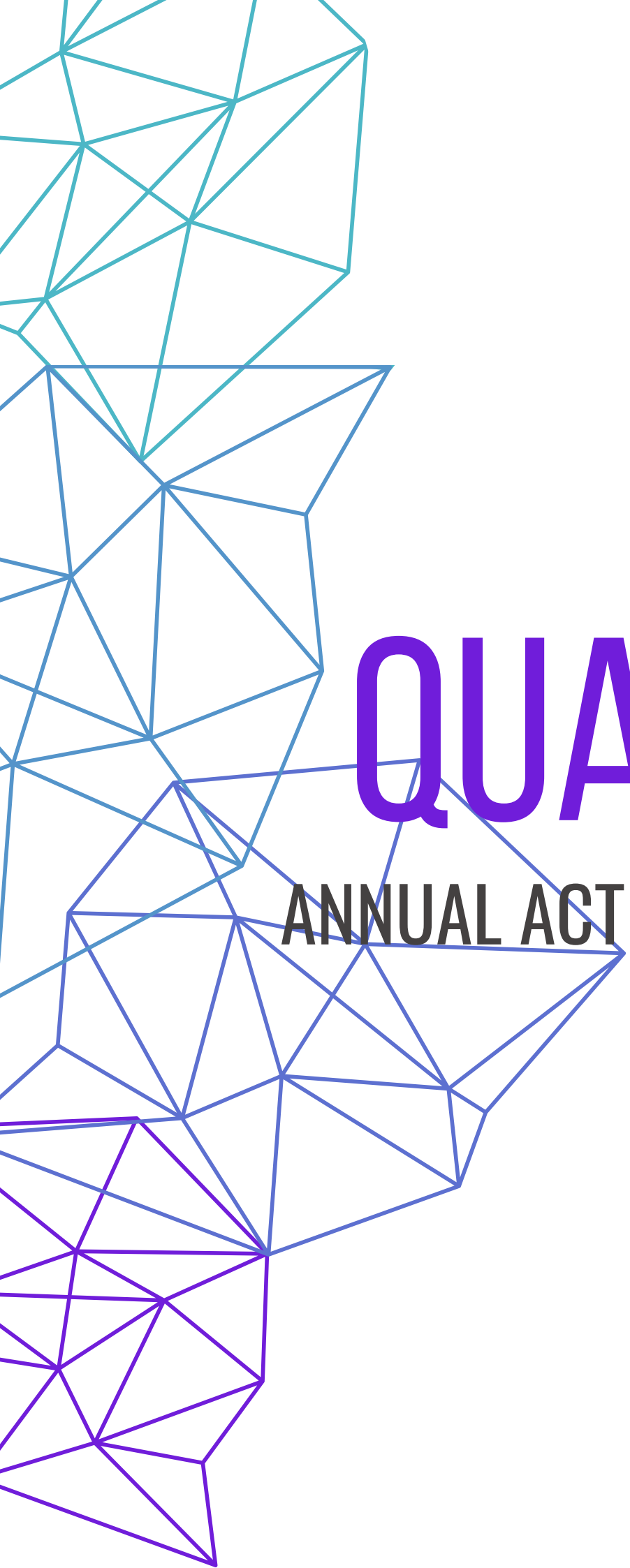


DIM QUANTIP

ANNUAL ACTIVITY REPORT 2022 - 2023

QuantiP

Domaine de Recherche et d'Innovation Majeur

Région îledeFrance

FOREWORD

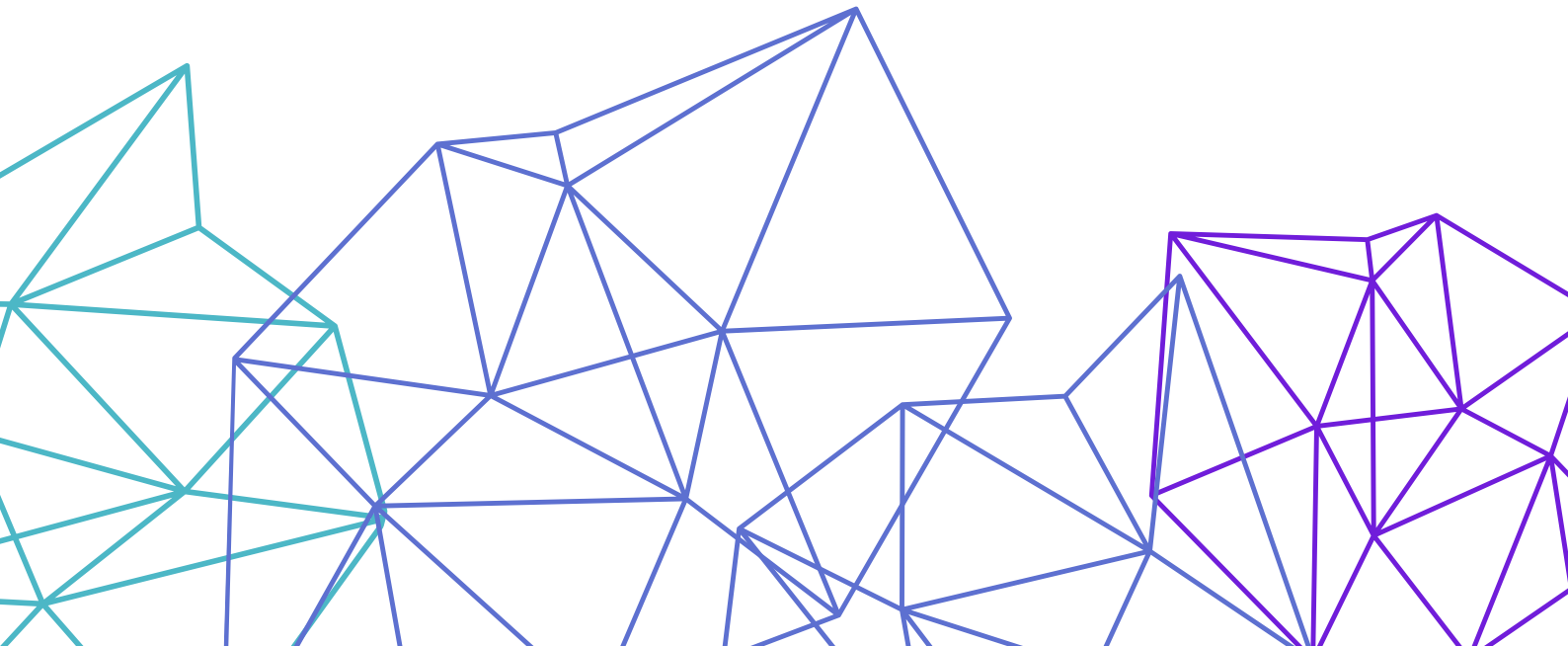
QuanTiP – a short name for Quantum Technologies in Paris Region – was founded in May 2022 as one of the Major Research and Innovation Networks (DIM) funded by Région Île-de-France (Paris Region).

Following the success of DIM SIRTEQ, QuanTiP acts in all fields of quantum technologies: computing, simulation, communications, sensing, and all the scientific and technological resources necessary to develop these fields. QuanTiP pays particular attention to technology transfer from the academy to the industry, with dedicated valorization and training program. We also develop targeted communication towards the general public, students and pupils.

Two years after its start, it is now time to present its first accomplishments in terms of scientific advances, animation, training, and valorization. The whole team of DIM QuanTiP is therefore happy to present its annual activity report. You will find in this document a presentation of QuanTiP and its thematic and transverse axes, a report on the budget and our actions of animation and training, the list of projects selected in 2022 and 2023 in the frame of our science, animation and valorization calls, as well as the scientific status reports of the projects funded in 2022.

