MINISTRY OF FOREIGN AFFAIRS
OF DENMARK
Invest in Denmark

QUANTUM COMPUTING TO THE AID OF MANKIND

DANISH EMERGING TECH WEBINAR SERIES

NASSCOM IN PARTNERSHIP WITH INVEST IN DENMARK - September 9th 2021

AGENDA

1. **Welcome by Nasscom**
2. The Danish quantum ecosystem
3. Gopal Karemore, Novo Nordisk
4. Mark Jones, Molecular Quantum Solutions
5. Q&A and wrap-up

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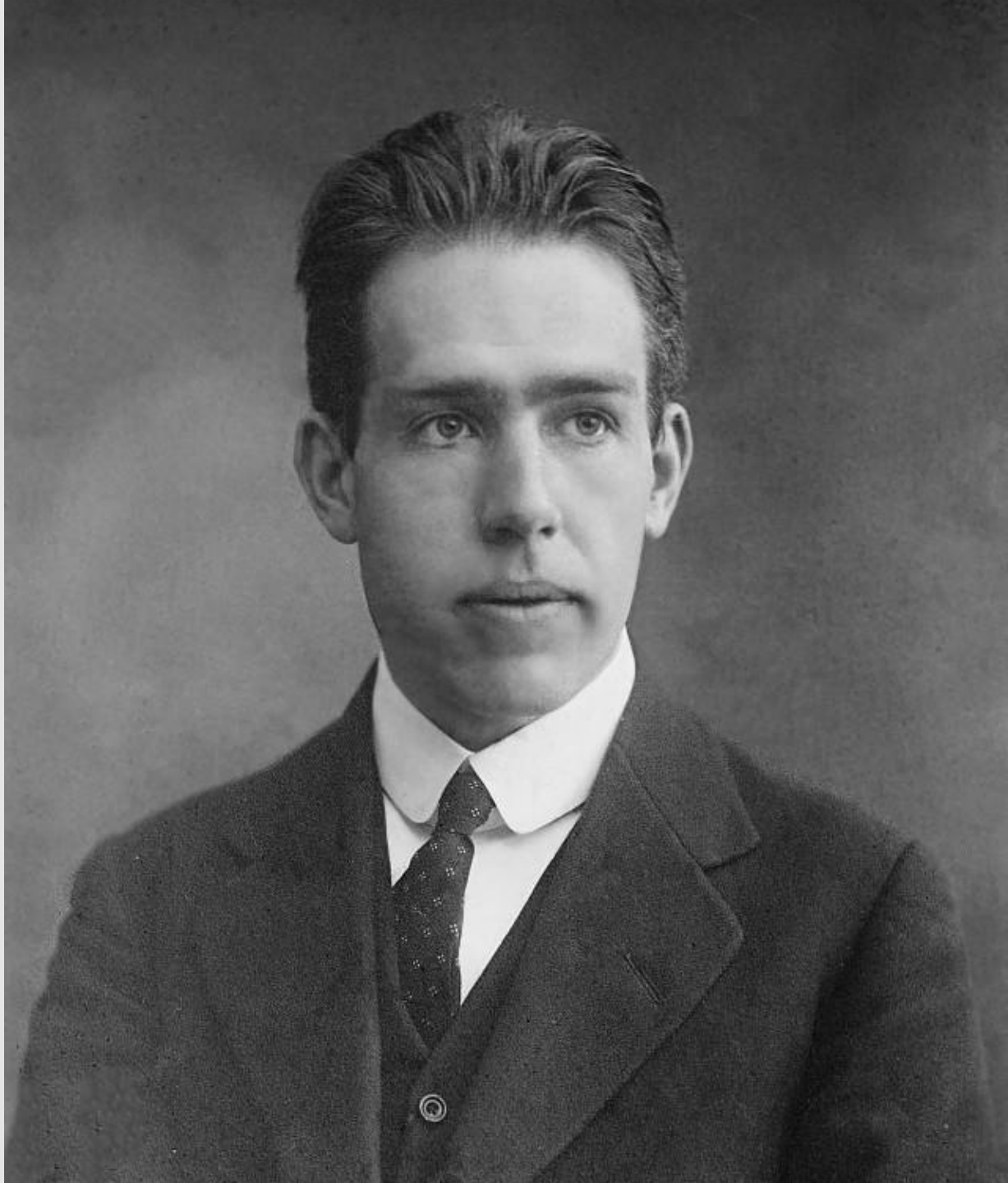
THE LEGACY OF BOHR

For over 100 years, Denmark has been at the forefront of ground-breaking discoveries within quantum physics starting with **Niels Bohr** in 1913 when he formulated his theory about the hydrogen atom based on quantum theory, that energy is transferred only in certain well defined quantities.

