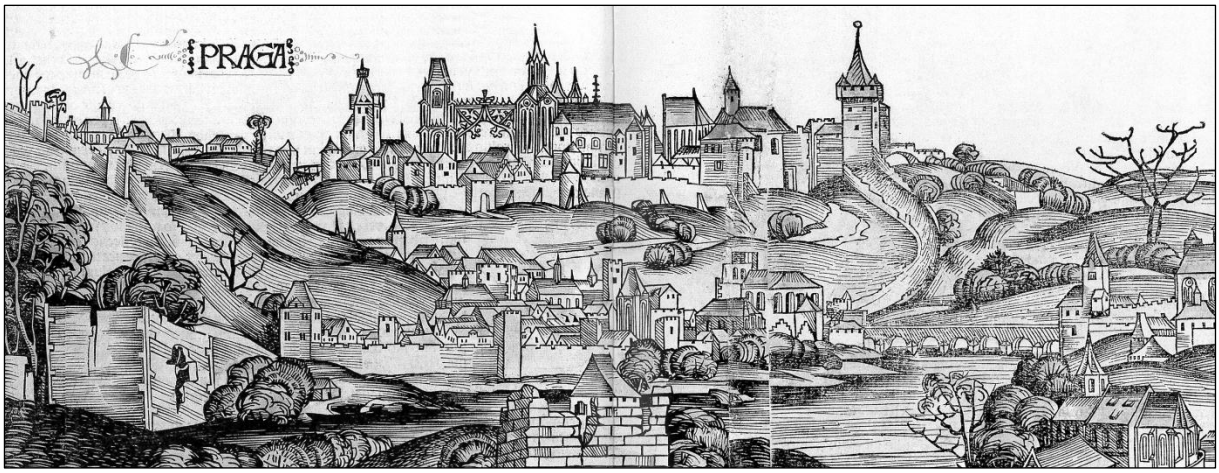
International multidisciplinary conference

Frontiers of Quantum and Mesoscopic Thermodynamics 2026 - FQMT'26

Zero Announcement



The conference is focused on

Non-equilibrium and Many-body phenomena, Physics of information,
Foundations of quantum physics,
Open quantum, Mesoscopic, Biological, and Gravitational systems.

26 July – 1 August 2026, Prague

https://fqmt.fzu.cz/26/

FQMT Conference Series Overview

FQMT conferences form a series of successful conferences (FQMT'04, FQMT'08, FQMT'11, FQMT'13, FQMT'15, FQMT'17, FQMT'19, FQMT' 21 – online, FQMT' 22 – hybrid, and FQMT'24) which are traditionally held in Prague. For the details of the conference programs and the history of the FQMT conferences see the www pages: https://fqmt.fzu.cz/.

The contributions from the previous conferences have been published in Physica E (vol. 29, issues 1-2, 2005, and vol. 43, issue 3, 2010), Physica Scripta (vol. T151, 2012, and vol. T165, 2015), Fortschritte der Physik (Progress of Physics), vol. 65, 2017, and the European Physical Journal Special Topics (vol. 227, issues 15-16, 2019, vol. 230, issue 4, 2021, vol. 232, no. 20-22, 2023), and 2025 to appear.

The title of the conferences is traditional and reflects main topics of early FQMT conferences. However, the range of the topics of the recent FQMT conferences, including the FQMT'26, is broader to cover new developments.

Public Lectures at the FQMT Conferences - Overview

The previous public lectures were presented by the following speakers:

FQMT'04		
	Anthony Leggett:	Does the everyday world really obey quantum mechanics?
FQMT'08		
	Georgy Shlyapnikov:	Novel physics with ultracold fermions
	Marlan Scully:	The demon and the quantum: From thermodynamics to quantum mechanics and beyond
	Raymond Chiao:	The Big Bang and the Cosmic Gravitational-wave Background (CGB): Using quantum mechanics to detect the first rumors in the Universe
FQMT'11		
	Martin Rees:	From Big Bang to Biospheres
	Claude Cohen-Tannoudji:	Laser manipulation of atoms
FQMT'13		
	Serge Haroche:	Juggling with photons in a box to explore the quantum world
	Pavel Kroupa:	How astronomers define our world view
FQMT'15		
	Gerard 't Hooft:	The quantum deep down
	Marlan Scully:	The photon sheds light on the quantum
FQMT'17		
	John Pendry:	Metamaterials and the science of invisibility
	Anton Zeilinger:	From quantum puzzles to quantum information technology

FQMT'19

William Phillips:	Time, Einstein and the coolest stuff in the universe
Rainer Weiss:	The beginnings of gravitational wave astronomy
Wolfgang Ketterle:	Cooling close to absolute zero temperature: A recipe for discoveries

FQMT'21

The conference was held online only and no public lectures were included.