QuanTiP

Hélène Perrin, Coordinator



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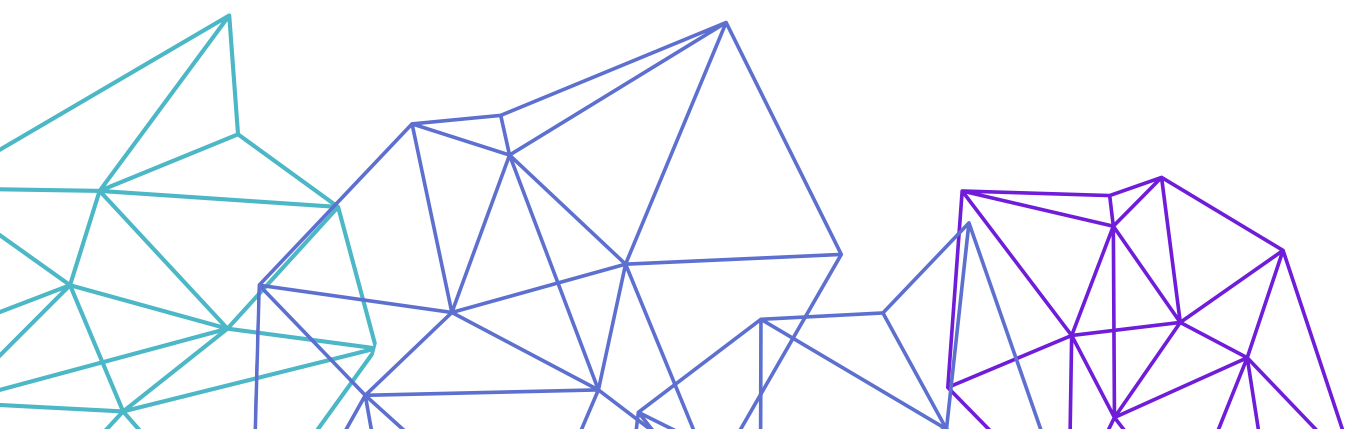
DIM QUANTIP
OBJECTIVES

In 2022, the project QuanTiP (Quantum Technologies in Paris Region) was selected for 5-year funding by the Paris Region as one of the major research and innovation networks (DIM). Managed by the CNRS (Centre National de la Recherche Scientifique), the DIM QuanTiP aims to support, structure, and promote research and innovation efforts in the competitive field of quantum technologies.

With an approach combining physics, applied mathematics, computer science, chemistry, materials, and engineering, QuanTiP covers all the major aspects of quantum technologies: “Quantum computing” and “Quantum simulators”, set to revolutionize our computing capabilities, “Quantum communications”, which will enhance data security, and “Quantum sensors and metrology”, which will enable ultimate sensitivities. QuanTiP members are committed to the maturation of quantum technologies —a key issue for sovereignty and growth— by developing structuring facilities and large-scale interdisciplinary projects, facilitating exchanges between researchers, entrepreneurs, and industry, and supporting the training of tomorrow's quantum engineers through research. In this way, the DIM is nurturing the regional ecosystem, paying particular attention to the transition between fundamental research and technological development, to bring about breakthrough innovations and new applications of quantum technologies, both in industry and in other scientific fields.

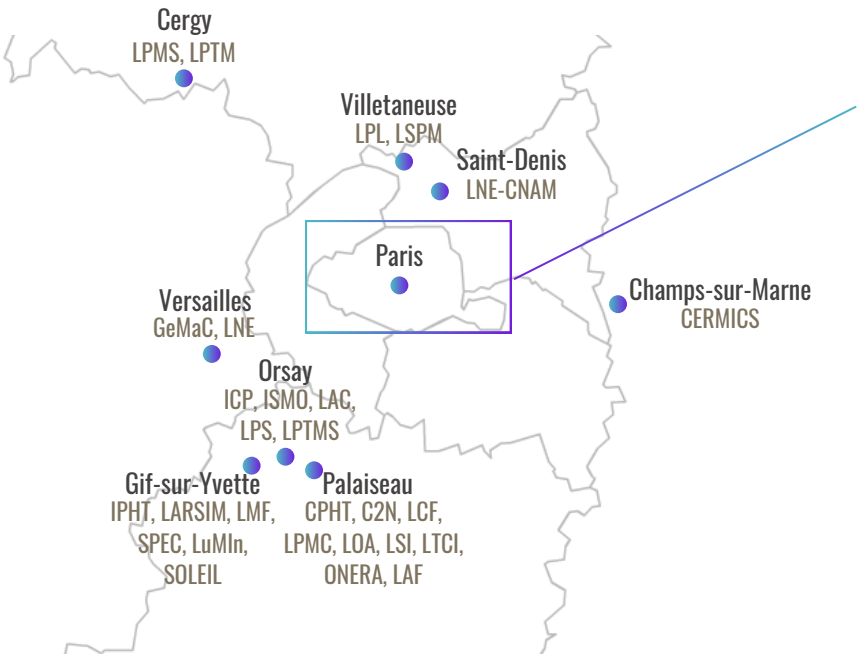
Through the calls for projects open to academic partners, the DIM QuanTiP provides doctoral and post-doctoral grants, funding for equipment, and technological transfer projects. It also supports scientific and general public events and proposes various training to the network members (start-up creation, scientific mediation, etc.). The DIM is committed to science communication and popularization.



NETWORK

QuanTiP gathers about 1200 scientists in all the fields relevant to quantum technologies, with about one half being permanent staff, one third PhD students and one sixth postdocs. They are coming from 152 research groups from 42 laboratories spread around the whole region, active in universities, engineering schools and/or research centers (CNRS, CEA, INRIA, LNE). QuanTiP academic network has important interactions with the socioeconomic quantum ecosystem, both large companies and startups originating from its laboratories.

Distribution of laboratories across the île-de-France

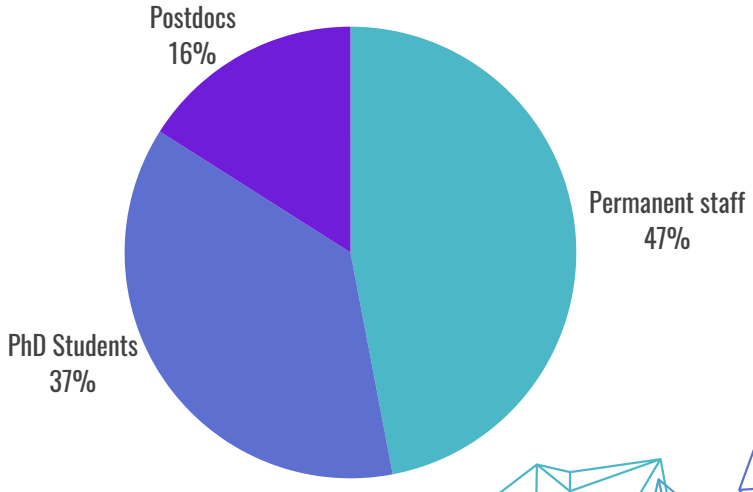


42 laboratories

152 teams (April 2024)

1185 researchers

Distribution per position (April 2024)

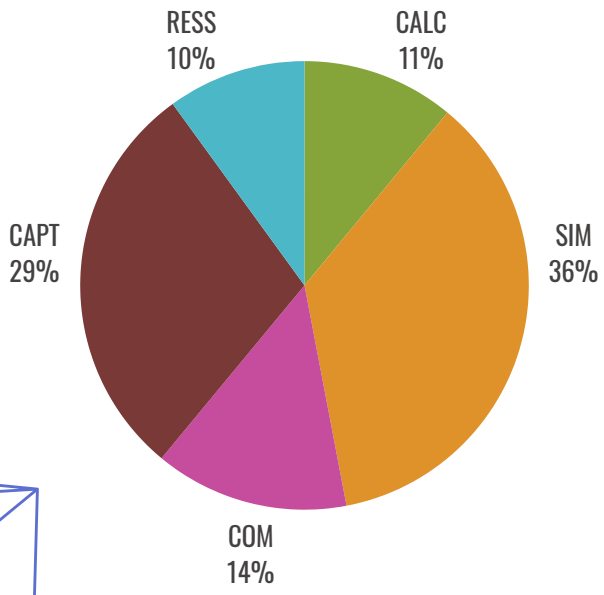


AXES

The DIM is structured into the four thematic axes related to our objectives, supported by three transverse axes covering scientific and technological resources for the thematic axes, scientific and economic impact of their results, and animation and training of the community.

