



# Press Dossier

Quantum Flagship  
Kick-off Event



Vienna, October 29-30, 2018



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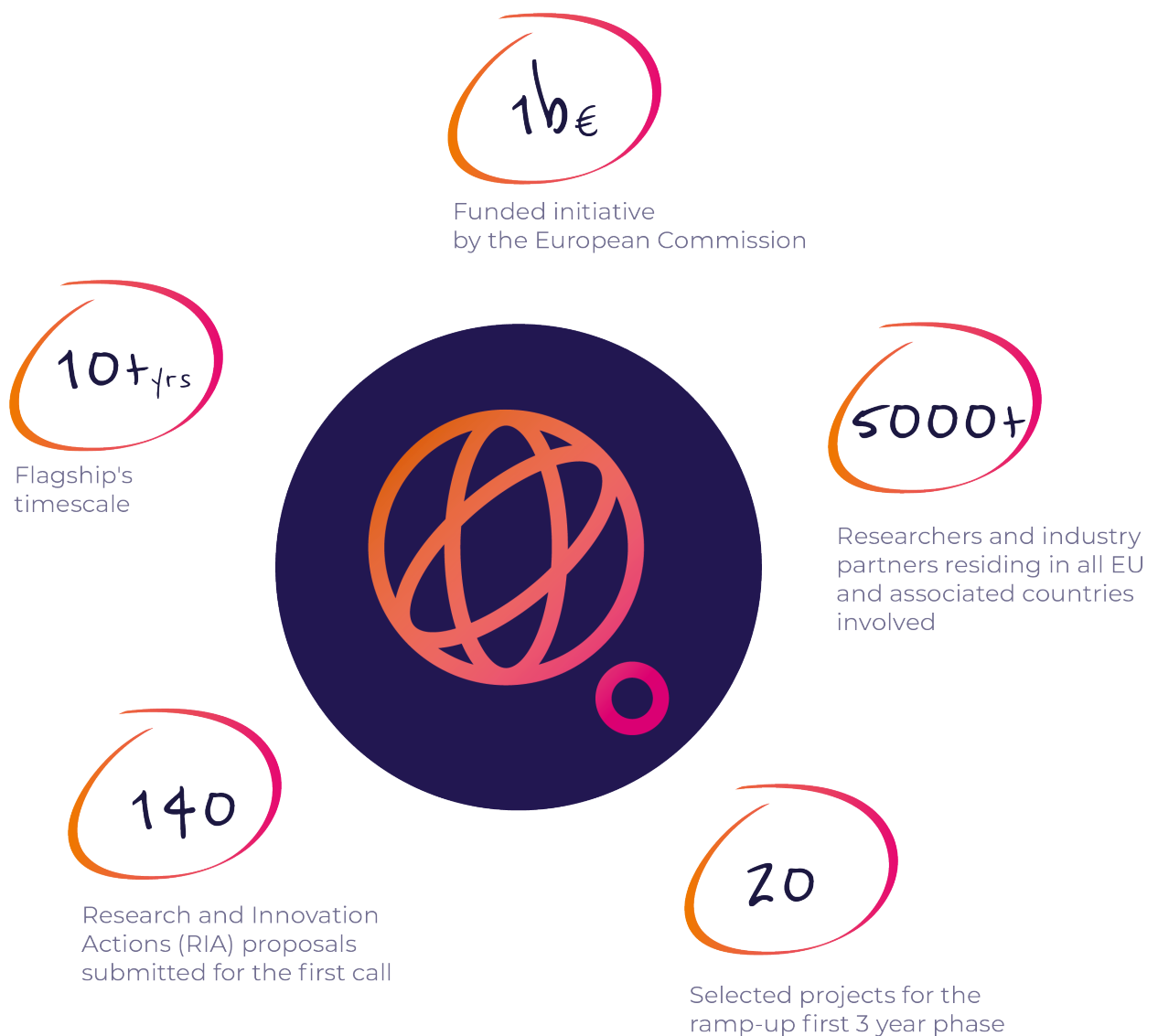


# The Quantum Flagship

The Quantum Flagship was launched in 2018 as one of the largest and most ambitious research initiatives of the European Union. With a budget of **€1 billion** and a duration of **10 years**, the flagship brings together research institutions, academia, industry, enterprises, and policy makers, in a joint and collaborative initiative on an unprecedented scale.

The main objective of the Flagship is to consolidate and expand European scientific leadership and excellence in this research

area as well as to transfer quantum physics research from the lab to the market by means of commercial applications and disruptive technologies. With over **5000 researchers** from academia and industry involved in this initiative throughout its lifetime, it aims to create the next generation of disruptive technologies that will impact Europe's society, placing the region as a worldwide knowledge-based industry and technological leader in this field.





# The Goals of the Quantum Flagship

In order to consolidate Europe as a leader in Quantum technologies, the goals of the flagship are the following:



Boost and drive a competitive European quantum industry to position Europe as a leader in the future global industrial landscape



Expand European scientific leadership and excellence in quantum research



Make Europe a dynamic and attractive region for innovative business and investments in quantum technologies



Benefit from advances in quantum technologies to provide better solutions to grand challenges in such fields as energy, health, security and the environment

## The Quantum Flagship's activities will be pursued by...

○ Creating a favourable ecosystem of innovation and business creation for quantum technologies.

○ Coordinating public investments and strategies in quantum technologies at the European level.

○ Creating a new generation of quantum technology professionals in Europe through focused education at the intersection of science, engineering and business, and by strengthening public awareness of key ideas and capabilities.

○ Facilitating a new level of coordination between academia and industry to move advances in quantum technologies from the laboratory to industry.

○ Supporting growth in scientific activities linked to quantum technologies.

○ Promoting the involvement of member regions that do not currently have a strong quantum technologies research programme.



# The Quantum Flagship Pillars

The **first quantum revolution** – understanding and applying physical laws in the microscopic realm – resulted in groundbreaking technologies such as the **transistor, solid-state lighting and lasers, and GPS.**

Today, our ability to use previously untapped quantum effects in customised systems and materials is paving the way for a **second revolution.**

With quantum theory now fully established, we are required to look at the world in a fundamentally new way: objects can be in different states at the same time (**superposition**) and can be deeply connected without any direct physical interaction (**entanglement**).

