

DELIVERABLE D5.1.3 SECOND YEAR ACTIVITY REPORT

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SUMMARY OF RECOMMENDATIONS FROM THE LAST REVIEW

The first review of the QUIE²T project took place on May 3rd, 2011 in Bratislava. In their Technical Review Report, the reviewers expressed overall satisfaction with the progress of the project and the obtained results, confirming that „*the project has achieved most of its objectives and technical goals for the period with relatively minor deviations*“. A few recommendations were issued concerning the future work, they are listed below with some indications on how they have been taken into account.

- **Enhance the visibility of the Virtual Institutes (WP2)**

The concept of Virtual Institutes is a new one with significant potential. However, the activity has not really caught on yet. One effort to improve the situation was to enhance the presentation on the web site by adding a collection of affiliated groups, publications, events and highlights for each Virtual Institute. Effective use of the expertise of VI members was made during the preparation and advisory activities for the QIPC conference, as well as the update and authoring of several strategic documents. However, the concept of a Virtual Institute as a self-contained entity seems not to have gained a wide acceptance.

- **The deliverable of bibliometry should be modified (WP2)**

In the report of year 1, we indicated the plan to use the resources and results obtained by the case study in the final report of the “Impact of FET Research Initiatives” (IFETRI) commissioned by the EC to the German VDI Technologiezentrum (project number SMART 2009/0052). The analysis is now available, but has raised severe criticism about its accuracy, and on the general usefulness and validity of bibliometric analysis tools. It was therefore decided not to continue this activity. This is further explained in the description of Task 2.3 below.

- **Consider to transform the web site into a project-independent initiative (WP3)**

Considerable effort has gone into the development of a high-quality web site. The site has actually gotten a much wider scope than initially expected, being used by other projects and groups for their data collection, presentations and even report handling. It would be certainly reasonable and desirable to ensure the future maintainance of the whole infrastructure. Some discussions and information exchange has taken place with people running the Quantiki site¹ (which is powered by the same software tools as the qurope site), however, no concrete steps were discussed so far to ensure the future sustainability of the qurope domain. This is something that will have to be solved in the third and final year of the project.

- **More explanations should be provided on the use of resources (WP5)**

A ‚*Statement on the use of resources*‘ has been included for each work package in the report section 3.2.2 below. Also more details are provided in the management section 3.4 ‚*Explanation of the use of resources*‘.

¹ <http://www.quantiki.org/>

WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

The following pages provide a detailed description of the progress of the work for each work package during this reporting period.

Work package 1: Community monitoring and overview

The main objectives of WP1 are:

- Collect and disseminate QIPC related relevant data;
- Establish and sustain contacts with other communities;
- Foster links between research, industry, politics and other stake holders.

The work towards these objectives is grouped in three tasks; the corresponding achievements during this reporting period are outlined below.

Task 1.1 Collect and analyse material for relevant databases

At the beginning of the project, a preliminary poll on the QUIE²T web site has not produced any significant new insights as to new or un-covered material that could be collected in addition to the data we already had available. The community contribution to the services offered on our web site has certainly been significant, such that it can be concluded that the community needs in this area are covered to the satisfaction of all interested parties. This task has been completed in reporting period 1.

Task 1.2 Setup and maintenance of databases

During the first year, an infrastructure has been set up to collect relevant data and to present it at the project web site. All the existing databases that were established by the predecessor project QUROPE have been ported to the QUIE²T web site, this includes in particular the industry database, and the collection of research groups and contact details. All databases are continuously monitored and relevant additions are disseminated via the QUROPE mailing list. The complete database collection is available at <http://qurope.eu/db/>.

Some statistical data can be extracted from the database collection:

- The [Jobs database](#) currently counts 163 entries, i.e. we had an approximate average of 1.5 submissions per week. This represents a slight decrease of number of job offers as compared to the same date last year, where we had 102 job offers, i.e. an average of almost 2 submissions per week.
- The list of [Research Groups](#) currently counts 205 records. This is 3 more groups as compared to last year and is supposed to cover the main groups in Europe.

- The collection of [Publications](#) currently counts 477 entries. This is a plus of 230 publications as compared to last year, i.e. the number of publications remained about constant at 4 publications per week.
- The [Events](#) database currently counts 128 entries, i.e. 53 events were added to the 75 entries we had last year.
- The [News](#) database currently counts 80 entries, a plus of 26 stories as compared to last year. On average about one exciting news story was added every two weeks.
- The industries database currently counts 50 entries, that is 4 industrial organizations were added this year.
- There are currently 376 registered users who are subscribed to the [QUROPE Mailing List](#), that is a plus of 32 users this year.
- We are also collecting basic statistics about page hits on our site. In May 2011 we registered the site at Google Analytics. The Table below shows the statistics for the period May 1, 2011 – Mar. 1 2012. Note that the page views only include hits of the exact corresponding page, i.e. no sub-pages are taken into account. For instance, the top-level page of the qurope.eu site has been hit 3514 times in the given time period, i.e. about 12 hits per day.

The most popular pages on the site, apart from the the sub-project pages, are the job database and the QIPC Roadmap. Also the hosted projects can be proud of their statistics: since the creation of the web site, the [AQUTE](#) home page has been hit a total of 11064 times (5089 last year), the [Q-ESSENCE](#) home page 11414 (5036), the [QUIE²T](#) home page 8495 (3825) times and the [SOLID](#) home page 5882 (2660) times.