Thematic axes / Tranverse axes	Quantum computing (CALC)	Quantum simulation (SIM)	Quantum communication (COM)	Quantum sensors and metrology (CAPT)
Scientific and technological resources (RESS)	Theoretical methods, new approaches, materials, integrated devices, dedicated technologies (microfabrication, cryogenics...)			
Scientific and economic impact (VALO)	Valorization, technological transfer to industry, identification of use cases in science and industry			
Animation and training (ANIM)	Communication, events, training and outreach			

Distribution of teams per main axis (April 2024)



QUANTUM COMPUTING

Axis leaders
Patrice Bertet (CEA-SPEC)
Alain Sarlette (INRIA Paris)

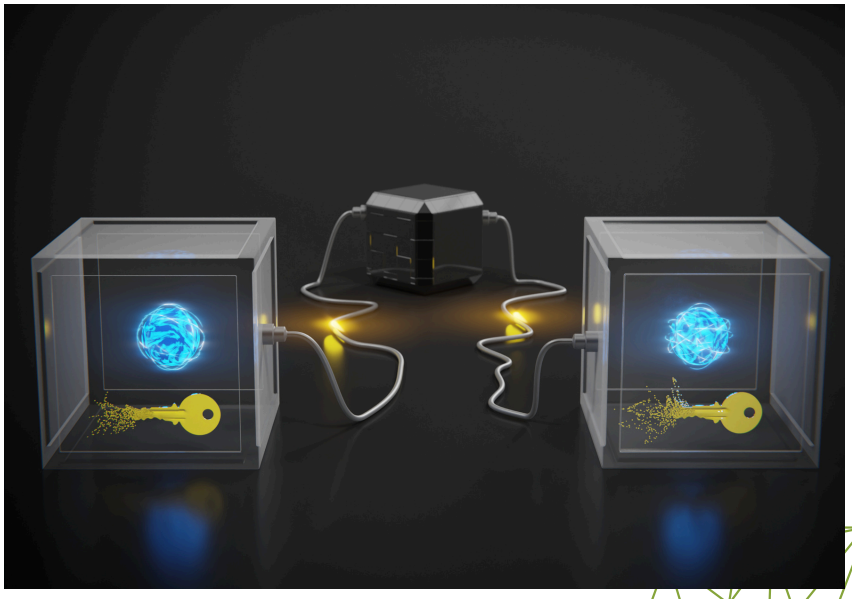
Board members
Thierry Lahaye (LCF)
Valentina Parigi (LKB)
Frédéric Magniez (IRIF)
Thomas Ayral (Eviden)

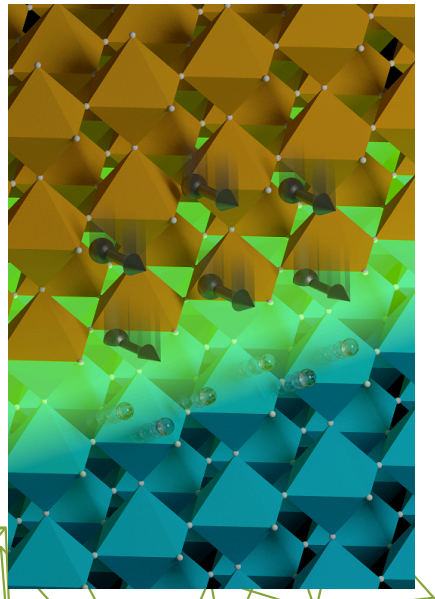
The objective of the Quantum Computing axis is to stimulate research in the Paris Region to develop the universal quantum computer, both on the experimental side (physical platforms for the device) and theoretical side (error correction procedures, algorithms for ideal or noisy computers).

Regarding the hardware, the Paris Region concentrates state-of-the-art experimental research on several platforms like superconducting qubits, trapped atoms and photonics, supporting leading international startups as well as research on a few more exotic platform candidates. The next goal is to attain high-fidelity basic quantum operations, demonstrating error correction capabilities compatible with the long-term goal of building a large-scale quantum computer. Progress along this line should also more directly enable demonstrations of NISQ computation, which has become a field of its own to highlight where quantum performance is already competitive on ultra-specific problems involving few dozen qubits and featuring occasional actual errors.

Regarding algorithms, new or improved quantum algorithmic routines are still being published on a regular basis. The coming years should see an interfacing effort, developing the typical quantum routines into end-to-end solutions for an ever wider range of applications. Beyond quantum modeling applications, standard computational tasks like extracting information out of differential equations, out of Monte-Carlo simulations, or with Machine Learning routines, should be pushed starting with efficient programming languages for exploiting quantum resources in actual use-cases, and down the stack to compilation into operations including optimal quantum error-correction requests.

This endeavor requires a conjunct effort of the physics, applied mathematics, and computer science communities involved in quantum technology research.

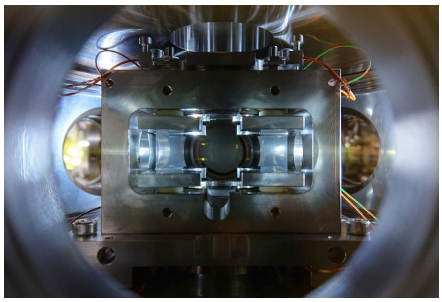
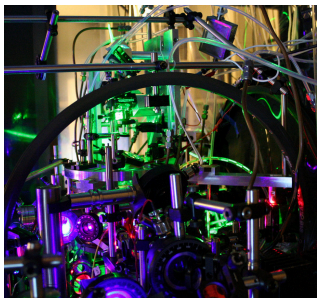
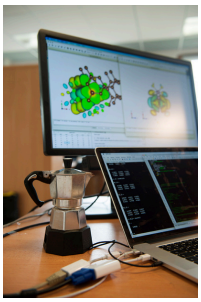
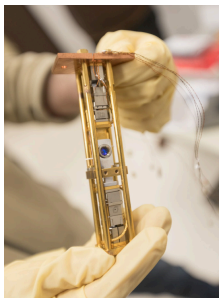




QUANTUM SIMULATION

Axis leaders
Jérôme Beugnon (LKB)
Laurent Sanchez-Palencia (CPHT)

Board members
Jacqueline Bloch (C2N) Jérôme Estève (LPS)
Christophe Mora (MPQ) Adrien Signoles (Pasqal)

The Quantum Simulation axis focuses on the experimental and theoretical study of quantum devices designed to solve complex problems in an analogical approach. Many scientific as well as applicative questions that are inaccessible even to large-scale classical computers do not necessarily require universal quantum computers. The idea of quantum simulation is to simulate the problem using another quantum system, easier to manipulate, and/or to explore extended configuration spaces. Verifying quantum simulators is crucial and requires interdisciplinary efforts to improve theoretical models. Their applications include understanding major challenging quantum phenomena such as high-Tc superconductivity, quantum magnetism, out-of-equilibrium dynamics in the presence of disorder, topological phases, as well as many other issues in materials science, high-energy physics, astrophysics, or quantum chemistry. Most of these problems are approached through optimization, which paves the way to extensions towards applications for industry and society.

