

Niels Bohr Quantum Summer School

Niels Bohr Quantum Summer School

Inspiration to shape the Future

Niels Bohr Institute – Copenhagen – Denmark

11 – 22 August 2025

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Participants

Austria:

Christoph Stein
Katerina Stloukalova
Paul Aigner
Thomas Sandø

Johannes Kepler University
University of Innsbruck
University of Innsbruck
University of Vienna

Denmark:

Adam Husted Kjelstrøm
Albert Lars Sigurd Malmros
Anna Bjerregaard
Anton Alnor Christensen
Chulhyeong Lee
Damien Roux
Hans Michael Christensen
Joan Alba Pares
Lars Henrik Olsen
Leo Konzett
Maria Gabriela Jordão Oliveira
Martin Seltsmann
Noah Kaufmann
Samuel John Padraig Bensted
Srushti Patil
Suhaib Al-Rousan
Thue Christian Thann Nikolajsen
Timour Korsak Javar Magnier
Victor Rueskov Christiansen
Victoria Inselmann

Aarhus University
University of Copenhagen
University of Copenhagen
Aarhus University
University of Copenhagen
Technical University of Denmark
University of Copenhagen
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University of Copenhagen
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Technical University of Denmark
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Aalborg University
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France:

Claire Mesny

INSA Lyon

Germany:

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Edison Argüello
Gerhard Huber
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University of Freiburg
Ulm University
Technical University of Munich
Technical University of Munich
University of Konstanz

Israel:

Dror Garti
Eyal Dar
Itay Gomelski
Jeongwon Kim
Michal Arieli
Michal Natan
Ron Cohen
Shani Avitan
Shiran Even Haim
Uri Israeli

Weizmann Institute of Science
Weizmann Institute of Science
The Hebrew University of Jerusalem
Tel Aviv University
The Hebrew University of Jerusalem
Bar Ilan University
Bar-Ilan University
Ben Gurion University
Technion – Israel Institute of Technology
The Hebrew University of Jerusalem

Lecturers

[Aashish Clerk](#), Professor, leader of the Pritzker School of Molecular Engineering, University of Chicago

[Charles Bennett](#), IBM Fellow, IBM Research

[Eliska Greplova](#), Associate Professor, leader of the Quantum Matter and AI (QMAI) group at Kavli Institute of Nanoscience, Delft University of Technology

[Giovanna Sammarco Tancredi](#), Senior Researcher, Quantum Technology, Microtechnology and Nanoscience, Chalmers Institute of Technology

[Jaewook Ahn](#), Professor, Department of Physics, Korea Advanced Institute of Science and Technology

[Jeffrey Grover](#), Research Scientist, Research Laboratory of Electronics Massachusetts Institute of Technology

[Jonatan Kutchinsky](#), Vice President, Cryogenic Electronics, Quantum Machines

[Poul Erik Lindelof](#), Professor Emeritus, consultant in physics based archeology

[William Oliver](#), Henry Ellis Warren (1894) Professor of Electrical Engineering and Computer Science & Professor of Physics, Massachusetts Institute of Technology

[Wolfgang Dür](#), Professor of Theoretical Physics University of Innsbruck

Speaking at QCopenhagen

[Cathal Mahon](#), Chief Business Officer, Deep Tech Lab Denmark

[Jonatan Kutchinsky](#), Vice President, Cryogenic Electronics, Quantum Machines

[Jørgen Ellegaard Andersen](#), professor, Centre for Quantum Mathematics, University of Southern Denmark, and CEO of QPurpose

[Marcus Rommel](#), Senior Research Engineer at Nanofabricationlab, MC2 at Chalmers University of Technology & Chief Technology Officer at Con-Science AB

[Sabrina Maniscalco](#), Professor of Quantum Information, Computing, and Logic and Chief Executive Officer at Algoritmia



Aashish Clerk

Professor, leader of the Pritzker School of Molecular Engineering, University of Chicago

Controlling quantum systems using engineered dissipation

Any kind of quantum technology requires the ability to robustly prepare and manipulate complex quantum states. While the most straightforward approach involves tailoring unitary evolution to achieve these goals, there is growing interest in approaches that harness controlled non-unitary evolution. This can be achieved in a number of different physical platforms by strategically engineering dissipative processes. This general approach is often referred to as “reservoir engineering” or “autonomous control”, and has already been used experimentally to prepare non-classical states and even implement a kind of autonomous quantum error correction. My lectures will give a general introduction to these ideas, providing concrete examples and also discussing challenges and opportunities when trying to extend the approach to truly many-body systems.