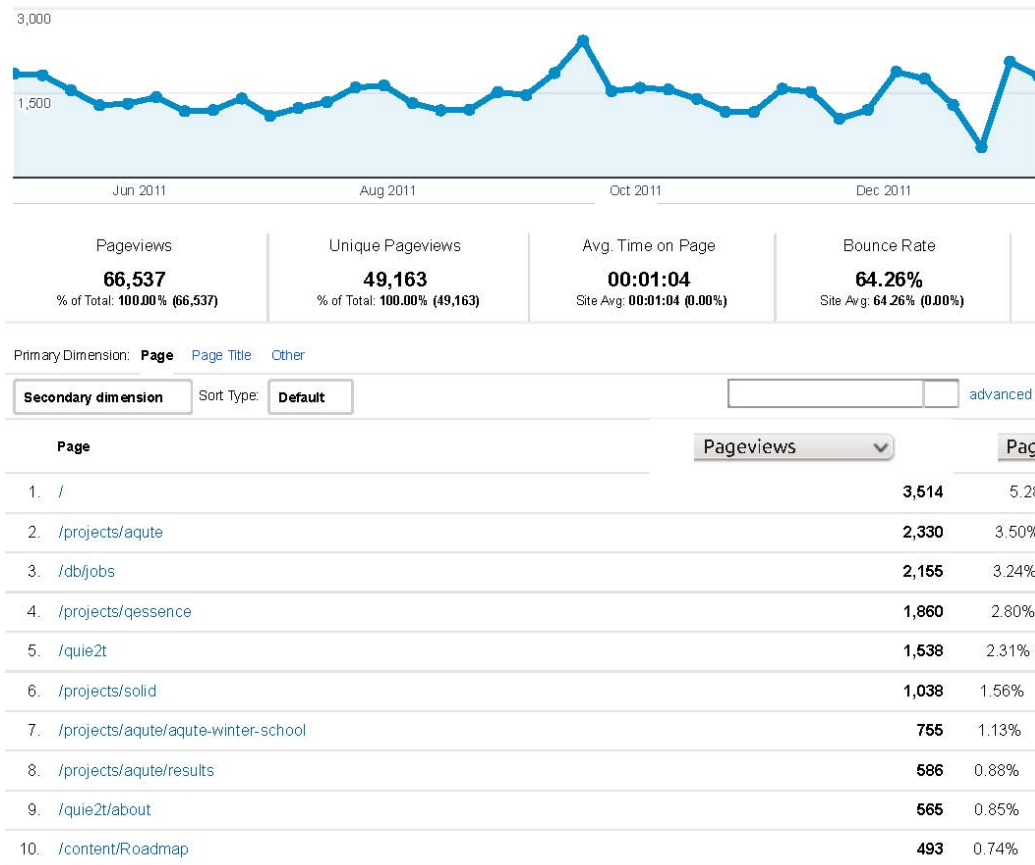


Figure 1 Google Analytics statistics overview report on the qurope.eu domain. The covered date range is 1.5.2011 – 1.2.2012.

Task 1.3 Establish sustainable contacts with industry and policy makers

In the first year we not only expanded and updated the industrial database and improved our contacts with industries but also identified the emergence of a clear quantum technologies industry.

In this second year we have continued to work on expanding and sustaining these industry contacts. There have been two primary areas of activity, improving the web site and organising industrial sessions at several conferences.

The industry section of the QUIE²T website now includes an introductory front page² where we have tried to highlight the new quantum technology companies identified in year 1. We have also made a first attempt at trying to classify, or provide keyword associating to the industries in our database. It needs to be said that the first attempt was not so useful and we intend to revisit this in the final year, as this year also had other priorities.

The main focus this year was on organising a special industry session at a big QIPC conference. This is part of D1.3.1, which is not due until M36, however the major target, the

² <http://qurope.eu/db/industries/about/>

QIPC conference fell in year 2. Nonetheless, we also took the opportunity this year to expand our presence to several other major conferences. The three main events were:

- QIPC 2011 – This is the conference for quantum information in Europe and our target vehicle for previous industrial sessions. Previous years have seen a focus on quantum communication, this being one of the more advanced areas for quantum technologies, and we have brought people in from outside of the community. This year however we decided to have a mix of “external” and internal” speakers covering computing as well as communication, on the industry side and from within the community we brought forward the idea of quantum metrology with a couple of talks on emerging concepts for quantum technology. The speakers were:
 - Dr Walter Riess, Head of the Science and technology Department of IBM-Zurich,
 - Dr Grégoire Ribordy, CEO of IDQ
 - Dr Jürgen Appel from the Niels Bohr Institute in Copenhagen
 - Dr Bruno Sanguinetti from the Group of Applied Physics in Geneva.

- QCRYPT2011 – This is a new conference series on Quantum Cryptography. The aim of this series is to bring together researchers working on all aspects of the subject (both on the theoretical and experimental sides) and to support the building of a research community in Quantum Cryptography. We took the opportunity to organise an **Industry Venture Session** involving a selection of the new quantum technology companies identified in year 1. The following is a list of companies and people invited and the session was based around short presentations of the products and the vision of each company, and followed by a moderated panel discussion on the topic «How to enlarge the market».
 - IDQ (Grégoire Ribordy)
 - qutools (Henning Weier)
 - SeQureNet (Sébastien Kunz-Jacques)
 - CriptoCam (Paolo Tombesi)
 - Atos (Charlotte Rugers) - formerly Siemens Netherlands section
 - Austrian Institute of Technology (Thomas Länger)

- ECOC – This is the European conference on optical communication – primarily a classical communication conference, so here we aimed at addressing the industries that are potentially interested in quantum technologies. We invited several (see list below) leading researchers from Europe, Canada and Japan to talk about real world quantum communication. We also note that for the opening day of the conference Prof. Nicolas Gisin was invited to give a plenary session talk to the over 1000 strong audience on day 1 of the conference providing an exceptional outreach opportunity to the industry dominated conference.
 - Quantum Repeaters - Wolfgang Tittel, Université de Calgary, Canada
 - Commercial QKD & SwissQuantum: Grégoire Ribordy, CEO IDQ, Switzerland
 - Low Cost QKD - John Rarity, University of Bristol, UK