The focus of the axis is to develop and mature quantum simulators along several lines:

- Development of a variety of quantum simulation platforms, in quantum gases, photonic systems and solid-state materials
- Develop protocols to implement, develop, and validate quantum simulators in a variety of scientific problems, taking advantages of a close synergy between experiments and theory
- Valorize existing platforms and explore present-day possibilities
- Extend applicative use-cases in close synergy between academia and industry

QUANTUM COMMUNICATION

Axis leaders
Nadia Belabas (C2N)
Alex Bredariol Grilo (LIP6)

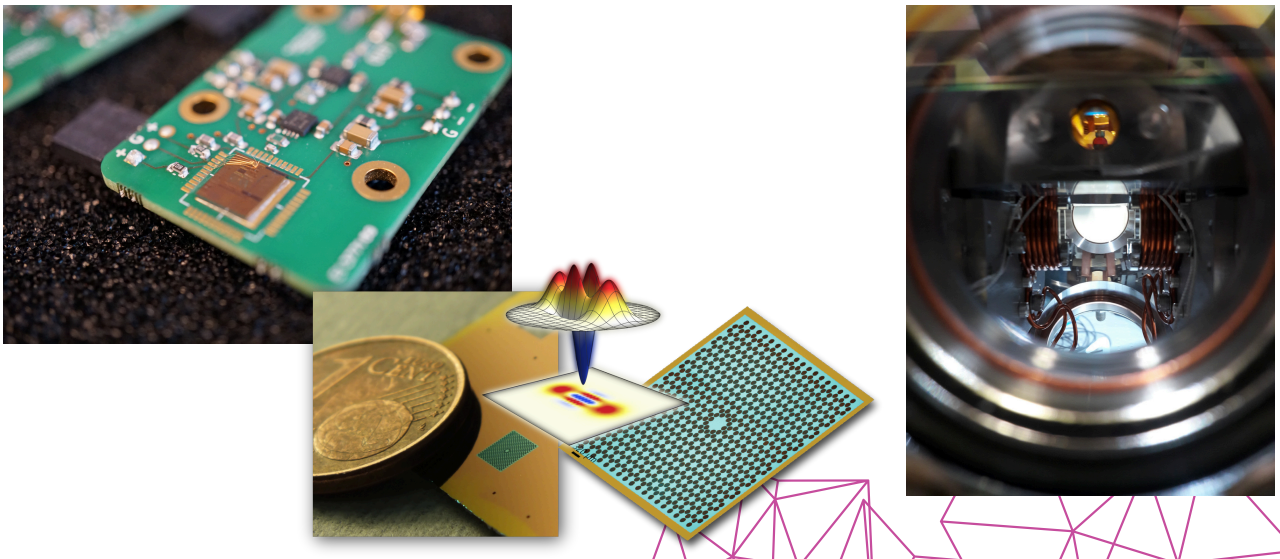
Board members
Alexei Ourjoumtsev (JEIPCF)
Maria Amanti (MPQ)
Romain Alléaume (LTCI)
Tom Darras (WeLinq)

One of the most mature applications of quantum technologies is the secure exchange of information via quantum communications, which generalizes quantum cryptography methods. The aim of the community is to build hybrid quantum communication networks (combining several physical quantum information platforms and several types of encoding) and to enable secure exchanges that are resistant to attacks by supercomputers, whether classical or quantum. To achieve this, current research is pushing forward all the components of a quantum network: the sources and detection of photons and entangled states, quantum memories, and atom-light interfaces using hybrid or opto-mechanical systems, useful for developing quantum repeaters to extend the network and improve existing cryptographic technologies.

Quantum cryptography have developed very rapidly in recent years, both theoretically (security proofs, device validation criteria) and experimentally (increasingly high-performance systems). It therefore appears to be a forerunner for quantum technologies, particularly for the transition between research and applications "out of the laboratory". In this field, the region is very well endowed, with state-of-the-art teams and excellent theory-experience and physics-computing synergies. Several manufacturers (Thales, Nokia, iXblue...) and startups (Quandela, VeriQloud, Kets, Cryptonext...) are involved.

The Quantum communication axis of QuanTiP supports research and innovation with three main objectives, using technologies developed in the Paris Region 1) Developing quantum cryptography 2) Improving sources and detectors 3) Enabling long-distance quantum communications.

The building blocks and efforts in point 2 and 3 are relevant notably for optical quantum computation hardware. Conversely, the progress achieved in 1 and 3 are useful for distributed and secure computation or sensing.



QUANTUM SENSORS AND METROLOGY

Axis leaders

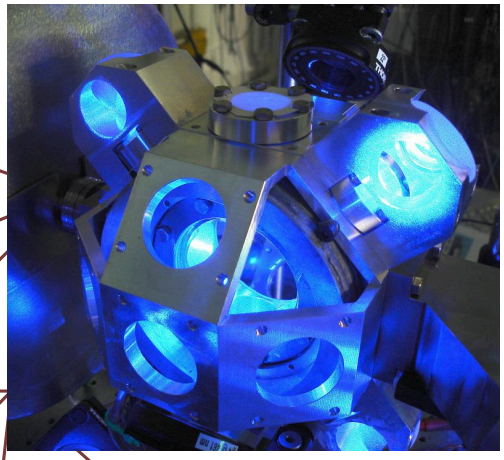
Ivan Favero (MPQ)
Franck Pereira (SYRTE)

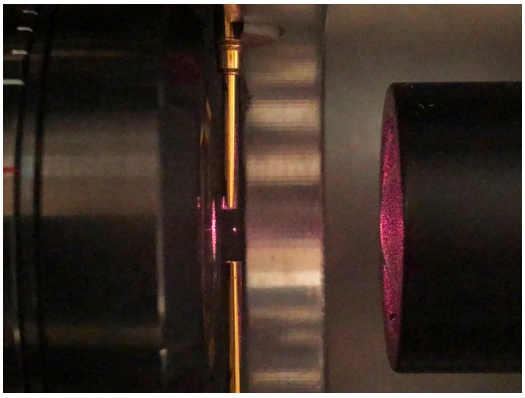
Board members

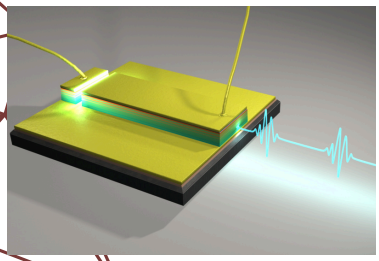
Fabienne Goldfarb (LUMIN)
Mathieu Manceau (LPL)
Laura Thevenard (INSP)
Dimitri Labat (Chipiron)

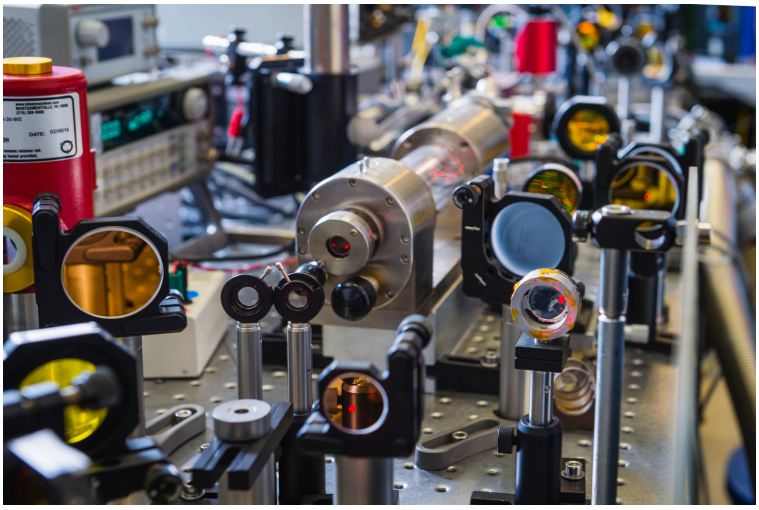
Whatever the physical system used (atoms, molecules, spins, optomechanical devices of micro- or nanometric dimensions), the Quantum Sensors and Metrology axis aims at developing quantum sensors exploiting the quantum properties of matter and light to achieve very high sensitivity to external force fields.