FQMT'22

Guy J. Consolmagno:	Astronomy, God, and the Search for Elegance
Harrison Schmitt:	From Coyotes to Moonbeams

FQMT'24

Peter Hänggi:	The ring of Brownian motion: Its beneficial use for physics and elsewhere
Theo Geisel:	Musical Synchronization and the Secrets of Swing
Allen M. Hermann:	Fundamental Aspects of the Physics of Music
John Mather:	Discoveries with the James Webb Space Telescope

Conference overview

Frontiers of Quantum and Mesoscopic Thermodynamics 2026 - FQMT'26

26 July (Sunday) – 1 August (Saturday) 2026, Prague, Czech Republic

https://fqmt.fzu.cz/26/

The FQMT'26 conference will be held at the traditional venue, the Pyramida Hotel, located near the Prague Castle. All FQMT conferences have been held in Prague and their welcome parties have been always organized in the Wallenstein Palace, the seat of the Czech Senate.

Scope of the conference

The main goal of the conference is to contribute to a better understanding of the behavior of quantum systems out of equilibrium. To reach this aim we also need to include studies and improve our knowledge of systems in equilibrium and steady state situations. The conference will thus address foundations of quantum physics, quantum many body physics, statistical physics, and thermodynamics relying on the theoretical and experimental methods of condensed matter physics and quantum optics. To cover transition between quantum and classical behavior and to understand better under which conditions quantum behavior emerges, the systems of the order of mesoscopic (nanoscale) size (both artificial and natural origin) will be especially considered. Special attention will be given to non-equilibrium quantum systems, physics of information and physics of biological systems. Subjects from astrophysics, gravitation or cosmology related to the above scope will also be included.

Topics

Fields

- Non-equilibrium statistical physics, thermodynamics
- Foundations of quantum physics
- Cosmology, gravitation, astrophysics
- Many body physics, quantum field theory
- Quantum optics, optoelectronics, plasmonics, and atomtronics
- Physics of imaging and quantum sensors
- Quantum simulations
- Metrology
- Tests of quantum gravity
- Physics of quantum information and computing
- Quantum machine learning
- Biophysics, physics of active matter, quantum biology
- Physics of neural networks, artificial intelligence

Phenomena

- Non-equilibrium quantum phenomena
- Transport phenomena far from equilibrium
- Quantum measurement, vacuum, entanglement, coherence
- Macroscopic quantum behavior, cold atoms and molecules
- Turbulence at various scales
- Dissipation, dephasing, noise, decoherence
- Light - matter interactions
- Emergent phenomena in strongly interacting open systems
- Topological states of quantum matter, quantum phase transitions
- Dynamics of cellular structures

Systems

- Quantum open systems at various space and time scales
- Quantum heat engines, molecular motors
- Mesoscopic, nano-electromechanical and nano-optical systems
- Biological systems, organoids

Multidisciplinary Character of the Conferences

The aim of the FQMT'26 conference is to create a bridge between researchers from the fields of physics and related disciplines as covered by the above conference topics. Following the tradition of the FQMT conferences, the FQMT'26 will again bring together a unique combination of both young and experienced scientists across a disciplinary spectrum covering the above-mentioned topics. The interdisciplinary character of the conference will be supported by the choice of key speakers who, apart from their specializations, are not only able to report specific results within their fields but are also able to discuss the state of the art of their fields from the standpoint of a broader perspective of overlap with other fields. It is an objective to gather important scientists from overlapping branches of physics who can mutually benefit from the exchange of different views and ideas, experiences from studies of many different systems and various theoretical and experimental approaches to the study of current problems in physics. It is intended that this arrangement of the scientific program of the conference will again significantly contribute to the formulation of challenging questions and problems, as well as their related answers that are nowadays essential to improve the understanding of the foundations of quantum physics, many body physics, quantum statistical physics of systems far from equilibrium, the physics of nanoscale and biological systems, and further, will motivate new collaboration and intensive discussions between experts from differing fields of physics, chemistry, and biology.

