SWISS QUANTUM DAYS

Swiss Quantum Days 2026
Program Booklet

Engelberg
January 28 - 30, 2026

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Swiss Quantum Initiative

The Swiss Quantum Initiative is one of the measures adopted by the Federal Council in 2022 to support research and innovation. Its mission is to consolidate Switzerland's excellent position in the field of quantum science and technologies.

Basel Precision Instruments

BASPI is a leading provider of ultra-low noise electronics and cryogenic microwave filters and thermalizers. By unlocking new measurement possibilities, they enable innovators to explore new frontiers of quantum computing and science.

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CSEM is an internationally recognized Swiss technology innovation center that develops and transfers advanced technologies with high societal impact to industry.

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Based in Geneva and part of IonQ, IDQ develops and industrializes quantum technologies, delivering trusted quantum-safe communication and detection solutions for governments, enterprises, and research institutions worldwide.

QAI Ventures

QAI Ventures is a global ecosystem builder and venture capital firm investing in Quantum- & Advanced Computing technologies while supporting founders with funding, scaling, accelerators & global networks.

Zurich Instruments

Zurich Instruments brings innovation to quantum control systems in the form of efficient workflows, tailored specifications, and a high degree of reliability.

ZuriQ

ZuriQ is building scalable quantum computing systems based on a novel 2D architecture for ions in Penning traps.

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Agenda

Time	Wednesday, January 28, 2026
12:00	Arrival, Lunch & Posters Up
13:30	Welcome by SQD Organizing Committee
13:40	Status on Quantum in Switzerland, Klaus Ensslin, SQC President
13:55	Invited Talk Yiwen Chu (ETHZ)
14:30	Álvaro de Melo (UniBas)
14:50	Marco Scigliuzzo (EPFL)
15:10	Martynas Skrabulis (ETHZ)
15:30	Coffee Break
16:00	Jodok Happacher (UniBas)
16:20	Carolina Lüthi (CSEM)
16:40	Diego Visani (ETHZ)
17:00	Keynote Talk Jun Ye (JILA/NIST)
17:45	Poster Session
19:30	Dinner

Time	Thursday, January 29, 2026
08:30	Invited Talk Tomasz Smoleński (UniBas)
09:05	Jonas Daniel Gerber (ETHZ)
09:25	Arianna Nigro (UniBas)
09:45	Lorenzo Graziotto (ETHZ)
10:05	Giulia Venditti (UniGe)
10:25	Coffee Break
10:55	Invited Talk Guglielmo Mazzola (UZH)
11:30	Ekaterina Fedotova (EPFL)
11:50	Thea Budde (ETHZ)
12:10	Kabir Khanna (UniGe)
12:30	Alberto Mercurio (EPFL)
12:50	Lunch & Free Afternoon
19:30	Dinner

Time	Friday, January 30, 2026
08:30	Invited Talk Boris Korzh (UniGe)
09:05	Timon Baltisberger (UniBas)
09:25	Sophie Egelhaaf (UniGe)
09:45	Angelo Gelmini (UniGe)
10:05	Shashank Kumar (UniGe)
10:25	Coffee Break
10:55	Invited Talk Yihui Quek (EPFL)
11:30	Daniel Haxell (PSI)
11:50	Aaron Daniel (UniBas)
12:10	Matteo Simoni (ETHZ)
12:30	Prize Announcements & Closing Remarks
12:50	Lunch & Departure

Scan to read the Abstracts of the Invited and Contributed Talks

Our Keynote Speaker

Professor
Jun Ye

JILA, National Institute of Standards and Technology and University of Colorado Boulder, Colorado 80309-0440, USA

Research focus: Quantum science and precision metrology — quantum matter probed with novel light source

Explore the Ye Group

Quantum engineering for practical advantages in clock

State engineering and many-body physics provide coherent quantum systems at increasingly large sizes, revolutionizing the performance of clocks and promising new discovery opportunities. Minute-long coherence in the optical domain has been demonstrated for many thousands of atoms. Entanglement can also be embedded in clock operation. The permeation of quantum metrology to all corners of physics, including the demonstration of a nuclear clock, sparks new ideas for testing fundamental laws of nature and searching for new physics.