There are many transformative applications, varying from products with a relatively short time to market to **revolutionary new technologies** that may require more than a decade of research and development.

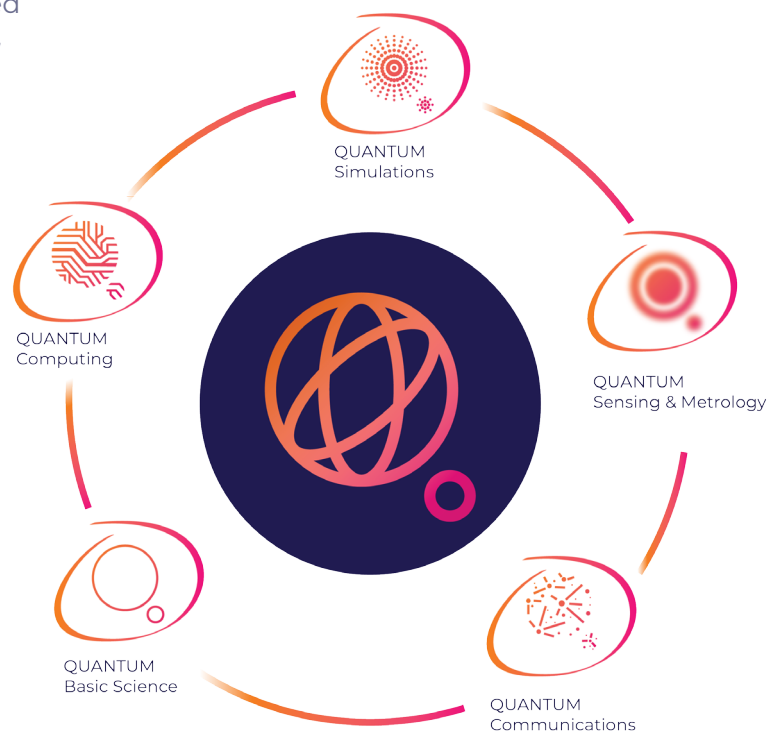
**Quantum computers** are expected to be able to solve, in a few minutes, problems that are unsolvable by the supercomputers of today and tomorrow. This, in turn, will seed breakthroughs in the design of chemical processes, new materials, such as higher temperature superconductors, and new paradigms in machine learning and artificial intelligence. Based on quantum coherence, data can be protected in a completely secure way that makes eavesdropping impossible. Given the explosive growth of cybercrime and espionage, this is a highly strategic capability.

**Quantum technologies** will also give rise to simulation techniques well beyond current capabilities for material and chemical synthesis, and to clocks and sensors with

unprecedented sensitivity and accuracy, with potential impact in navigation, the synchronisation of future smart networks and medical diagnostics.

The **developments** in the leading areas of quantum technologies can be expected to produce transformative applications with real practical impact on ordinary people. **Each of these areas has its own timeline.**

New **quantum sensors** are expected to emerge in commercial markets in the **near future**, for instance, whereas **quantum computers** are more than **a decade away.** The technology tracks showing the underlying scientific and engineering milestones paving the way for disruptive applications are based on predictions from leading scientists in Europe. This timeline should be seen as illustrative and incomplete. History has proven that it is very difficult to predict the key applications of a disruptive technology; such technologies invariably create their own applications. Section 3 provides a more detailed description of the milestones on the technology





## QUANTUM Communications

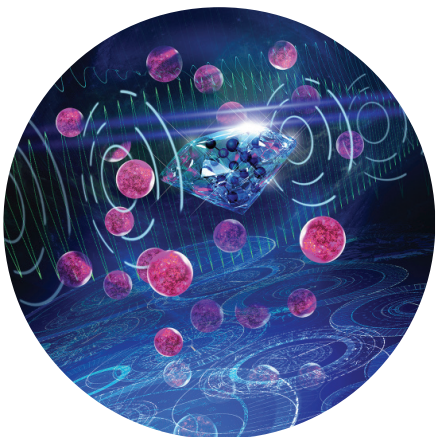
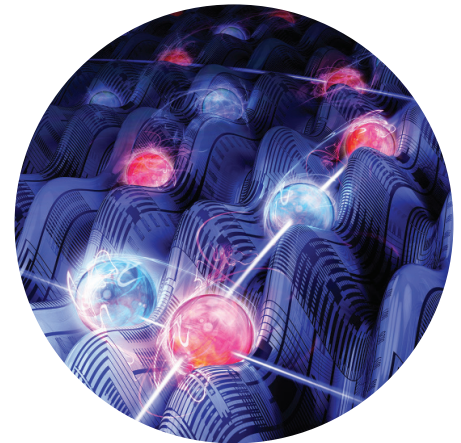
**Quantum communication** will help protect the increasing amounts of citizens' data transmitted digitally, for instance health records and financial transactions. A typical implementation of quantum networks uses single photons. If anything intercepts a single photon it

will be noticed, meaning that with quantum technology we can achieve the most secure form of communication known, impossible to intercept without detection. For point-to-point communication, this is already on the market today and will be developed further into a quantum internet.

## QUANTUM Simulations

Closely related to quantum computers are **quantum simulators**. They will be key to the design of new chemicals, from drugs to fertilisers for future medicine and agriculture, and of new materials, such as high-temperature superconductors for energy distribution without losses. Some quantum simulators are specialised

quantum computers. Others imitate the idea of a wind tunnel: while there, small models are used to understand the aerodynamics cars or planes, some quantum simulators use simple model quantum systems (such as an array of single atoms) to understand systems that would be even more difficult to experiment with.



