki University of Technology has a team of 2 professors, 4-5 PhD-level scientists and 7-8 PhD students working in the area of experimental low temperature quantum electronics. The research covers electron transport phenomena in normal and superconducting nanostructures as well as their applications in low noise devices operating at the quantum limit. Recent research interest include transport measurements in carbon nanotubes, studies of thermoelectric and non-equilibrium effects in hybrid nanostructures, and measurements of noise in

CNTs and superconducting qubits. On the application side various quantum amplifiers, electron pumps and on-chip microcoolers are under development.

M7b. University of Turku

<http://www.physics.utu.fi/>

The quantum computing group of the Physics Department of the University of Turku, is led by Prof. K.-A. Suominen and studies decoherence in quantum computing systems. Prof. Souminem has recently co-authored with S. Stenholm the textbook "Quantum Approach to Informatics" (Wiley, 2005). The group of Dr. P. Lahti focuses instead on the fundamentals of quantum mechanics and measurements. Finally, on the experimental side, Prof. K. Gloos and Dr. S. Vasiliev are planning to study two-dimensional electron gas on liquid helium surface, which has been proposed as one possible realization of a quantum computer.

P8. Universite Paris-Sud XI (UPS) – France

<http://www.lri.fr>

<http://www.lri.fr/quantum/>

The Laboratoire de Recherche en Informatique (LRI) is a research unit within the Université Paris-Sud on the Orsay campus associated with the CNRS (National Center for Scientific Research) since 1974 (Joint Research Unit 8623). The Quantum Group of LRI includes five full time researchers : J. Kempe, I. Kerenidis, F. Magniez, S. Laplante and M. Santha. The group has made important contributions in quantum algorithms, computational and communication complexity, and fault-tolerant computing. It was a member of the FP5 project QAIP in the 5th Framework Programme of the EU, and it currently participates in the FP5 project RESQ, and in the FP6 Integrated Project QAP. The group will moreover organize the 9th Workshop on Quantum Information Processing in January 2006 in Paris.

M8a. University Paul Sabatier

<http://www.quantware.ups-tlse.fr/>

The quantum information team at the University Paul Sabatier is made by theoretical physicists (D. Shepelyansky, B. Georgeot and O. Giraud, D. Braun, R. Fleckinger and K. Frahm) who investigate the properties and possible applications of realistic quantum computers. They study their operability in the presence of decoherence and physical imperfections, using in particular tools from many-body physics and random matrix theory, and elaborate methods to improve the accuracy of quantum computation. The team also develops efficient quantum algorithms, in particular for the simulation of physical systems, and investigates general properties of quantum information and quantum communication.

P9. Commissariat a l'Energie Atomique (CEA) – France

<http://www.cea.fr>

<http://www-drecam.cea.fr/drecam/spec/Pres/Quantro/Qsite/>

The aim of the Quantronics group of the Commissariat a l'Energie Atomique, is to develop electronic circuits that display quantum effects. The Quantronics group has run experiments involving quantum coherence at different levels in mesoscopic devices: ballistic transport in atomic contacts and epitaxial thin films, quantum coherence in mesoscopic conductors, and quantum bit circuits. In particular the group has developed a new superconducting quantum bit circuit (nicknamed the quantronium), with a single shot readout circuit and a specific design to limit decoherence. This circuit was the first solid-state circuit to behave fully quantum-mechanically, and a series of experiments inspired from NMR were performed with it. Recently, the decoherence mechanisms acting on the quantronium were thoroughly investigated, and different methods to fight them were used. We develop now a new QND readout, and quantum gates.

M9a. Centre de Recherches sur les tres Basses Temperatures

<http://crtbt.grenoble.cnrs.fr/>

Prof. O. Buisson and Prof. L. Levy have recently created a new research group on Superconducting phase qubits (with Prof. Frank Hekking developing the theory for this new group). They have achieved important results on the Cooper pair box, and on multilevel phase qubits.

P10. Centre National de la Recherche Scientifique (CNRS) – France

<http://www.cnrs.fr>

The CNRS-IO group has two components, which are the “Atom Optics” group lead by A. Aspect, and the “Quantum Optics” group lead by P. Grangier (contact person for CNRS-IO). The Atom Optics group has a widely recognized expertise in the field of Bose-Einstein condensation (BEC) and atom lasers, and was for instance the first group to obtain a Helium BEC. Recently the group has developed an atom chip activity, which is of primary relevance for QIPC. The Quantum Optics group has a long experience with non-classical light, quantum (QND) measurements, cold atom physics and quantum information. Recently the group pioneered single-atom optical tweezers using large numerical aperture lenses, and the use of spatial light modulators (SLM) to generate arrays of single-atom traps (JOSA, 2004). This activity is currently pursued with the objective of implementing neutral atoms quantum registers, as proposed by several theory groups (Phys. Rev. A, 2002). In addition to A. Aspect and P. Grangier, the operational leaders of the project activities in the Atom Optics and Quantum Optics groups are respectively C. Westbrook and A. Browaeys. C. Westbrook has a confirmed expertise about “BEC on chips”, and A. Browaeys has excellent knowledge of cold collision physics, acquired at NIST in the group of B. Phillips. Several other permanent, postdoctoral and doctoral researchers will also be involved in the project. The lab has very good technical support for mechanical and optical design, and for electronics, and the SCALA project will build upon sophisticated experimental equipments, set up during several RTD projects in FP5 (ACQUIRE, ACQN, QUBITS, QGATES) and FP6 (CONQUEST, SCALA).

The CNRS-ENS team has a long standing experience in cavity QED. It has pioneered cavity QED experiments in the microwave domain with the observation of cavity-enhanced spontaneous emission in the eighties. The circular atom/cavity set-up is a major achievement in this field, combining extremely long photonic and atomic lifetimes. It made possible in the past years many experiments on fundamental quantum mechanics and quantum information processing. Recent achievements include a new type of quantum gate based on a controlled collision between two Rydberg atoms in a detuned cavity, the complete and direct determination of the Wigner function of the cavity field (Phys. Rev. Lett. 2002), and the generation of non-classical states, noticeably of large Schrödinger cat states through the resonant interaction of an atom with a mesoscopic coherent field (Phys. Rev. Lett., 2003). The present development of this work include entanglement between remote cavities, quantum algorithms, and the very promising development of cryogenic atom chips for individual Rydberg atoms. The team is led by four persons with permanent positions: S. Haroche, J.-M. Raimond, M. Brune and G. Nogues. Additionally, J. Reichel has very recently joined the team, bringing in his know-how as one of the founders of “atom chip” research.

M10a. Laboratoire de photonique et nanostructures, CNRS-LPN

<http://www.lpn.cnrs.fr/fr/Commun/>

The Laboratory for Photonics and Nanostructures (LPN) is one of the main sites of the French National Nanofabrication Facilities Network, possessing state of the art equipment for semiconductor growth and nanostructuring. Its in-house research focuses on the development of novel nanostructures and their use in fundamental and exploratory research. The groups most closely involved in Quantum Information research are those headed by I. Abram and A. Levenson, their activities in the Laboratory including the implementation of Cavity QED effects in semiconductor microcavities and photonic crystal cavities, the development of single photon sources with particular quantum properties (indistinguishability, entanglement, etc.) for use in

quantum cryptography or quantum logic gates, the implementation of continuous variable quantum cryptography protocols, or the implementation of Electromagnetically Induced Transparency, slowing-down light for quantum memory and information processing applications.

M10b. Laboratoire Kastler Brossel, CNRS-ENS

http://www.spectro.jussieu.fr/Optquant/Index_Eng.html

The quantum optics group of the LKB, led by E. Giacobino and C. Fabre, has a widely recognized expertise in the experimental and theoretical study of quantum fluctuations of light and of specific quantum effects such as squeezing, quantum correlations and entanglement. Its current subjects of interest are the generation and use of EPR-entangled bright light beams, the study of the quantum properties of optical images and the generation of quantum entanglement between light and matter. The experiments are performed using either parametric interaction in nonlinear media, semiconductor microcavities or cold atomic ensembles.

M10c. Laboratoire de Photonique Quantique et Moléculaire, CNRS-ENS Cachan

<http://www.lpqm.ens-cachan.fr/>

The CNRS-ENS Cachan Team is led by Prof. J.-F. Roch, Ass. Prof. F. Treussart and Dr. F. Grosshans (who just joined the team). Its domain of expertise is quantum optics, more specifically the realization of various single photon sources, their characterisation and their application to quantum key distribution (QKD). The team leader, J.-F. Roch, has worked on non classical states of light since the end of the 80's. The team has developed, in close collaboration with CNRS-IO Grangier team, an efficient and reliable room temperature single photon source based on photoluminescence of a single colour defect in a diamond nanocrystal. The group recently studied new near-infrared emitting single defects in diamond with narrow emission, that are very promising for applications to open-air as well as fiber-based QKD.