Today Denmark is still cutting-edge in quantum research and on of the strongest hubs for quantum technology development in the world.

Denmark is e.g. getting twice as much funding from EU research programmes for quantum projects compared to the general funding level.

What does this mean for?



DENMARK – A QUANTUM TECHNOLOGY PIONEER

Denmark can offer companies an attractive environment to work collaboratively with **world-class research institutions** to strengthen R&D, commercialisation and product pipeline.

Denmark can also offer **state-of-art design, testing and manufacturing competences and facilities** relevant to quantum technology development and a **growing start-up environment**.

Finally, but not lease, Denmark has a **strong focus on educating** talent needed for the second quantum revolution.

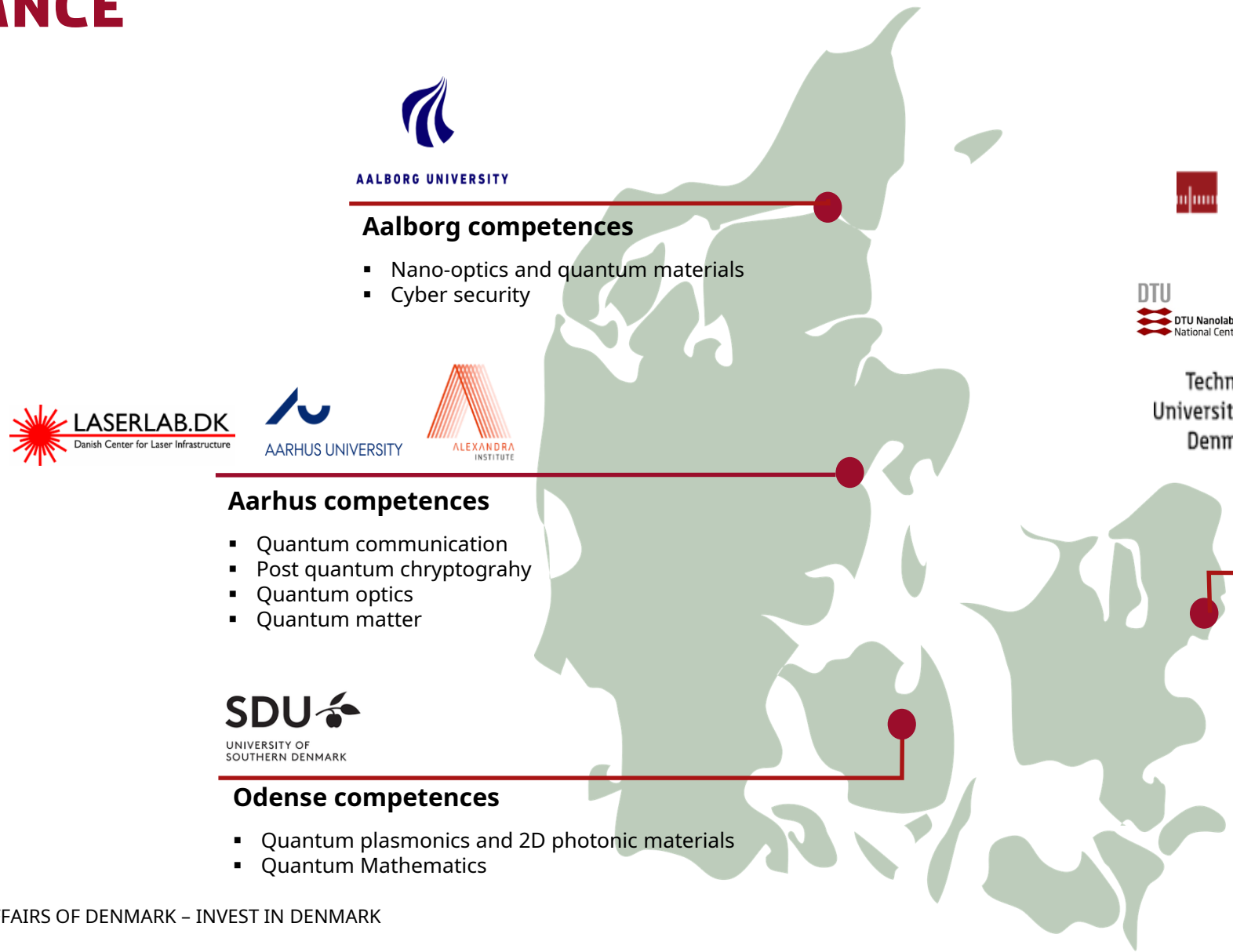
WORLD-CLASS RESEARCH INSTITUTIONS

STATE-OF-THE-ART DESIGN, TESTING AND MANUFACTURING COMPETENCES AND FACILITIES

GROWING QUANTUM STARTUP ENVIRONMENT

STRONG TALENT PIPELINE

DANISH QUANTUM RESEARCH STRONGHOLDS AND CLUSTERS AT A GLANCE



AALBORG UNIVERSITY

Aalborg competences

- Nano-optics and quantum materials
- Cyber security

LASERLAB.DK
Danish Center for Laser Infrastructure

AARHUS UNIVERSITY

ALEXANDRA INSTITUTE

Aarhus competences

- Quantum communication
- Post quantum chryptograhy
- Quantum optics
- Quantum matter