Charles H. Bennett

IBM Fellow, IBM Research

Thermal disequilibrium and the emergence of classicality and complexity

Modern cosmology has revived interest in some early 20th century puzzles that had seemed to be more philosophical than scientific, e.g. the Boltzmann’s brain problem of whether we might be merely statistical fluctuations in an old dead universe rather than inhabitants of a young live one, and the Wigner’s friend problem of the possible experiences of an inhabitant of an unobserved quantum system. We consider how thermodynamic disequilibrium stabilizes classicality and structural complexity in systems that would otherwise lack both.



Eliška Greplova

Associate professor, Kavli Institute of Nanoscience, Delft University of Technology

Quantum Computing in the Age of AI

Contemporary quantum computers and simulators keep increasing in size and complexity. While this enormous progress allows both academia and industry to explore quantum systems at an unprecedented scale, the newest generation of devices also comes with unparalleled control and calibration challenges. Enter artificial intelligence: At the heart of all quantum computing problems lies a data interpretation task. How much can the predictive and generalization power of AI help us tackle these challenges? In this talk I will explain how to apply modern computational methods, including AI, to control and learn physics of contemporary quantum devices and I will give a perspective on how AI can aid us as we scale up the newest generation of quantum technologies.



Giovanna Sammarco Tancredi

Senior Researcher, Quantum Technology, Microtechnology and Nanoscience, Chalmers Institute of Technology

Building a scalable quantum processor

Superconducting circuits are among the leading platforms for building scalable quantum computers, offering a promising path toward practical quantum information processing. These lectures provide an overview on how to design a scalable quantum processor based on superconducting qubits, introducing its key components and discussing the challenges ahead.



Jaewook Ahn

Professor, Department of Physics, Korea Advanced Institute of Science and Technology

Quantum Computing with 3D Graphs of Rydberg Atoms

This talk introduces a new approach to quantum computing using dynamically reconfigurable 3D graph structures formed by Rydberg atoms in free space. Combining high-speed “throw-and-catch” atom manipulation with fast quenching protocols, we may enable the creation of transient graph topologies that encode computational problems on demand. This method may overcome limitations of fixed arrays, operating within tight coherence time constraints while allowing complex, high-connectivity structures. I’ll present early experimental strategies, control models for atom dynamics, and theoretical time-evolving quantum graphs, to discuss potential applications in optimization and analog quantum computation.



Jeffrey Grover

Research Scientist, Research Laboratory of Electronics
Massachusetts Institute of Technology

Superconducting qubits represent a leading modality to realize a fault-tolerant quantum computer, owing to their lithographic fabrication, controllability, and fast operating speeds. Implementing high-fidelity operations on them, however, requires complicated calibration and control techniques, especially when multiple qubits are coupled together. In these lectures, we will cover how to bring up these systems in the lab—from spectroscopy to crosstalk, and pi pulses to benchmarking gates.



Poul Erik Lindelof

Professor Emeritus

Consultant in physics based archeology, University of Copenhagen

Selected solid state experiments at HCØ/NBI 17-65 years ago: Mesoscopic electron devices and spin/qubit.