They can be used to measure a wide range of physical quantities, opening up applications in numerous fields with high societal impact, such as climate and natural resource monitoring, healthcare, positioning, navigation and timing, or natural disaster prevention. While these sensors are often limited by classical noise sources, measurement protocols exploiting quantum correlations offer the possibility of pushing their sensitivity below the standard quantum limit.









SCIENTIFIC AND TECHNOLOGICAL RESOURCES

Axis leaders
Danijela Marković (LAF)
Alexandre Tallaire (IRCP)

Board members
Yann Le Coq (SYRTE)
Marie-Pierre Adam (LUMIN)
Mark-Oliver Goerbig (LPS)

The Scientific and Technological Resources axis of QuanTiP is transverse and strongly interdisciplinary as it aims at supporting research efforts in sensing, computing, communication, and simulation, by providing them with the essential building blocks required for their development.

It encompasses theoretical models, numerical and analytical mathematic tools, but also new approaches that will facilitate the adoption of quantum information processing techniques in particular. Material science and associated fabrication technologies to achieve “quantum-grade” platforms that are robust yet flexible, ranging from bulk crystals to nanomaterials, are also an important part of this transverse axis.

The integration of quantum functionalities into compact, well designed and efficient devices, that feature hybrid combinations of material systems and allow an easy manipulation of their quantum states is an absolute necessity to achieve the foreseen goals. This will rely on enabling technologies that must be specifically developed for this area. They include for example adapted cryogenic systems, highly stable and narrow lasers, low-noise electronic circuits, as well as micro and nanofabrication approaches.

SCIENTIFIC AND ECONOMIC IMPACT

Axis leaders

Matthieu Delbecq (LPENS)
Agnès Maître (INSP) since 2024
Pascale Senellart (C2N) in 2022-2023

Board members

Eleni Diamanti (LIP6)
Sylvain Gigan (LKB)
Almazbek Imanaliev (LNE)
Riadh Issaoui (LSPM)
Elvira Shishenina (BMW)

The goal of the Scientific and Economic Impact axis is to stimulate the socio-economic and scientific impact of research into quantum technologies. The actions are supported by a board of about 5 people who ensure an effective interface between the scientific community and the socio-economic world.

The objectives are to develop use cases for quantum technologies for new scientific or industrial applications and to encourage, train and support the DIM members in their efforts to exploit these technologies. Several dedicated events and actions are organized every year for these purposes, open to all, from PhD candidates to researchers. These include a valorization awareness day with lectures on intellectual property, entrepreneurship and testimonies from quantum entrepreneurs as well as a 3-day entrepreneurship training school.

These days help to arouse the interest of players in the academic world, who are still too little informed about the possibilities available to them in this field. They provide an opportunity to identify technologies and potential candidates who could benefit from QuanTiP to get started. One of our challenging mission is to identify such ambitious projects based on promising technologies at a very early stage and provide them with the means to demonstrate proof of concept or design a prototype that validates the fact that this technology can leave the laboratory. This is done with the help of comparatively upstream pre-maturation actions that are lacking in the current ecosystem.

ANIMATION AND TRAINING

quantip.anim@univ-paris13.fr

Axis leaders

Jérôme Lodewyck (SYRTE)
Senka Ćuk (QuanTiP)

Board members

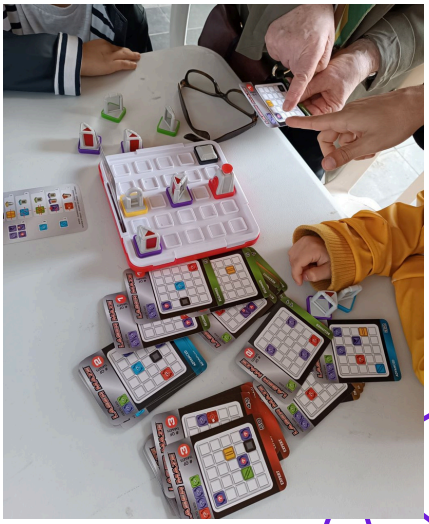
Valia Voliotis (INSP)
Michèle Leduc (LKB)
Denis Vion (SPEC)
Mattia Walschaers (LKB)

PhD missions

Lucas Jarjat (LPENS)
Aurore Young (LKB)
Joël Gomes (SYRTE)

The Animation and Training axis aims to promote a common scientific culture and to strengthen exchanges and collaborations among researchers and partners of the DIM. It also seeks to raise the visibility of our research network, both locally and internationally, through appropriate communication and initiatives targeting the academic world, companies, and the general public.

The axis nourishes collaboration with our partners in the ecosystem (QICS, PCQT, Quantum Saclay), as well as with associations and fablabs (Atouts Sciences, Science ouverte, Ludomaker...). To develop our outreach action, we benefit from the help of PhD students with a dedicated outreach PhD mission. They participate in science fairs or lab tours, give talks in high schools, have realized a French version of the board game `Entanglion' introducing the fundamental concepts of quantum computing, and prepare a demonstration experiment for future exhibitions.



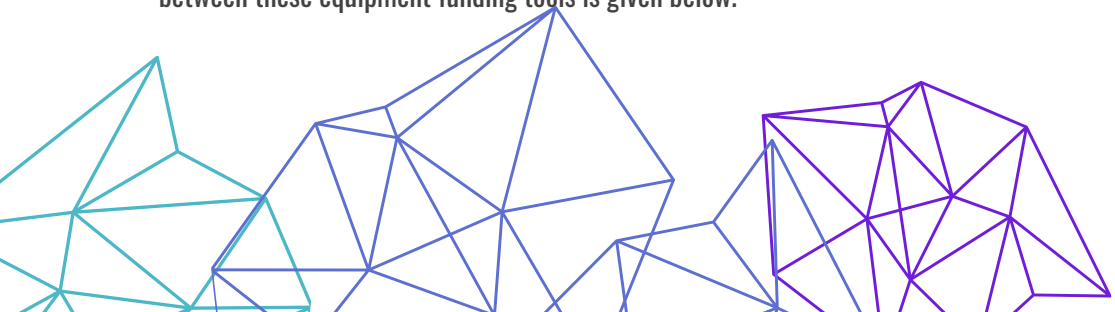
ANNUAL REPORT

BUDGET

DIM QuanTiP started its activities in May 2022 with the launch of the PhD call and the recruitment of Senka Ćuk, project manager, in June 2022. QuanTiP was awarded by Paris Region 1.4 M€ in equipment / investment costs and 0.9 M€ in operation costs (including salaries, PhD and postdoc fellowships) for its first operation year May 2022 – May 2023, a bit less than the total requested budget of 2.5 M€ as the Region finally labeled 9 DIM and not 8 as initially scheduled. In addition, we obtained 194 k€ from the regional representation of the state in Paris Region (DRARI), which supported our actions towards valorization (3 projects funded in 2022 and 2023) and training in innovation and entrepreneurship. For its second year (2023), QuanTiP received a grant of 2.5 M€ from the Region, 1.5 M€ for equipment and 1 M€ for operating costs. We have been informed that this budget is renewed for 2024.