Our Invited Speakers

Professor **Yiwen Chu**
from ETHZ speaking about **“An Ultra-Cold Mechanical Quantum Sensor for Tests of New Physics”**

Hybrid Quantum Systems Group

Professor **Boris Korzh**
from the University of Geneva speaking about **“Superconducting nanowire detectors: from quantum communication and computing to emerging applications “**

Quantum Technologies Group

Professor **Guglielmo Mazzola**
from UZH speaking about **“Quantum Sampling: The Case for Quantum Advantage”**

Department of Astrophysics, UZH

Professor **Yihui Quek**
from EPFL speaking about **“The unreasonable effectiveness of (classical) decoding in (quantum) computing “**

Computer Science and Communication Systems and Pysics, EPFL

Professor **Tomasz Smoleński**
from PSI and EPFL speaking about **“Optical control of many-body electronic phases in atomically thin materials”**

Quantum Opto-Electronics Group

Abstracts of Invited & Contributed Talks

Wednesday, January 28

Session chair: tbc

13:55 - 14:30 Yiwen Chu **Invited Talk**

An Ultra-Cold Mechanical Quantum Sensor for Tests of New Physics

Preparing quantum systems in their ground state is essential for quantum information processing and quantum sensing protocols. Excitations out of the ground state degrade the fidelity of quantum processors and add noise to quantum sensors, limiting their ability to detect weak signals. In this presentation, I will discuss direct measurement of excited-state populations of GHz-frequency modes in a high-overtone bulk acoustic wave resonator (HBAR). The measured populations can be as low as (1.2±5.5)x10^(-5), which corresponds to an effective temperature of about 25 mK–lower than in other MHz- or GHz-frequency quantum systems. Together with its large effective mass, this makes the HBAR an excellent platform for tests of new physics. I will present the implications of our results on possible signatures of gravitational waves and dark photons.

14:30 - 14:50 Álvaro de Melo

Non-reciprocal interactions between a mechanical oscillator and an atomic spin system

Non-reciprocal interactions violate the action-reaction symmetry of Newton's third law, giving rise to phenomena such as amplification, synchronization, and spontaneous parity-time symmetry breaking. In quantum systems, non-reciprocal interactions have recently attracted significant interest as a new tool to engineer functionality, with potential for sensing and signal processing applications. Here we report experiments on non-reciprocal interactions in a hybrid mechanical-atomic system coupled by light. We observe spontaneous coupled oscillations, two-mode squeezing dynamics, limit cycles and phase synchronization of the two systems.

14:50 - 15:10 Marco Scigliuzzo

Quantum acoustics with superconducting circuits

Superconducting circuits provide a powerful platform to control and detect mechanical motion at the quantum level. We report progress toward collective squeezing and entanglement by measuring motion correlations among 6 mechanical resonators optomechanically coupled to microwave fields. We further explore the coupling of high-overtone bulk acoustic resonators via piezoelectric interactions to realize phononic band structures. We also present integrated phononic shielding for qubits, that promises to enhance coherence while maintaining fabrication simplicity. Finally, we show the realization of traveling wave parametric amplifiers used to detect small signals in the mentioned experiments.

15:10 - 15:30 Martynas Skrabulis

Impulsive force detection below the standard quantum limit

Small mechanical damping rates and efficient optical readout make optomechanical oscillators great force sensors. At the standard quantum limit (SQL), force sensitivity is bounded by the oscillator's zero-point fluctuations. Here, we experimentally demonstrate the detection of impulsive forces 2.3 dB below the SQL. Our platform is an optically levitated nanoparticle. We beat the SQL by squeezing the oscillator's momentum fluctuations below the zero-point value before exposure to the impulsive force, followed by anti-squeezing, boosting the signal-to-noise ratio. We foresee applications of our system for high-precision measurements of fundamental interactions in collision experiments.