M10d. Laboratoire de Spectrométrie Physique, CNRS-UJF

<http://www-lsp.ujf-grenoble.fr/recherche/a1t4/a1t4a3/plus.htm>

The quantum information group at the Laboratoire de Spectrométrie Physique currently has three permanent researchers (J.-P. Poizat, A. Auffèves-Garnier - experiments -, and C. Simon - theory). Its main research topics include the creation of entangled photons from quantum dots (experiment/theory), giant optical nonlinearities in semiconductor microcavities (experiment/theory), superconducting single photon detector (experiment), quantum information processing with spins in quantum dots (theory) and fundamental aspects of quantum physics.

P11. Universität Bonn (UBONN) – Germany

<http://www.uni-bonn.de>

http://www.iap.uni-bonn.de/ag_meschede/english/index_eng.html

The research group of D. Meschede and A. Rauschenbeutel at Institut für Angewandte Physik of the University of Bonn has developed methods to control all degrees of freedoms of neutral atoms for about a decade now. Some of its major achievements include the realization of a deterministic source of single neutral atoms, an optical conveyor belt to exert controlled transport of single atoms, continued imaging of single atoms, and the realization of a multi qubit quantum register with full addressability from neutral atoms. Most recently the implementation of sub-wavelength position control of neutral atoms in a standing wave dipole trap has opened the route to implement neutral quantum gates by methods of cavity QED as well as by controlled cold atom collisions at the level of single atoms. We expect to construct elements of quantum processors atom by atom in the near future with a perspective for generating also cluster states.

M11a. Technische Universität Darmstadt

<http://www.physik.tu-darmstadt.de/iap/>

The quantum information teams at the Technische Universität Darmstadt, perform experimental and theoretical research in the field of quantum information processing. These activities are centered at the Institute of Applied Physics. Experimental research, led by Prof. G. Birkel, includes, but are not limited to the realisation of functional quantum processors based on atomic quantum systems, the creation of entangled atom pairs through photodissociation, as well as the application of solid state laser systems for quantum communication purposes. Theoretical activities, led by Prof. G. Alber, include research on quantum dynamics, entanglement, and quantum error correction.

M11b. Universität Hannover

<http://www.iqo.uni-hannover.de/>

The Institute of Quantum Optics (IQ) at the University of Hannover, has a long standing tradition in quantum optics. The main focus of the institute is quantum metrology, atom optics and atom interferometry. Its valuable expertise is reflected by its involvement in numerous national, bi-national and European research networks, as well as research contacts to the US. In particular, the IQ coordinated European ADVENTURE/STREP. It also leads a large national network focused on "Measurements with photons, atoms and molecules at the quantum limit". One focus of the quantum-optics groups of the IQ is high-precision atom interferometry on the ground and in space as well as new "quantum" measurement strategies. The IQ initiated the European satellite mission HYPER together with the SYRTE und has the lead in building facilities to study quantum matter and atom lasers in microgravity (QUANTUS). The atom optics group is headed by Prof. W. Ertmer, a recognized international expert in atom optics, quantum engineering and laser physics and Vice-President of the University of Hannover.

M11c. Johannes Gutenberg- Universität

<http://www.physik.uni-mainz.de/quantum/bec/index.html>

The group of I. Bloch at the Institut für Physik of the Johannes Gutenberg University at Mainz, carries out research in the field of quantum information with neutral atoms in optical lattices. The group was the first to observe the quantum phase transition from a superfluid to a Mott insulator in such a setup, which initializes a large quantum register in a single step (Nature, 2002). In further experiments, the group has been able to demonstrate controlled collisional interactions between individual atoms in an optical lattice which could form a powerful basis for creating highly entangled many-body states in only a few experimental steps (Nature, 2003). More recently, the group demonstrated entanglement schemes using resonant control over the interactions between particles via Feshbach resonances (Phys. Rev. Lett, 2004) and via coherent spin changing collisions.

M11d. Universität Siegen

The newly established Quantum Optics research group at the University of Siegen, carries over extensive experience in manipulating trapped ions from Prof. W. Neuhauser's research group (one of the pioneers of ion trapping) at the University of Hamburg. Key researchers at present include Prof. C. Wunderlich and Dr. V. Elman. One of its major achievements has been the development of a novel scheme for QI research with trapped ions that is being realised experimentally. This scheme combines the best features of two experimental "worlds": nuclear magnetic resonance on the one hand, and trapped ions on the other, to date the two most successful realisations of quantum information processing.

P12. Technische Universität Carolo-Wilhelmina zu Braunschweig (BRS) – Germany

<http://www.imaph.tu-bs.de>

<http://www.imaph.tu-bs.de/qi/>

The focus of the Quantum Information group led by R.F. Werner are conceptual and mathematical issues of abstract quantum information theory. This has included the theory of entanglement, from the now current definition of mixed state entanglement (provided by Prof. Werner in 1983), to detailed studies of the entanglement of highly symmetric states. The quantum channel capacity, especially of Gaussian channels and channels with memory is another long-term topic. At the moment most activities are devoted to the theory of quantum cellular automata. The methods used are for the most part mathematically rigorous, although numerical simulation is also used to assess the status of various conjectures in the field. The group currently comprises 2 postdocs, 3 PhD students, and 4 students working towards the Diplom degree.

M12a. Universität Düsseldorf

<http://www.thphy.uni-duesseldorf.de/>

The newly founded quantum information theory group at Institute for Theoretical Physics III, Heinrich-Heine University of Duesseldorf, is led by Prof. Dr. D. Bruss and presently consists of 5 group members, including Dr. H. Kampermann. The main research interests of the group lie in the characterisation and classification of entanglement, quantum cloning and state estimation, new protocols and security analysis in quantum cryptography, and the implementation of quantum gates and quantum networks.

M12b. Universität Potsdam

<http://www.quantum.physik.uni-potsdam.de>

The Potsdam quantum information group is performing research on entanglement theory, in particular for systems with continuous variables and infinite dimensions (quantum fields, bosons and fermions on lattices, and graphs). The asymptotic scaling with system size is investigated. The group also aims at characterizing state transformations with respect to the preservation or degradation of entanglement. The study of continuous variables is motivated by quantum optics applications where many operations and states can be cast into Gaussian form. This approach provides a framework to quantify the distillation of entanglement using optical devices (beam splitters, photo-detectors etc.) Finally the group investigates the emergence of decoherence in quantum dynamical systems, in particular within non-equilibrium statistical mechanics.

M12c. Physikalisch-Technische Bundesanstalt

http://www.ptb.de/en/org/2/_index.htm

The Physikalisch-Technische Bundesanstalt (PTB) is the national metrology institute of Germany. The Quantum Information team, led by Dr. A. Zorin, includes 5 PhD researchers and 1 engineer belonging to Group 2.45 “SET and Quantum computing” of PTB. The research is focused on the quantum standards of electrical quantities, in particular, the SET-based capacitance and current standards, and the superconducting Josephson qubit with emphasis on the development of fabrication technology and measuring technique. The investigated objects present the micro- and nano-circuits comprising normal and superconducting tunnel junction. The group possesses appropriate facilities including clean room of class 100, thin film deposition and etching equipment, optical and electron-beam lithography, as well as dilution refrigerators and measuring equipment.

P13. Universität Stuttgart, 3. Physikalisches Institut (USTUTT) – Germany

<http://www.physik.uni-stuttgart.de/institute/pi/3/>

The research team in Stuttgart uses defects in insulators for QIPC, and it is devoted to construct hardware for quantum computing and quantum information transfer out of diamond. Recent highlights include the first single spin state readout and coherent state superposition (Phys. Rev. Lett., 2004). Basic elements for quantum computing have been demonstrated (Phys. Rev. Lett., 2004 and 2005), and controlled nano-implantation of defects is used to explore the scalability of the approach. The integration of defect into photonic structures is a major goal. Quantum repeaters and memory are investigated based on photon to spin conversion in defect centers. The transfer of electron spin coherence to nuclear spin coherence is used to increase the phase memory time of the system. The research team comprises 30 members. Leading members are J. Wrachtrup, F. Jelezko and T. Gaebel. International collaboration with various leading laboratories exists, like M. Lukin (Harvard), S. Praver (Melburne) and P. Hemmer (Texas A&M). The institute is member of the Stuttgart collaborative research center on controlled dynamics of correlated quantum states. The laser laboratory comprises equipment from kHz spectral to fs time resolution with single molecule sensitivity.