The operation costs cover mainly the PhD (125 k€ each) and postdoc (60 k€ each) grants, but also the salary of the project manager, the overheads of CNRS, as well as all the animation, training and outreach events organized by the DIM. In 2022, we funded the equivalent of 3 PhD fellowships (2 full fellowships and two half-fellowships) and 5 1-year postdoc fellowships. In 2023, we funded 3 full PhD fellowships and 4 one-year postdoc fellowships (5 were ranked but there was a late resignation, the grant will be used in 2024). The competition is particularly high for the PhD grants, with 23 applications representing 19 full fellowships in 2023 for 3 full grants. The operation costs supports scientific events such as schools, workshops and conferences, including a 20 k€ to organize our first international conference dedicated to quantum simulation at École Polytechnique, thanks to the efforts of the Quantum Simulation axis led by Laurent Sanchez-Palencia and Jérôme Beugnon. We have also developed our actions towards the general public and high school pupils by hiring two PhD students each year for outreach missions: Joël Gomes in 2022, Aurore Young in 2023 and Lucas Jarjat in 2022 and 2023. Finally, the operation cost is used to train the members of the DIM, and especially young researchers, in science as well as in valorization of science in the industry. In 2024, to develop our animation, outreach and communication impact, we have decided to hire a communication and events officer, Zoé Vessière, who joined the team in April 2024.

The particularity concerning the equipment budget is that it is a co-funding: the Region funds up to 66% of the total equipment cost of the project. The funding is distributed through our equipment calls. The `Large equipment call' concerns projects of total cost larger than 152 k€, with the participation of QuanTiP between 100 and 200 k€. These projects should imply at least two teams from two different laboratories. The `Small and medium equipment call' deals with smaller projects, for which a collaboration is not mandatory, with a participation of QuanTiP between 15 and 50k€. In addition to these two funding tools, the major part of the equipment budget was dedicated in the year 2022 to supporting two structuring projects, as requested by the Region for benefiting from the DIM label. These large equipment projects, with a collaboration with an industry partner, concerned the acquisition of a new MBE machine for the production of high purity III-V semiconducting materials for quantum technologies, and a collaborative project on the benchmarking of quantum simulators, featuring atomic and solid states simulators. An overview of the repartition between these equipment funding tools is given below.



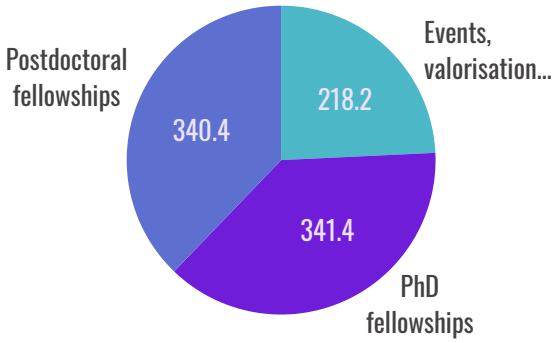
2022

1.4M€
Investment budget (equipment)

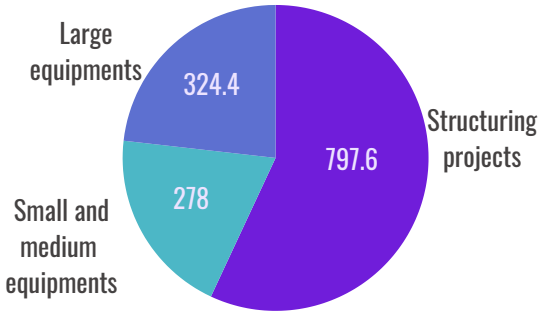
900k€
Operation budget (salaries...)

+ 194k€
DRARI Île-de-France

Operation budget 2022 (k€)



Investment budget 2022 (k€)

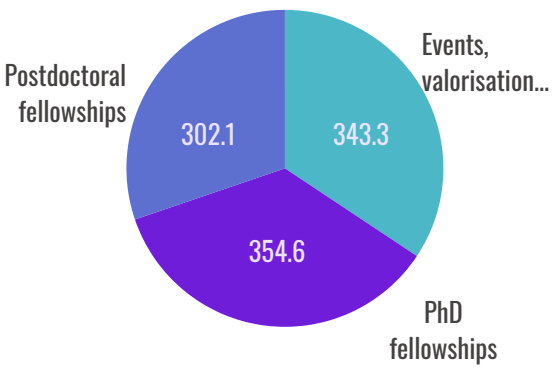


2023

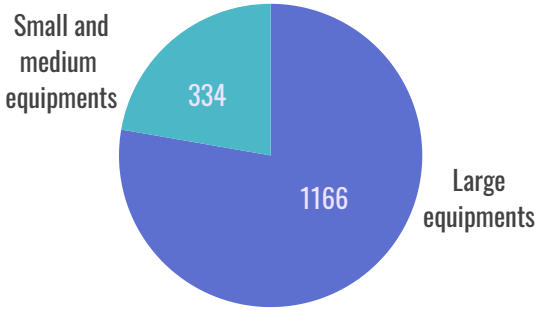
1.5M€
Investment budget (equipment)

1M€
Operation budget (salaries...)

Operation budget 2023 (k€)

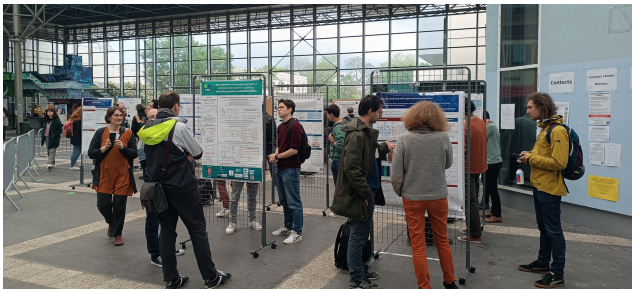


Investment budget 2023 (k€)



ANIMATION AND TRAINING

QuanTiP organizes each year its annual meeting, on the campus of Université Sorbonne Paris Nord. In 2022, the first QuanTiP meeting – which was also its kickoff – took place on November 10, with the presentation of the network, its axes and highlights, poster presentations, and above all a memorable presentation of the newly awarded Nobel Prize Alain Aspect. We decided in 2023 to hold the annual meeting in May, when the availability of lecture halls is better. It took place on May 12, in the lecture hall of the Technology institute and nearby forum, a very convenient place for the poster session. It will be organized in the same place in 2024, on May 29. The QuanTiP annual days represent a great opportunity for the network to meet in presence at least once a year, and they gather around 160 participants, including PhD students and postdocs who are particularly encouraged to attend.

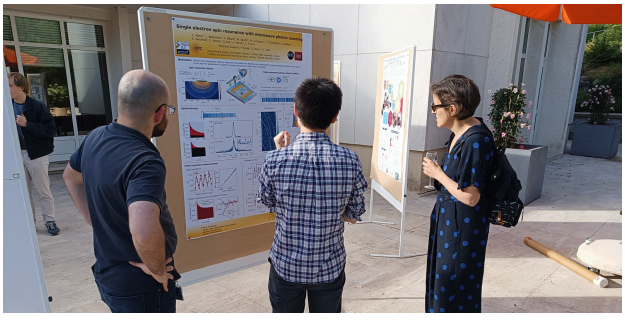



Annual meeting 2023

QuanTiP is committed to encouraging the exchanges between academy and industry. To this aim, we train the members of the DIM, and especially the young researchers, to the challenges of the industry context, with a one-day training on valorization and a 3-day school on entrepreneurship. In 2023, we have amplified this action with the organization of our first Quantum career day on December 12, with short presentations in the morning from academy, industry and startups on use cases of quantum technologies, and a round table on the training of future quantum technicians, engineers and scientists. The afternoon was dedicated to a quantum job fair, targeting students and postdocs, with booths of our industry partners and posters offering PhD theses and postdoc positions in academic laboratories. The success of this first edition convinced us to organize a similar event in 2024.