Abstracts of Invited & Contributed Talks

Session chair: tbc

16:00 - 16:20 Jodok Happacher

All-Diamond Scanning Probes: Beyond Nanoscale Magnetometry

All-diamond scanning probes incorporating single color center spins form the basis of a powerful scanning microscopy technique for nanoscale magnetic imaging, offering exceptional sensitivity and spatial resolution. In this presentation, I will highlight recent advances and new directions in quantum sensing that extend the capabilities of all-diamond probes beyond magnetometry, including electric field detection, local magnetic manipulation, and photonic enhancement of optical spectroscopy. Together, these developments establish this platform as a versatile tool for exploring a broad range of condensed matter phenomena at the nanoscale.

16:20 - 16:40 Carolina Lüthi

Implementation of an All-Optical NV-Center Nuclear Spin Gyroscope

Gyroscopes are used for navigation in various applications including aerospace, autonomous guidance, and consumer electronics. In these settings, compact and stable devices are essential. Recently, gyroscopes exploiting the nuclear spin of nitrogen–vacancy (NV) centers in diamond have been proposed. We discuss the implementation in which polarization and readout are achieved purely optically. The gyroscope sensitivity is limited by the number of addressed spins, photon collection efficiency, and the effective transverse relaxation time T2*. We discuss how the sensitivity can be enhanced through the NV-center excitation and collection efficiencies and a path for miniaturization.

16:40 - 17:00 Diego Visani

Building a quantum-limited scanning force microscope

Improving the sensitivity of nanomechanical force sensors is essential for advancing quantum sensing and metrology. To this end, we are developing a scanning force microscope that employs ultracoherent silicon nitride membranes as mechanical resonators. I will present our recent progress in implementing cavity-optomechanical readout at cryogenic temperatures. A key challenge in this work is laser phase noise, which introduces additional uncertainty in the sensor readout. Inspired by stabilization techniques used in trapped-ion and cold-atom experiments, we have implemented both active and passive laser phase noise suppression, enabling quantum-limited displacement readout of the membrane.

17:00 - 17:45 Jun Ye **Keynote Talk**

Quantum engineering for practical advantages in clocks

State engineering and many-body physics provide coherent quantum systems at increasingly large sizes, revolutionizing the performance of clocks and promising new discovery opportunities. Minute-long coherence in the optical domain has been demonstrated for many thousands of atoms. Entanglement is also employed in clock operations. The permeation of quantum metrology to all corners of physics, including the demonstration of a nuclear clock, sparks new ideas for testing fundamental laws of nature and searching for new physics.

Abstracts of Invited & Contributed Talks

Thursday, January 29

Session chair: tbc

08:30 - 09:05 Tomasz Smoleński **Invited Talk**

Optical control of many-body electronic phases in atomically thin materials

Understanding and controlling strongly correlated many-body systems is one of the central challenges in modern condensed matter physics. Among the most promising experimental platforms for exploring this frontier are van der Waals heterostructures based on transition metal dichalcogenide monolayers. These structures uniquely bridge the gap between conventional quantum materials and cold-atom quantum simulators, by combining the functionality of the former with the tunability approaching that of the latter.

In this talk, I will review our recent low-temperature magneto-optical investigations of collective electronic phases in these structures. In the first part, I will demonstrate the formation of novel optical excitations arising from collective excitations of electronic Wigner crystals [1]. In the second part, I will focus on twisted MoTe2 bilayers, where strong interlayer hybridization gives rise to flat topological valence bands supporting robust ferromagnetic metals as well as fractional and integer Chern insulators. I will show that the spin state of all these topological ferromagnets can be dynamically reversed by illuminating them with circularly polarized light, paving the way for all-optical generation of programmable topological circuits [2].