## QUANTUM Sensing & Metrology

In addition to Quantum Communication, **Quantum sensors** will arguably be the basis for the first applications of Quantum Technologies. They provide the most accurate measurements and will drastically increase the performance of consumer devices and services, from medical diagnostics and imaging to high-precision navigation, to future applications in the

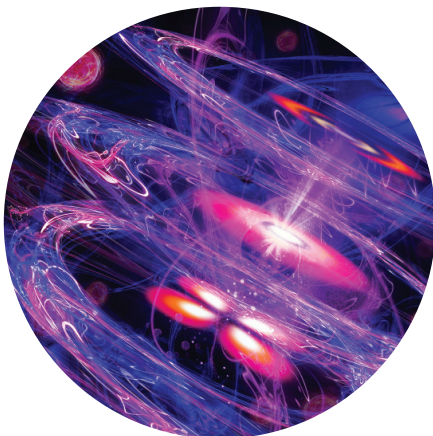
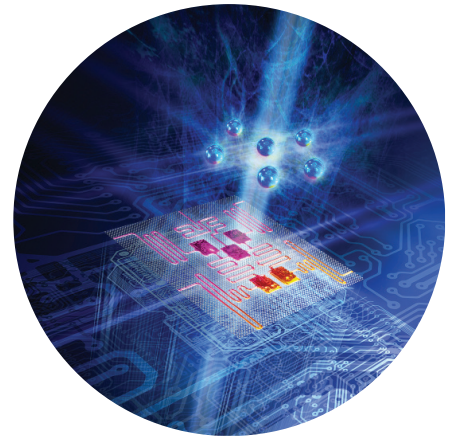
Internet of Things. Quantum sensors use similar technologies as quantum computers and networks: they detect the tiniest disturbances because they are based on e.g., single electrons, the smallest possible charges and magnets. Quantum metrology uses quantum sensors to define the standards for e.g. time-keeping or electrical measurements.



## QUANTUM Computing

**Quantum computers** will make enormous computing power available to solve certain problem classes. They are built from “quantum bits” (individual atoms, ions, photons or quantum electronic circuits) and exploit superposition and entanglement, to solve problems we could never solve otherwise. That includes, for example, processing vast amounts of data faster than

ever before to search databases, solve equations, and recognise patterns. They may even have the potential to train artificial intelligence systems, e.g. for digital assistants that help doctors to diagnose diseases and suggest the most promising therapy, or to optimise the routes of all cars in a city simultaneously to avoid traffic jams and reduce emissions.



## QUANTUM Basic Science

The area of **Basic Science** will cover the research and development of basic theories and components, addressing a foundational challenge of relevance for the development of quantum technologies in at least one of the four areas that

have been mentioned previously (Quantum Communications, Quantum Simulations, Quantum Sensing and Metrology as well as Quantum Computing) to improve the performance of the components or subsystems targeted in those areas.





# Coordinators of the Quantum Flagship Support Action Team

The Quantum Support Action (QSA) initiative has been an important and necessary preparatory step to make sure the full potential of the Quantum Flagship can be attained right from its start. It has lasted 16 months, set up activities that will continue beyond its run-time, and lay down the foundation for future Coordination and Support Actions which will be part of the Quantum Flagship. The work of the QSA is being performed within a set of four workpackages, each of which is mapped to one of the key areas and objectives defined for the project. Each workpackage has defined a specific set of tasks that will contribute to the ultimate goal of attaining the project objectives.

The **QSA coordinator is Prof Dr. Tommaso Calarco.**

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## Work packages of the QSA

### WP1 Strategy and Structuring

WP1 will define, populate and run a Strategic Research Agenda Working Group as well as structure the community by developing coherence and identifying synergies between academia and industry, as well as national and international projects and programmes, including event coordination

**Leader: Rob Thew** (University of Geneva, CH)

E. [Robert.Thew@unige.ch](mailto:Robert.Thew@unige.ch)



### WP3 Outreach and Education

WP3 will raise awareness with potential future stakeholders, decision makers and educators as well as prepare for outreach to the general public.

**WP3 leader is Frank Wilhelm-Mauch** (Universität des Saarlandes, DE).

E. [fwm@lusi.uni-sb.de](mailto:fwm@lusi.uni-sb.de)



### WP2 Innovation and Exploitation

WP2 will establish an Innovation Working Group to create transparency on relevant existing players, (planned) activities and best practices and to actively connect them to foster innovation in QT and exploitation of research results.

**Leader: Thierry Debuisschert** (Thales SA, FR).

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### WP4 Organisational Structures and Processes

WP4 will detail and help implementing the Flagship's Governance Structure

**WP4 leader is Thomas Strohm** (Robert Bosch GmbH, DE)

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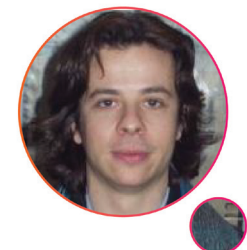


### WP5 Management

WP5 will take care of the management aspects of the project and implement a Helpdesk to route external requests and input to the right work package or information resource

**WP5 leader is Daniele Binosi** (ECT\*, IT)

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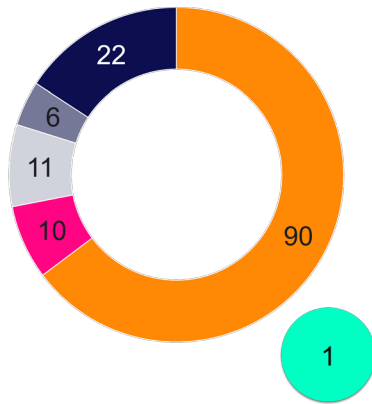




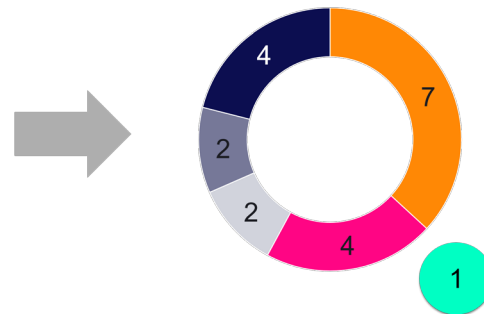


# 20 Selected Projects for ramp-up phase

Proposed



Funded



- Fundamental Science
- Quantum Communication
- Quantum Computing
- Quantum Sensing & Metrology
- Coordination & Support Action

## QUANTUM Basic Science

### PROJECT: S2QUIP

(Scalable Two-Dimensional Quantum Integrated Photonics)