- High Rate QKD - Andrew Shields, Toshiba, Cambridge, UK
- Tokyo QKD Networks - Masahide Sasaki, NICT, Japan
- Free Space QKD - Rupert Ursin, University of Vienna, Austria
- Quantum Hacking - Harald Weinfurter, University of Munich, Germany

On a more general note, we have also been involved in discussions with a consultancy company (mi2g Intelligence Unit), headed by a DK Mattai who is/was in charge of something called Quantum Innovation Labs (QIL) who was proposing an initiative entitled: “International Quantum: Exchange for Innovation”. This was presented as a \$1billion initiative to harness quantum technologies for the corporate and government environment. While this sounds exciting a great deal of time was spent trying to understand the validity of the whole proposal and after several phone calls and Skype conferences (Mattai, Buzek, Calarco, Binosi, Thew) it remained unclear. We also used other avenues to better understand who this person was and what was going on and finally he admitted that the \$1Billion does not exist. He then proposed a more modest brainstorming workshop. At this point “...due to the economic crisis taking up all his time ...” he dropped out of contact. Although this seems like a complete waste of a lot of people’s time perhaps we should simply take the positive view of this in that there is money, serious money, out there and people that think that quantum information science and technologies are looking more and more like a good investment. Apart from that, the coordinator continues to receive, and closely follows, the ATCA daily digest that is distributed by DK Mattai.

Statement on the use of resources for WP1

- **IPSAS:** 3 person months (coordination activity) consistent with the initial work plan (10 person months over the duration of the whole project, of which 3 declared in the first year). Contributed to task T1.2 (Setup and maintenance of databases) and to deliverable D1.2.1 (Mid-term database update).
- **FBK-ECT*:** 0.77 person months (coordination activity) consistent with the initial work plan (4 person months over the duration of the whole project, of which 2 declared in the project first year). Contributed to task T1.2 (Setup and maintenance of databases) and to deliverable D1.2.1 (Mid-term database update).
- **UNIGE:** 2.02 person months (coordination activity) not consistent with the initial work plan (8 person months over the duration of the whole project, of which 2.73 declared in the project first year). The initially scheduled 8pm were not consistent with the budget that was allotted to UNIGE, by now more than the total budget has already been spent with only 4.75PM. There will be no further cost claims from UNIGE and we will try to equalize the current overspending by a budget re-allocation in the final year. Contributed to tasks T1.2 (Setup and maintenance of databases) and T1.3 (Establish sustainable contacts with industry and policy makers), and to deliverable D1.2.1 (Mid-term database update).

No other major cost items occurred in WP1 during this reporting period.

Work Package 2: Strategy, vision and sustainability

The planned objectives of this work package (to be mainly achieved through the elaboration of a series of documents and tools and their regular updates) were mainly two:

- To provide the community with a widely accepted comprehensive strategic vision and future goals of QIPC research;
- To explore possible ways to ensure the future sustainability of the field.

The activity during the second year of the project has been particularly intense. The failure of the Flagship-Pilot “The Quantum IT Challenge” for which QUIE²T acted as the official representative of the QIPC community (see <http://qurope.eu/content/flagship-initiatives/> for the documentation of the entire process) has sent us “back to the blackboard”, since Flagship initiatives were judged by the QIPC community in general and the QUIE²T Steering Committee in particular as the main path towards the sustainability of the whole field. Luckily, we could profit from the fact that the roadmap document “Quantum Information Processing and Communication: Strategic report on current status, visions and goals for research in Europe” had been already delivered in June 2010, and thus concentrate completely on the sustainability task (as opposed to the vision task). In addition, we have actively participated in the CHIST-ERA project selection process.

Task 2.2 QIPC Strategic Report, Quantum Information Classification Scheme and position documents

As already said the updating of the roadmap document has taken place in the project first year as a result of the launch of FET Flagship Initiatives. The porting, revision and update of the Quantum Information Classification Scheme (QICS) has been done as per the original work plan schedule. The new version 1.2 has seen no major modifications, but its maintenance has now been transferred to the QUIE²T web site, where it can be edited and maintained as an electronic on-line document³.

Task 2.3 QIPC Virtual Observatory

The purpose of this task was to further exploit the invaluable asset represented by the plethora of different QIPC-related data collected by the previous CAs in the field – most notably the QUIE²T predecessors ERA-Pilot QIST and QUROPE –, and reorganized as well as updated by WP1.

During the project first year two objectives were reached:

- The application of appropriate visualization tools for particular data sets has been reached (see, e.g., the integration of Google maps showing the location of the groups appearing in the Research Groups database, implemented in collaboration with WP1 and WP3);
- The delineation of bibliometric indicators for the QIPC field as a case study in the final report of the “Impact of FET Research Initiatives” (IFETRI) commissioned by

³ <http://qurope.eu/content/qics/>

the EC to the German VDI Technologiezentrum (project number SMART 2009/0052); the analysis is available at <http://studies.cwts.nl/projects/ifetri/>.

However doubts were raised from many community members about the accuracy of the IFETRI bibliometric analysis (some of the most cited people are not faithfully represented in the analysis), and in general on the usefulness and validity of bibliometric analysis tools. Given these problems and the need to divert as many resources as possible to task 2.4, we did not continue this activity.

