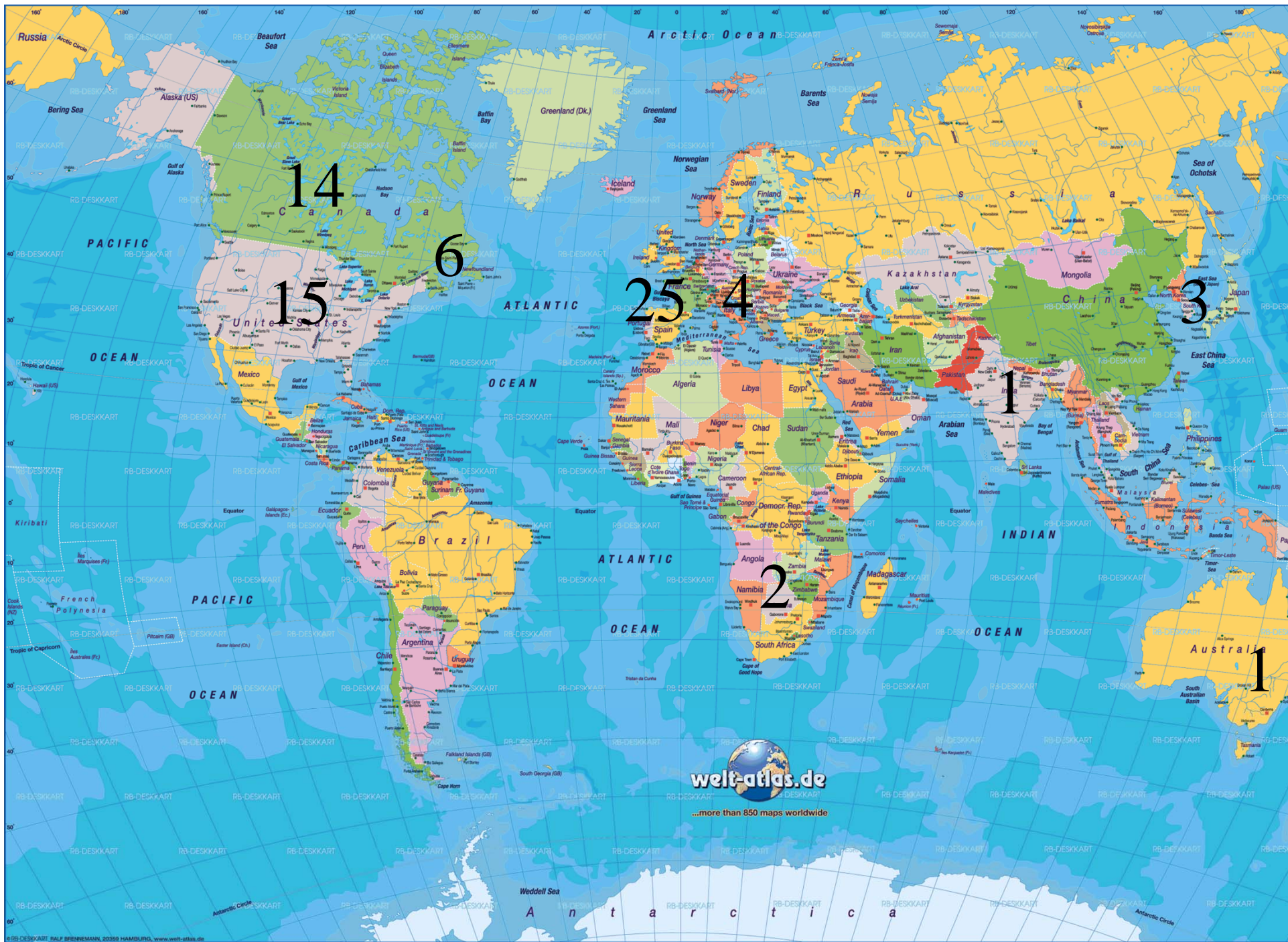
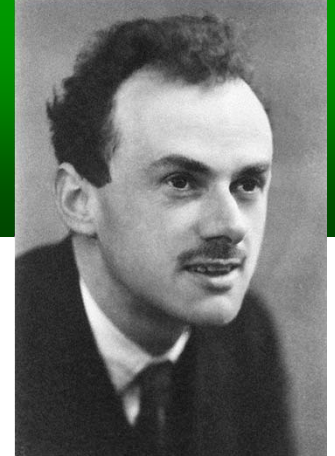