SDU
UNIVERSITY OF SOUTHERN DENMARK

Odense competences

- Quantum plasmonics and 2D photonic materials
- Quantum Mathematics

DFM
Danish National Metrology Institute

DTU
DTU Nanolab
National Centre for Nano Fabrication and Characterization

DANISH TECHNOLOGICAL INSTITUTE

Technical University of Denmark

DTU

DANFYSIK

UNIVERSITY OF COPENHAGEN

Copenhagen competences

- Solid state research
- Quantum photonics
- Post quantum cryptography and quantum key distribution technology (QKD)
- Ultra precise measurement
- Design competences of accelerator systems and subsystems
- Nano- and microfabrication
- Magnetism and quantum materials
- Quantum metrology (Frequency references, characterizations and quantum light sources)

STRONGHOLDS IN DANISH QUANTUM R&D: OVERVIEW

The following areas have been identified as strongholds in quantum technology development in Denmark and as research areas with a potential to create commercial value for industry in the near term; in all areas active projects are ongoing:

QUANTUM SENSING	QUANTUM ELECTRONIC COMPUTING	PHOTONIC QUANTUM TECHNOLOGY	QUANTUM COMMUNICATION	QUANTUM ELECTRONIC MATERIALS
• New approaches to sensing in proof-of-principle demonstrations of magnetic-field detection beyond quantum limits (ultra precise measurement)	• New kind of information processing, in which quantum parrelism is used as a ressource to greatly accelerate computational speed	• Novel devices based on photons and hardware development for photonic quantum simulators, quantum networks, quantum chryptograhy, and novel light sources	• Development of completely new systems for high-rate quantum key distribution (QKD) that efficiently solves alle the challenges in a single system for the first time	• Synthesis and charecterization of the essential material platforms

COMPANIES WORKING WITH QUANTUM TECHNOLOGY AND ENABLING TECHNOLOGY IN DENMARK

CRYPTOGRAPHY

CRYPTOMATHIC
ZYBERSAFE
Alea Quantum Technologies
DENCRYPT

CONSULTANCY

KPMG
Deloitte.
TRIFORK.

LASER AND SINGLE PHOTON SOURCES

Sparrow Quantum
NKT Photonics

INTEGRATED OPTICS

Accelink
SiPhotonIC TECHNOLOGIES

NANOFABRICATION AND MATERIALS

Beamfox
Microsoft
DTU
DTU Nanolab
National Centre for Nano Fabrication and Characterization
DANISH TECHNOLOGICAL INSTITUTE
NIL TECHNOLOGY

SENSING AND MEASUREMENT TECH

NLIR
Mid-Infrared Sensors
FOSS
Ibsen photonics
DFM
Danish National Metrology Institute