M13a. Universität Dortmund

http://e3.physik.uni-dortmund.de/index_en04.html

Quantum information research at the University of Dortmund is carried out by the chair E3 (experimental physics 3, Prof. D. Suter) and focuses on three main areas: (i) the implementation of quantum algorithms by liquid-state NMR and optimization of the required quantum gate operations; (ii) decoherence in large quantum systems, to estimate scaling properties for future generations of quantum information processors, with experiments performed via solid-state NMR; (iii) development of building blocks for scalable quantum computers, based on semiconductor nanostructures, molecular systems, and rare-earth ions in solid matrices. The experimental tools of the group include laser-assisted magnetic resonance, nuclear magnetic resonance, and electron spin resonance.

M13b. Universität Jena

http://www.ipht-jena.de/BEREICH_1/abt13_cryo_electronics/index.html

The Department of Quantum Electronics of IPHT (Institute of Physical High Technology) in Jena has an intense research activity on applications of superconductivity. Our current activity concerns the experimental and theoretical investigations of the solid-state qubits, based on nano-scale Josephson junctions connected in a superconducting loop and controlled by magnetic field. We work with Josephson junctions fabricated by ourselves in our clean room. In our cryogenic laboratory we reach temperatures on the order of 10 mK as required for quantum measurements on our Josephson junctions.

M13c. Universität Karlsruhe

http://www-tfp.physik.uni-karlsruhe.de/index_en.shtml
<http://iaks-www.ira.uka.de/>

The theoretical quantum information group at Karlsruhe University, is led by Prof. G. Schön, Dr. A. Shnirman and Dr. Y. Makhlin (now at the Landau Institute), and it is part of the Karlsruhe based DFG-center for Functional Nanostructures (CFN). The group has been among the first to propose the use of Josephson circuits as qubits (Nature, 1999), describing also the ways how to perform the necessary gate and read out the state of the qubits. In recent years it has concentrated on the analysis of the noise in various circumstances and the laws governing the decay of coherence. The group has good contacts to the leading groups in Europe working in the field of solid state qubits.

The activities of the Quantum Information Processing research group at the Institute for Algorithms and Cognitive Systems (IAKS) at the Universitaet Karlsruhe are twofold. The Quantum Cryptography Group headed by Prof. J. Mueller-Quade, focuses on models and definitions of security for quantum cryptographic protocols, on applications of quantum cryptography besides key exchange, and on protocols coping with additional threats like premature abort or coercibility. The Quantum Computing research, consists of the development of quantum error correcting codes, quantum complexity theory, algorithms for quantum control, differential geometry of quantum control, quantum thermodynamics, and thermodynamics of computation. Members of the two Quantum Information Processing research groups at the IAKS are T. Decker, M. Grassl, D. Janzing, F. Schmueser, D. Unruh, and R. Zeier.

P14. Max-Planck Gesellschaft zur Foerderung Wisseschaften E. V. (MPG) – Germany

<http://www.mpg.de>

<http://www.mpg.mpg.de>

The experimental group of Prof. Rempe at the Max-Planck-Institute for Quantum Optics studies quantum information processing with individual atoms in high-finesse optical cavities, to realize quantum interfaces between stationary atoms and flying photons for distributed quantum computing. The group demonstrated a deterministic single-photon source (Phys. Rev. Lett., 2002) by means of an adiabatic passage technique (Phys. Rev. Lett., 2000). They have invented a new method to characterize the coherence properties of single photons by time-resolved intensity-interference (Phys. Rev. Lett., 2004). They have also been able to trap single atoms with single photons (Nature, 2000), and cool an intracavity atom by means of a novel technique dubbed cavity cooling (Nature, 2004). The technique avoids spontaneous emission and might be useful to cool an atomic quantum bit. Most recently, the group has trapped a single atom inside a high-finesse cavity for record-long times exceeding several 10 seconds (Nature Phys., 2005), and they have demonstrated cavity addressing and cavity coupling of the individual atoms of an atomic register stored in an optical conveyor belt (Phys. Rev. Lett., 2005). Besides cavity QED, the group also investigates ultracold atomic gases in the quantum-degenerate regime and explores new techniques to generate cold ensembles of dipolar molecules, all with potential applications in quantum information processing.

The theory group at the Max-Planck Institute for Quantum Optics is led by Prof. I. Cirac and is carrying out research in the following topics related to quantum information processing: (i) proposal and theoretical analysis of new ways of implementing quantum information processing with quantum optical systems; (ii) development of a theory of entanglement; (iii) development of new tools, based on Quantum Information concepts, to simulate quantum many-body systems; (iii) analysis of quantum channels and quantum repeaters; (v) analysis of new ways of performing quantum simulations with trapped ions and neutral atoms.

M14a. Walther-Meissner-Institut für Tieftemperaturforschung, Bayerische Akademie der Wissenschaften

<http://www.wmi.badw.de/index-en.html>

The group of Prof. R. Gross at the Walther-Meissner Institute is focusing on the fabrication and experiments with flux-type and phase-type Josephson junction qubits (spectroscopy, Rabi-oscillations, Ramsey, spin echo, etc.). A particular goal is the fabrication and characterization of flux-type qubits involving so-called π -Josephson junctions. These junctions generate a π phase shift in superconducting rings and shift the ring to the degeneracy point without any external flux-bias. Over the last two years part of the group's work is being directed to the coupling of flux-qubits (quantum two-level systems) to linear and non-linear oscillators (cavity QED on a chip). A recent highlight is our proposal for the generation and detection of Fock states using a superconducting qubit coupled to a superconducting microwave resonator.

M14b. Universität Erlangen-Nürnberg

<http://kerr.physik.uni-erlangen.de/leuchs/englisch/>

<http://www.optik.uni-erlangen.de/git/>

<http://fluxongroup.physik.uni-erlangen.de/>

The quantum information processing group of Prof. Leuchs studies quantum information processing with solitons in optical fibres, quantum information processing with polarization states, and quantum key distribution with continuous variables.

The main interest of the quantum information theory group led by Dr. Lütkenhaus lays instead in the interface between quantum information theory and quantum optics. For example the group is working on the theory side to close the gap between theoretical concepts for quantum key distribution and their experimental implementation. Advanced practical schemes together with their appropriate security proof should offer provable secure communication over a growing distance. Optical systems together with linear optical elements (beam splitters and phase shifters) are also investigated. They offer a range of manipulations that are suitable to process quantum information with today's technology.

Finally, the group of Prof. Ustinov focuses on experiments with flux-type and phase-type Josephson junction qubits. This group is also involved in development of superconducting digital logic interface to qubits within FP6 STREP project RSFQUBIT. A major result of Ustinov's team has been the observation of quantum tunneling and energy levels for a single Josephson vortex (Nature, 2003). Other achievements of this group are the proposal and demonstration of a prototype of vortex qubit (Phys. Stat. Sol., 2002), observation of multi-photon transitions in a phase qubit (Phys. Rev. Lett., 2003), quantum dissociation of a vortex-antivortex pair (Phys. Rev. Lett., 2003), the first experimental test of a superconducting digital interface for vortex qubits (Eur. Phys. J., 2004), and, very recently, the demonstration of coherent Rabi oscillations in phase qubits.

M14c. Ludwig-Maximilians Universität

<http://scotty.quantum.physik.uni-muenchen.de/index.html>

The group at the Ludwig-Maximilians-University in Munich, lead by Prof. H. Weinfurter, focuses on photonic quantum communication and experiments with entangled photons on the foundations of quantum physics. Projects include, for example, practicable quantum cryptography, design of single photon sources, and efficient generation of entangled photon pairs and multi-photon states. In addition, studies on entanglement have been recently extended to work on atom-photon entanglement.

M14d. Technische Universität München

<http://www.org.chemie.tu-muenchen.de/glaser/>

The quantum information processing group led by G. Abstreiter (Walter-Schottky Institut), has its main interest in the use of optical spectroscopic techniques to probe the electronic, optical and physical properties of low dimensional semiconductor nanostructures. Currently the group is investigating the potential that quantum objects provide for incorporation in novel opto-electronic devices such as optical memories, photonic nanostructures and deterministic current sources as well as to reveal fundamental information about isolated single and coupled quantum dots.