In 1960 Henning Højgaard Jensen became a professor at the Institute of Theoretical Physics (in 1963 named the Niels Bohr Institute) at the University of Copenhagen. He came from a professorship at the Technical University of Denmark, where he was a celebrated teacher in physics. The plan was, that he should start teaching the first year physics students at the University of Copenhagen at the then brand new H.C. Ørsted Institute. Henning Højgaard Jensen at the same time had the plan of starting up solid state low temperature research (Finn Berg Rasmussen, Ole Per Hansen, Malte Olsen (a dilution cryostat to reach 20 mK) and Poul Erik Lindelof (then Gregers-Hansen) (magnetoresistance in bismuth). Ole Per Hansen set up an evaporation system which we used for thin films and Josephson tunnel junctions. The devices were measured in my glass cryostat at 1.7 K. Sn og In thin films were the precondition for < 1micrometer thin film constriction Josephson junctions using a special razorblade technique developed in close collaboration with Mogens Levinsen, a master student of Ole Per Hansen. Many Josephson devices and mesoscopic superconductors and normal metals were subsequently fabricated, not least thanks to many students and to my technical assistant in those days, Ole Eg.

After my doctoral thesis on superconductivity, 1981, I turned the direction of my research towards semiconductor heterostructures, inspired by the discovery of the quantum Hall effect in 1979. Samples were picked up at various laboratories abroad and nano processed by a purchased JEOL scanning electron microscope (SEM). I subsequently sent in an application to the Research Council for a center of molecular beam epitaxy (MBE) and lithographic facilities in 1985. Ing. Claus B. Sørensen was (and still is) the key person of setting up these facilities.

I filmed the setting up of the nanofabrication laboratory and the MBE instrument 1985-1990, and I will show this video in my talk.

Finally, my presentation will highlight various successful and unsuccessful experiments with many collaborators until my retirement in 2008: Several coupled GaAl-xAs quantum dot qubits and quantum point contacts. Carbon nanotube qubits, integrating carbon nanotubes into GaAs crystals, InAs submicron rod quantum dots, Aharonov-Bohm qubit rings, MBE growth of GaAs flat structures, attempts to generate single photons using surface acoustic waves.



William Oliver

Henry Ellis Warren (1894) Professor of Electrical Engineering and Computer Science & Professor of Physics at Massachusetts Institute of Technology.

Introduction to Quantum Computing

In this lecture, we look at an intuitive picture of quantum computing, including quantum interference and quantum parallelism. We will look at single-qubit and two-qubit gates and how to realize a universal gate set. We will survey different types of quantum computing platforms and compare them against one another.

Superconducting Qubits

In this lecture, we will dive in deeper to superconducting qubits and how they work. We'll review Josephson junctions and quantization of qubit circuits. We will review recent experiments with them that have yielded high fidelity single-qubit and two-qubit gate operations.



Wolfgang Dür

Professor of Theoretical Physics, University of Innsbruck

Quantum communication and quantum networks

In these lectures we discuss the basic principles of long-distance quantum communication, where protocols such as entanglement purification and quantum repeaters are introduced. We will also deal with quantum communication networks, where we concentrate on utilizing multipartite entangled states to enhance capabilities, and go beyond point-to-point communication.

Most prominently, we will consider graph states and their application for quantum communication and computation, including their local manipulation to enable different protocols, or to flexibly generate desired target states. We will provide a glimpse towards stack models or operating systems for future quantum networks, and briefly discuss applications in the context of distributed quantum computation and sensor networks.

Monday 11 August

09:00 – 10:00 Registration for official opening of the summer school at the Niels Bohr Building, Jagtvej 155, 2200 Copenhagen.

💡 There are several ways of public transportation to get to the Niels Bohr Building from Cabinn Copenhagen. Use the app Rejseplanen to find the best route and pay with Rejsekort

10:00 – 12:00 Opening speech

Danish Minister of Higher Education and Science, Christina Egelund, will open the summer school followed by a reception and possibility to meet and network with special invited guests.

🚶 12:00 – 12:30 Students walk to Blegdamsvej 17

12:30 – 13:00 Welcome, practical information and presentation round

Professor Klaus Mølmer, Associate Professor Kim Splittorff, University of Copenhagen, and programme coordinator Louise Juel Broch, DeIC

🎓 **13:00 – 14:00 Introduction to Quantum Computing**

Professor William Oliver, Massachusetts Institute of Technology

🌿 14:00 – 14:15 Short Break

🎓 **14:15 – 15:15 Quantum Computing with 3D Graphs of Rydberg Atoms**

Professor Jaewook Ahn, Korea Advanced Institute of Science and Technology

🚶 15:15 – 16:00 Transport to Kongens Nytorv

💡 From the Niels Bohr Institute you walk 10 minutes to Trianglen Station and take the metro M3 to Kongens Nytorv and then you walk to Det Kongelige Teater. Remember your Rejsekort!

