Lisbon Training Workshop on Quantum Technologies in Space

Summary:

The training workshop took place at the Instituto Superior Técnico (IST) in Lisbon from September 11th to 14th, 2017. The local organizers were Yasser Omar (Instituto de Telecomunicações & Instituto Superior Técnico, ULisbon), Jose Manuel Leitao (Instituto de Telecomunicações) and Fatima Barata (Instituto de Telecomunicações & Instituto Superior Técnico, ULisbon). During the event, before and afterwards, the overall organization also included Rainer Kaltenbaek (University of Vienna) and Eamonn Murphy (European Space Agency).

The event was divided into two separate COST events, a training school during the four morning sessions, covering topics from all four working groups (WGs), and a workshop during the afternoon sessions comprising a scientific workshop during the first three afternoons, and on the last afternoon there was a special event focused on working group 2 (WG2, Applications of quantum technologies in space) and a meeting of the management committee (MC).

Statistics:

During the morning sessions we had overall 149 signatures, during the afternoon sessions we had overall 162 signatures. However, one should ideally take into account that essentially all participants in the morning sessions also took part in the afternoon sessions and vice versa. Some participants in the morning and afternoon sessions with their names not on the respective lists added their names per hand. Of the participants, we collected signatures from 5 female and 33 male Early Career Investigators (ECIs) in the morning sessions (+ signatures of 3 male ECIs added by hand). In the afternoon, we collected signatures from 3 female and 8 male ECIs (+ signatures of 2 male ECIs added by hand).

SOME MORE STATISTICS

Program:

Monday, September 11th	
08:30 – 09:00	Registration
09:00 – 10:00	Tutorial on Quantum Communication in Space I/II, Christoph Marquardt, Max Planck Institute, Erlangen
10:00 – 11:00	Tutorial on Quantum-enhanced measurements I/II, Antoine Heidmann, Laboratoire Kastler Brossel, Paris
11:00 – 11:30	Coffee break
11:30 – 12:30	Hands-on Mission Analysis Aspects, Florian Renk, European Space Operations Center, Darmstadt
12:30 – 14:00	Lunch
14:00 – 14:30	The Quest for Quantum Projects in Space, Diego Pozo-Morillas, Airbus D & S, Toulouse
14:30 – 15:00	BEC interferometry in µg, Naceur Gaaloul, Leibniz University Hannover
15:00 – 15:30	Testing gravity with atomic sensors on ground and in space, Guglielmo Tino, University of Florence
15:30 – 16:00	Coffee break

16:00 – 16:30	Optical Communications at ESA, Zoran Sodnik, European Space Agency
16:30 – 16:40	Optical Communications in Space, Paolo Villoresi, University of Padova
16:40 – 17:30	Panel Discussion, Quantum Technologies in Space, Chair: Christoph Marquardt, Panel participants: Alexander Koujelev (CSA), Heike Poignand (SES), Manuel Rodrigues (ONERA), Zornan Sodnik (ESA)
17:30 – 18:00	Coffee break
18:00 – 20:00	Poster session and exhibition
Tuesday, September 12th	
09:00 – 10:00	A Fundamental Science Space Mission – LISA Pathfinder and the LTP Experiment, Rüdiger Gerndt, Airbus D & S, Friedrichshafen
10:00 – 11:00	Tutorial on Quantum-enhanced measurements II/II, Antoine Heidmann, Laboratoire Kastler Brossel, Paris
11:00 – 11:30	Coffee break
11:30 – 12:30	Hands-on Bose-Einstein Condensates for Space, Stephan Seidel, Leibniz University Hannover
12:30 – 14:00	Lunch
14:00 – 14:30	Design considerations of a satellite quantum communication payload, Matthias Fink, Institute for Quantum Optics and Quantum Information Vienna
14:30 – 15:00	Satellite-based quantum communication, Jean-Philippe Bourgoin, Institute for Quantum Computing, Waterloo
15:00 – 16:00	Panel Discussion, Quantum Communication, Chair: Yasser Omar, Panel participants: Philippe Bourgoin (IQC), Matthias Fink (IQOQI Vienna), Bettina Heim (OHB), Imran Khan (Max Planck Institute Erlangen)
19:00 – 22:00	Conference Dinner
Wednesday, September 13th	
09:00 – 10:00	Implementation and Results of a Large Science Space Mission – Rosetta Mission, Rüdiger Gerndt, Airbus D & S, Friedrichshafen
10:00 – 11:00	Tutorial on Quantum Communication in Space II/II, Christoph Marquardt, Max Planck Institute, Erlangen
11:00 – 11:30	Coffee break
11:30 – 12:30	Hands-on Optical Trapping, James Millen, University of Vienna
12:30 – 14:00	Lunch
14:00 – 14:30	Testing quantum technology on a cube satellite, Harald Weinfurter, Ludwig-Maximilan University, Munich
14:30 – 15:00	MAQRO & New Science Ideas, James Bateman, Swansea University
15:00 – 15:30	Space test of Newtonian self-gravitation, André Großardt, Queen's University Belfast
15:30 – 16:00	Coffee break
16:00 – 16:30	Searches for dark matter using cold atoms on ground and in space, Peter Wolf, Systèmes de Référence Temps-Espace, Paris
16:30 – 17:30	Panel Discussion, ESA's New Science Ideas, Chair: Mike Cruise, Panel participants: Bob Dirks (TNO), André Großardt (Queen's Univ. Belfast), Rainer Kaltenbaek (Univ. Vienna), Peter Wolf (SYRTE, Paris)
17:30 – 18:00	Coffee break
18:00 – 19:00	Evening Talk: Tests of quantum mechanics and gravitation with atom interferometry, Mark Kasevich, Stanford University
Thursday, September 14th	
09:00 – 09:30	Platforms for Quantum Technologies in Space, Mike Cruise, University of Birmingham
09:30 – 10:00	Controlling nanoparticles in vacuum, James Millen, University of Vienna
10:00 – 10:30	QuSpace: Quantum opto-mechanics in Space, Bob Dirks, TNO

