NEWSLETTER N.8, March 2020

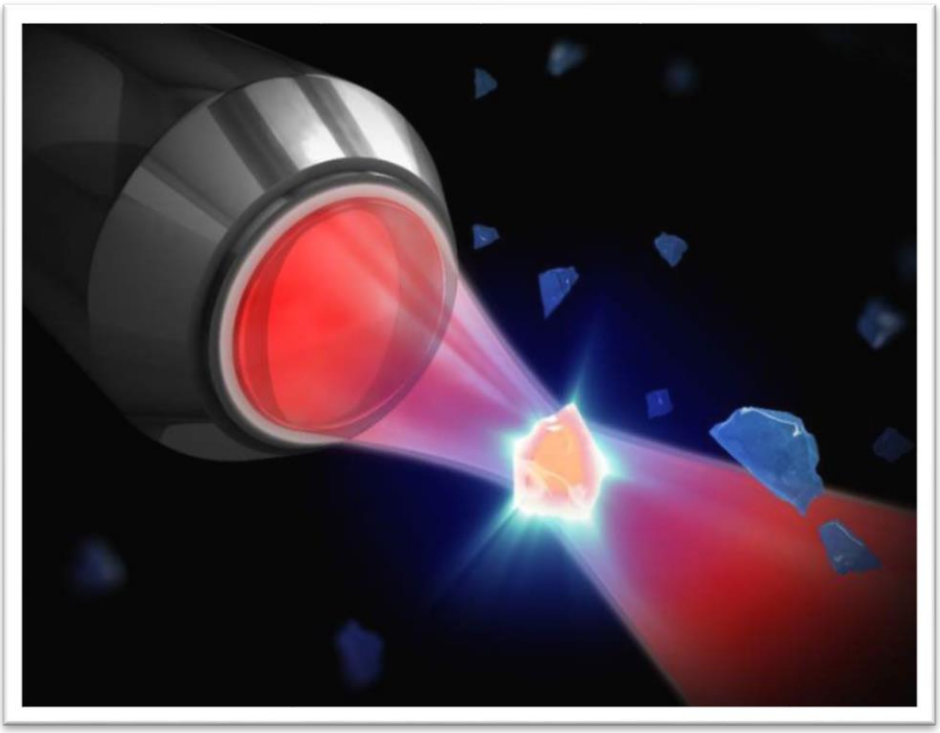

Image of the article on the Smithsonian Magazine (February 5, 2020) describing the TEQ experiment. *Credits: UCL*

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UPDATES OF WORK DONE

"The Quantum and the cosmos" Workshop

Research in quantum foundations is exploring new and previously unexpected directions, but not all of them are easy to assess empirically. The universe offers new possibilities to test quantum theory outside the lab and to explore the possible quantum nature of gravity. The workshop "The Quantum and the cosmos" has been organized to bring together experts in quantum mechanics, cosmology and quantum gravity, to discuss questions like: Does gravity need to be quantum? What are the possible routes to quantum gravity? What are the possible quantum effects in cosmology? Does quantum gravity eliminate space-time singularities like a big bang? Is space-time relational? Can alternatives to quantum mechanics be tested by cosmological observations?

In compliance with the principle of synergy among European grants and programs, the workshop is organized in collaboration with the COST Action QTSpace.

Program Committee:
Angelo Bassi (University of Trieste - INFN)
Ward Struyve (Katholieke Universiteit Leuven)

Local Organizers:
Matteo Carlesso (University of Trieste - INFN)
Luca Ferialdi (University of Trieste - INFN)

A total of 100 participants registered before the deadline filling up all available places and confirming the growing interest in such topic. A waiting list had to be put in place for aspiring participants.

Speakers were selected among the most prominent scientists in Europe and internationally. In particular, we were honored to have among the speakers Prof. Sir Roger Penrose from Oxford University.