# International summer school on Computational Quantum Materials



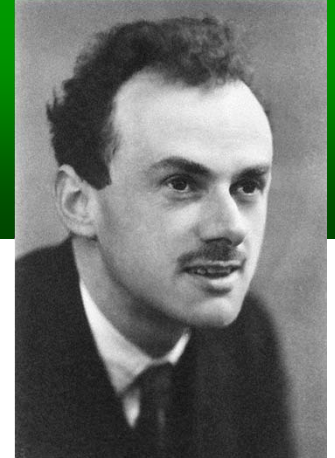


# Dirac



- The underlying physical laws necessary for the mathematical theory of a large part of physics and the whole of chemistry are thus completely known, and the difficulty is only that the exact application of these laws leads to equations much too complicated to be soluble.

# Dirac



- It therefore becomes desirable that **approximate practical methods of applying quantum mechanics should be developed, which can lead to an explanation of the main features of complex atomic systems without too much computation.**
  - *Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character, Vol. 123, No. 792* (6 April 1929)



# The theory of everything

$$H = K + V_{e-e} + V_{e-i} + V_{i-i} + V_{s-o}$$

- 10-1000 eV vs 10 meV (3-5 orders of magnitude)

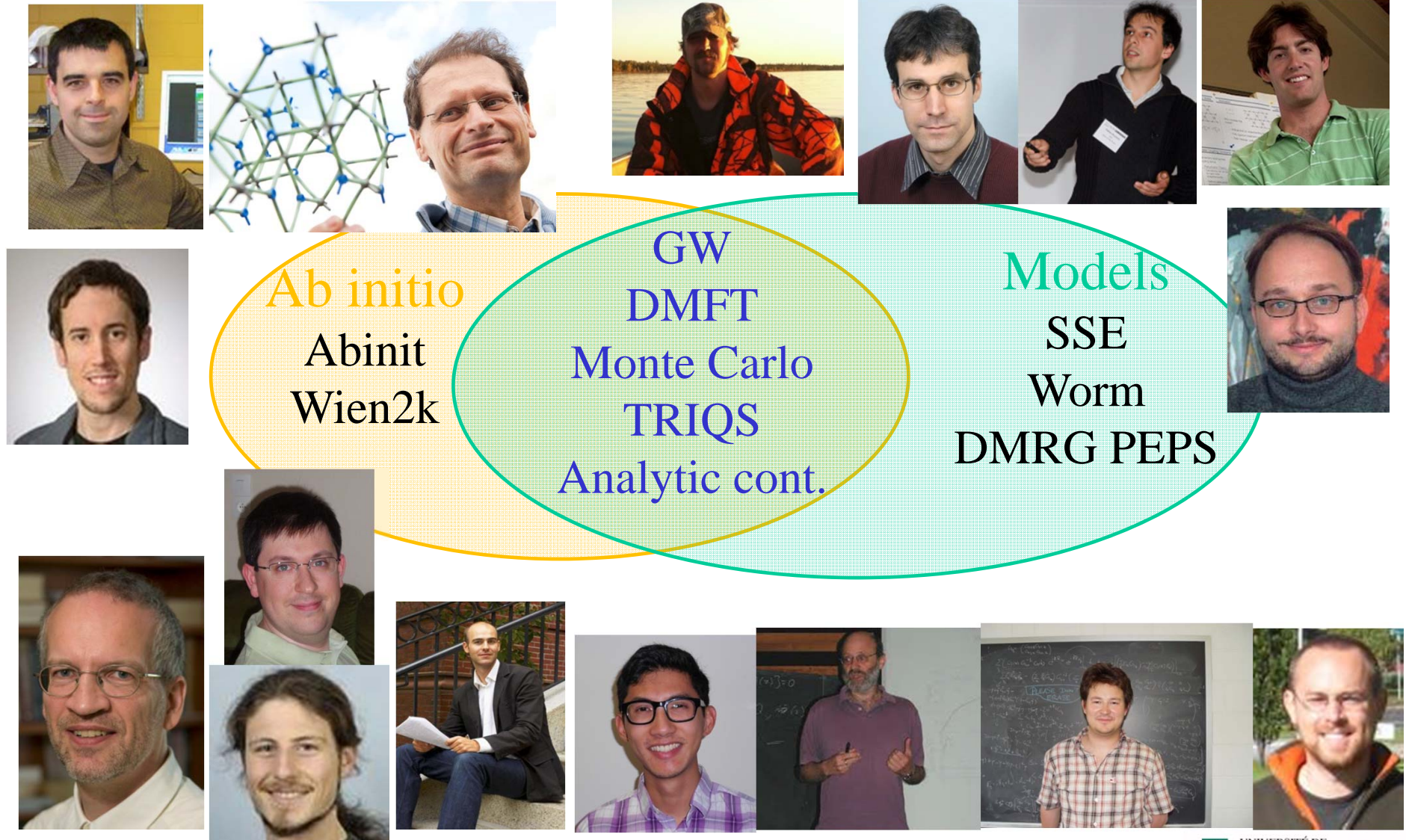


# The theory of everything

$$H = K + V_{e-e} + V_{e-i} + V_{i-i} + V_{s-o}$$

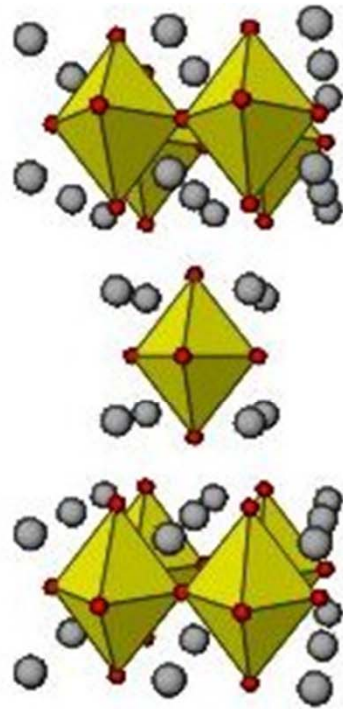
- 10-1000 eV vs 10 meV (3-5 orders of magnitude)
- Broken symmetry (lattice)
- Born-Oppenheimer approximation
- Density functional theory (DFT)
- Methods for effective low energy Hamiltonian (DMFT, GW)
- Beating Moore's law: better algorithms