Task 2.4 Towards sustainability in QIPC

As already mentioned this is the task that accounts for most of the efforts from the WP participants. The reason is threefold:

- The aforementioned failure of the FET-Flagship Pilot proposal;
- The opening of the call FP7-ICT-2011-9 and with that the objective ICT 2011.9.9 FET Proactive: Quantum ICT (QICT) including ERA-NET-Plus;
- The coming of the Framework Programme for Research and Innovation Horizon2020.

The first step we have completed was to submit a feedback to the Green Paper of the European Commission in preparation of the Common Strategic Framework for EU Research and Innovation Funding [COM (2011) 48]. The feedback is articulated in three essential points

- The need for strengthening basic and purely curiosity-driven research funding;
- The need for strengthening FET-like research, that is “high-risk high-payoff” research, potentially leading to disruptive technologies;
- The need for continuity of FET-like collaborative research instruments (IPs, STREPs, CSAs) which constitute a complementary instrument to individual research instruments (as the ERC grants)
- The need for simplification of the EU funding system.

This feedback, that has been submitted on behalf of the QIPC community (and therefore was backed up by the more than 200 groups working in this research field) replace D2.4.1 “White paper for sustainability”, and is submitted as such with this report.

It should be noticed that the feedback articulates arguments for both the QIPC community as well as FET; this is a constant in the activity we have carried out for this year, because we felt that sustainability of the FET program and not only the one of QIPC was at stake.

ICT Call 9 include a 7 M€ budget reserved for an ERA-NET-Plus initiative. To begin with the very same existence of QIPC as a FET Proactive initiative in Call 9, its increased budget (22 M€) and the presence of the ERA-NET-Plus has to be regarded as a success of QUIE²T and its predecessor QUROPE. In addition, the presence of this ERA-NET Plus initiative in some sense partially close the gap between QIPC and the fields selected for the Flagship-Pilot program. QUIE²T has worked all this year to gather the required critical mass (which is 5 member states engaged for 5 years and committed to make a call of a minimal financial volume of 5 M€) in order to make this happen. At the moment of writing this report there is a

fairly high chance that the ERA-NET-Plus action will materialize. This will obviously rise the QIPC budget for the call which will go from a minimum of 27 M€(for a 5 M€initiative) to a maximum of 36 M€(for a full scale 14 M€initiative).

The last set of activities towards the sustainability of the field has been the promotion of QIPC and FET in several committees (e.g., the ITRE committee) proposed to structure the Horizon 2020 program for research and innovation. This activity is particularly time-consuming while at the same time being very difficult to report; all we can say about it is that we have been able to contribute ideas that have materialized black on white in several key documents, as well as present a talk on the 19th of October at the task force of the Social Democrat (SD) group of the ITRE committee for research. The slides of this talk, as well as accompanying handout documents distributed at the event, are presented as an unexpected deliverable for this WP (UD2.4.1)

All this activities can be regarded again as a fulfillment of QUIE²T Milestone 5, though as far as we are concerned, this is really the fulfillment of the QUIE²T mission.

Statement on the use of resources for WP2

- **UULM:** 6 person months (coordination activity) not consistent with the initial work plan (8 person months over the duration of the whole project, of which 4 declared in the project first year). The reason in this case is that it was decided to use the funds to pay a part time secretary for 12 months who would help in the organisation of all the activity that has been carried out. The time spent by Prof. Calarco (quantifiable in 1.5 person month) has not been charged on the project budget.
- **FBK-ECT*:** 2.5 person months (coordination activity) not consistent with the initial work plan (4 person months over the duration of the whole project, of which 3 declared in the project first year). The required additional person month resources have been drawn from work package 3.

No other major cost items occurred in WP2 during this reporting period.

Work Package 3: Dissemination activities

The main objective of WP3 is to increase the general visibility of QIPC related research in Europe, and to assure a constant information flow within the community and beyond.

Task 3.1 Setup an information exchange platform

Work on this task has started already before the beginning of the project, an operational web site was in place on day one of the project. The information exchange platform is entirely web based and can be administered remotely by any authorized administrator. The main „out“ channel to distribute information to the QIPC community is the QUROPE mailing list⁴, any registered user is automatically subscribed to the list. This year, like last year, about one message has been broadcast via that channel every week.

To receive information there are several possible channels, the most convenient way, apart from subscribing to the QUROPE mailing list, is to subscribe to one or several of the news feeds that are offered at the bottom of many relevant pages (eg for news or jobs announcements).

This task has been completed in the project's first year.

Task 3.2 Development and maintenance of a comprehensive web portal

As mentioned before, the web site was operational with the start of the project. It was decided early on to use a web-based Content Management System (CMS) that would allow administrative tasks to be carried out remotely by several people. The hosting has been offered (and we are greatly thankful for that) by the Niels-Bohr Institute in Copenhagen, who agreed to continue the service following the successful hosting of the predecessor project QUROPE.

The main domain for the web site has been chosen deliberately to be <http://qurope.eu/>. It is supposed to be an umbrella domain for several QIPC related subjects and projects. The main web site is currently divided into five domains:

- [Quantum Information](#): contains general, also specialized, material about QIPC-related issues
- [QUIE2T Coordination Action](#): specific to the QUIE²T CA that acts as a maintainer for the whole web portal
- [Virtual Institutes](#): contains material pertaining to the work of the four Virtual Institutes
- [QIPC Projects](#): the part of the web portal where other QIPC related projects may register
- [FP7](#): contains information about the EC funding schemes and the seventh framework in particular

⁴ <http://qurope.eu/content/qurope-mailing-list/>

The web site currently offers the following main features:

- An open registration service, any user can register and start submitting content to the site.
- A huge collection of relevant data bases⁵, like news, events, jobs, publications, research groups, etc.
- Search function, revision control.
- Discussion forums⁶, publicly available (only registered users can participate).
- On-line maintenance of the QUROPE mailing list, any registered user is automatically subscribed to the list.
- Collection of news feeds⁷ from interesting sites.
- A hosting service for other QIPC projects, including advanced features like intranet, discussion forums, atomated data aggregation (news, events, etc.).
- The whole QIPC Roadmap⁸ is maintained on the QUIE²T web site, both its web and printable form. A printable pdf version can be obtained directly from the web source.
- The possibility to add webforms or application forms to web pages. This has been used by several projects for the organization of meetings or conferences (e.g. the [first CHIST-ERA conference](#)), or for other application gathering (e.g. like the SOLID project for its [training activities](#)). It is also used on the application page for the QUIE²T [Quantum Envoy](#).