DATA SCIENCE AND MODELLING

Quantum Wise
MQS Molecular Quantum Solutions
Hafnium Labs

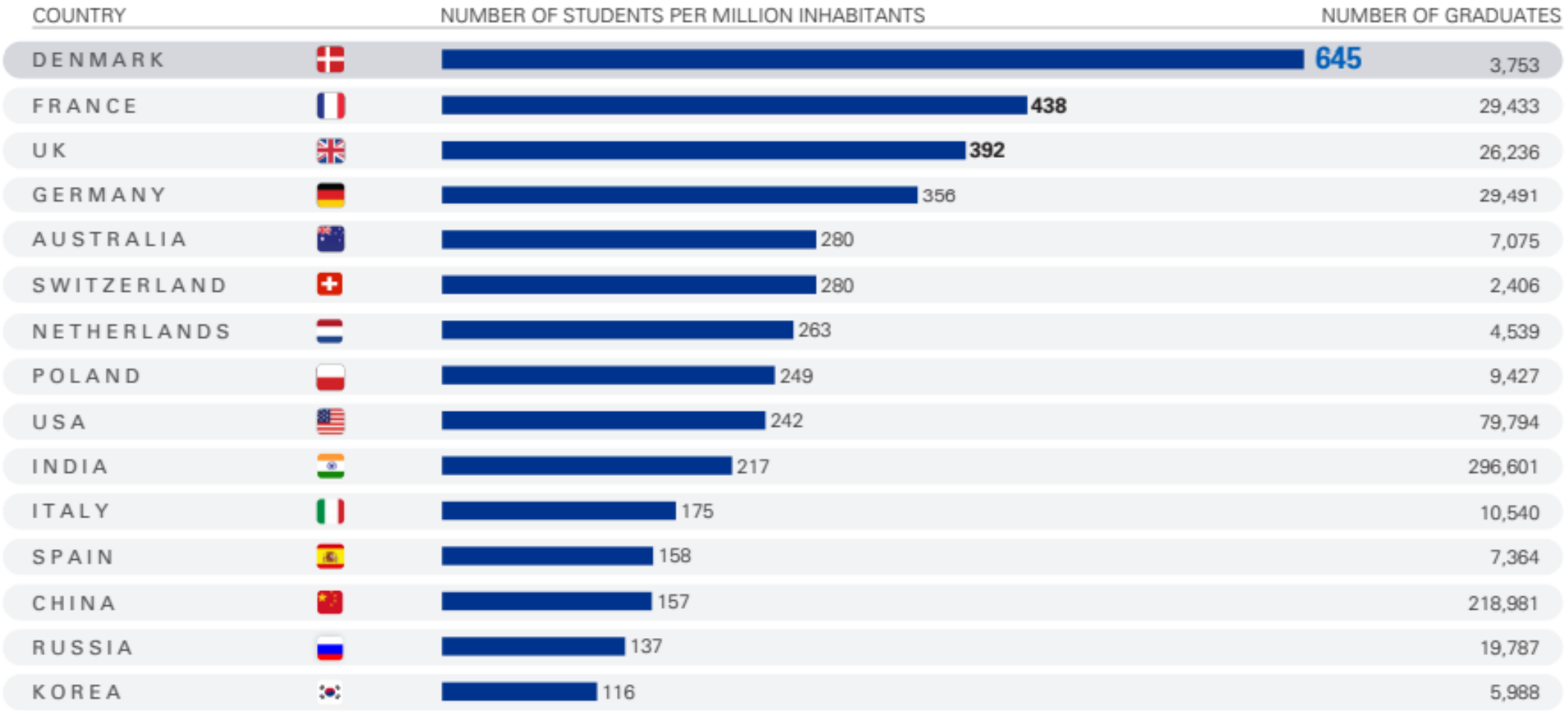
QUANTUM COMPUTING

IBM

CRYOTECHNOLOGY

QDevil

QUANTUM TALENT



Source: Quantum Delta - Nederland, 2020

FUTURE TALENT POOL*

Denmark is at the forefront when it comes to taking active steps in securing that industry will have access to the neccesary competences in order to realize the full potential of quantum technology.

Practical Quantum Technology Education for Industry

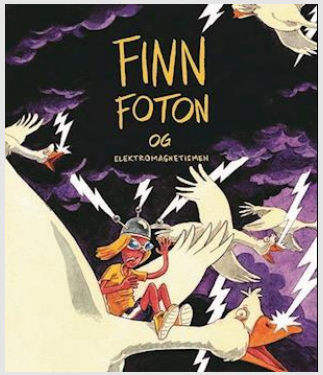
A new project at Aarhus University funded by EU to:

- Map future industry needs for competences
- Develop new intuition-based course modules and curricula for non-phycisist
- Create a common language for specialists working with quantum technology - e.g. engineers and project managers.

New Master programme in Quantum Science (QMSc)

Copenhagen University will launch a new Master of Quantum Science from 2022.

The pilot phase started in the Fall term of 2019 and is a collaboration between The Niels Bohr Institute (Physics), Qmath (Quantum Mathematics) and DIKU (Department of Computer Science).



erc European Research Council

*Illustrations from the childrens book ”Finn Foton” about electromagnetism and quantum technology by authors Johannes Töws, Jan Egesborg & Ulrich Busk Hoff (2020) here in a Danish (2020) and Japanese (2020) edition. Also pictured is ”Kvante Karina” by University of Southern Denmark and Kvantebanditter.

ESTABLISH YOUR QUANTUM R&D ACTIVITIES IN DENMARK TO:

- Work with internationally recognized quantum technology researchers and research groups through R&D collaborations with Danish universities
- Get access to state-of-the art research facilities and consultancy services through Danish government-approved Research and Technology Organisations (RTOs)
- Take advantage of funding schemes financed by the Danish Innovation Fund in collaboration with Danish partners in industry and academia
- Benefit from working in a multidisciplinary ecosystem that can drive complicated R&D with world-class competences within data science, nano-technology, photonics and material science
- Collaborate with a critical mass of world-leading industry players in e.g. pharma, fintech and robotics to develop and test NISQ era applications
- **INVEST IN DENMARK IS READY TO ASSIST YOU!**

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