Valorization Awarness Day 2022 and 2023

Quantum Career Day 2023

Entrepreneurship Residential School 2023

ANIMATION AND TRAINING

Beside its own international conference, for which we provide a dedicated report, QuanTiP also supports all along the year scientific events, schools and training programs organized by its members. This included among others a workshop celebrating the 100 years of Louis de Broglie's description of matter waves, the General Congress of the Physics Society's 150th anniversary, the 20th international conference on luminescence, a 3-week workshop on quantum many-body physics in the presence of an environment, the annual meeting of the French Quantum technology network TeQ, as well as doctoral training, with Cold atom schools in Les Houches and a quantum `hackathon' with optical computers (LOQCathon). We have also funded an outreach project from Hugues Pothier, who has set up a theater show about superconductivity and quantum mechanics. The full list is given with the list of funded projects.

Supraconductor : theater

QuanTiP organizes its own outreach events, with the help of the outreach team (Joël Gomes, Lucas Jarjat and Aurore Young since 2024). They concern mainly participation in public events (the Fête de la science, the `Before' outreach event of the SFP General Congress in 2023, etc.), presentations given in high schools, and lab tours for young people. To encourage more DIM members to take part in outreach actions, we have supported their participation in training sessions on scientific communication and outreach led by the association TRACES, which are very successful. These sessions are organized in coordination with other DIMs from the Paris Region.

© Masterclass Training (provided by TRACES association)

Mediation during a visit at LPL

INTERNATIONAL CONFERENCE ON QUANTUM SIMULATION

The DIM annual conference, dedicated in 2023 to quantum simulation, the International Conference on Quantum Simulation (ICQSIM2023), was held from November 13 to 17, 2023 at the École Polytechnique (Palaiseau) under excellent conditions. The premises provided by École Polytechnique were perfectly suited in terms of size and audiovisual equipment. We also benefited from strong support from the events and audiovisual departments for organization, set-up and technical support. Meals and breaks were taken in the hall adjoining the amphitheatre where the speeches were held, with all the necessary equipment, which enabled convivial exchanges during meals. Participants were also able to visit the stands of the sponsors present throughout the conference.

From a scientific point of view, the conference attracted 150 participants, including 11 invited presentations, 22 contributed presentations, 74 posters and 1 public lecture. Both organizers and participants were very satisfied with the oral presentations. Many of the slots were given over to relatively young speakers, who, like the more established researchers, gave presentations of excellent quality. Christophe Salomon's public lecture was also a great success, attracting a large audience of nearby researchers. The audience was always present and asked many questions at the end of the presentations, and the discussion sessions were also very lively. The two poster sessions were very lively, with plenty of enthusiasm from presenters and visitors alike. The number of people attending the conference was constant over the four days, which is remarkable for a free conference close to the workplace of many participants.

The only downside was the difficulty in attracting female speakers as both guests and contributors, despite an active search by the organizers and the scientific committee. In fact, many scientists declined the invitation, and very few applied as contributors.
In the end, despite this reservation, the conference was a complete success.

Further organizational details can be found on the conference website at https://icqsim2023.sciencesconf.org/.

SCIENTIFIC COMMITTEE
Jérôme BEUGNON
Jacqueline BLOCH
Jérôme ESTEVE
Christophe MORA
Hélène PERRIN
Laurent SANCHEZ-PALENCIA
Adrien SIGNOLES

ORGANIZING COMMITTEE
Jérôme BEUGNON
Laurent SANCHEZ-PALENCIA

Number of participants : 150

Invited speakers: 10 men / 2 women,
6 national/ 6 international

Landry Bretheau (LPMC, École Polytechnique, Palaiseau)
Iacopo Carusotto (Pitaevskii BEC Center, INO-CNR, Trento)
Leonardo Fallani (University of Florence)
Louis-Paul Henry (Pasqal, Massy)
Daniel Jirovec (University of Delft)
Cécile Repellin (LPMMC, Grenoble)
Christian Roos (University of Innsbruck)
Christophe Salomon (LKB, Paris)
Clément Sayrin (LKB, Paris)
Marco Schiro (Collège de France, Paris)
Jon Simon (Stanford University)
Leticia Tarruell (ICFO, Barcelona)

Country of origin of the participants
Austria (2), Belgium (3), Switzerland (5), Germany (9), Spain (2), United Kingdom (1), Italy (2), Japan (4), Luxembourg (1), United States (1), Portugal (2), Netherlands (1), France (116)

Contributed speakers
18 men / 4 women
12 international/10 national

FUNDED PROJECTS 2022

In 2022 we have been able to fund 2 full PhD fellowships and 2 half-fellowships, 5 1-year postdoc fellowships, 2 Large equipment collaborative projects and 6 Small and medium equipment projects. Our equipment budget was mostly (to around 800 k€) used for the funding of two structuring projects. The detailed list is given below. For each project, a scientific status report is given on the page indicated in front of the project name. In addition, we have supported 1 valorization project, for which a status report is also provided. We have also awarded 3 prizes in the frame of the technological contest that took place during the Valorization Awareness Day, and supported 10 scientific or outreach events and student training sessions. The number of funded projects is indicated together with the number of applications. A table summarizes the spreading of the different projects among the scientific axes, either as main or as secondary axes, many projects concerning several research axes of the DIM.

Axis	PhD		Postdoc		Structuring Projects		Large Equipment		SM Equipment		Total	
	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis
CALC	1		1	1		1		1			**2**	**3**
SIM	1,5		3	1	1		1				**6,5**	**1**
COM				1		1		1	2	1	**2**	**4**
CAPT	0,5	2	1	1		1		1	3	2	**4,5**	**7**
RESS					1		1		1	2	**3**	**2**
Total	**3**		**5**		**2**		**2**		**6**		**18**	

PHD FELLOWSHIPS 3/8

P. 21. Coupled two-component Bose-Einstein condensates: Interactions beyond the mean-field approximation (coupledBEC). **T Bourdel.** LCF

P.22. Fermionic-bosonic qubits (FeBosQ). **M Goffman.** SPEC

P.23. Quantum logic spectroscopy (SLQ). **L Hilico.** LKB

P.24. Quantum metrology and simulation with ultracold dysprosium atoms (QuantDy). **S Nascimbene.** LKB

POSTDOCTORAL FELLOWSHIPS 5/6

P.25. Bipartition of a Magnetic Atom Quantum Simulator (Bi-MAQS). **B Laburthe-Tolra.** LPL

P.26. Open-system dynamics of long-range setups (OpenLongR). **L Mazza., M Schiro.** LPTMS JEIPCF

P.27. Quantum Optomechanics in Liquid Media (OQUILI). **I Favero.** MPQ

P.28. Strongly interacting photons in semiconductor microcavities (STROPHE). **S Ravets., C Ciuti.** C2N MPQ

P.29. Topological superconductivity in Kitaev materials (TSKM). **J-N Fuchs.** LPTMC

STRUCTURING PROJECTS

P.30. High purity MBE III-V system for optics and quantum transport (ULTRA-MBE). **A Lemaître.** C2N Quandela

P.31. Quantum simulators: modelling and validation. **M Cheneau., Robert de Saint Vincen., T Yefsah., J Estève., G Roux., L Mazza., T Ayral.** LCF LPL LKB LPS LPTMS Eviden