#### Coordinating Institution:

KUNGLIGA TEKNISKA HOEGSKOLAN

Coordinator: Klaus Jöns

### PROJECT: 2D-SIPC

(Two-dimensional quantum materials and devices for scalable integrated photonic circuits)

#### Coordinating Institution:

ICFO - THE INSTITUTE OF PHOTONIC SCIENCES

Coordinator: Dmitri Efetov

### PROJECT: QMiCS

(Quantum Microwave Communication and Sensing)

#### Coordinating Institution:

BAYERISCHE AKADEMIE DER WISSENSCHAFTEN

Coordinator: Frank Deppe

### PROJECT: SQUARE

(Scalable Rare Earth Ion Quantum Computing Nodes)

#### Coordinating Institution:

KARLSRUHER INSTITUT FUER TECHNOLOGIE

Coordinator: David Hunger

7 projects

### PROJECT: PhoG

(Sub-Poissonian Photon Gun by Coherent Diffusive Photonics)

#### Coordinating Institution:

THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS

Coordinator: Natalia Korolkova

### PROJECT: PhoQuS

(Photons for Quantum Simulation)

#### Coordinating Institution:

SORBONNE UNIVERSITE

Coordinator: Alberto Bramati

### PROJECT: MicroQC

(Microwave driven ion trap quantum computing)

#### Coordinating Institution:

FOUNDATION FOR THEORETICAL AND COMPUTATIONAL PHYSICS AND ASTROPHYSICS

Coordinator: Nikolay Vitanov



## QUANTUM Communications

### PROJECT: **CiViQ**

(Continuous Variable Quantum Communications)

#### **Coordinating Institution:**

ICFO - THE INSTITUTE OF PHOTONIC SCIENCES

**Coordinator:** Valerio Pruneri

### PROJECT: **QIA**

(Quantum Internet Alliance)

#### **Coordinating Institution:**

TECHNISCHE UNIVERSITEIT DELFT

**Coordinator:** Stephanie Wehner

## QUANTUM Simulations

### PROJECT: **PASQuanS**

(Programmable Atomic Large-Scale Quantum Simulation)

#### **Coordinating Institution:**

MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV

**Coordinator:** Immanuel Bloch

## 4 projects

### PROJECT: **QRANGE**

(Quantum Random Number Generators: cheaper, faster and more secure)

#### **Coordinating Institution:**

UNIVERSITE DE GENEVE

**Coordinator:** Hugo Zbinden

### PROJECT: **UNIQORN**

(Affordable Quantum Communication for Everyone: Revolutionizing the Quantum Ecosystem from Fabrication to Application)

#### **Coordinating Institution:**

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH

**Coordinator:** Hannes Hübel

## 2 projects

### PROJECT: **Qombs**

(Quantum simulation and entanglement engineering in quantum cascade laser frequency combs)

#### **Coordinating Institution:**

CONSIGLIO NAZIONALE DELLE RICERCHE

**Coordinator:** Augusto Smerzi





## QUANTUM Sensing and Metrology

### PROJECT: ASTERIQS

(Advancing Science and TEchnology thRough dIa-  
mond Quantum Sensing)

**Coordinating Institution:**

THALES SA

**Coordinator:** Thierry Debuisschert

### PROJECT: iqClock

(Integrated Quantum Clock)

**Coordinating Institution:**

UNIVERSITEIT VAN AMSTERDAM

**Coordinator:** Florian Schreck

4 projects

### PROJECT: MetaboliQs

(Leveraging room temperature diamond quantum  
dynamics to enable safe, first-of-its-kind, multimodal  
cardiac imaging)

**Coordinating Institution:**

FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG  
DER ANGEWANDTEN FORSCHUNG E.V.

**Coordinator:** Christoph Nebel

### PROJECT: macQsimal

(Miniature Atomic vapor-Cells Quantum devices for  
Sensing and Metrology AppLications)

**Coordinating Institution:**

CSEM CENTRE SUISSE D'ELECTRONIQUE ET DE  
MICROTECHNIQUE SA - RECHERCHE ET DEVELOPPE-  
MENT

**Coordinator:** Jacques Haesler

2 projects

## QUANTUM Computing

### PROJECT: AQTION

(Advanced quantum computing with trapped  
ions)

**Coordinating Institution:**

UNIVERSITAET INNSBRUCK

**Coordinator:** Thomas Monz

### PROJECT: OpenSuperQ

(An Open Superconducting Quantum Computer)

**Coordinating Institution:**

UNIVERSITAT DES SAARLANDES

**Coordinator:** Frank Wilhelm-Mauch





# Spokespersons of the 20 Projects



## S2QUIP

**Spokesperson**  
Klaus Jöns

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(shared group account)



Photo credit: The Moon

**Dr. Klaus Jöns** is leading the research division on hybrid integration of quantum emitters which is embedded in the quantum nano photonics group led by Prof. Val Zwiller studying the generation, manipulation, and detection of single photons. The hybrid integration subgroup is developing quantum photonic circuits for integration of single quantum emitters. We have successfully integrated single InP nanowire quantum dots in SiN waveguides and developed means to route single photons on silicon-based chips. Klaus Jöns obtained his PhD in 2013 at the University of Stuttgart in the Group of Prof. Peter Michler.

Afterwards he joined the Quantum Transport Group at the Kavli Institute of Nanoscience in Delft as a postdoc, where he developed the deterministic integration of nanowires in photonic circuits. He received a Marie-Curie fellowship in 2015 to join KTH and was appointed a permanent researcher position in 2018. In addition to his expertise on hybrid quantum circuits Klaus Jöns is an expert on two-photon resonant excitation of semiconductor nanostructures and deterministic entangled photon pair generation from different types of quantum emitters. His combination of skills in nanotechnologies and photonic quantum circuitry as well as his strong background in quantum emitter spectroscopy and entanglement measurements make him an ideal coordinator for this multidisciplinary project, with knowledge in all relevant research areas of S2QUIP.

**Prof. Dmitri K. Efetov** is a professor and group leader at ICFO, whose research program concentrates on the development of novel composite materials known as “van der Waals (vdW) hetero-structures”, which consist of graphene and other 2D materials. His group aims to use the enhanced quantum effects in these materials to enable applications for quantum technologies and provide new types of quantum systems with which to encode, sense and control quantum information.