Additional information on the conference series history, including programs of the public lectures and concerts presented at the previous conferences, can be found in the file 'The history, characteristics, and overview of the FQMT conference events'. For the history of the FQMT conferences and details of their programs, see also the FQMT overview pages.

Public Lectures and Special Talks

Following the tradition of FQMT conferences, the FQMT'26 program will include several public lectures and special talks which will present interesting topics in a form attractive for both the conference participants and general audience.

The speakers will be announced later on.

The lectures and talks will be held at special venues and accompanied by concerts.

Musical, Art and Social Programs

An encompassing social program includes the number of social events and tours in order that participants may enjoy not only physics but also Prague during the conference, sometimes in a way, which is hardly available to common visitors of Prague. Hence, for accompanying persons this is an opportunity of rare quality to visit this city.

Participants of FQMT'26 conference will have an exceptional opportunity to spend some time in the Wallenstein Palace. The participants and their partners could enjoy the large baroque Garden of the Wallenstein Palace with its nice Sala Terrena for discussions during the evening welcome party. A guided tour will be organized through the huge baroque complex of the Wallenstein Palace. This would be a unique experience by itself since it is difficult to see all these places under ordinary circumstances.

In keeping with the multidisciplinary character of the scientific program, the cultural richness of the city of Prague and the tradition of the previous FQMT conferences, the FQMT'26 program will feature concerts performed by world-class musicians, held at outstanding venues of the city. The list of these places will highly probably include the National House of Vinohrady (Neo-Renaissance social and culture center with luxurious halls), the Gothic Cathedral of St. Vitus at Prague Castle (one of the symbols of the Czech Lands), and the Baroque Strahov Monastery (with its famous library and exceptional view of Prague) or the Břevnov Monastery.

The scientific, the fine arts, and the musical programs are intended as a complement to one another, where scientists, historians of the arts and musicians are encouraged to mingle and share their knowledge and experience. An encompassing social program is planned which will include tours and a number of very special events unavailable to the general tourist.

The conference is held under the auspices of

Prof. RNDr. Radomír Pánek, Ph.D.
President of the Czech Academy of Sciences

The conference is supported by

- Committee on Education, Science, Culture, Human Rights and Petitions of the Senate of the Parliament of the Czech Republic
- Institute of Physics, the Czech Academy of Sciences
- Institute for Quantum Science and Engineering, Colleges of Science and Engineering, Texas A&M University, USA
- College of Engineering and Science, University of Detroit Mercy, USA

The conference is organized by

- Institute of Physics of the Czech Academy of Sciences
- Committee on Education, Science, Culture, Human Rights and Petitions of the Senate of the Parliament of the Czech Republic

Organizing Committee

Conference chair: Václav Špička (*Institute of Physics, Czech Academy of Sciences, Prague*)
Jiří Bok (*Charles University, Prague*)
Howard Brubaker (*Detroit*)
Pavla Bušová (*Prague*)
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Vladimír Kunický (*Prague*)

Jiří J. Mareš (*Institute of Physics, Czech Academy of Sciences, Prague*)
Theo M. Nieuwenhuizen (*University of Amsterdam*)
Claudia Pombo (*Amsterdam*)
Marie Svobodová (*Tacca Agency, Prague*)
Jarmila Šidáková (*Prague*)

Scientific Committee

(not yet complete)

Chair: Václav Špička (*Institute of Physics, Czech Academy of Sciences, Prague*)
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Biman Bagchi (*Indian Institute of Science, Bengalúru*)
Vanderlei Salvador Bagnato (*IFSC-University of São Paulo*)
Roger Balian (*IPhT, Saclay*)
Gordon Baym (*University of Illinois at Urbana – Champaign*)
Dietrich Belitz (*University of Oregon, Eugene*)
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Hansjoerg Dittus (*German Aerospace Center, Cologne*)
Mark Dykman (Michigan State University, East Lansing)
Daniel Esteve (*CEA-Saclay*)
Karl John Friston (*University College London*)
Steven Mark Girvin (*Yale University, New Haven*)
Peter Hänggi (*University of Augsburg*)
Dudley Herschbach (*Harvard University*)
Ortwin Hess (*Imperial College, London*)
Gregg Jaeger (*Boston University*)
Christopher Jarzynski (*University of Maryland, College Park*)
Andrew N. Jordan (*Chapman University, Orange*)
Richard Jozsa (*University of Cambridge*)
Wolfgang Ketterle (*Massachusetts Institute of Technology, Cambridge*)