10:30 – 11:00	Technology developments in ground based astronomy with potential interest to space science mission, Gerald Hechenblaikner, European Southern Observatory
11:00 – 11:30	Coffee break
11:30 – 12:00	Satellite-based QKD activities at TNO/QuTech, Clara Osorio Tamayo, TNO
12:00 – 12:30	Talk by the winner of the poster prize, Kevin Günthner, Max Planck Institute, Erlangen
12:30 – 14:00	Lunch
14:00 – 14:30	The Case for QT in Space, Paolo Bianco, Airbus D & S, Portsmouth
14:30 – 15:00	Laser Communication Terminals as crucial building blocks for QKD from Satellite to Ground, Herwig Zech, Tesat
15:00 – 15:30	Coffee break
15:30 – 16:30	Panel Discussion, Working Group 2, Chair: Rainer Kaltenbaek, Panel participants: Paolo Banco (Airbus D & S), Christoph Marquardt (Max Planck Institute, Erlangen), Herwig Zech (Tesat)
16:30 – 17:00	Coffee break
17:00 – 19:00	Management Committee Meeting

Description:

The goal was for young scientists but also for experienced scientists and engineers from the fields of quantum physics, space industry and space agencies to get an overview of fields lying outside their normal fields of expertise. For example, several of the morning tutorials as well as the hands-on sessions aimed at making scientists from the field of quantum physics acquainted with aspects of mission planning, satellite orbit control and satellite communication. In addition, the tutorials on quantum communication and quantum-enhanced measurements aimed at making the audience acquainted with the fundamentals of the respective fields of quantum physics and quantum optics. The summer school as well as the afternoon workshop covered all four WGs. For the morning sessions, the tutorials and the training sessions were chosen in order to address aspects of all four WGs. In particilar we had tutors from all WGs.

The afternoon sessions aimed at giving an overview of current developments in the scientific community, space industry and space agencies (European, Canadian and American) with respect to quantum technologies. The invited talks as well as the panel sessions, the poster session and the evening talk were chosen to address topics and aspects of all four WGs. The talks on Thursday afternoon and the panel discussion on Thursday were aimed specifically at WG2 but still with topics of interest to all four WGs.

A central goal of the training school was also to further interaction between established scientists and young scientists, between big space industry and start-ups as well as between space agencies and the scientific community. Part of that agenda was to be fulfilled by simultaneously having morning training sessions and afternoon scientific sessions where participants of both events were encouraged to participate in morning and afternoon sessions. In particular because quantum technologies in space are a relatively new field, the goal was to establish contacts between all stake holders involved, also in order to make them acquainted with the different vocabulary and approaches.

Discussion & Conclusions:

The Training Workshop was a success in many respects, but it also showed potential for improvement for future events to be organized in the course of the present COST action QTSpace. One particular issue was that the fact that we had two separate events for the morning and

afternoon led to the sub-optimal situation that people were expected to and did actually participate in both sessions but the signature lists for the morning and afternoon events only contained the names of the trainees for the morning session and only of speakers and some other participants for the afternoon sessions. For example, the names of the trainees were not on the signature lists for the afternoon sessions, and the names of the organizers only appeared on the lists for the afternoon sessions.

One issue was that the hands-on training sessions were, in part, not very hands on but more lecture style. We hope that the experience gathered in the Lisbon Training School will help in the organization of future events organized in the course of the QTSpace COST action.

Another noteworthy issue was that especially people from the space community (industry and agencies) would have liked there to be even more introductory lectures on topics in quantum physics (quantum communication and quantum-enhanced measurements). Still, we think that it was important mostly for stake holders in the scientific community to come to grasps with topics familiar to people from the space community.

Especially since this was the first summer school in the course of QTSpace, we find that the event was a huge success, and the organizers got very positive feedback from all participants.