Prior to joining ICFO in 2017, he had worked as a postdoctoral researcher at the Massachusetts Institute of Technology (MIT, USA) in the Research Laboratory for Electronics (RLE). During this time he initiated a collaboration with BBN Raytheon Technologies to work out a single photon detector device which is based on graphene’s unique hot electron properties, which allowed to extend single photon detection to THz and even GHz frequencies. Dmitri received a Diploma (M.Sc.) in Physics from ETH Zurich (Switzerland) in 2007. He then earned a M.A., M. Ph. and a Ph.D. in Physics from Columbia University (USA) in 2014, working under the supervision of one of the pioneers of graphene Prof. Philip Kim. Dmitri received the Charles H. Towns Award for his outstanding research achievements during his PhD.

## 2D-SIPC

**Spokesperson**  
Dmitri Efetov

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## SQUARE

**Prof. David Hunger** will coordinate the project and lead WP4. He received his PhD in 2010 working on ultracold atoms and Bose Einstein condensates coupled to micromechanical oscillators. In parallel, he developed fiber-based high-finesse optical microcavities, a cavity platform that has become a widespread tool for cavity QED, spectroscopy and sensing.

As a group leader with Nobel laureate Ted Hänsch, he used these cavities to demonstrate a scanning cavity microscope, cavity-enhanced Raman hyperspectral imaging, and fluorescence enhancement of various solid-state quantum emitters. In June 2016 he accepted a W3 Professor position at the faculty of Physics of the KIT.

**Spokesperson**  
David Hunger

**Spoken Languages**  
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## QMICS

**Spokesperson**  
Frank Deppe

**Spoken Languages**  
German, English

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Frank Deppe is Junior Group Leader “Superconducting Quantum Circuits” at the Walther-Meißner-Institut (WMI) in Garching near Munich, Germany. In addition, he is private lecturer (“Privatdozent”) at Technische Universität München (TUM) with the official right to supervise Bachelor, Master, and PhD theses. During his PhD studies, he performed experiments on superconducting flux quantum circuits, partly in the group of Kouichi Semba at NTT Basic Research Laboratories in Japan and partly in the group of Rudolf Gross at TUM. As a postdoc, he continued at the WMI, where, together with Dr. Achim Marx, he co-organizes the Superconducting Quantum Circuits Group. After holding a personalized postdoc position within the Collaborative Research Center 631 on “Solid State Quantum Information Processing” of the German Research Foundation, he became a permanent scientist at the WMI in 2014.

Frank Deppe was/is principal investigator in several national and EU projects. He is associate member of the excellence cluster ‘Nanosystems Initiative Munich’ (NIM). In 2017, he received the German university teaching license (“Habilitation”) and private lecturer status (“Privatdozentur”) at TUM. Frank’s main areas of expertise are superconducting quantum circuits, ultrastrong light-matter coupling, and propagating quantum microwaves for communication and sensing. His publication list is author of 34 publications in peer reviewed journals with a total of roughly 1500 citations and an H-index of 16.





## PhoG

**Spokesperson**  
Natalia Korolkova

**Spoken Languages**  
English, German, Russian

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**Dr. Natalia Korolkova** is a reader at the University of St. Andrews and a group leader of the Theoretical Quantum Information group. Natalia Korolkova received her PhD in theoretical quantum optics in 1996 from Moscow State University. In 1996/1997 she was appointed as a postdoctoral researcher at the Department of Optics, Palacky University in Olomouc, Czech Republic, in the field of quantum statistics of light fields, non-classical light and quantum cryptography.

In 1997 she joined the Quantum Metrology group at Erlangen University, Germany, as a Humboldt Fellow with topics quantum multimode correlations of bright optical beams and quantum optics with fiber solitons. During 1999-2003 she was leading the Quantum Information group at the Center of Modern Optics at the University of Erlangen, Germany. Since September 2003 Natalia Korolkova is with the School of Physics and Astronomy at the University of St. Andrews, Scotland. Her expertise lies in quantum information processing using quantum continuous variables of light and matter, where she has published pioneering works and well received reviews. Her further expertise is in studies of non-classical correlations in Gaussian states (including quantum entanglement and discord), open quantum systems, quantum state reconstruction and quantum communication.

**Alberto Bramati** received his PhD in physics in 1998 at the University Pierre et Marie Curie (UPMC), now Sorbonne Université, on the generation of squeezed states in semiconductor lasers. After a post-doc in the group of Pr. Lugiato and Pr. Di Trapani on optical solitons and quantum imaging, in 2001 he was recruited at UPMC.

In 2006 he was elected junior member of the Institut Universitaire de France, appointed full professor in 2007, elected OSA Fellow in 2015 and senior member of the Institut Universitaire de France in 2018. He co-authored more than 100 papers in international journals (including 1 Science, 3 Nature Phys., 2 Nature Photonics, 3 Nature Communications, 2 Scientific Reports, 16 PRL; h-index=34, >4000 citations). He supervised 13 PhD students.

## PhoQuS

**Spokesperson**  
Alberto Bramati

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## MicroQC

**Prof. Nikolay V. Vitanov** is the the coordinator of MicroQC. He received his PhD in physics in 1994 at Sofia University. He was postdoc at Imperial College London (1994-1995), Helsinki Institute of Physics (1995-2001), and Technical University of Kaiserslautern (2002-2003). Associate Professor (since 2004) and Full Professor (since 2009) at the Department of Physics of Sofia University, Corresponding Member (since 2014) of the Bulgarian Academy of Sciences.

He has published about 200 articles in scientific journals, including three major reviews, with over 7000 citations. His main interests are in quantum optics, quantum control, quantum computation, semiclassical and classical optics. He pioneered the theoretical development of new adiabatic and composite quantum control techniques in quantum systems with two, three and more states, many of which have been experimentally demonstrated. His theoretical work is directed toward several physical platforms: trapped ions, trapped atoms, doped solids, classical optics.