Here below the list of invited speakers:

Giovanni Amelino-Camelia (University of Naples, Italy)
Markus Aspelmeyer (University of Vienna, Italy)
Julian Barbour (University of Oxford, UK)
Sougato Bose (University College London, UK)
Mariam Bouhmadi Lopez (university of the Basque Countrby, Spain)
Caslav Brukner (University of Vienna and IQOQI Vienna, Austria)
Thibault Demaerel (Katholiekie Universiteit Leuven, Belgium)
Lajosi Diosi (Wigner Research Centre for Physics, Hungary)
Sandro Donadi (Frankfurt Institute for Advanced Studies, Germany)
Domenico Giulini (University of Hannover, Germany)
Henrique Gomes (Cambridge University, UK)
Adrian Kent (Cambridge University, UK)
Claus Kiefer (Institute for Theoretical Physics Cologne, Germany)

Tim Koslowski (university of Würzburg, Germany)
Jean-Luc Lehners (Max-Plank-Institute for Gravitational Physics, Potsdam, Germany)
Stefano Liberati (SISSA, Italy)
Renate Loll (Radboud University Nijmegen, Netherlands)
Christian Maes (Katholiekie Universiteit Leuven, Belgium)
Jerome Martin (Institute d'Astrophysique de Paris, France)
Mercedes Martin-Benito (Complutense University of Madrid, Spain)
Flavio Mercati (University of Napoles, Italy)
Daniele Oriti (Ludwig Maximilian University Munich, Germany)
Mauro Paternostro (Queen's University Belfast, UK)
Tomasz Pawlowski (University of Wrocław, Poland)
Roger Penrose (Oxford University, UK)
Alejandro Perez (Centre de Physique Theorique Marseille, France)
Patrick Peter (Institute d'Astrophysique de Paris, France)
Tejinder P. Singh (Tata Institute of Fundamental Research, India)
Antoine Tilloy (Max-Planck Institute of Quantum Optics, Germany)
Hendrik Ulbricht (University of Southampton, UK)
Nino Zanghì (University of Genoa, Italy)

The workshop was planned for 23 to 26 March 2020 in Trieste but will be postponed to 2021 due to the Coronavirus outbreak in Northern Italy.

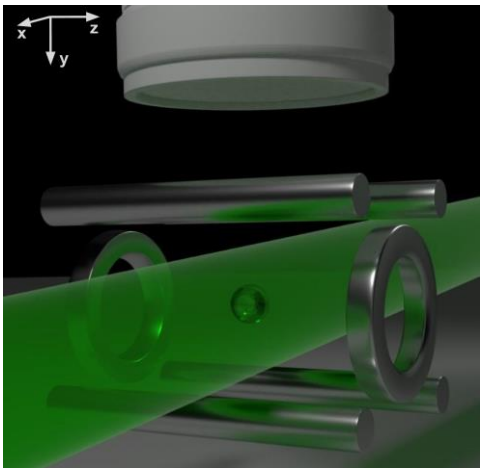
TEQ meeting in Southampton

On March 13, 2020, experimentalists of TEQ Consortium held a meeting hosted by the University of Southampton to discuss updates on the experimental side of the project. The partner also discussed the forthcoming deliverables D 2.2 and D 3.2 due March 31 and April 30. Respective WP leaders presented draft reports and fed the documents with comments and notes from the participants. In compliance with the public health measures to limit the coronavirus diffusion, the meeting has been held in remote mode.

Participants:
UCL: Peter Barker, Antonio Pontin
AU: Michael Drewsen
Southampton: Andrea Vinante, Hendrik Ulbricht
INFN: Massimiliano Bazzi, Catalina Curceanu
TUD: Liberato Manna, Arjan Houtepen

Agenda

9:30 - 10:00	Update on ongoing experiment: - Nanocrystal synthesis and trapping - Particle trapping and cooling - Electronics - Cryostat experiment at Soton
10:00 - 10:30	Discussion about achievements on deliverables and milestones in this RP
10:30 - 11:00	Discussion on next steps on the realisation of the TEQ experiment testing CSL



A schematic diagram of the trap illuminated by a laser and detection. Credits: Hendrik Ulbricht (University of Southampton, UK).

TEQ Steering Committee in Aarhus

The next TEQ Steering Committee Meeting was organized to be held on May 4th and 5th 2020, at Aarhus University. On the first day, space was to be given to young members of the Consortium to present the results for their research and to further discuss the progresses of the TEQ experiments and theory. This should have given fuel for discussion of the progresses of the TEQ research among all the participants. The second day was going to be dedicated to management issues in view of the project second reporting period.