The research group of Prof. Glaser (Department of Chemistry) is focused instead on quantum control of spin and pseudo-spin systems and the experimental implementation of quantum algorithms using nuclear magnetic resonance (NMR). Major achievements have been: the first 5-qubit quantum computer by tailored chemical synthesis, the first NMR-scalable implementation of a quantum algorithm on spin ensembles, first quantum algorithm in liquid-state NMR using an almost pure state based on the nuclear spin order of para hydrogen, time-optimal realisation of quantum gates in spin- and pseudo-spin systems. Prof. Glaser is involved in the QAP EU program, and a member of the SFB “solid state based quantum information processing”. In Munich, the groups of Professors Cirac, Glaser, Rempe and Weinfurter run a joint PhD program of excellence (<http://www.qccc.de>), which is part of the Elite Network of Bavaria, bringing together the fields of quantum computing, quantum control, quantum communication, and quantum information processing with partners in Harvard, Innsbruck, Waterloo, Melbourne on optimal steerings of quantum models on spin and pseudo-spin systems, Josephson elements, ion traps, SQUIDs etc.

P15. Weizmann Institute of Science (Weizmann) – Israel

<http://www.weizmann.ac.il>

<http://www.weizmann.ac.il/chemphys/gershon/>

The Theoretical Quantum Optics group at the Department of Chemical Physics is headed by Prof. G. Kurizki, and it is currently composed by 12 people (1 senior research associate, 6 postdocs/long-term visiting researchers, 3 Ph.D students and 2 M.Sc. students). Its current QIPC-related projects include: (i) dynamical control of decay and decoherence (universal approach to Zeno/anti-Zeno modified decoherence; applications to entangled photons, atoms, molecules, quantum dots, condensates and superconductors), (ii) teleportation and entanglement of continuous variables in material systems (coordinates and momenta of atoms via collisions and half-collisions/dissociation, collective phase and number variables of coupled BEC), (iii) spatiotemporal quantum correlations and interferometry of atoms, molecules and BEC with translational-internal entanglement

On the experimental side, quantum information is dealt by the experimental group at the Department of Condensed Matter Physics headed by Assoc. Prof. A. Yacoby. The group includes a research associate and 2 Ph.D students, and its major focus is on experimental coherent control and manipulation of single-electron spin qubits in GaAs.

M15a. Tel-Aviv University

<http://www.tau.ac.il/~quantum/>

The Quantum group at Tel-Aviv University is led by Prof. L. Vaidman and is composed by Dr. Y. Aharonov and Dr. B. Reznik, and 8 graduate students (half of which are Ph.D. students). The research interests spans different aspects of quantum information sciences: quantum measurement problem (nonlocal measurements, interaction-free measurements, weak measurements, analysis of measurability of quantum states), quantum teleportation schemes, quantum games, the search for classically defined tasks which quantum device can do better than classical devices, and finally quantum cryptography (secure key distribution with orthogonal states, quantum gambling).

P16. Università degli studi di Camerino (Unicam) – Italy

<http://www.unicam.it>
<http://camcat.unicam.it/~quele/qog/>

The Quantum Optics and Quantum Information Group, in the Department of Physics of the University of Camerino, led by Prof. P. Tombesi, is formed by Assoc. Prof. D. Vitali, three researchers (I. Marzoli, S. Mancini, G. Di Giuseppe), two postdocs (S. Rebic and G. Ciaramicoli) and several graduate and undergraduate students. In the last five years the group has carried out research in many topics of Quantum Information Theory, including active decoherence control in quantum computing, entanglement with cavities and atoms, a scheme for quantum teleportation with slow light, noise reduction and entanglement manipulation in optomechanical systems. Recently constituted in 2004, the Laboratory of quantum optics of the group is already concentrated on a particular quantum communication protocol: the realization and the study of quantum key distribution protocol, in particular on decoherent and noisy channels. The Quantum Optics and Quantum Information group is engaged in a number of national and international research programmes, as for example, the project on ‘Quantum communication with slow light’ and ‘Theoretical study of novel devices based on quantum entanglement’, funded by the Italian Ministry for Research (MIUR). The group is also the coordinator of the STREP QUELE, being also a contractor in the European FP6 projects CONQUEST, QAP and SCALA. The group has collaborative links to other international groups including Orsay, Ulm, Paris, Cambridge, Mainz and Brisbane.

M16a. Università degli Studi di Bari

<http://www.ba.infn.it/~pascrazio/>
<http://www.ba.infn.it/~facchi/>

The Quantum Information research at the Physics Department of the University of Bari is carried out by S. Pascazio, P. Facchi, T. Yoneda and G. Florio, who also collaborate with A. Garuccio and V. Berardi. The team has a long-term expertise in statistical mechanics, quantum field theory, irreversibility and fluctuation phenomena, interferometry, mesoscopic systems and decoherence, entanglement and correlated systems. The present interest is focused on the control of decoherence and on the possibility of tailoring invariant (decoherence-free) "Zeno subspaces." The Bari group has long-term collaborations with other teams in Japan, Austria, United States, Canada and the Czech Republic.

P17. Fondazione ISI (ISI) – Italy

<http://www.isi.it>
http://www.isi.it/1/no/research_detail.html

The ISI team has a considerable experience in the theoretical modeling of many-body processes as well as in the theory and mathematical foundation of quantum information and computation. ISI is a node of the TMR network "The Physics of Quantum information" and is and has been involved in IST FET networks TOPQIP (coordinator), SQUID (coordinator), and partner in Q-ACTA and SQUBIT. ISI is the birthplace of several key concepts in quantum information theory, like Holonomic Quantum Computation and Noiseless (decoherence free) Codes. Since 1996 the ISI group has been working in the field of quantum information theory on several topics, including the problem of decoherence, general quantum computational schemes, quantum algorithms, solid state implementations of QC (quantum dots, Josephson junctions, charge and spin flying qubits in quantum wires), holonomic and topologic QC, entanglement in highly correlated systems and phase transitions, quantum processing with excitonic qubits etc. An important example is the theory of quantum error avoiding codes (noiseless/decoherence free codes), pioneered in 1997 by P. Zanardi and Mario Rasetti, for the control of decoherence in quantum computers. In 1999 Zanardi and Rasetti proposed the use of non-Abelian quantum holonomies as a method to implement fault-tolerant quantum information processing. This approach gave rise to the general conceptual framework of Holonomic Quantum Computation.

M17a. Università degli Studi dell'Insubria

The group led by L. Lugiato at University of Insubria in Como is well known in the field of Quantum Optics and includes a permanent researcher (A.Gatti), a postdoc (E. Brambilla) and a PhD student. Recently the group has studied the multimode spatial entanglement in spontaneous parametric down-conversion (PDC). A collaboration with the group led by P. Di Trapani in the same University has allowed to achieve the first experimental demonstration of the quantum nature of spatial correlations in high-gain PDC, a result that paved the way to the possibility of parallel quantum information processing, and contributed to establishing the field of Quantum Imaging, which has become a focus of interest in Quantum Optics. In particular, they have demonstrated the possibility of performing the so-called “ghost imaging” using correlated thermal beams.

M17b. Università di Pavia

<http://www.qubit.it>

The Quantum Information Theory group at Pavia University, has long standing collaborations both with the US (Northwestern University and the MIT) as well as in Europe (Braunschweig, Hannover, Moscow, Nottingham, Oxford, Rome and Utrecht). The research focuses on quantum information theory and theoretical quantum optics. In particular, the currently used method for Homodyne Quantum Tomography has been introduced by QUIT, along with the first method for quantum calibration of measuring apparatuses and quantum operations, the invention of super broadcasting, the first efficiently programmable detectors, the first optimal transmission of reference frames, the first derivation of optimal phase estimation with mixed states, along with new general methods for optimization of covariant measurements and channels - which generalize Holevo's theory.

M17c. Politecnico di Torino

<http://www.polito.it/NTL>

The team of the Nanoscience Theory Lab (NTL) at the Physics Department of the Polytechnic University of Torino has an extremely broad experience in the theoretical modeling of many-body processes in semiconductors as well as in the design and optimization of potential solid-state implementations of quantum information/computation schemes. Concerning quantum information processing, together with P. Zanardi and co-workers (ISI, Torino) the group has been working on potential semiconductor-based implementation schemes. In particular, it has studied noiseless-encoding strategies in semiconductor quantum-dot arrays (Phys. Rev. Lett., 1998) and, more recently, we have proposed the first all optical quantum computer based on semiconductor macroatoms/molecules (Phys. Rev. Lett., 2000).