New features that have been added during this reporting period include:

- An overview page for the database collection⁵ with automatic updates for latest additions.
- Ability to filter most databases by subjects and keywords.
- Google maps with locations of events⁹ and jobs¹⁰.
- An overview page for the industry database².
- A page to show the contact information for all the research groups in the database¹¹ (with additional information for authorized users).
- The Quantum Information Classification Scheme (QICS) is now maintained directly on the web site¹². A printable pdf version can be obtained directly from the web source.
- A collection of Frequently Asked Questions¹³ (FAQ) to guide new users of the site.
- A collection of introductory material to quantum information¹⁴.
- A collection of affiliated groups, publications, events and highlights for each Virtual Institute, see e.g. <http://qurope.eu/vi/q-comp/>

⁵ [Hhttp://qurope.eu/db/](http://qurope.eu/db/)

⁶ [Hhttp://qurope.eu/forum/](http://qurope.eu/forum/)

⁷ [Hhttp://qurope.eu/aggregator/](http://qurope.eu/aggregator/)

⁸ [Hhttp://qurope.eu/content/Roadmap/](http://qurope.eu/content/Roadmap/)

⁹ [Hhttp://qurope.eu/db/events/map/](http://qurope.eu/db/events/map/)

¹⁰ [Hhttp://qurope.eu/db/jobs/map/](http://qurope.eu/db/jobs/map/)

¹¹ [Hhttp://qurope.eu/db/group_contacts/](http://qurope.eu/db/group_contacts/)

¹² [Hhttp://qurope.eu/content/quantum-information-classification-scheme-qics/](http://qurope.eu/content/quantum-information-classification-scheme-qics/)

¹³ [Hhttp://qurope.eu/faq/](http://qurope.eu/faq/)

¹⁴ [Hhttp://qurope.eu/qipc/basics/](http://qurope.eu/qipc/basics/)

- The ESF project FARQUEST has decided to host its web page at the QUROPE site: <http://qurope.eu/projects/farquest/>.

Task 3.3 Maintenance and update of existing QUROPE databases

The available databases have been discussed in the description of WP1, the work of WP3 consisted in setting up the infrastructure to submit and present the data in a comprehensive manner. The complete database collection is available at <http://qurope.eu/db/>.

Task 3.4 Information and promotion material

- QUIE²T was represented at the Commission's *fet11* conference taking place from 4 to 6 of May in Budapest¹⁵. An exhibit proposal that was submitted in response to a European Commissions call has been successfully evaluated and was among the 28 exhibition stands present at the conference. According to the commission, "*fet11 is a unique conference on visionary, high-risk and long-term research in information science and technology. Featuring an exceptionally broad range of scientific fields the event will seed new ideas across disciplines that will reshape the future*".

In the same spirit as the Brussels exhibit one year before, the exhibit at *fet11* brought some of the research highlights of the consortia to specialist and to non-specialist audiences in an interactive manner. The aim was to show the trans-formative potential of the fundamental research. At the same time we could attract the interest of young researchers motivating them to take on the challenges of cutting edge technological research. The presentations were interactive with minimal textual content, using videos as well as demonstrations that would give the audiences an opportunity for hands on experience of some complicated technology experiments. Such the progress in different strands of QIFT activities in Europe was demonstrated.

In addition, a project flyer that served as a press release was distributed at the conference, see Figure 2.

- Oxford as WP3 leader has created some video clips based on key scientific highlights that were launched on the web during this reporting period. The research ideas and results in these films reflect the FET ideas of the commission. The videos are publicly available on YouTube:

<http://www.youtube.com/user/TheQubitLab/videos/>

QUIE²T is also in constant contact with the producers of the documentary movie that was initiated by the predecessor program QUROPE, with the aim to input on current status of the science and explore venues of improvement. The production company that was in charge of the movie had experienced substantial difficulties during the financial crisis of the last two

¹⁵ <http://www.fet11.eu/>

years and was forced into bankruptcy in Feb. 2011. However, all obligations, liabilities and contracts were transferred to a new production company, with the same person in charge, so that the project schedule has not been changed (in contrast to the working title that is now 'Taming the Quantum World'). The currently expected release date is November 2013. A detailed report and the current production schedule is submitted with Deliverable D3.4.4..

However, another teaser trailer has been produced (after the one that was presented at the QUROPE conference in Rome), and is available (though password protected) at <http://vimeo.com/28151262/>. It is used as a promotional item to further gain interest by potential funding partners.

Progress in Quantum Information Foundations and Technologies in Europe

Kamna Pruvost, Joshua Nunn

The European Coordination Action QUIE2T, supports research into Quantum Information Foundations and Technologies. We'll be at the *fet11* event in Budapest (<http://www.fet11.eu/>) showcasing our medium and long-term research in superfast quantum computing and ultra-secure quantum communications, including:

- Ion Trap Quantum Processors

The traps store individual ionised and laser-cooled quantum atoms which are used as quantum bits. We'll present three traps developed at Oxford using semiconductor micro-fabrication technology. There'll also be a rotating model of a single ion trap from Ulm University where people can start playing and experimenting with this hands-on device.