Andrei Khrennikov (*Linnaeus University, Växjö*)
Stefan Klumpp (*University of Goettingen*)
Norbert Kroo (*Wigner Physics Research Center, Budapest*)
Anthony J. Leggett (*University of Illinois at Urbana - Champaign*)
Igor Lerner (*University of Birmingham*)
Maciej Lewenstein (*ICFO – The Institute of Photonic Sciences, Barcelona*)
Heiner Linke (*Lund University*)
Peter Vaughan Elsmere McClintock (Lancaster University)
Yigal Meir (Ben Gurion University, Beer Sheva)
Ralf Metzler (*Universität Potsdam*)
Franco Nori (*RIKEN, Wako-shi, and University of Michigan, Ann Arbor*)
Henri Orland (*CEA-Saclay*)
Giorgio Parisi (*Università di Roma I. La sapienza*)
Felix Ritort (*University of Barcelona*)
Christophe Salomon (*Laboratoire Kastler Brossel, Paris*)
Marlan Scully (*Texas A&M University, Baylor University and Princeton University*)
Georgy Shlyapnikov (*Université Paris-Saclay*)
Wolfgang Schleich (*University of Ulm*)
Ady Stern (*Weizmann Institute, Rehovot*)
Michael Thorwart (*University of Hamburg*)
Jan van Ruitenbeek (*Leiden University, Kamerlingh Onnes Laboratory*)
Vlatko Vedral (*University of Oxford, Clarendon Laboratory*)
Rainer Weiss (*Massachusetts Institute of Technology, Cambridge*)
Anton Zeilinger (*University of Vienna*)

Scientific Background

The FQMT'26 program will be focused on conceptual and experimental challenges of non-equilibrium statistical physics, quantum thermodynamics, foundations of quantum mechanics, quantum field theory, metrology, physics of fundamental constants, physics of gravitation, quantum many body physics, quantum optics, physics of quantum information, and biophysics.

Recent advances in technologies have led to an enormous boost in the possibility of creating new, well-defined structures. At the same time, measurements, sensors, imaging and other observation techniques at microscopic, mesoscopic and macroscopic scales have enabled us to measure or observe both natural and artificial structures at various space scales.

With the increasing refinement and use of quantum sensors and simulators, these advances have also opened the way to a deeper understanding of complex quantum phenomena and the related foundations of quantum physics and information.

In addition, various methods allow us to investigate not only equilibrium features of complex many body systems, but also time evolution of these systems (which are in general far from equilibrium) at different time scales. This increasing ability to study subtle details of the dynamics of systems yields new versions of old questions and creates new challenges in many fields of physics.

At the FQMT'26, special attention will be paid, for several reasons, to mesoscopic systems. Various systems, of natural and artificial origin, can exhibit mesoscopic features depending on inherent inner parameters and interactions with their environment. Typical mesoscopic systems are of nanometer size, enabling fast developing nanoscale technologies for the preparation of structures with well-defined inner parameters, providing an enormous diversity of systems subject to interaction with the external environment. Nanoscale structures include not only very small artificially prepared structures, but also structures occurring in living cells, as for example complex molecules, proteins and molecular motors. Such systems lie on the border between different disciplines where the dynamic behavior of these systems and corresponding various methods of their description (individual and statistical, microscopic and macroscopic, classical and quantum) meet. These (often open) systems are commonly dominated by quantum effects, by topology of their structures and states, and by strong interactions with their environment. Due to their position between the macro and micro world, these systems exhibit many surprising phenomena which can lead to a better understanding of quantum mechanics, many-body physics, and the relation between classical and quantum behaviors by sensitive choice of parameters.