🚶 **16:00 – 18:30 Guided tour through the streets of Copenhagen**

Discover Copenhagen on a two-hour walking tour with local guides, exploring some of the city's most iconic landmarks. Highlights include Nyhavn, Amalienborg Palace, The Marble Church, Rosenborg Castle, and The King's Garden.

Along the way, you'll hear stories about Copenhagen's history, everyday life, and vibrant culture. This is a fun and engaging way to experience the Danish capital and connect with fellow participants along the way.

Read more at [Copenhagen By Mie](#).

🍕 18:30 – 21:00 Pizza at NBI

Tuesday 12 August

🎓 09:00 – 10:00 Introduction to student challenge

Associate Professor Kim Splittorff, Niels Bohr Institute,
University of Copenhagen

💡 The student challenge will give you a chance to collaborate on a present day problem within quantum technology. There will be a number of challenges which you can choose to work on depending on your personal interests. The solutions will be presented on the final day of the school.

☂️ 10:00 – 10:15 Short break

🎓 10:15 – 12:15 Quantum Computing with 3D Graphs of Rydberg Atoms

Professor Jaewook Ahn, Korea Advanced Institute of Science and Technology

🍽️ 12:15 – 12:45 Lunch

🎓 12:45 – 14:45 Superconducting Qubits

Professor William Oliver, Massachusetts Institute of Technology

☂️ 14:45 – 15:00 Break

🎓 15:00 – 16:00 Discussions

Professor William Oliver, Massachusetts Institute of Technology
Professor Jaewook Ahn, Korea Advanced Institute of Science and Technology

Wednesday 13 August

🎓 09:00 – 10:00 Controlling quantum systems using engineered dissipation

Professor Aashish Clerk, Massachusetts Institute of Technology

☀️ 10:00 – 10:15 Short break

🎓 10:15 – 12:15 Control and calibration of multi-qubit systems

Professor Jeffrey Grover, Massachusetts Institute of Technology

🍽️ 12:15 – 12:45 Lunch

🎓 12:45 – 12:55 Introduction to Entrepreneurship

CEO Jakob Svagin, BioInnovation Institute, Quantum Center of Excellence Lead,
Anne Gladbo Platz, BioInnovation Institute and Vice President Cryogenic Electronics
Jonatan Kutchinsky, Quantum Machines

12:55 – 13:15 The Danish quantum ecosystem and what we do in DeiC

Head of Quantum Infrastructure, Henrik Navntoft Sønderskov, DeiC

🎓 13:15 – 17:10 “Hands-On” in Q Labs

Associate Professor Kim Splittorff, Niels Bohr Institute,
University of Copenhagen

Thursday 14 August

🎓 09:00 – 12:15 “Hands-On” in Q Labs

Associate Professor Kim Splittorff, University of Copenhagen

🕒 12:15 – 12:45 Lunch

🎓 12:45 – 14:45 Controlling quantum systems using engineered dissipation

Professor Aashish Clerk, Massachusetts Institute of Technology

🕒 14:45 – 15:00 Short break

🎓 15:00 – 16:00 Quantum communication and quantum networks

Professor Wolfgang Dür, University of Innsbruck

Friday 15 August

🎓 **09:00 – 11:00 Quantum communication and quantum networks**

Professor Wolfgang Dür, University of Innsbruck

☕ 11:00 – 11:15 Short break

🎓 **11:15 – 12:15 Control and calibration of multi-qubit systems**

Professor Jeffrey Grover, Massachusetts Institute of Technology

🍽️ 12:15 – 12:45 Lunch

🎓 **12:45 – 14:00 Discussions**

Professor Wolfgang Dür, University of Innsbruck

Professor Jeffrey Grover, Massachusetts Institute of Technology

🖼️ **14:00 – 14:15 Preparing poster session**

🖼️ **14:15 – 16:00 Student poster session**

As part of the summer school, we will have a poster session where all summer school participants can present their own research.