# Overview

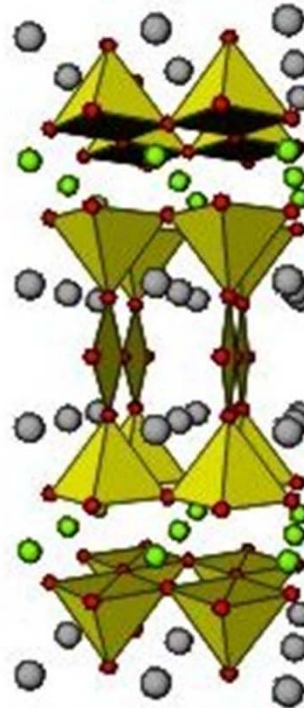




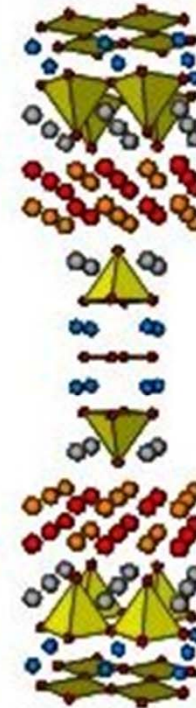
# Quantum Materials



$\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$



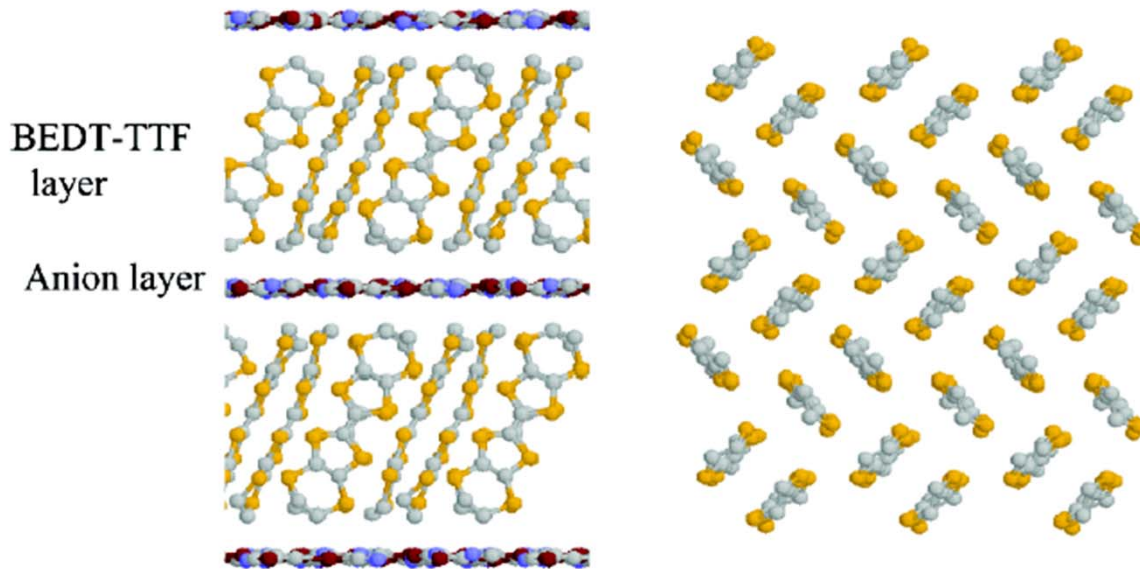
$\text{YBa}_2\text{Cu}_3\text{O}_{7-d}$



$\text{Tl}_2\text{Ca}_2\text{Ba}_2\text{Cu}_3\text{O}_{10}$

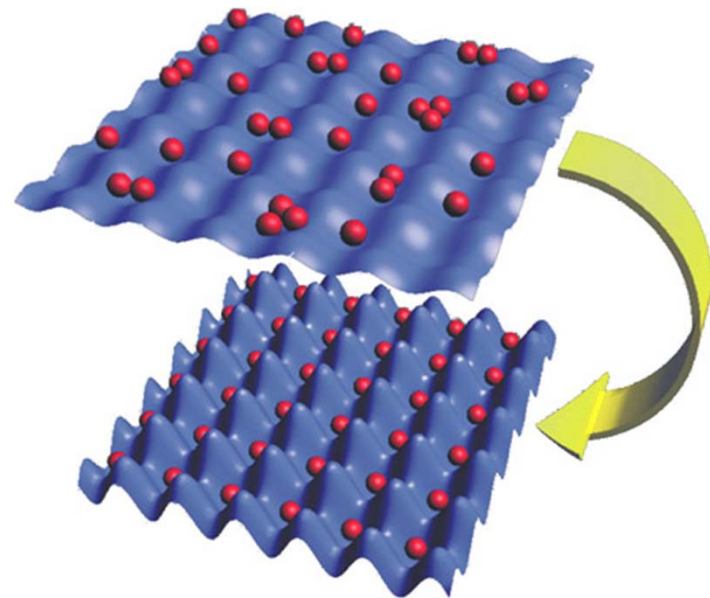
- High-temperature superconductors





- Organics

- Cold atoms in optical lattices



# Local computing infrastructure

- 6 compute nodes (24 cores 2.1GHz AMD, 32GB RAM) = 144 cores, 192GB RAM
- 1 login node (same 24 cores, 32GB RAM)
- CentOS 7 OS
- Gbit Ethernet local network

# POSTERS

- Set them up for the whole school.
- Preceded by « poster advertisement »
- Special times:
  - Monday May 30, 14h00 to 15h00
  - Tuesday May 31, 14h00 to 15h30



# Final exam

- Thursday night June 9
- Friday morning June 10
- Multiple Choice
- YOU CAN STILL REGISTER TODAY



Université de Sherbrooke, through the Canada First Research Excellence Fund, is launching an ambitious **33.5M\$** research program to become a key player in the second quantum revolution of the 21<sup>st</sup> century.

Bring quantum science to the next level by fostering a unique synergy between quantum information, quantum materials and electrical engineering

-

Recruit the best talent of physicists and engineers to exploit groundbreaking discoveries and go ***from quantum science to quantum technology***

### **Partnerships**

Strengthen their **existing** and build **future** partnerships and collaborations with high-tech companies and established research centres, which are pushing the boundaries of quantum-based research, to put Université de Sherbrooke in an excellent position on the world stage.

### **Contact us**

We are looking for motivated individuals and interested parties to be part of this exciting adventure.

[SubventionApogee@usherbrooke.ca](mailto:SubventionApogee@usherbrooke.ca)

# From Quantum Science to Quantum Technology

*Accelerating the second quantum revolution*



***From quantum science to quantum technology Initiative*** is an ambitious **40M\$** research program at the interface of quantum information sciences, quantum materials and quantum engineering.

Quantum sciences is at a stage that it is ready to yield technologies with transformative impact on our society

We offer a world-class research environment where the best talent of physicists and engineers can work together on groundbreaking research, exchanging ideas, and technology development

Through partnerships with established research centres and high-tech companies, pushing the boundaries of quantum-based research, we will accelerate the second quantum revolution and move from **Quantum Science to Quantum Technology**

## Contact us

We are looking for motivated individuals and interested parties to be part of this exciting adventure.

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