### Spokesperson

Nikolay V. Vitanov

### Spoken Languages

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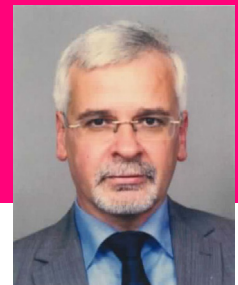
Nikolay Vitanov

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## CiViQ

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ICREA Prof. at ICFO **Valerio Pruneri**, project coordinator for CiViQ, is an ICREA Industrial Professor, Corning Inc. chair and group leader at ICFO. He has over 40 granted or pending patent families and 70 invited talks at major international conferences in the field of photonics, optical materials, multifunctional surfaces and quantum optics. His research at ICFO has so far lead to two spin-offs (**www.quside.com** and **www.sixsenso.com**). He has been General and Technical co-chair of the Conference on Lasers and Electro-optics (CLEO) Europe in 2017 and 2015, respectively.

He is an international R&D advisor of ACREO fiber optic centre in Sweden, member of the advisory board of VLC Photonics, technical advisor of Medlumics SL, member of the EPS-QEOD board. For his research and technology transfer effort, he received the Philip Morris Prize for Scientific and Technological Research, the Pirelli Research Fellowship, the IBM Faculty Award, the Paul Ehrenfest Best Paper Award, the Duran Farrell Prize for Technological Research and the Corning Inc. Chair.

## QIA

**Stephanie Wehner** is Antoni van Leeuwenhoek Professor at QuTech, Delft University of Technology. Her passion is communication in all its facets, and she has written numerous scientific articles in both physics and computer science. Stephanie is one the founders of QCRYPT, which has become the largest conference in quantum cryptography.

She is Roadmap Leader of the Quantum Internet and Network Computing efforts at QuTech, and is the coordinator of the European Quantum Internet Alliance project. From 2010 to 2014, her research group was located at the Centre for Quantum Technologies, National University of Singapore, where she was first Assistant and later Dean's Chair Associate Professor. Previously, she was a postdoctoral scholar at the California Institute of Technology in the group of John Preskill. In a former life, she worked in the classical internet industry and as a professional hacker.

**Spokesperson**  
Stephanie Wehner

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## QRANGE

**Spokesperson**  
Hugo Zbinden

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**Prof. Hugo Zbinden** obtained his PhD at the University of Berne in 1991, for his work on rare-earth solid-state lasers. In 1993, he joined the group of applied physics of the University of Geneva. His research has spanned various areas from optical sensors, single photon detectors, quantum communication and the foundations of quantum mechanics.

He has been involved in EU projects, QuComm, RamboQ, SECOQC, Sinfonia, Q-Cert. He is leading the Quantum Technologies group, which is working on quantum cryptography, single photon detection and metrology. In 2001, he co-founded ID Quantique, a company active in the field of QKD and quantum random number generation. He has published more than 160 peer-reviewed papers with an h-index of 50 (ISI).

## UNIQRORN

**Dr. Hannes Hübel** received his Ph.D. in 2004 at the Queen Mary University in London. In 2004 he joined the Quantum Optics, Quantum Nanophysics and Quantum Information Group, headed by Prof. A. Zeilinger, as a post-doctoral researcher. In 2008, he became senior Post-Doc at the same institution, where he led the development of an entanglement based QKD system for the EU-FP6 SECOQC and EU-FP6 QAP projects. He also realised novel sources for quantum communication applications in the national Trans-Q project. In 2010, he was awarded a Postdoctoral Fellowship by the Institute of Quantum Computing, University of Waterloo, Canada. In this group, he led the effort for the first direct generation of photon triplets and collaborated with space hardware manufacturer COMDEV on a satellite QKD study, funded by Defense Research and Development Canada.

In 2011 he became assistant professor at the University of Stockholm, Sweden focusing on long distance fibre and free space quantum communication. As member of the Linnaeus Center in Advanced Optics and Photonics (ADOPT), he worked also on the implementation of nanophotonics for quantum experiments. Since 2015 he is the leader of the Optical Quantum Technology group at AIT, aiming to bring quantum communication applications to market. He is coordinating national projects and international projects in areas such as coexistence schemes for QKD and classical communication, high rate generation of entangled photons, as well as an industrial projects on CV-QKD.

**Spokesperson**  
Hannes Hübel

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## iqClock

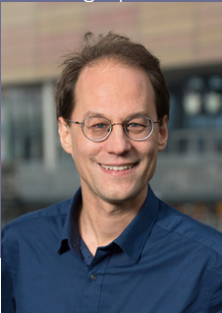
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Photographer: J.W. Steenmeijer (2017)



**Prof. Florian Schreck** has received his PhD in the group of Christophe Salomon at the E.N.S. on the creation of Li quantum gas mixtures and the production of bright solitons. After a postdoc with Mark Raizen at UT Austin on mesoscopic quantum gases, he joined Rudi Grimm's group in Innsbruck (Austria). In 2008 he founded his own research, which created the first quantum gas of Sr in 2009, followed by other successes such as reaching quantum degeneracy by using only laser cooling or the creation of ultracold Sr<sub>2</sub> molecules. In 2013 F. Schreck became full professor at the University of Amsterdam and obtained funding through an ERC CoG (2013, 1.8M€), an NWO Vici grant (2014, 1.5M€), and an NWO Zwaartekracht grant (2017, 0.7M€).

He has three research projects with the goals of creating a truly continuous atom laser, studying many-body physics with RbSr groundstate molecules, and creating novel types of artificial gauge fields, also in combination with quantum gas microscopy. His own research team encompasses 3 postdocs, 8 PhD and 2 master students, four of which have acquired their own funding (e.g. NWO Veni, Marie Curie). The excellent training that students receive in his group is demonstrated by the first two members of his group (Simon Stellmer, Meng Khoon Tey) who are on track to obtain tenure.

**Spokesperson**  
Yeshpal Singh

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**Yeshpal Singh** is leading the lab for Precision Metrology and Quantum Measurements at the University of Birmingham. He has been Marie-Curie Research Fellow at the University of Birmingham and as an experimentalist is greatly interested in the field of quantum atom optics with a particular emphasis on ultra-cold atoms and degenerate gases. At the UoB, he has run several EU, UK and international projects.