- Quantum memory

Oxford is developing a *quantum memory* which can store photons and then release them, a crucial technology for quantum computing with light. Our memory is very simple, consisting of a room-temperature glass cell filled with cesium vapour, and a laser. You'll be able to see the cell at the exhibit, and we'll explain how we stored short pulses of light just a fraction of a nanosecond long.

- Diamond qubits

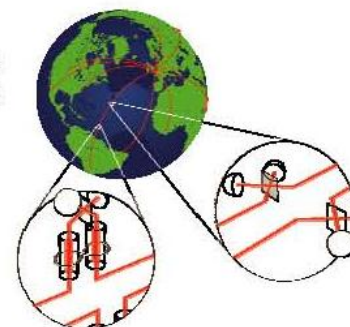
We all know diamond is an amazing material; it's even perfect for quantum computing! Qubits embedded in diamond are protected from noise, allowing operation in ambient conditions. These qubits are also the world's smallest magnetic sensors. Along with the University of Stuttgart we will showcase a millimetre-sized device with millions of these tiny sensors.

- QKD

We'll showcase the latest developments in *quantum key distribution* – which allows guaranteed-secure quantum communication – from Swiss firm IDQUANTIQ, including a demonstration of six encrypted links at Siemens in the Netherlands.

- Quantum random number generators

These devices exploit the fundamental randomness of quantum physics to output random numbers for cryptography, gaming and research. A "Quantum Roulette" will allow visitors to play to win prizes!



Quantum networks could span the globe providing ultrasecure telecoms

Figure 2 Project flyer presented at *fet11*.

Task 3.5 Traveling professor ‘Quantum Envoy’

This task is concerned with a rather concrete kind of dissemination activity. The idea is to organize and support a travelling professor, i.e. a prominent scientist who, during a limited period of time, travels to various locations throughout Europe, and presents general aspects of QIPC in public lectures or presentations. The targeted audience for these lectures is the general public and interested newcomers, e.g. university and high school students.

A call for applications has been published on the QUIE²T web site at

<http://qurope.eu/quie2t/calls/quantum-envoy/>

The call has also been broadcast several times to the QUROPE mailing list, however so far only one application has been received. There were concrete talks and email exchanges on two occasions: one for a public lecture tour in Europe by Hans Bachor, the other for a public lecture of Ignacio Cirac in Vienna. On both occasions, sufficient funds were available from original sources so no support from QUIE²T was needed. The lesson we learned from these exchanges is that one needs not only a speaker and a program, but also an infrastructure to publicise the event to a broad target audience. One possibility that seems most promising in this regard is to organize some public lectures during our own big QIPC conference, which already happened once with a very successful public evening at the QIPC07 conference in Barcelona. The possibility was discussed for the QIPC conference in Zurich but did not materialize because of schedule constraints. It will be pushed again for the agenda of the second conference to be organized next year.

The only application received this year has been approved by the QUIE²T Steering Committee, so the following event will be supported by QUIE²T next year:

- The application came from Profs. M. Leduc, H. Perrin and P. Grangier who are currently organizing the 23rd International Conference on Atomic Physics (ICAP 2012), to be held at Ecole Polytechnique in Palaiseau, France from July 23rd to 27th, 2012. A web site is available at <http://www-lpl.univ-paris13.fr/ICAP2012/>.

On this occasion, it was decided to organize a round table between several Nobel Prize winners who will be present at the conference: Bill Phillips, Claude Cohen-Tannoudji, Wolfgang Ketterle, Ted Hänsch, John Hall, and Roy Glauber. The general theme is the birth of cold atoms physics, in which all participants have played a major role.

Given the major role of atoms and ions cooling and trapping in the current developments of Quantum Information Science, and also of the major role of quantum optics, founded by Roy Glauber, for Quantum Communications, QUIE²T was asked for a support of 6000 Euros, devoted to the organization of the Round Table.

The support of QUIE²T will be acknowledged on the program and during the event, and QUIE²T will be included in the official list of sponsors. Quantum Information Science will be strongly represented at the Conference, both in the Program Committee and the sessions on Quantum Information and Quantum Simulations. The Round Table is part of a special evening that will be open to attendance by people not

registered at the conference, in line with the QUIE²T objective of broad dissemination. The preliminary expected attendance of the event is between 750 and 800 participants.

As a preview, we are in the process of planning a Quantum Envoy event at Oxford in the final period. Some 3 to 6 'Quantum Lectures' from top scientists in the field, and targeted at non-specialist audiences including aspiring young students, will be held. In addition new video clips to popularise and make accessible some complex science issues, are being planned.

Task 3.6 Scientific Exchange and Learning Center

A preliminary infrastructure for an interactive learning center has been set up at the QUIE²T web site: <http://qurope.eu/qipc/> with a collection of on-line background and learning material at <http://qurope.eu/qipc/basics/>. However, it is currently still lacking significant content, even though the procedure is straightforward and the threshold for participating is low. Currently it contains a small collection of web links and movies. Some content harvesting has been planned with the Quantiki web site¹, were similar efforts were put into place.