[1] L. Wang, F. Menzel, F. Pichler, P. Knuppel, K. Watanabe, T. Taniguchi, M. Knap, T. Smolenski, arXiv: 2512.16552 (2025).
[2] O. Huber, K. Kuhlbrodt, E. Anderson, W. Li, K. Watanabe, T. Taniguchi, M. Kroner, X. Xu, A. Imamoglu, T. Smolenski, arXv:2508.19063 (2025), Nature (in press).

09:05 - 09:25 Jonas Daniel Gerber

Switchable Spin-Orbit Coupling in Graphene: A New Control Knob for Quantum Computing

Quantum computing demands materials with long coherence times and precise quantum control. Bilayer graphene offers exceptional properties for realizing spin-qubits: a nuclear-spin-free environment, electrostatically definable nanostructures, and record spin-valley lifetimes up to 30 seconds. A key challenge is enhancing spin-orbit coupling for efficient spin manipulation. By placing bilayer graphene on WSe□, we achieve a more than tenfold enhancement of spin-orbit coupling while preserving graphene's excellent mobility. Remarkably, this coupling can be switched on and off in real-time using electric fields, opening new pathways for quantum technologies in computing and spintronics.

09:25 - 09:45 Arianna Nigro

Ge/Si1-xGex planar heterostructures for spin qubit applications

The performance of quantum technologies depends on the quality of the materials hosting qubits. Planar Ge/Si□□□Ge□ heterostructures are promising for hole-spin qubits through precise strain control. This work reports the growth of epitaxial Ge/Si□□□Ge□ heterostructures by chemical vapor deposition. Atomically sharp interfaces were confirmed by scanning transmission electron microscopy, and strain in the Ge quantum well (QW) was systematically tuned and quantified by Raman spectroscopy. Its effect on heavy-hole/light-hole splitting was probed via soft x-ray angle-resolved photoemission spectroscopy. To improve scalability, multi-QW structures were also realized and structurally characterized.

Abstracts of Invited & Contributed Talks

09:45 - 10:05 Giulia Venditti

Angular-momentum-flavored Majorana zero modes

The search for new compounds hosting robust Majorana zero modes (MZMs) for fault-tolerant quantum computing requires a deeper understanding of these states. We study a d + id superconductor placed on a three-dimensional topological insulator and show that the vortex-core MZMs can carry a nontrivial angular momentum. This establishes new 'flavors' of Majorana modes, independent of the Chern number and classified with respect to the windings of the order parameter and underlying normal state. Contextually, we discuss the topological protection of the MZM, set by the bulk gap, quasiparticle poisoning by trivial in-gap states, and its localization length.

arXiv:2509.19031

Session chair: tbc

10:55 - 11:30 Gugliemo Mazzola — Invited Talk

Quantum Sampling: The Case for Quantum Advantage

I will discuss general conceptual and practical limitations to achieving quantum advantage — including data loading and readout, quantum gate times, and competition from classical solvers — and argue why a quantum Metropolis algorithm may represent one of the most promising candidates.[1,2]

[1] Quantum computing for chemistry and physics applications from a Monte Carlo perspective, G Mazzola, The Journal of Chemical Physics 160 (1), 010901
[2] Quantum-enhanced markov chain monte carlo, D Layden, G Mazzola, et. al. Nature 619 (7969), 282-287

11:30 - 11:50 Ekaterina Fedotova

Direct observation of Pauli blocking of cavity superadiance in a mesoscopic Fermi gas

We present a cavity-microscope–tweezer device that allows probing of cavity superradiance in a mesoscopic, quantum-degenerate Fermi gas confined in an optical tweezer trap. Using this platform, hosting 15–1000 atoms, we study the impact of Pauli blocking on collective light emission by controlling atomic density and atom–light coupling strength. The threshold for cavity-mediated ordering exhibits a non-monotonic dependence on density, resulting from the transition of light-coupled excitations from single-particle to particle–hole character. In addition, we observe spin-density wave ordering driven by opposite light coupling to the two spin components in our setup.