P18. Scuola Normale Superiore (SNS) – Italy

<http://www.qti.sns.it>

<http://www.nest.sns.it>

At the Scuola Normale Superiore there are two groups actively involved in various projects of Quantum Information. The theoretical activity is performed by the group of Prof. R. Fazio, while the experimental one by Prof. F. Beltram group.

The group of Prof. Fazio (which is composed by 1 staff member, 4 postdocs and 5 Ph.D. students), is actively involved in several projects in Quantum Information. The group has participated as a node in several EC projects as SQBIT and SQBIT2 and TOPQIP and it will be part of the IP project EuroSQIP. The main activities are

- Solid state quantum information with superconducting
- Nanocircuits

- Quantum entanglement and quantum phase transitions
- Quantum computation and quantum chaos
- Quantum channels with memory

The activity of the experimental group of Prof. Beltram (which is composed by 1 staff member, 1 postdoc and 2 Ph.D. students) is focused on the development of novel optoelectronic devices for the implementation of quantum information and communication systems. The main effort is directed towards the engineering of semiconductor nanodevices based on surface-acoustic-waves (SAWs). The aim is to incorporate single-electrons SAW-pumps in planar 2D electron/ 2D hole gas pn-junctions to realize single-photon sources. Furthermore, the group is also involved in the fabrication of solid-state single-electron interferometers for quantum information experiments.

M18a. Università degli Studi di Catania

The members of the group of G. Falci in Catania have working experience in solid state quantum computation, in quantum dynamics of systems of Josephson junctions, quantum phase transitions, and quantum mechanics of open systems. In particular the group has been deeply involved in the theory of geometric quantum computation with superconducting nanocircuits, the study of dephasing in Josephson junctions and the properties of entanglement in critical systems.

M18b. Università di Pisa

The BEC research group at the University of Pisa, led by Prof. E. Arimondo, is composed of 2 university professors (E. Arimondo and F. Fuso), 3 researchers (D. Ciampini, R. Mannella, O. Morsch), 2 postdocs (M. Cristiani, S. Wimberger), and 3 PhD students. Since 1999 it has been doing research on BECs of Rb atoms, in particular studying their dynamics inside optical lattices, including nonlinearity-induced dephasing and rephasing of the condensate, nonlinear Landau-Zener tunneling and dynamical instabilities. Furthermore, the group has studied the photoionization of ultra-cold and Bose-condensed Rb atoms as well as ultra-cold collisions between Rb and Cs. On the theoretical side, it has recently worked on nonlinear effects in the kicked harmonic oscillator and rotor and in resonantly enhanced tunneling.

P19. Dipartimento di Fisica, Università di Roma “La Sapienza” (ROM) – Italy

<http://quantumoptics.phys.uniroma1.it/>

The Quantum Optics group at Università “La Sapienza” in Rome has been engaged in experimental and theoretical researches in Quantum Information since ten years. Its advanced know-how on linear and non-linear optics has been applied to several tasks, such as quantum state teleportation, state symmetrization, teleportation of a quantum gate, optimal quantum cloning and U-Not gate, quantum process and state tomography, generation and detection of entanglement, generation of qudits and hyper-entangled states, amplification and purification of single qubits, detection of Fock states, frequency hopping of a single photon. Currently the group is composed by seven staff members and some under-graduated students. F. De Martini and P. Mataloni have been members of the network of excellence QUIPROCONe, and in the last years the group has coordinated the European FP5 project ATESIT, the Advanced Research INFM projects CAT and CLON, and other scientific projects at a national level. The group has well established collaborations with the groups of M. D’Ariano and C. Macchiavello, J. Fiurasek and R. Filip, N. Cerf, V. Buzek, S. Popescu. The laboratory in Roma is equipped with several CW and mode locked laser systems, a regenerative Ti:Sa amplifier, nonlinear crystals, single-photon detectors, bulk and fiber optics elements.

The main activity of the Mesoscopic Quantum Computing Rome group led by Prof. Cosmelli, concerns the development of a superconducting qubit based on the magnetic flux states of an rf-SQUID with tunable critical current (double SQUID), and in particular, the development of proper reading and writing devices and strategies, including the development of a proper readout in order to allow a quiet free evolution of the qubit, the use of a hysteretic dc-SQUID as discriminator for the SQUID flux state, the use of accurately timed fast current and flux pulses, to turn on and off the bias of the readout

devices to initialize the qubit, and the development of coupling schemes for more qubits, The possible use of RSFQ pulses for SQUID control are also presently under study.

P20. Fondazione Bruno Kessler (FBK) – Italy

<http://www.itc.it>
<http://www.ect.it>

The European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) of the Fondazione Bruno Kessler in Trento (Italy) is one of the few Centres world-wide which provides a dedicated combination of meeting (workshops), collaboration, and innovative research activities for a large international scientific community.

The QIPC group has coordinated since 2000, under the leadership of T. Calarco, the theoretical activity of the FP5 RTD Projects ACQUIRE and ACQP, based on atom-chip quantum-gate ideas originally developed in collaboration with P. Zoller. Since the beginning of 2005 T. Calarco has been in charge of coordinating the activity of data collection and elaboration of a European QIPC guideline within the project ERA-Pilot QIST, which has recently delivered the first European QIPC Strategic Report.

In 2007 Dr. Calarco accepted a professorship in Ulm. The scientist in charge for the Trento node is now Dr. D. Binosi. Since 2005 Dr. Binosi has been actively involved in the preparation and coordination of the European QIPC Strategic Report, data collections, and the writing of several position documents, within the aforementioned ERA-Pilot QIST project.

M20a. European Laboratory for Nonlinear Spectroscopy

<http://www.lens.unifi.it/>

The Cold Atom Team at European Laboratory for Nonlinear Spectroscopy (LENS) in Florence has a long standing expertise in the experimental study of the physics of ultracold quantum gases, such as the production and study of Bose and Fermi gases (and mixtures of the two) in traps, optical lattices and disordered potentials. Some important results that have been recently achieved by the group in this field, and which have opened new directions of research, are: the condensation of bosonic potassium, the production of a mixture of Bose and Fermi gases with attractive interaction, the production of a mixture of Bose gases of two different species, the study of transport of both a superfluid Bose gas and a degenerate Fermi gas in optical lattices, the study of Bose gases in disordered potentials, and, finally, interferometry with Fermi gases in optical lattices.

P21. Stichting Centrum voor Wiskunde en Informatica (CWI) – Netherlands

<http://www.cwi.nl>

Quantum information research at the Center for Mathematics and Computer Science (CWI), Amsterdam, is carried out in the group Quantum Computing and Advanced Systems research (INS4). There is close cooperation with the crypto group at the CWI (PNA5) and the theoretical computer science group at the University of Amsterdam. Prof. H. Buhrman leads the quantum group (7 researchers) centered around algorithmic, information theoretic, and cryptographic principles of quantum computing. The emphasis lays on the development of new quantum algorithms and new applications of quantum information processing. The results appear frequently in the top journals (Phys. Rev. Lett., Phys. Rev. A, Journal of the ACM and SIAM journal on computing) as well as the top conferences in computer science (FOCS, STOC, SODA and Computational Complexity), that carry equal if not more weight than the journal publications. Prof. Buhrman was coordinator of the European funded project QAIP and the group is involved in the RESQ and QAP project funded by the EU, as well as several major nationally funded projects (VICI, SION, DIAMANT).

P22. Delft University of Technology (TU Delft)– The Netherlands

<http://www.tudelft.nl>
<http://qt.tn.tudelft.nl/index.php>

Quantum information research at the Delft University of Technology, is carried out by two experimental groups which are both among the world leaders in the field.

The experimental group led by L. Kouwenhoven, L. Vandersypen and Y. Nazarov, performs experiments on spin states of electrons in quantum dots. Its main achievements have been the single shot readout of the spin of a single electron, the analysis of the influence of nuclear spins on electron spins in quantum dots. Quantum dots are achieved in GaAs heterostructures but there are plans to fabricate them in semiconductor nanowires and in carbon nanotubes, with strong and weak spin-orbit interaction respectively. Also, single photon sources will be developed in solid state systems, coupled to electron spins.

The experimental group of K. Harmans and H. Mooij, focuses instead on the experimental research and development of superconducting flux qubits. Among its main achievements there is the observation of Rabi oscillations of single qubits, as well as response to two- and three pulse excitation (with Rabi frequencies as high as 5 GHz, and typical T1 times of 2 microseconds, T2 times of 200 ns to 4 microseconds with spin-echo correction). A combined system of qubit and harmonic oscillator has also been produced, with coherent oscillations at sum and difference frequencies. Finally, first experiments have also been performed with two coupled qubits, and detailed spectroscopy and conditional coherent dynamics have been achieved.