Please prepare and bring a poster presenting your project with you.

The poster should fit within the measurements 90 x 190 cm.

The poster session is an internal event, but we will invite staff and students from the Niels Bohr Institute to come have a look.

Saturday 16 August

Saturday free to do your own thing ... Ideas could be:

👤 **Changing of the guards** (12:00 at Amalienborg. Is the King home? See if the flag is up)

🏳️ **Copenhagen Pride Parade** (13:00 from Frederiksberg Rådhus, Pile Allé, Frederiksberg Allé, Skt. Thomas Plads, Vesterbrogade, Hammerichsgade, Vester Voldgade, Rådhuspladsen). Lots of street parties and side events – See more here www.copenhagenpride.dk/

✚ **Assistens Kirkegaard** (Find the graves of Niels Bohr and H.C. Andersen) www.visitcopenhagen.dk/koebenhavn/planlaeg-din-tur/assistens-kirkegaard-gdk964360

🛶 **GreenKayak** (Book a kayak and help keep the harbour clean. Book here: <https://bookings.greenkayak.org>)

🏖️ **Swimming at Islands Brygge Harbour Bath:** www.visitcopenhagen.com/copenhagen/planning/islands-brygge-harbour-bath-gdk482346

Find inspiration for other things to do at www.visitcopenhagen.com



Sunday 17 August

🚢 10:45 – 11:45 Transport to Ungdomsøen

Ferry leaves from Nyhavn at 11.15. We will eat lunch on the ferry.

🧑 11:45 – 14:30 Visit to Ungdomsøen laser game and other activities

Bring a towel and a bathing suit if you want to go swimming

We will be divided into three groups and will take turns in a laser game.

🚢 14:50 Sailing back to Nyhavn

💡 Ungdomsøen is a youth-led island community based on the former sea fort Middelgrundsfortet, just off the coast of Copenhagen. Originally built in the 1890s as part of Denmark's coastal defences, the island was transformed in 2015—thanks to support from Danish foundations and the Scout Movement – into a space for young people to lead, create, and collaborate.

Opened in 2019, Ungdomsøen empowers 15–31-year-olds to run their own projects, workshops, and events with minimal adult involvement. Guided by values such as inclusivity, hands-on learning, and youth leadership, the island serves as both a retreat and a platform for civic engagement and personal development.



Monday 18 August

🏠 09:00 – 10:00 Selected solid state experiments at HCØ/NBI 17–65 years ago: Mesoscopic electron devices and spin/qubit

Professor Emeritus, Poul Erik Lindelof, University of Copenhagen

☕ 10:00 – 10:15 Short break

🏠 10:15 – 12:00 Discussions

Professor emeritus, Poul Erik Lindelof, University of Copenhagen

IBM Fellow, Charles H. Bennett, IBM Research

🍽️ 12:00 – 12:30 Lunch

🏠 12:30 – 13:30 Thermal disequilibrium and the emergence of classicality and complexity

IBM Fellow, Charles H. Bennett, IBM Research

🚶 13:30 – 14:00 Students walk to the Niels Bohr Building

🏠 14:00 – 15:00 Quantum Computation using Majorana-Based Topological Qubits

Partner Research Manager Roman Lutchyn, Microsoft

🍽️ 18:30 – 21:30 Midway Dinner at Det Glade Vanvid, Læderstræde 3

Note that the doors will open at exactly 18:30 and if you are late, you will not be let in.

Det Glade Vanvid:

Appetizer and sparkling wine (also alcohol free)