11:50 - 12:10 Thea Budde

Analog Quantum Simulations of Particle Physics Phenomena

Recent advances in analog quantum simulation platforms have enabled unprecedented control and scalability, opening the door to exploring increasingly complex quantum systems. In particular, quantum simulations of gauge theories offer a promising route to address novel questions in particle physics that are intractable with classical methods.

Abstracts of Invited & Contributed Talks

12:10 - 12:30 Kabir Khanna

Measurement-induced Entanglement in Quantum Critical Matter

Local measurements can generate long-range entanglement between distant qubits, akin to the mechanism underlying quantum teleportation. Such non-local effects of measurements have also been observed in a many-body setting but our analytic understanding in this case is scarce due to the vastness of the many-body Hilbert space. We circumvent this issue and give the first exact results on the effect of local measurements on a broad class of 1D quantum critical states, namely, Luttinger Liquids. Our framework enables a systematic understanding of measurement-induced phenomena in critical many-body systems and highlights their utility as resource states.

12:30 - 12:50 Alberto Mercurio

QuantumToolbox.jl: Making simulations of open quantum systems easier and faster

We present QuantumToolbox.jl, an open-source Julia package for simulating open quantum systems. Designed with a syntax familiar to QuTiP users, it leverages Julia's high-performance ecosystem for fast and scalable simulations. The package includes efficient time-evolution solvers with support for distributed computing, GPU acceleration, and automatic differentiation, enabling gradient-based optimization and quantum control. Benchmark tests show significant performance gains over existing frameworks, making QuantumToolbox.jl a powerful and flexible tool for both theoretical research and practical applications in quantum science.

Friday, January 30

Session chair: tbc

08:30 - 09:05 Boris Korzh — Invited Talk

Superconducting nanowire detectors: from quantum communication and computing to emerging applications

Superconducting nanowire single-photon detector (SNSPD) development in recent years has culminated in demonstrations of single-photon sensitivity from the ultraviolet to beyond 29 μm, which makes them the only time-resolved single-photon detector to operate across such a broad range of wavelengths. Other attractive characteristics include intrinsic photon-number resolution, ultra-low dark count rates and scalability to cameras approaching megapixel scales. These rapid breakthroughs are poised to impact a broad range of applications in quantum science, high-energy physics, remote sensing, astronomy, and biomedical imaging.

09:05 - 09:25 Timon Baltisberger

Indistinguishable photons from a two-photon cascade

Two crucial aspects of photonic quantum technologies are indistinguishability and entanglement, both giving rise to a wide range of non-classical effects. The biexciton cascade in self-assembled semiconductor quantum dots can produce polarization-entangled photon pairs. However, the cascaded emission of this ladder system leads to timing jitter in photon emission, translating to a reduced indistinguishability of photons from both transitions. Using the Purcell-effect of an open microcavity to accelerate one transition of the two-step-cascade, we manipulate the timing jitter of the emitted photons in-situ, and create highly indistinguishable photons from both steps in the cascade

Abstracts of Invited & Contributed Talks

09:25 - 09:45 Sophie Egelhaaf

Certifying quantum channels

The use of high-dimensional systems for quantum communication opens interesting perspectives, such as increased information capacity and noise resilience. In this context, it is crucial to certify that a given quantum channel can reliably transmit high-dimensional quantum information. Here we develop efficient methods for the characterization of high-dimensional quantum channels, a key ingredient for future quantum communication technologies. We apply these methods to a photonics experiment using a commercial optical fibre and develop an accurate noise model. Our techniques can furthermore be used to characterise other channels such as quantum memories which we will also briefly discuss.