Statement on the use of resources for WP3

- **IPSAS:** 3 person months (coordination activity) consistent with the initial work plan (10 person months over the duration of the whole project, of which 4 declared in the project first year). Contributed to tasks T3.2 (Development and maintenance of a comprehensive web portal), T3.3 (Maintenance and update of existing QUROPE databases), T3.5 (Traveling professor 'Quantum Envoy') and T3.6 (Scientific Exchange and Learning Center), and to deliverables D3.2.3 (Mid-term web site update with integration of new features), D3.4.4 (Report on the documentary movie production and final presentation), D3.5.2 (Report on the second year Quantum Envoy activities) and D3.6.2 (Database of introductory and overview material).
- **FBK-ECT*:** 0.76 person months (coordination activity) consistent with the initial work plan (8 person months over the duration of the whole project, of which 2.26 were declared in the first year). However notice that 1.5 person month have been redirected to WP2. Contributed to tasks T3.2 (Development and maintenance of a comprehensive web portal) and T3.3 (Maintenance and update of existing QUROPE databases).
- **UOXF.DU:** 2.4 person months (coordination activity) consistent with the initial work plan (6 person months over the duration of the whole project, of which 1.2 were declared in the first year). Contributed to task T3.4 (Information and promotion material), and to deliverable D3.4.4 (Report on the documentary movie production and final presentation).

No other major cost items occurred in WP3 during this reporting period.

Work Package 4: Synergy for QIPC science

The objectives of WP4 as spelled out in the description of work are:

- The coordination and organization of scientific meetings;
- Providing stimulation for scientific exchange across sub-fields, generations and disciplines;
- Providing incentives for young researchers.

The work towards these objectives is organized in two tasks, with this year's highlight being the big QIPC conference that was organized in Zurich.

Task 4.1 Organization and support of International Conferences and Meetings

In 2011, one of the two big international conferences initiated by QUIE²T was organized. WP 4's responsibilities in terms of the tasks related to the organization of scientific meetings were:

- a) To publish a call for proposals on the project web site and to broadcast it to the community;
- b) To evaluate the received proposals;
- c) To provide logistic support for the local organizers during the preparation of the event;
- d) To collect the material for the event and draft a report.

Points a) and b) were already completed during reporting period 1, the QIPC 2011 Conference¹⁶ was held at ETH Zürich from September 5 - 9, 2011. The conference program included 32 invited talks, 70 contributed talks and more than 100 poster presentations covering a broad range of topics.

Regarding point c), the QUIE²T coordinator and the WP4 work package leader held constant contact with the local organizers to ensure the conference would meet the expectations and high standards of the previous meetings. In particular, the Advisory Board of Experts and the Virtual Institute directors were consulted for input to the conference program, invited speakers and session topics, so as to guarantee the widest possible scope and coverage of scientific fields.

¹⁶ <http://www.qipc2011.ethz.ch/>

For point d), a preliminary report was assembled right after the conference that was used by the local organizers as a basis for their final report on the event. This report is available at the QUIE²T web site¹⁷, while the final report, including a detailed budget overview, is attached to this document.

Apart from the scientific program, some extra-scientific events were organized, specifically under the auspices of QUIE²T:

- **Industry Session**

After the successful Industry Sessions held at the previous QIPC meetings in Barcelona'07 and Rome'09, this event again offered a platform for exchanges between academic researchers and industry leaders. The session was opened by QUIE²T work package leader Tommaso Calarco, who briefly explained the aim and the history of the activity, and hosted by QUIE²T work package leader Nicolas Gisin, who further explained the new format of having representatives from industry and academic research in the session.

This year, there were presentations by Dr. Bruno Michel, from IBM Research, Zürich, Dr. Grégoire Ribordy, CEO of ID Quantique, Dr. Jürgen Appel from the Niels Bohr Institute in Copenhagen, and Dr. Bruno Sanguinetti from the Group of Applied Physics in Geneva. The event was well attended and sparked a number of interesting questions and lively discussions. At the end IBM announced they will organize a workshop in 2012 with invited scientists and EU representatives to assess the potential of quantum technologies (contact Dr. Walter Riess, IBM Rüschlikon).

ID Quantique had a stand at the conference, showcasing some of their commercial products, like for instance QUANTIS (a true random-number generator) and CLAVIS2 (a QKD research platform).

- **QIPC Young Investigator Award ceremony**

This is described in Task 4.2 just below.

- **EU funding note**

The EU funding session was covered by two distinct events: the first was held on Wednesday morning, with key speakers Werner Steinhögl from the European Commission, and Dirk Holste from the ESF project FARQUEST. A complementary second session was held on Wednesday after lunch, which provided opportunity for more specific questions.

The morning session included talks by W. Steinhögl on '*QI Science & Technology in the European FET programme*' and Dirk Holste who presented the '*ESF Forward Look FARQUEST*'. The lunch session started with a contribution by Ales Fiala, the FET Open Head of Unit, on '*Quantum Information science in the Open scheme of FET*'. This was followed by a more detailed outline by W. Steinhögl on the upcoming

¹⁷ <http://gurope.eu/content/qipc-2011-conference-report/>

calls and funding opportunities. Both sessions were well attended and raised a number of questions and remarks by interested participants.

- **Rump session**

For the first time in the series, QIPC 2011 featured a so-called 'Rump Session'. In this informal session participants gave short presentations on recent results, work in progress, and other topics of interest to the QIPC community. The open microphone session stimulated a discussion of the future of quantum information processing and communication.

The session was open to all participants of the conference and guests. The event was a great success with contributions on a variety of different topics that incited some heated discussions.

In summary, the QIPC 2011 conference in Zürich continued the highly successful series of conferences that were initiated by the FP6 Coordination Action program QUROPE, and therefore assured a continuous coverage of major QIPC events in Europe every two years. The international QIPC are generally considered to be the yearly key event of the QIPC community in Europe and this status was clearly upheld by this year's conference in Zürich. The community presented itself in a very vigorous and scientifically proliferate state. The number of participants has increased compared to the earlier events with 14 prominent overseas speakers who accepted the invitation to come to Zürich. The number of attendees, the wide variety of topics and activities, as well as a high proportion of young researchers among the participants testifies to the fact that QIPC research in Europe is well on par and highly competitive with comparable activities elsewhere in the world.