3 courses inspired by the season

7 selected wines from our wine bar, with 4 kinds of non-alcoholic wine

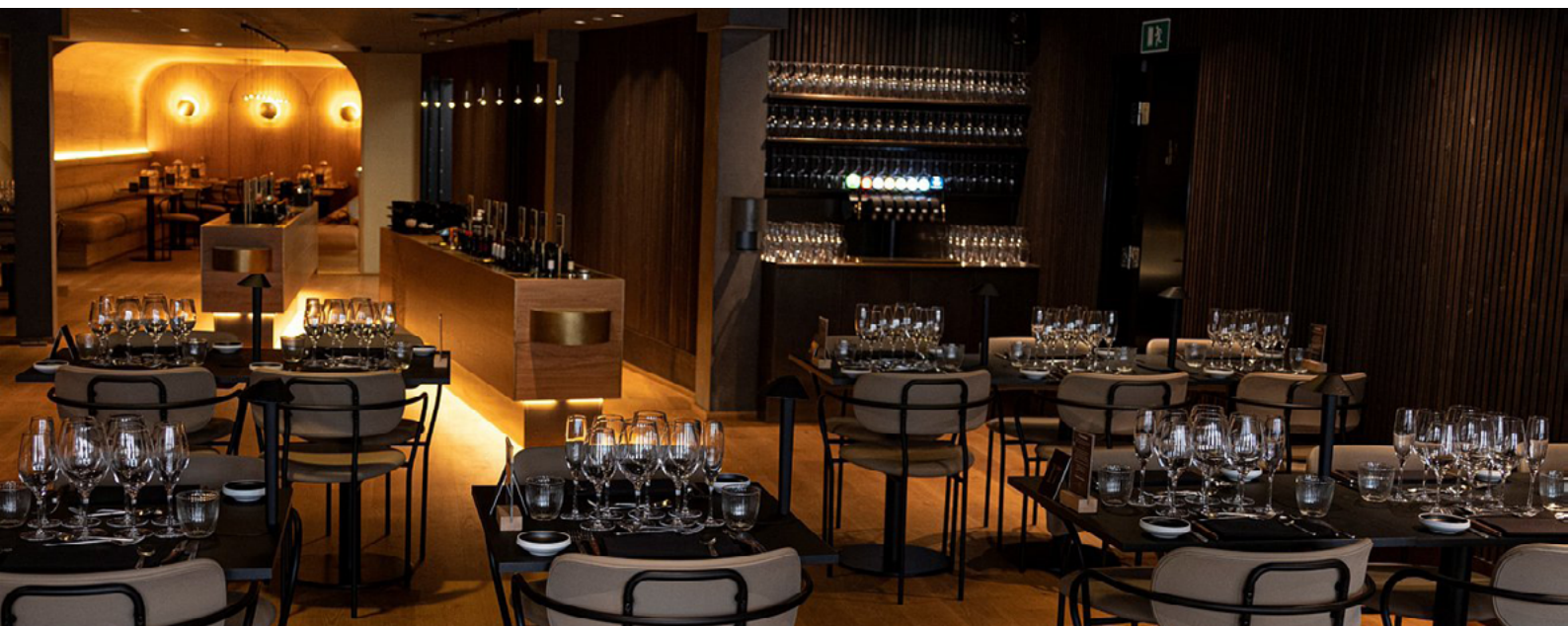
Beer, soda and ice water

Sourdough bread with herbs served with a spread of the season

Petit-fours with coffee

Selected coffee and tea, with choice of decaffeinated coffee/tea

The Chef's choice of digestif. Including aged rum, Cognac and Calvado



Tuesday 19 August

 **10:00 – 12:00 Working with student challenge**

 12:00 – 12:30 Lunch

 **12:30 – 13:30 Quantum Computing in the Age of AI**

Associate professor, Eliška Greplová, Delft University of Technology

 13:30 – 13:45 Short break

 **13:45 – 14:45 Q Systems Giovanna Sammarco Tancredi**

 **14:45 – 16:00 Discussions**

Associate professor, Eliška Greplová, Delft University of Technology

Professor, Giovanna Sammarco Tancredi, Chalmers University

Wednesday 20 August

🎓 09:00 – 11:00 **Giovanna Sammarco Tancredi**

🎓 11:00 – 12:00 **Discussions**

🍽️ 12:00 – 12:30 Lunch

🎓 12:30 – 14:30 **Quantum Computing in the Age of AI**

Associate professor Eliška Greplová, Delft University of Technology

📚 14:30 – 16:00 **Working with student challenge**

Thursday 21 August

🏠 09:00 – 12:00 Workshop at BioInnovation Institute

Why Solving a Real Problem Matters

Group Exercise: What Problem Could You Solve?