09:45 - 10:05 Angelo Gelmini

Quantum storage and entanglement distribution over the Geneva metropolitan network

Quantum repeaters require long-lived and highly multimode quantum memories, as the entanglement distribution rate scales linearly with the mode number. We developed a memory in 171Yb:Y2SiO5 at 980nm with a bandwidth of 250MHz, an optical storage time of 125μs, and a multimode capacity reaching 10'000. Interfacing with a 980-1550nm photon-pair source demonstrates storage of entanglement through a Bell test, while sending telecom photons through 25km of fibre spool. In a field-test using the metropolitan Geneva Quantum Network, we demonstrate storage and distribution of entanglement over 5.66km of standard optical fibre, paving the way for generation of entanglement between remote memories.

10:05 - 10:25 Shashank Kumar

Geneva Quantum Network

The Geneva Quantum Network (GQN) is a metropolitan-scale testbed interconnecting academic, industrial, and international sites across Geneva through 260 km of telecom-grade fiber. It integrates advanced infrastructure with wavelength-division multiplexing, White Rabbit synchronization, and a Rolex atomic clock for precise time dissemination. The network supports entanglement distribution, quantum key distribution (commercial and prototype), and quantum sensing such as temperature monitoring. This talk outlines the architecture, synchronization framework, and experimental progress, positioning GQN as a key platform for scalable quantum communication research in Switzerland.

Session chair: tbc

10:55 - 11:30 Yihui Quek **Invited Talk**

The unreasonable effectiveness of (classical) decoding in (quantum) computing

Coding theory has found unexpectedly broad applications in quantum information and computation, even in fields that have nothing to do with error correction on the surface. Why is it so useful? In this talk I will survey the unreasonably broad applications of decoding, from cryptography to quantum algorithms and quantum advantage. I will focus in particular on our new algorithm that can prepare quantum Gibbs states without ever running a Lindbladian, but by solving a decoding problem.

11:30 - 11:50 Daniel Haxell

Enhancing Kerr-Cat Qubit Coherence with Controlled Single-Photon Dissipation

A superconducting Kerr-nonlinear oscillator subject to a two-photon drive stabilizes opposite-phase coherent states, which define the basis states of the error-protected Kerr-cat qubit (KCQ). Beyond these states, the oscillator hosts a rich excited-state spectrum composed of quasi-degenerate manifolds. In this talk, I will explain how leakage to these manifolds limits KCQ coherence by creating pathways for bit-flips. I will then discuss how we suppress leakage through engineered single-photon dissipation, cooling population from excited manifolds back to the KCQ. Our experiment extends the KCQ bit-flip time to 3.6 milliseconds, indicating a path to fully realize the potential of this qubit.

11:50 - 12:10 Aaron Daniel

Path Integral Approach to Input-Output Theory

We present an approach to input-output theory using the Schwinger-Keldysh path integral formalism that gives us direct access to the full output field statistics. By making the toolbox of non-equilibrium quantum field theory accessible, our formalism simplifies the treatment of nonlinear systems and provides a uniform way of obtaining perturbative results. We showcase this by computing the output field statistics of a Kerr nonlinear oscillator at finite temperatures through the use of diagrams and diagram summation techniques. We find a reduction in reflection that is not due to photon leakage but rather associated to the squeezing of the output light.

12:10 - 12:30 Matteo Simoni

Non-linear cooling and control of a mechanical quantum harmonic oscillator

Non-linearities are key for the non-classical manipulation of quantum harmonic oscillators. In atomic systems, these have commonly been inherited from a two-level system through a linearized coupling. Here, we instead explicitly harness the non-linearity of the atom-light interaction itself to cool, diagnose and control non-Gaussian multi-component Schrodinger's cat state manifolds of a mechanical oscillation of a trapped ion in a micro-fabricated Penning trap, utilising processes up to fourth order in the creation and annihilation operators. This provides a new toolbox for control of atomic systems, which might be utilised in bosonic error correction using rotation-symmetric codes.