M22a. Universiteit Leiden

<http://molphys.leidenuniv.nl/qo/index.html>
<http://www.ilorentz.org/beenakker/>

Quantum Information Processing and Communication at the University of Leiden, is studied both experimentally and theoretically. On the experimental side, the research of the group led by Prof. H. Woerdman and M. de Dood, focuses mainly in quantum optics, and in particular in the development and study of high intensity sources of entangled photons. On the theoretical side The Lorentz Institute group headed by Prof. C. Beenakker, concentrates on the general theoretical study of solid state quantum information systems.

P23. University of Gdansk (UG) – Poland

<http://www.univ.gda.pl>

Quantum information research at the Institute of Theoretical Physics and Astrophysics (IFTiA), of the University of Gdansk is pursued by 5 permanent staff (R. Alicki, R. Horodecki, M. Horodecki, W. A. Majewski, M. Zukowski), one postdoc (M. Piani), and 6 Ph.D. students. Among its main achievements, the IFTiA group has contributed pioneering work both in entanglement theory (including the discovery of bound entanglement), as well as in multiphoton interferometry (where the first proposal of entanglement swapping has been put forward). Moreover, IFTiA has played a major role in developing the theory of quantum open systems. Recently, the phenomenon of negative quantum information has been discovered in collaboration with researchers from Bristol and Cambridge Universities. The group has participated in the European projects EQUIP, QUPRODIS, RESQ, and from Nov. 2005 will participate in the FP6 Integrated Projects SCALA and QAP. It is also involved in several projects funded by the Polish Ministry of Scientific Research and Information Technology, and individual research grants. Finally the group shares a permanent collaboration with the groups of A. Zeilinger (Vienna) and H. Weinfurter (Munich).

M23a. Gdansk University of Technology

The Quantum Information Group at the Faculty of Applied Physics and Mathematics of Gdansk University of Technology is led by P. Horodecki and counts two Ph.D. and two M.Sc. students. The group is member of the National Laboratory for Physics of Information Processing, and participate in the EU-funded Integrated Project SCALA (starting 1 November 2005) and two research projects funded by the Polish Ministry of

Scientific Research and Information Technology. Some of its major theoretical results concern mixed entanglement and quantum communication including entanglement distillation, bound entanglement, entanglement measures, entanglement detection and thermodynamical aspects of quantum correlations. Recent results include novel methods in quantum secret key distillation, and locking of quantum entanglement.

M23b. Nicolaus Copernicus University

Quantum Information research at Nicolaus Copernicus University (Torun) is led by Prof. K. Banaszek and incorporates two Ph.D. and one M.Sc. students. Some of its major theoretical contributions to the field, include the analysis of trade-offs between state disturbance and information gain in scenarios motivated by quantum state estimation, the derivation of decoherence-free subsystems in bosonic channels, the construction of a source of polarization-entangled photons based on parametric down-conversion and its utilization to demonstrate entanglement-enhanced communication over collective-noise channels. Currently running projects include the generation of spectrally uncorrelated photon pairs, characterization of the modal structure of nonclassical sources of radiation, and quantum error correction in optical systems. The group is currently participating in the EU-funded Integrated Project QAP, and is member of the National Laboratory for Atomic, Molecular, and Optical Physics funded by Polish Ministry of Scientific Research and Information Technology.

Dr. A. Kossakowski is also working in the Institute of Physics of the Nicolaus Copernicus University, carrying out research in the fields of quantum open systems (quantum dynamical semigroups), investigations of positive maps and quantum conditional probability operator. He has a permanent collaboration with the Tokyo quantum group of prof. M. Ohya, and participate in Polish funded projects in QIPC.

M23c. Polish Academy of Sciences

Quantum information research at the Center for Theoretical Physics of the Polish Academy of Sciences (Warszawa) is carried out by M. Kus, R. Demkowicz Dobrzański, and J. Grabowski. The group participate in the European projects QUPRODIS and SCALA, as well as in a Polish funded ones. Major achievements of the group includes investigations of bipartite and multipartite entanglement, geometry of quantum states, cloning and connections between quantum chaos and entanglement production.

M23d. Jagiellonian University

Quantum information research at the Institute of Physics of the Jagiellonian University (Kraków) is carried out by J. Zakrzewski, K. Życzkowski and W. Słomczynski. The group participate in the EC projects QUPRODIS and SCALA, as well as in a Polish funded ones, and has produced several contributions to the investigations of geometry of the set of quantum states, quantum operations and analysis of quantum entanglement, the theory of open quantum systems and positive maps.

P24. Institut de Ciencies Fotoniques (ICFO) – Spain

<http://www.icfo.es/>

The Institute for Photonic Sciences (ICFO) in Barcelona has a very broad program of activities in QIPC both in experiment and theory. Experimental group of Prof. J. Eschen is one of the leading group in physics of trapped ions and ion based QIPC. Eschner's group and the group led by Prof. M. Mitchell collaborate closely with E. Polzik on QIPC with cold atomic ensembles. The groups of Prof. L. Torner and Prof. J. P. Torres carry out research on nonlinear optics, and entanglement of light. The theory group of Prof. A. Acin is among the leading ones in quantum cryptography and quantum communications. Finally, the theory group of Prof. M. Lewenstein conducts research on several branches of QIPC from theory of entanglement, to implementations of QIPC in quantum optical

systems, and quantum simulators and QIPC with large scale many body systems. ICFO collaborates very closely with the two distinguished invited professors, J. I. Cirac and E. Polzik.

M24a. Universidad Central de Barcelona

<http://sophia.ecm.ub.es/qic-ub/>

The Quantum Information and Computation group at Barcelona Central University, is led by Prof. J.-I. Latorre and includes several Ph.D and M.Sc. students. Its main interests concern the interplay between quantum information and quantum phase transitions, quantum information based numerical codes for many body systems, adiabatic computing and quantum treatments of NP-problems.

M24b. Universidad Autonoma de Barcelona

<http://giq.iafe.es>

The QIPC group at Physics department at Universidad Autonoma includes 5 senior scientist (Profs. E. Bagan, M. Baig, A. Bramon, R. Munoz, A. Sanpera), several postdocs, PhD's and M.Sc. students. The interest of the group spans state estimations, entanglement theory, implementations in quantum optics, cold gases, many body systems and particle physics, optimal quantum gates.

The QIPC group at Optics Department at Universidad Autonoma (head R. Corbalan), include several senior scientists (Drs. V. Ahufinger, J. Mompart, G. Morigi) who concentrate their efforts on QIPC in many body systems and disordered systems, implementations in quantum optics, atom optics and cold atoms physics, ion traps and ion chains, decoherence theory.

P25. Institute of Physics of the Slovak Academy of Sciences (IPSAS) – Slovakia

<http://www.quniverse.sk>

The Research Center for Quantum Information of the Institute of Physics of the Slovak Academy of Sciences has been founded in 2001 and is presently one of the most active basic-research groups in Slovakia. The Center has active research contacts to institutions across Europe, Northern and Latin America, Japan and Australia. The Center is or has recently been involved in the European projects EQUIP, QUBITS, QUPRODIS, QGATES and QAP. Prof. Buzek coordinates the projects CONQUEST and INTAS IT 04-77-7289. Research activities in the Center are focused on quantum state and process reconstruction, multi-partite communication protocols, quantum simulations, application of quantum information theory to quantum statistical physics and analysis of quantum decoherence. The Research Center for Quantum Information is led by Prof. V. Buzek (Expert of the IST Committee of the EC). The Center has 6 permanent staff (Dr. M. Ziman, Dr. P. Stelmachovic, Dr. M. Plesch, Dr. G. Drobny, M Le Gohebel – research manager - and a secretary), on postdoc and 4 Ph.D. students.

P26. Chalmers Tekniska Hoegskola Aktiebolag (Chalmers) – Sweden

<http://www.chalmers.se>

<http://www.mc2.chalmers.se/mc2/aqpl/>

The research in Quantum Information Processing at Chalmers is performed at the Microtechnology and Nanoscience Department - MC2 in the new microelectronics research building, with its 1200 m² clean room facility, presently one of the best university clean room facilities in the world. The Applied Quantum Physics theory group works on the dynamics of small clusters of 3-5 Josephson junction charge-phase qubits coupled to cavity-type quantum oscillators, as well as schemes for controllable coupling of charge-phase qubits. The senior group members are Prof. G. Wendin, Prof. V. Shumeiko and Assoc. Prof. G. Johansson. The group coordinates SQUBIT-2 and EuroSQIP. The Experimental Mesoscopic Physics group has achieved coherent quantum control of a single charge qubit based on a Cooper pair box using the RF-SET for read-out. The work is now progressing towards multiple qubits where the state is read out using the quantum capacitance of the Cooper-pair box, and using superconducting cavities to couple qubits together. Senior group members are Prof. P. Delsing, Assoc. Prof. T. Duty and Assoc. Prof. T. Bauch. The group participates in ACDET-II. The High Frequency Digital Electronics Group works on designing RSFQ classical interfaces for controlling and reading out

charge-phase and flux qubits. The group is headed by Assoc. Prof. A. Kidyarova-Shevchenko and coordinates RSFQUBIT.