Agenda

May 4th, 2020	May 5th, 2020
09:15 - 09:30 Welcome and introduction 09:30 – 10:00 Talk 1 + discussion 10:00 - 10:30 Talk 2 + discussion 10:30 - 11:00 Coffee break 11:00 - 11:30 Talk 3 + discussion 11:30 – 12:00 Talk 4 + discussion 12:00 - 12:30 Talk 5 + discussion 12:30 – 14:00 Lunch 14:00 - 14:30 Talk 6 + discussion 14:30 - 15:00 Talk 7 + discussion 15:00 - 15:30 Coffee break 15:30 – 16:00 Talk 8 + discussion 16:00 – 16:30 General discussion 16:30 - 18:00 Innovation Opportunity Workshop 19:00 - Social Dinner	09:00 - 10:30 Steering Committee Meeting 10:30 - 11:00 Coffee break 11:00 - 12:00 Steering Committee Meeting 12:00 - 13:00 Lab tour 13:00 – 14:00 Lunch **Participants** TBA

The Innovation Opportunity Workshop was going to be led by a group researchers of the FET BRIEFING, an EU-funded project that provides guidance from the early to the later stages of the innovation process, by fostering connections with business stakeholders.

The meeting had to be cancelled due to the Coronavirus outbreak in Europe. It was decided to hold remote meetings in case specific issues have to be discussed in the following weeks and months, before the end of Reporting Period II.

Quantum Café

A fourth edition of the Quantum Café has been organized to take place on March 1, 17 and 31. The program offered three evenings of science popularization combined with theatrical readings and live music.
Here below the program in the leaflet:

The Quantum Café had to be postponed to the fall 2020 due to the Coronavirus outbreak in Northern Italy.

PUBLICATIONS

(for more info, please go to www.tequantum.eu → 'Publications')

Here below, the last period's publications (some were published in 2019 but were not included in the TEQ Newsletter #7):

Authors	Title	Journal	Volume	Pages	Year
Marchese, Marta, Hannah McAleese, Angelo Bassi, and Mauro Paternostro	A macrorealistic test in hybrid quantum optomechanics	Journal of Physics B: Atomic, Molecular and Optical Physics	53.7		2020
Piscicchia, K. et al.	Testing the Pauli Exclusion Principle in the Cosmic Silence	Acta Physica Polonica B	51.1		2020
Zheng, Di, Yingchun Leng, Xi Kong, Rui Li, Zizhe Wang, Xiaohui Luo, Jie Zhao, Chang-Kui Duan, Pu Huang, Jiangfeng Du, Matteo Carlesso, and Angelo Bassi	Room temperature test of the continuous spontaneous localization model using a levitated micro-oscillator	Physical Review Research	21.1	013057	2020
Giordani, T. et al.	Experimental Engineering of Arbitrary Qudit States with Discrete-Time Quantum Walks	Physical Review Letters	122.2	020503	2019
Marton, J. et al.	VIP2 in LNGS - Testing the Pauli Exclusion Principle for electrons with high sensitivity	Journal of Physics: Conference Series	1275		2019
Piscicchia, Kristian et al.	High Precision Test of the Pauli Exclusion Principle for Electrons	Condensed Matter	4.2		2019
Barontini, Giovanni, and Mauro Paternostro	Ultra-cold single-atom quantum heat engines	New Journal of Physics	21.6		2019
Brunelli, Matteo, and Oussama Houhou	Dissipative Synthesis of Mechanical Fock-Like States	Proceedings	12.1		2019

Barontini, Giovanni, and Mauro Paternostro	Ultra-cold single-atom quantum heat engines	New Journal of Physics	21.6		2019
Brunelli, Matteo, and Oussama Houhou	Dissipative Synthesis of Mechanical Fock-Like States	International Journal of Modern Physics D	*12*(1)		2019
Milazzo, Nadia, Salvatore Lorenzo, Mauro Paternostro, and Massimo G. Palma	Role of information backflow in the emergence of quantum Darwinism	Physical Review A	100.1	012101	2019
Bernards, Fabian, Matthias Kleinmann, Otfried Gühne, and Mauro Paternostro	Daemonic Ergotropy: Generalised Measurements and Multipartite Settings	Entropy	*21*(8)		2019
Bavaresco, Jessica, Mateus Araújo, Časlav Brukner, and Marco Túlio Quintino	Semi-device-independent certification of indefinite causal order	Quantum	3		2019
Zych, Magdalena, Fabio Costa, Igor Pikovski, and Časlav Brukner	Bell's theorem for temporal order	Nature Communications	10	3772	2019