He is very well versed in building consortia, funding acquisition and running grants and has published 27 research articles in internationally reputed journals, including Science, Nature Physics, and PRL.





## ASTERIQS

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**Thierry Debuisschert** is a scientist at Thales Research & Technology where he is responsible for applied quantum physics activity. His expertise covers non-linear optics, quantum optics, quantum cryptography and NV centers in diamond. He has contributed to numerous research projects at national or European level in these fields.

He was coordinator of the European integrated project DIADEMS (2013-2017) dedicated to the development of magnetometers based on NV centres in diamond. Currently, he is coordinating the ASTERIQS project and he is involved in the quantum coordination and support action QSA which is dedicated to the implementation and support of the Quantum Flagship.

## MetaboliQs

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**Christoph E. Nebel** studied Electrical Engineering at the University of Stuttgart, Germany, where he graduated in 1990 with a PhD. After that, he became a Post-Doc at Xerox Research Centre in Palo Alto, CA, USA, financed by an Alexander von Humboldt Fellowship (Lynen Program), Germany. In 1992 he returned back to Germany, to become Team Leader at the Walter Schottky Institute, Technische Universität München. In 1998 he matured his university teaching quality by Habilitation in Physics, and shortly after that he became Privatdozent at the Physics Department of the Technische Universität München, Germany. In 2004, he accepted a call from the National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan, to become Team Leader at the newly founded Diamond Research Centre, where he focused on the characterization and realization of bio sensors from diamond. In 2007 he became guest professor at Waseda University, Tokyo, Japan and in 2008 he returned to Germany to become head of the Department "Micro- and Nanosensors" at the Fraunhofer Institute for Applied Solid State Physics (IAF), Freiburg, Germany. In 2017 he became head of the business unit "Diamond Devices (GF5)" and in 2018 guest professor at Kanagawa University, Japan. He has more than 310 publications in refereed journals, is co-inventor of > 20 patents, edited 5 books and presented numerous invited and plenary talks on international conferences.





## macQsimal

**Jacques Haesler, PhD:** Senior Project Manager. He received his M.S. degree in physical chemistry in 2002 with the Ciba Spécialité Chimique Award, and received his PhD in 2006 from the University of Fribourg, where he focused his research on the development of a novel Raman Optical Activity (ROA) spectrometer. After one year of postdoc on plasmon-enhanced Raman spectroscopy at the Swiss federal laboratories for materials science and technology (EMPA), he joined the Time and Frequency section at CSEM SA – Centre Suisse d'Électronique et de Microtechnique in Neuchâtel. Since 2008, as a senior R&D Engineer, he was responsible of the Swiss Miniature Atomic Clock (SMAC) development, from the atomic vapor cell fabrication to the system level clock integration, and participated to the development of atomic gyroscopes at CSEM. As a Project Manager since 2009, he managed different developments, mainly for the European Space Agency (ESA), in the field of Miniature Atomic Clocks (MACs) and flash imaging LiDARs. He is now managing the Time and Frequency projects portfolio as well as risky and strategic projects at CSEM. He is author and co-author of more than 25 scientific publications in peer-reviewed journals (12) and conference proceedings (14) and 5 patents.

### Spokesperson

Jacques Haesler

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**Thomas Overstolz, PhD (M):** Senior R&D Engineer. He received his M.S. degree in physical electronics from the University of Neuchâtel in 2001, and in 2007 his PhD from the University of Neuchâtel, based on his work on MEMS hybrid platforms for tuning of optical components. In 2005 he joined Centre Suisse d'Electronique et de Microtechnique (CSEM), where he works as senior R&D engineer and project manager, responsible for MEMS technology integration in various projects such as tunable blazed gratings for spectroscopic applications and quantum cascade lasers, accelerometers, alkali metal vapor cells for atomic clocks, ultra-thin reinforced nano-porous membranes, large area AFM probe arrays for bio-medical applications, as well as PMUT based sensors. He is author and co-author of more than 50 scientific publications and 8 patents.

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## Qombs

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**Augusto Smerzi** (Ph.D in Physics) is a staff research director at CNR, co-director of the Quantum Science and Technology in Arcetri (QSTAR) institute, and leader of the theory group at QSTAR, Florence. The group is internationally renowned for the quantum theory of phase estimation, having made fundamental contributions to the development of the field. These results have established the Fisher information as a tool for the characterization of complex quantum states, in particular their entanglement and metrological usefulness.

Furthermore, the group has an established expertise on the study of the nonlinear dynamics of coherent matter waves in the context of dilute, trapped Bose-Einstein condensates. The group has a long-standing record of successful collaborations with experiments. AS is Mercator Fellow of the Deutsche Forschungsgemeinschaft (DFG).

## PASQuans

**Prof. Andrew Daley** is Chair of Theoretical Quantum Optics at the University of Strathclyde. He has made significant contributions to the fields of quantum simulation and out-of-equilibrium many-body dynamics of ultracold quantum gases, both in theoretical work that sets a roadmap for ongoing experiments and in direct collaborations with experimental groups.

He will play a role in the PASQuans project leadership team representing the theory groups. He is currently the Principal Investigator of a UK Engineering and Physical Sciences Research Council Programme grant on “Designing out of equilibrium many-body quantum systems”, involving 7 investigators at the three universities (Strathclyde, Oxford, and Cambridge).

He received a United States National Science Foundation CAREER Award in 2012, and in 2009 received the Ludwig Boltzmann Prize of the Austrian Physical Society (ÖPG) (which is awarded every two years for the best research by a theoretical physicist under the age of 35 in Austria).

**Spokesperson**  
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## OpenSuperQ

**Education and career:** 1991-96 studies of physics at Karlsruhe Institute of Technology (KIT), Germany, graduated with a Diplom; 1996-99 doctoral studies at KIT (supervisor Prof. Dr. Gerd Schön), graduated as Dr. rer. nat.; 1999-2001 postdoctoral research (supervisor Prof. Dr. Johan E. Mooij) at Delft University of Technology, Netherlands; 2001-2005 senior researcher (supervisor Prof. Dr. Jan von Delft) at Ludwig-Maximilians-University (LMU), Munich, Germany; Habilitation 2004 and appointment as Privatdozent (lecturer) at LMU; 2006-2011 associate professor at the Institute for Quantum Computing and the Department of Physics and Astronomy, University of Waterloo, Canada continuing as full professor on leave (2011-13) and adjunct professor (2013-16); since 2011 full chair professor at Saarland University.