P27. Kungl Tekniska Högskolan (KTH) – Sweden

<http://www.kth.se>
<http://www.kprc.se/>

KTH is the largest Technical University in Sweden and is the co-ordinator of the major Swedish R&D program in Photonics (through the Kista Photonics Research Centre). In quantum optics KTH made early contributions to squeezed laser diodes, sub shot noise manipulation with semiconductor light emitters, and on spontaneous emission control in light emitters. In the area of quantum information, KTH demonstrated among the first quantum cryptography experiments in the third telecom window at 1550 nm, and has also worked on quantum lithography, quantum interferometry and quantum imaging. In quantum information KTH was/is involved in the FP5 projects QUCOMM (awarded the 2004 Descartes price, with KTH being the coordinator), and S4P, and the FP6 Integrated Project SECOQC and QAP (to start in 2006). Key Researchers from KTH are G. Björk and A. Karlsson, who both have been working in the area of quantum optics and quantum information for the last ten years.

M27a. Lund Institute of Technology

<http://www.lth.se/english/default.asp>

The Photon Echo Group at Lund Institute of Technology is one of the groups within the Lund Laser Centre (LLC), which constitutes the largest research unit in the field of laser, optics and spectroscopy in the Nordic countries. As part of the LLC the group has access to an extensive optics equipment park including 30 major laser systems. The Photon Echo group presently consists of 5 persons. The group has extensive experience from work on rare-earth-ion doped inorganic crystals (RE crystals), including spectroscopy, measurement of dephasing and decoherence times in the crystals, fundamental questions related to the phase memory of the crystals, all-optical signal processing, all-optical information storage, quantum gate operations in RE crystals and other issues in quantum information. Current research is strongly focused on experimental development of quantum computer hardware and quantum memories in rare-earth-ion-doped inorganic crystals.

P28. University of Basel (UniBas) – Switzerland

<http://www.unibas.ch>
<http://theorie5.physik.unibas.ch>

The Basel Center of Excellence in Quantum Coherence and Quantum Computation (QC2) consists of the groups of D. Loss, C. Bruder, W. Belzig, and G. Burkard (theory), and C. Schönberger plus a newly appointed (N.N.) professor (experiment). The Basel QC2 is a globally leading institution in QIPC research with a focus on solid-state QIPC and hosts the largest theoretical research effort on spin-based QIPC (Loss-DiVincenzo) worldwide (D. Loss, G. Burkard), research on superconducting qubits (G. Burkard, C. Bruder, W. Belzig), quantum information theory, and experimental solid-state QIPC (C. Schönberger, N.N.). The Basel QC2 is very strongly connected with other leading groups in Europe, the U.S., Japan, and elsewhere. International collaboration is sustained with frequent scientific visits in both directions and a long-standing involvement of the QIPC research in Basel in US research programs (DARPA and ONR). D. Loss is a member of NSEC at Harvard University (Nanoscale Science and Engineering Center) and the Center for Spintronics and Quantum Computation at the University of California at Santa Barbara. The Basel QC2 center is affiliated with the Swiss National Center of Competence in Nanoscale Science (NCCR) with the University of Basel as its leading institution, and with the Center for Quantum Systems for Information Technology (QSIT).

P29. University of Geneva, Group of Applied Physics (GAP) – Switzerland

<http://www.gapoptics.unige.ch>

The Optics section of the group of Applied Physics (GAP) of Geneva University has its major R&D effort concentrated on Quantum Communication. In the last years we demonstrated, among others, quantum teleportation over km long distances (Nature, 2003), a quantum information interface (Nature 437, 116-120, 2005), entanglement purification (Nature, 2001), optimal photon cloning (Phys. Rev. Lett., 2002), and distribution of entanglement over 50 km of telecom optical fibers (Phys. Rev. Lett., 2004). The GAP is also active on the theory side with several contributions. Finally, on the more applied side, the GAP has played a pioneering role in the development of quantum cryptography, and a spin-off company, id Quantique SA, is successfully bringing these developments to niche markets.

M29a. École Polytechnique Fédérale de Lausanne

<http://imowww.epfl.ch/qd/>

The Quantum Devices (QD) group at École Polytechnique Fédérale de Lausanne is part of the Institute of Quantum Electronics and Photonics, comprising a total of 5 research groups (approx. 80 people) covering several areas of physics and technology of photonic devices (semiconductor nanostructures and nanodevices, ultrafast optical characterisation, novel materials). The QD group comprises 2 postdoctoral scientists, 4 PhD students and one technician. Its research activities are in the field of nanostructured photonic devices for communications, particularly quantum dot lasers for telecom applications and single-photon emitters and detectors for quantum cryptography. The facilities include a molecular beam epitaxy system for the III-V semiconductor growth, access to the Institute's class 1000-10000 clean room, electro-optical characterisation including at high-frequency up to 20 GHz (digital oscilloscopes, network analyser), and a micro-photoluminescence set-up with spatial resolution 1 μm , and high sensitivity in the 900-1600 nm wavelength range. The group has been previously involved in the European FP5 project GSQ, and is participating in FP6 Integrated Project ZODIAC, in FP6 Network of Excellence ePIXnet, and, finally, in several national projects.

P30. ETH Zürich, Quantum Photonics Group (ETHZ) – (Switzerland)

<http://www.itp.phys.ethz.ch/>
<http://www.itp.phys.ethz.ch/condmat/blatterj/>
<http://www.nanophys.ethz.ch/>
<http://www.quantumoptics.ethz.ch/>
<http://www.iqe.ethz.ch/quantumphotonics/>
<http://www.nmr.ethz.ch/>
<http://www.xuv.ethz.ch/>
<http://www.nano-optics.ethz.ch/>

There are 7 groups which pursue quantum information processing related research at ETH Zurich. The group of G. Blatter (theory; physics) investigates quantum information processing based on mesoscopic superconducting structures. K. Ensslin's research (experimental; physics) focuses on electrical manipulation of electron spin qubits. T. Esslinger (experimental; physics) investigates ultra-cold bosonic and fermionic atoms in optical lattices and their potential applications in quantum computation schemes. In recent work they have been able to demonstrate the preparation of a quantum register with fermionic atoms by putting a quantum degenerate gas of potassium 40 into a three dimensional optical lattice (Phys. Rev. Lett., 2005). They have also demonstrated single atom counting of atoms extracted from a Bose-Einstein condensate (Phys. Rev. Lett., 2005).

The group of A. Imamoglu (experimental; physics) pursues measurement, manipulation and entanglement of single solid-state emitters in photonic nanostructures. Recently they achieved deterministic coupling of a single quantum dot to a photonic crystal defect cavity (Science, 2005). Nuclear magnetic resonance forms the focus of B. Meier's group (experimental; chemistry). F. Merkt (experimental; chemistry) investigates novel methods for manipulating Rydberg atoms and molecules. The central theme in V. Sandoghdar's research (experimental; chemistry) is the coupling of single-molecules to optical micro-cavities using nano-optics. These 7 groups have formed a ETH-funded center for "Quantum Systems for Information Technology" (QSIT) which enables them to share insights and initiate new research directions.

P31. University of Bristol (UoB) – (United Kingdom)

<http://www.bristol.ac.uk>

Bristol University node consists of the quantum optics experimental group led by J. Rarity (Electrical engineering), and the quantum information theorists R. Jozsa and A. Harrow (Computer Science), N. Linden and A. Winter (Mathematics) and S. Popescu (Physics). This group is uniquely interdisciplinary in spanning four departments and two faculties. The theory group has made fundamental contributions across the range of theoretical quantum information theory: in quantum algorithms and communication, in entanglement, in quantum coding, and in a variety of theoretical aspects of implementation of quantum information processing. The experimental group of Prof. John Rarity has made pioneering contributions to the implementation of quantum cryptography and is now developing ultra-bright sources of single photons and entangled photon pairs and applying these sources to quantum logic and communications. The Bristol group has been involved in many previous European projects including the QUIPROCONE network. It is currently active in FP5 programmes RESQ, RAMBOQ, ATESIT, and FP6 programmes SECOQC, QAP and ACDET. Theory and experimental groups are both active members of the UK quantum information processing consortium (QIP-IRC).