DISSEMINATION ACTIVITIES

(for more info, please go to www.tequantum.eu → 'Dissemination')

Since the beginning of 2020, the dissemination activities held were a total of 17, addressing nearly 1150 people. Here below the details (speaker, title of the talk, title of the event, type of audience):

Catalina Oana Curceanu	Gli aromi del Modelo Standard. Dagli atomi ai quark	Koru Scienza, Koru Caffe	General public
Catalina Oana Curceanu	Uno, nessuno, centomila - quanti Universi esistono? La Fisica Moderna cerca le risposte	Seminar at Liceo Touschek	High school students
Angelo Bassi	Models of spontaneous wave function collapse	QSFP School	Physics community
Angelo Bassi	Spontaneous wave function collapse models: what they	Invited seminar	Physics community

	are and how they can be tested		
Caslav Brukner	Timeless formulation of Wigner's friend scenarios	The Quantum Information Structure of Spacetime Workshop	Academic and Students
Catalina Oana Curceanu	Sinfonia Celeste: Onde gravitazionali, buchi neri e stelle di neutro	talk at Biblioteca di Frascat	General public
Catalina Oana Curceanu	Da Dracula al gatto di Schroedinger. Ma che avventura la Fisica!	STEM event, Women and Girld in Science	High school students
Catalina Oana Curceanu	Din Romania la Frascati pe urmele misterelor cosmice!	Talk at Colegiul Cronos	High school students
Catalina Oana Curceanu	Dal bit al qubit: le meraviglie del mondo quantistico	Talk at Liceo Touschek	High school students
Catalina Oana Curceanu	, La fisica nucleare nell'interno stellare	ATA Star Academy	General public
Hendrik Ulbricht	Proof-of principle experiments for QT in space	QTSpace school	Researchers and students
Angelo Bassi	Recent results on gravitational decoherence and collapse	Photonics West 2020	Physics community
Angelo Bassi	Spooky Action at a distance	ICTP Winger College on Optics: Quantum Photonics and Information	Undergraduate and graduate students
Andrea Vinante	Ultralow damping with ferromagnetic microparticles levitated by Meissner effect	Micromechanics Conference Obergurgl	Academic
Alessio Belenchia	Entropy Production in Continuously Measured Quantum Systems	QQQ workshop	Researcher and academics
Matteo Carlesso	Rethinking it all	Winter College on Optics: Quantum Photonics and Information	Academic
Catalina Oana Curceanu	Babbo Natale a zonzo nell'Universo fra le stele e buchi neri	Seminar for children	Children

ANY OTHER RELEVANT INFORMATION

TEQ featured on the Smithsonian Magazine

Smithsonian
MAGAZINE

A New Experiment Hopes to Solve Quantum Mechanics' Biggest Mystery

Physicists will try to observe quantum properties of superposition—existing in two states at once—on a larger object than ever before

By **Ramin Skibba**
SMITHSONIANMAG.COM
FEBRUARY 5, 2020

On February 5, 2020 the Smithsonian Magazine published an article exclusively discussing the TEQ research and the potential it has to solve Quantum Mechanic's biggest mystery. Starting from explaining what Quantum mechanics has meant for Bohr and his followers, the author points out how for certain today's physicists the textbook version of quantum physics is no longer satisfactory and are trying to break boundaries. "A new experiment, known as the TEQ collaboration, could help reveal a boundary between the weird quantum world and the normal classical world", writes the author explaining how the TEQ experiment is actually built and will be implemented at labs of the University of Southampton and what are the theories behind it. Peter Barker and Matteo Carlesso from the TEQ Consortium gave meaningful contributions to the article.
To read the full article: https://www.smithsonianmag.com/science-nature/new-experiment-hopes-solve-quantum-mechanics-biggest-mystery-180974132/