Task 4.2 QIPC Young Investigator Award

In order to provide some incentive and reward for excellent young researchers in the field of QIPC, the 'QIPC Young Investigator Award' was established by the predecessor program QUROPE and proved to be successful in bringing public visibility and recognition to young researchers.

The prize is awarded to a researcher under the age of 35 for the best research recently published or presented at a major conference.

Already during the first reporting period, the leader of WP 4 had prepared the call for nominations including fair and transparent evaluation criteria. It has been validated by the project consortium and was published on the QUIE²T web site. A total of five nominations were received within the deadline. The nominations were first screened by the QUIE²T coordinator and the WP4 work package leader. After establishing the eligibility of the nominations, they were forwarded to the QUIE²T External Advisory Board of Experts who held a vote and issued a recommendation. This recommendation was then approved by the QUIE²T steering committee.

The 2011 European Quantum Information Young Investigator Award has been awarded jointly to

Dr. Ronald Hanson

"For his experimental work on the coherent control and measurements of single spins in solids, and his proven leadership and independence through the successful establishment of his own research group."

and to

Dr. Stefano Pironio

"For his theoretical contributions to the study of quantum correlations and quantum communications, concerning in particular device-independent quantum cryptography."

The prize was awarded during the QIPC 2011 conference in Zürich in Sep. 2011. The award ceremony was hosted by QUIE²T work package leader Prof. Nicolas Gisin, who briefly introduced the two awardees, and presented them with their diplomas. This was followed by a short presentation of the work of the two prize winners.



Figure 3 From left to right: L. Theussl, N. Gisin, R. Hanson, S. Pironio, A. Wallraff.

Statement on the use of resources for WP4

- **IPSAS:** 4 person months (coordination activity) consistent with the initial work plan (10 person months over the duration of the whole project, of which 4 declared in the project first year). Contributed to tasks T4.1 (Organization and support of International Conferences and Meetings), and T4.2 (QIPC Young Investigator Award).
- **IOTA:** 3 person months (coordination activity) consistent with the initial work plan (9 person months over the duration of the whole project, of which 3 were declared in the first year). Contributed to tasks T4.1 (Organization and support of International Conferences and Meetings), and T4.2 (QIPC Young Investigator Award).

The only other major cost item occurred in WP4 during this reporting period was the prize money for the Young Investigator Award that amounted to 4000 EUR.

Work Package 5: Project management

Work package 5 ensures the administrative coordination and management of the project. The following consortium management tasks were carried out during the reporting period.

Distribution of the Community Financial Contribution

The amount of EUR 219.814,00 was received as the second-year payment on 27.5.2011. From this amount, the following shares were distributed from the coordinator to the partners:

- P2 (UULM): EUR 15.000,00
- P3 (FBK-ECT*): EUR 25.000,00
- P4 (IOTA): EUR 20.000,00
- P5 (UNIGE): EUR 15.000,00
- P6 (UOXF.DU): EUR 15.000,00

The remaining amount of EUR 129.814,00 was kept by the coordinator.

Budget Re-Allocation

A budget re-allocation was agreed upon by partners P1 (IPSAS) and P6 (UOXF.DU) whereas a sum of EUR 10.000,00 is transferred from the total budget of IPSAS to the budget of UOXF.DU. The transferred amount is reserved to cover various costs related to the dissemination activities and publications. No actual money transfer was effectuated; the change in budget will be taken into account at the final distribution of the community contribution.

Change of Project Officer

On 7.12.2011 Mr. David Guedj replaced Mr. Werner Steinhögl as the Project Officer responsible for monitoring the QUIE²T project. The information was distributed to all project partners.

Development of the project web site

The work to develop and maintain the project web site has been monitored by the coordinator. This is covered in detail in the description of WP3.

Annual project review and reports

The first annual review of the QUIE²T project was organized on Tuesday, 3rd of May 2011 in Bratislava. The local organization was secured by WP5, which included technical support and catering, as well as lodging for the participants. The overall progress of the project was certified to be good, with most of its objectives and technical goals achieved. Before that, the First Activity Report was assembled and written by WP5.

Project extension

It is planned to apply for a 6 months no-cost project extension in order to be able to organize the second QIPC conference in April/May 2013.

List of project meetings, dates and venues

- First QUIE²T review, Bratislava, May 3rd, 2011. Present QUIE²T members: D. Binosi, V. Buzek, P. Grangier, K. Pruvost, L. Theussl, R. Thew and C. Zeques.
- FET QIFT Open Day / Cluster Review, University of Warsaw, April 14-15, 2011. Present QUIE²T members: D. Binosi, T. Calarco, L. Theussl, R. Thew and I. Walmsley.
- QIPC2011, ETH Zurich, September 5-9, 2011. Present QUIE²T members: T. Calarco, N. Gisin, L. Theussl, R. Thew and I. Walmsley.

Project presentations

QUIE²T coordinator Vladimir Buzek was selected to share his experiences about running a CA at the FET Proactive Information Day - FP7-Call-9. The Information day took place on 18 Jan 2012 in Brussels and was attended by some ~250 people. The slides of the presentation are available for download at the Info Day Agenda web site¹⁸.

Statement on the use of resources for WP5

- **IPSAS:** 2 person months (management activity) consistent with the initial work plan (6 person months over the duration of the whole project, of which 2 declared in the project first year). Contributed to tasks T5.1 (Overall Management), and to deliverable D5.1.3 (Second Year Activity Report).

No other major cost items occurred in WP5 during this reporting period.

¹⁸ http://cordis.europa.eu/fp7/ict/fet-proactive/ie-jan12-ag_en.html