P32. The Chancellor, Masters and Scholars – University of Cambridge (UCAM-DAMTP) – United Kingdom

<http://cam.qubit.org>

The Centre for Quantum Computation (CQC) at the Department of Applied Mathematics and Theoretical Physics, University of Cambridge, conducts theoretical research into all aspects of quantum information processing including quantum information theory and cryptography and implementations based on e.g. charge qubits, surface acoustic waves, optical lattices and photonic crystals. The group's contributions to the field include pioneering work on the relationship between physics and computation, the invention of entanglement-based cryptography, the first demonstration of a quantum algorithm that outperforms all classical algorithms and the development of techniques to extend quantum cryptography to arbitrarily long distances. The group headed by Prof A. Ekert includes senior researchers Prof D. Deutsch, Dr A. Kent, Dr G. Mitchison and Dr N. Datta and 13 Postdocs and 6 Ph.D. students. The CQC maintains close links to other research groups in the UK, Europe, North America and Singapore, to industrial organisations such as Fujitsu and is part of the EU projects RESQ, TOPQIP and the integrated projects QAP and SCALA.

P33. Imperial College of Science, Technology and Medicine (ICSTM) – United Kingdom

<http://www.ic.ac.uk>

<http://www.imperial.ac.uk/research/qols/>

Imperial College host the Quantum Optics and Laser Science (QOLS) group in the Department of Physics and the Quantum Information Theory group at the Center for Mathematical Sciences. These groups conduct internationally leading research in the areas of quantum information science as well as theoretical and experimental quantum optics. The quantum information and quantum optics activities are led by Prof PL Knight FRS, Prof MB Plenio, Prof EA Hinds, Dr. J. Eisert, Dr. T. Rudolph and Dr. S. Scheel. Around 10 postdocs and 10 PhD students are working in the group. The theory group has made significant contributions to most areas of quantum information science and quantum optics.

The main areas of current activity are in quantum information science, the study of entanglement, its characterization, manipulation and creation, quantum many-body systems, methods for the practical implementation of quantum information processing in cavity QED, ion traps, BEC's, light modes and condensed matter systems, noise supported quantum information processing, quantum communication, quantum algorithms, optimization theory and graph theory etc. In quantum optics areas of current interest are cold atoms near surfaces, decoherence, multi-photon physics, cavity QED, Casimir effects etc. Further to this there are strong connections and joint projects with the experimental activities in the QOLS group that includes the experimental atomic physics including cold atom research, ion traps and multi-photon physics.

In the last five years the theory group has published more than 170 papers (including 1 Nature, 1 Rev. in Mod. Phys. and more than 30 Phys. Rev. Lett.) The group has strong research links with other research groups in the UK, Europe and North America and it is or has recently been involved in the following European projects: EQUIP, QUBITS, QUPRODIS, TOPQIP, QGATES, the Integrated Projects SCALA and QAP as well as the ESF-QIT programme

M33a. University of Hertfordshire

<http://strc.herts.ac.uk/tp/>

<http://perseus.herts.ac.uk/uinfo/research/stri/>

The quantum information group at the University of Hertfordshire is part of the Science and Technology Research Institute (STRI) and the Department of Physics, Astrophysics and Mathematics. Currently the group comprises Dr S. Huelga as permanent member of staff, Dr D. Tsomokos as a postdoctoral researcher and an M.Sc. student. The research activity focuses on developing quantum information processing protocols in noisy environments using atomic and superconducting qubits. The group is part of the Quantum Information Interdisciplinary Research Collaboration of the EPSRC as well as two other EPSRC networks involving various institutions within the UK. At a European level, the group participates to the thematic network QUPRODIS and the recently funded integrated project QAP. Finally it shares collaborations with theory and experimental groups in the EU, China, Australia and the USA.

M33b. University of York

The interdisciplinary Quantum Information activity at the University of York involves the group of Professor S. L. Braunstein at Computer Sciences (3 postdocs and 2 Ph.D. students), the group of Dr. T. Sudbery at Department of Mathematics (4 Ph.D. students) and the group of Dr. I. D'Amico at the Department of Physics. Research subjects cover entanglement theory, quantum information processing more generally, and implementations through continuous variables and spintronics. Professor Braunstein is the author of the proposal for unconditional quantum teleportation of light successfully implemented in 1998 (Science).

P34. The Chancellors Masters and Scholars of the University of Oxford (UOXF.DU) – United Kingdom

<http://www.physics.ox.ac.uk>

<http://ultrafast.physics.ox.ac.uk>

The Clarendon Laboratory is one of three major laboratories of the Department of Physics at the University of Oxford. The University is one of the world's leading academic institutions, and the Department of Physics is among the most highly rated in the UK. The Atomic and Laser Physics Sub-Department within the Clarendon Laboratory has a long history of research in quantum information processing, beginning with the founding of the Center for Quantum Computation by Prof. A. Ekert in the 1990s. Pioneering work in this Center established several important fundamental concepts, including quantum error correction and the universality of gate networks. The group has strong links with other research groups in the UK, Europe and North America and it is or has recently been involved in a number of EU projects, and coordinates (together with Imperial) the IST FP6 Integrated Project QAP. The Oxford node investigators, led by Prof. I. Walmsley have significant experience in organizing and running large-scale collaborative research programs, including provision for training of graduate students and postdocs. The CQC group includes A. Steane, J. Jones, C. Foot, D. Jaksch, D. Lucas and D. Browne. There are strong connections with the UK QIP IRC in the Department of Materials, directed by A. Briggs, and involving S. Benjamin and P. Kok.

P35. Universität Ulm

<http://www.physik.uni-ulm.de/quant/index.html.en>

<http://www.uni-ulm.de/qiv/>

Quantum information research at the University of Ulm is carried out by two institutes. The institute for quantum physics, headed by Prof. W. Schleich, aims at understanding the correlated nonclassical motion of trapped and free particles and to identify the effects of possible quantum control parameters including dissipation. In addition the team around Prof. M. Freyberger investigates real-valued quantum state representations which are particularly suited for quantum estimation procedures, by means of maximum likelihood techniques and Bayesian statistic. The institute for quantum information processing, headed by Prof. F. Schmidt-Kaler, studies quantum computing with ion crystals in linear Paul traps, decoherence of macroscopic quantum states, deterministic implantation of single atomic ions into solids with nm resolution and quantum information processing with single electrons in cryogenic Penning traps. The theoretical group of Prof. T. Calarco investigates optimal control methods for the physical implementation of scalable quantum gate schemes and the related interactions between atomic and solid-state qubit systems. The groups participate in several national and European-funded projects..

a.2 Sub-contracting

QUROPE WP3 (“Public outreach: Increasing the public visibility and awareness of the field”) will be responsible for raising the public level and the awareness of the QIPC field at an as wide as possible level. To cope with this highly non-trivial task, publication of articles in popular journals/magazines and presentation of popular/review talks at appropriate audiences has been foreseen, including, for the first time ever, a documentary movie “Quantum Information” targeted at broad audiences.

There is an agreement with the known documentary movie director Lars Becker-Larsen from Denmark [“The Copenhagen Interpretation” (2004); “Theory of Everything” (1998); “The lesson of Quantum physics” (1991)] about collaboration and partial funding of a documentary film on Quantum Information by QUROPE. In the spring of 2005 research & filming was performed by the L. Becker-Larsen at the QUPON conference in Vienna. By the end of 2005 the promotional DVD has been produced and fundraising has started.

Given the above, and the peculiarity of the proposed delivery, it is suggested that director L. Becker-Larsen serves as a sub-contractor for the realization of the documentary within QUROPE. He is allocated the budget of 60k€ towards production of the film. The rest of necessary funding will be provided by the Danish Film Institute and other sources.

A.3 THIRD PARTIES

In QUROPE there are no participants based outside of the EU Member and Associated states. On the other hand, a participant is based in Israel (Weizmann Institute), and three more ones in newly integrated European countries (Gdansk University in Poland, Institute of Physics of the Slovak Academy of Sciences in Slovakia and Univerzita Palackého v Olomouci in the Czech Republic).

We note also that QUROPE includes sixteen European or associated countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Israel, Italy, The Netherlands, Poland, Spain, Slovakia, Sweden, Switzerland, and United Kingdom), which provides an excellent coverage for integration at the European scale.