**Awards:** 1993-96 Fellow of the German National Merit Foundation; 2010 Distinguished Service Award, University of Waterloo; 2015 Google Research Award

**Selected service:** program committee of the APS March Meetings 2008 and 2018; since 2014: Executive Secretary of the Virtual Facility of Quantum Control; since 2016: Participation in the QuTe-Europe working group (QUARTET) interfacing the flagship high-level steering committee and the community

### Spokesperson

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**Photo credit:** @Thorsten\_Mohr



**Prof. Enrique Solano** worked several years at Max-Planck Institute for Quantum Optics (Garching, Germany) and at Ludwig-Maximilian University (Munich, Germany). He was Physics Professor at Pontificia Universidad Católica del Perú (Lima, Peru) until he became Ikerbasque professor at University of the Basque Country (Bilbao, Spain) since May 2008, where he is the director of the research group “Quantum Technologies for Information Science (QUTIS)”, [www.qutisgroup.com](http://www.qutisgroup.com). His group develops interdisciplinary research in quantum optics, superconducting circuits, quantum information and quantum technologies. Since January 2018 he is also distinguished professor at Shanghai University (Shanghai, China).

### Spokesperson

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Since January 2012, **Andreas Wallraff** is a Full Professor for Solid State Physics in the Department of Physics at ETH Zurich. He joined the department in January 2006 as a Tenure Track Assistant Professor and was promoted to Associate Professor in January 2010. Previously, he has obtained degrees in physics from Imperial College of Science and Technology, London, U.K., Rheinisch Westfälische Technische Hochschule (RWTH) Aachen, Germany and did research towards his Master's degree at the Research Center Jülich, Germany.

During his doctoral research he investigated the quantum dynamics of vortices in superconductors and observed for the first time the tunneling and energy level quantization of an individual vortex for which he obtained a PhD degree in physics from the University of Erlangen-Nuremberg. During the four years he spent as a research scientist at Yale University in New Haven, CT, USA he performed experiments in which the coherent interaction of a single photon with a single quantum electronic circuit was observed for the first time. His research is focused on the experimental investigation of quantum effects in superconducting electronic circuits for performing fundamental quantum optics experiments and for applications in quantum information processing. His group at ETH Zurich engages in research on micro and nano-electronics, with a particular focus on hybrid quantum systems combining superconducting electronic circuits with semiconductor quantum dots and individual Rydberg atoms, making use of fast and sensitive microwave techniques at ultra-low temperatures.

Andreas Wallraff received the Nicholas Kurti European Science Prize in March 2006 in recognition of a record of sustained achievement working at the forefront of quantum device research employing experimental low-temperature techniques. In 2009 he was awarded the prestigious European Research Council (ERC) Starting Independent Research Grant to work on hybrid cavity quantum electrodynamics with atoms and circuits. In 2011 Andreas Wallraff was awarded the ETH Zurich Max Roessler Prize. In 2013 Andreas Wallraff received an ERC Advanced Grant to perform research on quantum communication in the microwave domain.

Andreas Wallraff was a visiting professor at the Laboratoire Kastler Brossel de l'École Normale Supérieure (ENS), Paris, France in 2012.

Since 2013 Andreas Wallraff is member of the Department of Physics Strategy Commission. As its President since 2015, Andreas Wallraff is a member of the Physics Department Management Board. Being a member of the Laboratory for Solid State Physics since 2006 he acts as its vice chair since 2013. Andreas Wallraff is a Board Member of the ETH Zurich clean room facilities FIRST - Center for Micro- and Nanoscience (since 2006) and the joint ETH Zurich and IBM Rueschlikon BRNC - Binnig and Rohrer Nanotechnology Center (since 2015). Andreas Wallraff also plays a leading role in the ETH Zurich Quantum Engineering Initiative which aims at strengthening the ties between science and engineering in the domain of Quantum Information Science. Since its inception in 2012 Andreas Wallraff is a member of the Scientific Committee of the Swiss National Center of Competence in Research (NCCR) Quantum Science and Technology (QSIT).

### Spokesperson

Andreas Wallraff

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## AQTION

**Spokesperson**  
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**Dr. Thomas Monz** was born in 1981 in Hall in Tirol, Austria, finished his PhD at the University of Innsbruck in experimental physics in the group of Prof. Rainer Blatt in 2011. Since 2012 Dr. Monz is working as a senior scientist with a permanent position at the University of Innsbruck.

The research interests of Dr. Monz are the realization of quantum algorithms, the verification and validation of quantum objects, and the implementation of quantum error correction. For his work and more than 30 publications, he has received several awards, among others the Thesis award of the European Physical Society and the highest award by the Austrian Physical Society – the Fritz-Kohlrusch award.

From 2016 to 2017, Dr. Monz was working as Senior Product Specialist and Scientific Advisor for M Squared Lasers in Scotland, UK. In 2017 Dr. Monz returned to the University of Innsbruck to work on his habilitation.

Dr. Monz is known for holding the world-record on the largest entangled state – consisting of 14 qubits – and implementing Shor's algorithm in a scalable manner.







# Quantum Community Network

In order to be able to engage the large number of stakeholders in Europe appropriately, the Quantum Support Action (QSA) has established a network of multipliers, the Quantum Community Network (QCN).

The QCN is composed of distinguished members of the Quantum Technology (QT) community, who have agreed to commit to liaising with their national stakeholders and build the links to the QSA.

QCN members are encouraged to carry out the following actions:

-  Collect and share information and/or best practices on QT-relevant activities in their country
-  Help coordinate the interaction between the Flagship and National Initiatives
-  Assist in the promotion of gender equality in science
-  Provide, upon request, additional information about activities, regulation etc. in their country

## List of the current QCN members

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