Understanding Your Customer

Group Exercise: Who would care?

Reflections & Discussion

Jonatan Kutchinsky's Startup Journey in Quantum Tech

QCopenhagen

12:00 Registration of participants, lunch, networking and time to visit the exhibition

12:45 Welcome

Jens Nielsen, CEO, BioInnovation Institute and

Henrik Navntoft Sønderskov, Head of Quantum Infrastructure, DeiC

13:00 Opening speech

Morten Bødskov, Minister for Industry, Business and Financial Affairs

13:10 QPurpose

Jørgen Ellegaard Andersen, Professor & Director of Centre for Quantum Mathematics, University of Southern Denmark & Chief Executive

Officer of QPurpose

13:40 Algorithmiq

Sabrina Maniscalco, Professor, University of Helsinki & co-founder and Chief Executive Officer of Algorithmiq

14:10 Break and networking – time to visit the exhibition

14:40 From Micro Fluids to Quantum Circuits – a Nanofabrication Engineers Perspective

Marcus Rommel, Senior Research Engineer at Nanofabricationlab, MC2, Chalmers University of Technology & Chief Technical Officer at Con-Science AB

15:10 Inspiration to shape the future

Karin Beukel, PhD & Chief Innovation Officer, KU Lighthouse

15:30 Venture creation

Cathal Mahon, Chief Business Officer and companies from BII

16:20 Quick pitch round with exhibitors and closing remarks

Head of Quantum Infrastructure, Henrik Navntoft Sønderskov, DeiC

16:40 Networking and drinks – time to visit the exhibition

Friday 22 August

 09:00 – 12:00 Student challenge presentations

 12:00 – 12:30 Lunch + Student challenge prizes and goodbye

Phone numbers you might need

Emergency Services (Police, Fire, Ambulance): 112

Use only in life-threatening situations.

Non-Emergency Police: 114

For reporting crimes or incidents that are not urgent.

Medical Advice Line (non-emergency): 1813

For health concerns outside GP hours – Copenhagen area

Tourist Help – VisitDenmark (main line): +45 33 25 74 00

National tourism agency. Office hours only.

A few pointers to Denmark

You don't need cash

Denmark is nearly cashless. Bring a Visa or Mastercard – note that the ATMs charge a large fee if you withdraw cash.

Tap water is safe to drink

No need to buy bottled water – save money and refill your bottle anywhere.

No need to tip

Hospitality staff in Denmark earn a living wage, so tipping is not expected. If the card machine asks if you would like to add a tip, feel free to decline.

English is widely spoken

Estimated 90 % of Danes speak English

Use public transport

Trains and buses are clean, punctual, and efficient. Use the Rejseplanen app to plan your route. Use the app Rejseplanen to find your way around. Use the app Rejsekort to pay

Cycling is a way of life

Especially in Copenhagen – rent a bike to explore the city like a local. Just remember to follow traffic rules and use hand signals. A helmet is not required by law, but it is recommended.

Note, that if you rent an e-Scooter you have to wear a helmet.

You can rent bicycles via the app DonkeyRepublic

Red means stop

Danes stop for the red light in the pedestrian crossing.

Even if there are no cars.



Questions

If you have questions of any kind please reach out to the coordinator of the summer school.

Louise Juel Broch

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Places you are going during the summer school:

Niels Bohr Institute
Blegdamsvej 17
2100 Copenhagen Ø

Niels Bohr Building
Jagtvej 1
2200 Copenhagen N

BioInnovation Institute
Ole Maaløes Vej 3
2200 Copenhagen N

Cabinn Copenhagen
Arni Magnussons Gade 1
1577 Copenhagen V

**SparShipping (going to
Ungdomsøen)**
Nyhavn 71
1051 Copenhagen K

**Det Kongelige Teater
(going on guided tour)**
August Bournonvilles
Passage 8 (Kgs. Nytorv)
1055 København K

Det Glade Vanvid
Læderstræde 3
1201 Copenhagen K



**INNOVATION
CENTRE
DENMARK**



AARHUS UNIVERSITY