A good understanding of the time evolution of both classical and quantum systems is essential for an explanation of many observations and experiments of contemporary physics. Observed systems must often be treated as non-equilibrium, open systems in which their behavior is

influenced not only by their inner parameters, but also by properties of their environment and time dependent external fields. The theory of non-equilibrium behavior of quantum many-body systems is, however, far from complete. Important problems include such questions as irreversible behavior of real systems in comparison with reversible microscopic laws, emergence of classical macroscopic behavior from microscopic quantum behavior, charge (electron), spin and heat transport, limits to "phenomenological" thermodynamic descriptions, and the problem of how to properly describe open quantum systems far from equilibrium, especially in the case of strong interaction between a small system and reservoirs. Various versions of classical as well as quantum fluctuation and fluctuation-dissipation theorems can play an important role in these developments.

Non-equilibrium processes and the system's environment also play a decisive role in living organisms and there are many questions to be answered before we fully understand the laws which govern the performance of the structures essential for life. In this regard, it appears one of the necessary conditions for the proper performance of cells is that their dynamics be based on far from equilibrium states and related nonlinear, non-equilibrium transport. It is thus vital to work on a better understanding of active matter physics. There are also questions about the role of quantum physics in the behavior of various systems which are essential for living organisms, i.e., under which circumstances quantum effects, coherence, fluctuations, and noise can influence a cell's functions.

For quickly developing areas of neurosciences, biology of living cells and immunology the understanding of physics of neural and immunological networks as well as their parts, neural and immunological synapses, is vital. This is complemented by studies of artificial neural networks structures, cerebral organoids and detailed simulations of their behavior. All these interrelated issues are moreover related to the physics of information and the field of artificial intelligence.

Another challenging problem is stochastic behavior of considered systems caused either by their innate features of the systems or by noise related to the studied systems being open. Studies of temperature and quantum fluctuations, as well as quantum noise, dephasing and dissipation are of key importance, since these phenomena are closely related to the performance and the reliability of both artificially created nano-devices and "nano-engines" as well as natural "engines", as are for example molecular motors and processes in cells in general. Behavior of molecular motors is associated with more general considerations related to thermodynamics and the use of various mesoscopic structures. Among the central themes of classical thermodynamics are the concepts of "temperature", "system", "reservoir", and "engine". Due to quantum features of mesoscopic systems, it is necessary to deal with quantum thermodynamics to discuss possible quantum pumps, heat engines or refrigerators based on features of mesoscopic (molecular) systems. The task of quantum thermodynamics is to provide a good "phenomenological" frame for the "macroscopic" description of open

mesoscopic systems coming from more detailed studies of non-equilibrium quantum statistical physics of open systems and the foundations of quantum mechanics.

In general, the above problems arise in dissipation, dephasing and decoherence processes, and, on a very basic level, the foundations of quantum mechanics and related theories of quantum measurement. A better knowledge and insight into the foundations of quantum physics is essential for a proper formulation of the fundamental laws of physics. It is also essential for developing a suitable description of small quantum systems and their applications. This applies particularly to studies of light-matter interactions, cold atoms and molecules, quantum optics and physics of quantum information and computing, where questions of quantum interference, entanglement and decoherence processes, together with knowledge of time scales governing the dynamics of the studied systems, are essential and mutually beneficial. Various quantum (two-state) systems are nowadays intensively studied in the hope that their parameters and related dynamics will be suitable for quantum computers.

Many of the above-mentioned problems are also important for cosmology, gravitation and astrophysics, for the reason that these areas of investigation are strongly related to non-equilibrium statistical physics, many body physics, foundations of quantum physics, physics of quantum measurement, physics of the quantum vacuum, macroscopic quantum phenomena and also, mainly due to measurement methods used for observation and detection, to quantum optics, condensed matter physics, and physics of mesoscopic systems. In addition the methods developed within these fields can help us in better understanding of fundamental constants. These methods have also enabled the recent advances of various tests of quantum gravity (including e.g. quantum equivalence principle) and are therefore important for our better understanding of the Universe.

In summary, further experimental as well as theoretical studies of short to long time dynamics (via transport as well as optical properties) and the influence of initial and boundary conditions are needed. To understand better dynamics as well as equilibrium properties of classical and quantum systems, both theoretical and experimental experiences from such seemingly different, but in fact strongly correlated, fields as condensed matter physics, quantum optics, plasma physics, nuclear physics, physics of quantum information and computing, chemistry, biophysics and astrophysics, will be discussed during the conference program.