FUNDED PROJECTS 2022

LARGE EQUIPMENT (EML) 2/3

P.32. Harnessing three-body interaction in quantum gases (H3B). **R Lopes., T Bourdel.** LKB LCF

P.33. Nanolithographie Ultime Paris Centre (UltimaWrite). **Sirtori et al.** ENS

SMALL AND MEDIUM-SIZE EQUIPMENT (PME) 6/14

P.34. Laser cooling of Ytterbium atoms for atomic interferometry (RYbIA). **S Guellati-Kelifa.** LKB

P.35. Quantum Microscopy of Neuron assembly Electrical Activity (QuanMNEA). **F Treussart., M-P Adam., X Checoury.** C2N LUMIN

P.37. Quantum States of Motion of a Mechanical Resonator (Q-Star). **A Borne.** MPQ

P.38. Synthesis of 2D hexagonal boron nitride films by plasma and induction for quantum sensors (SYNICQ). **C Lazzaroni., G Hétet.** LSPM LPENS

P.39. Ultra-fast laser Platform for Bose Einstein condensATion (UPBEAT). **J-M Manceau.** C2N

P.40. Ultra-fast single-photon detector based on a high-temperature superconductor (DURAS). **C Feuillet-Palma., F Parmentier.** SPEC LPEM

VALORIZING RESEARCH THROUGH TECHNOLOGY TRANSFER (APV) 1/2

P.42. Multiple source fluorescnece imaging for quantum technologies (MULTIFLUO). **A Maître.** INSP

TECHNOLOGICAL CONTEST

Microscope at the quantum limit. **C Rouvière., N Treps.** 1st prize

Imager to characterise fluorescent nano-objects for quantum technologies. **H Defienne.** 2nd prize

The FESO device, which reduces the energy consumption of electronic chips by a factor of 1000. **M Bibes.** 3rd prize

SCIENTIFIC EVENTS 10/11

Annual conference of the GDR Nanosciences en champ proche sous ultra vide (NSCPU) CONFERENCE
Congrès général de la SFP (CGSFP) CONGRESS
Fabien Portier : from quantum transport to quantum microwaves (Fab4ever) WORKSHOP
Les Houches 2022 - Doctoral training : Quantum mixtures of ultracold atomic gases TRAINING
Louis de Broglie 2023 days : 100 years of matter waves (deBroglie2023) CONFERENCE
Quantum borders 2022 WORKSHOP
Quantum Many-body Physics in the Presence of an Environment (OpenQMBP23) WORKSHOP
Scientific IMPROMPTU "Superconductor!" THEATER
17th International Conference on Phonon Scattering in Condensed Matter (Phonons2023) CONFERENCE
20th International Conference on Luminescence (ICL2023) CONFERENCE

FUNDED PROJECTS 2023

In 2023 we have been able to fund 3 full PhD fellowships, 4 1-year postdoc fellowships, 7 Large equipment collaborative projects and 7 Small and medium equipment projects. The detailed list is given below. In addition, we have supported 2 valorization projects, we have awarded 3 technological contest prizes, and 4 scientific events and student training sessions. The number of funded projects is indicated together with the number of applications. The pressure on PhD grants was particularly high in 2023.

Axis	PhD		Postdoc		Large Equipment		SM Equipment		Total	
	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis	Main axis	Secondary axis
CALC		1		1	2	3		1	2	6
SIM	2		1	1	1	2	2	1	6	4
COM		1				2	1	1	1	4
CAPT			2		2	2	2	3	6	5
RESS	1	1	1	1	2	5	2	2	6	9
Total	3		4		7		7		21	

PHD FELLOWSHIPS 3/23

Driven dynamics of Yu-Shiba-Rusinov bound states (Shiba-Dyn). **P Simon.** LPS

HYbrid Boron nitride Integrated Structures for QUantum Sources (HYBISQUS). **A Delteil.** GEMaC

Laser-Trapped Circular Rydberg Atoms for Quantum Simulation (L-T CRAQS). **C Sayrin.** LKB

POSTDOCTORAL FELLOWSHIPS 4/8

Mobility Edge of the Anderson Transition (MEAT). **V Josse.** LCF

Quantum ContrOl of a meChanical resONator with a flUxonium qubiT (COCONUT). **S Deléglise.** LKB

Quantum sensors for extreme conditions based on SiV and GeV diamond centres (SensExtremeDAC). **J-F Roch.** LUMIN

Thermal transport in non-abelian quantum Hall states of graphene (ThermaNabe). **F Parmentier.** SPEC CEA

LARGE EQUIPMENT (EML) 7/8

High Throughput Electrical Testing of Quantum Devices & Materials (QuTest). **P Abgrall.** CEA

Metrological validation of Quantum Optomechanical Thermometry in the 1 K – 30 K range (Quantum T). **O Kozlova.** LCM

Novel resource states for quantum computing using single emitters in nanostructures (RESCUE). **H Le Jeannic., L Lanco.** LKB C2N

On-chip quantum interconnections with rare-earth ion-doped nanomaterials (CONEXO). **A Tiranov., K Bencheikh.** C2N IRCP

Quantum anomalous Hall effect with 2D magnets (Q-MAG). **R Ribeiro-Palau.** C2N

THz quantum sensing with quantum dots in resonators (TeraQD). **J Mangeney.** LPENS

2D transition metal dichalcogenides heterostructures: a new platform for the quantum control and simulation of superconducting condensates (QUANTUM2DTMD). **Y Gallais., Y Laplace.** MPQ LSI

FUNDED PROJECTS 2023

SMALL AND MEDIUM-SIZE EQUIPMENT (PME) 7/9

COherent viBRAtional control of cold and ultra-cold molecules (COBRA). **B Darquié.** LPL
Cold Atom Sources for Strontium and Ytterbium Systems (CASSYS). **J Lodewyck. S Lepoutre.** SYRTE LAC
Rare-Earth-based QUantum INertial Sensor (REQUINS). **A Louchet-Chauvet.** IL
ROtating mechanical force Sensor (ROSE). **L Rondin., L Longchambon.** LPL LUMIN
Spatial entanglement in nonlinear waveguide lattices (Q-LAT). **F Baboux.** MPQ
Telecom-Wavelength frequency converslon of photoNic qubits from quantum dot Sources (TWINS). **N Belabas., D Fioretto.** C2N
Time-resolved cathodoluminescence for controlling the levels of impurities in quantum grade Diamond (Ticacolid). **C Arnold.** GEMaC

VALORIZING RESEARCH THROUGH TECHNOLOGY TRANSFER (APV) 2/2

Continuous Variable ENtanglement-based and frequency MUltiplexed Quantum Cryptography (CV-ENMUQC). **V Parigi.** LKB
Single microwave photon detector for quantum detection (SIMPHOSEN). **E Flurin.** SPEC

TECHNOLOGICAL CONTEST

Tapered fibre manufacturing process: a versatile and efficient new tool for photonic coupling. **C Le Fur., I Favero.** 1st prize
Optimal key rates for quantum key distribution. **T Van Himbeeck., P Brown.** 2nd prize
A Micron Scale Lab on a Single Disk for Sensing and Metrology. **H Neshasteh., I Favero.** 3rd prize

SCIENTIFIC EVENTS

Les Houches 2023 - Doctoral training : ultracold molecules : quantum physics and application TRAINING
LOQCathon 2.0 - The second interdisciplinary quantum hackathon on linear optical quantum computation TRAINING
Quantum information: Theory and Applications WORKSHOP
2ème Colloque du GDR Technologies Quantiques (TeQ) CONFERENCE