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Hard Condensed Matter

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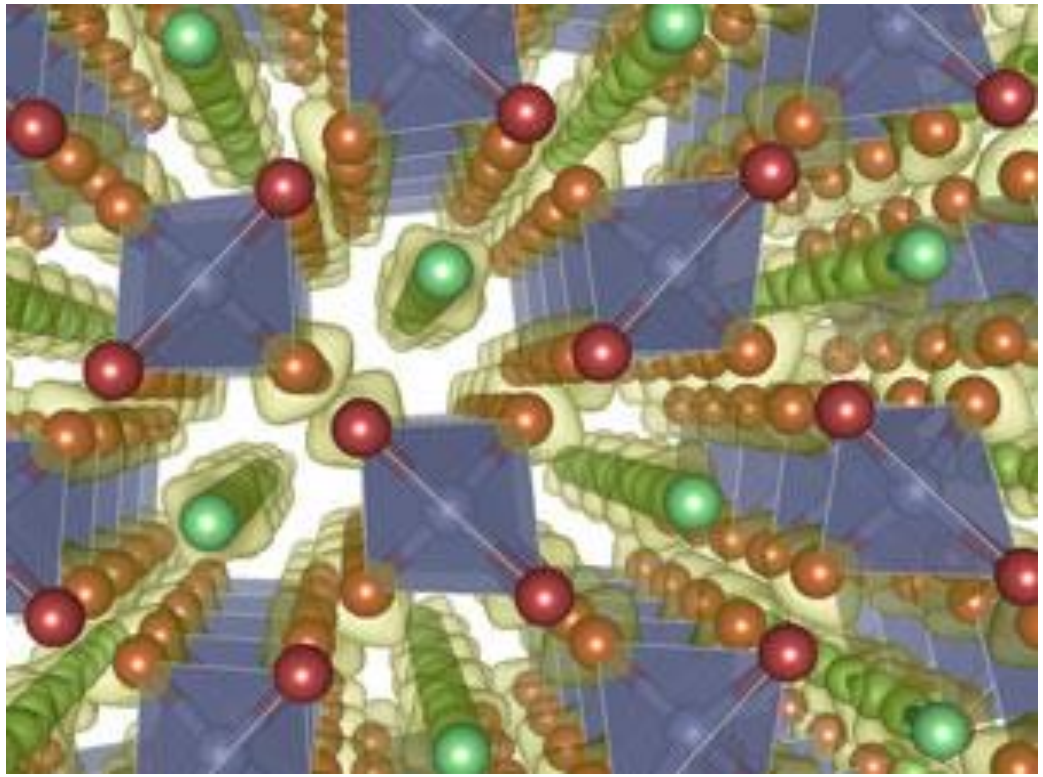
Hard Condensed Matter

- Part of SOPA's Institute for Condensed Matter and Complex Systems
- 15+ Academic staff
- 10+ Postdoctoral fellows
- 20 PhD students
- Research Themes:
  - Extreme Conditions Physics
  - Quantum Ordering
  - Computational Materials Science



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Extreme Conditions Physics

Centre for Science at Extreme Conditions (CSEC)

- Interdisciplinary research centre
  - 5 Schools from College of Science and Engineering
- In top-3 of academic high-pressure research centres
- 35+ Academic staff, 30 Postdocs, 70 PhD students

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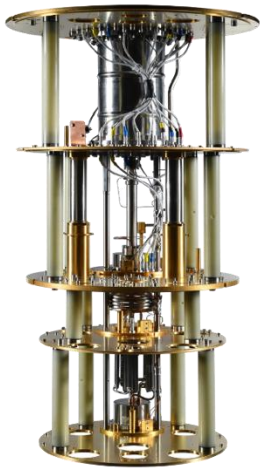
Extreme Conditions Physics

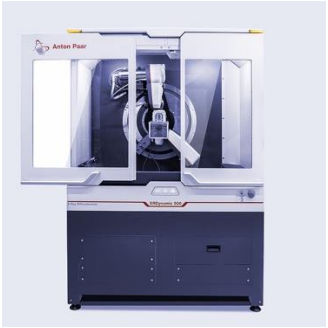
Centre for Science at Extreme Conditions (CSEC)



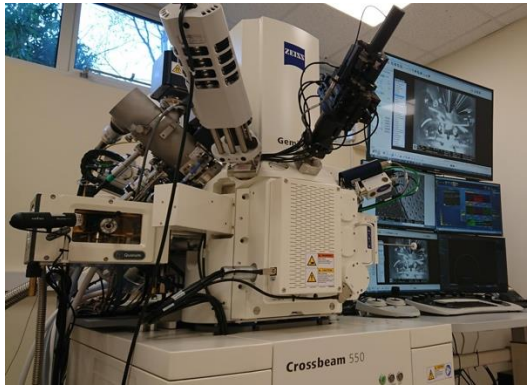
Synthesis

- Multi anvil presses
- Diamond anvil cells
- Crystal growth

Characterization



- X-ray diffraction
- Optical spectroscopy
- FIB-SEM
- Dilution refrigerator
- PPMS



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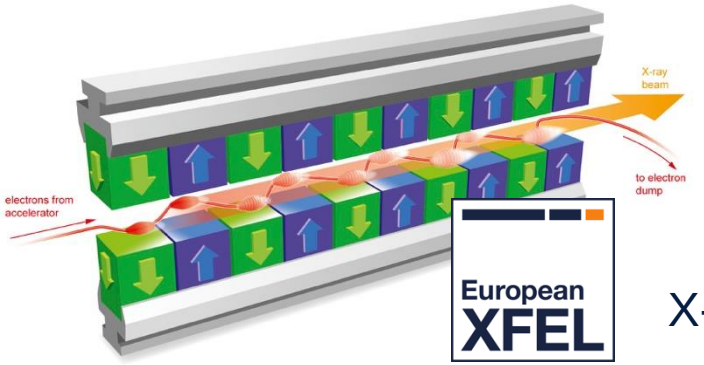
Extreme Conditions Physics

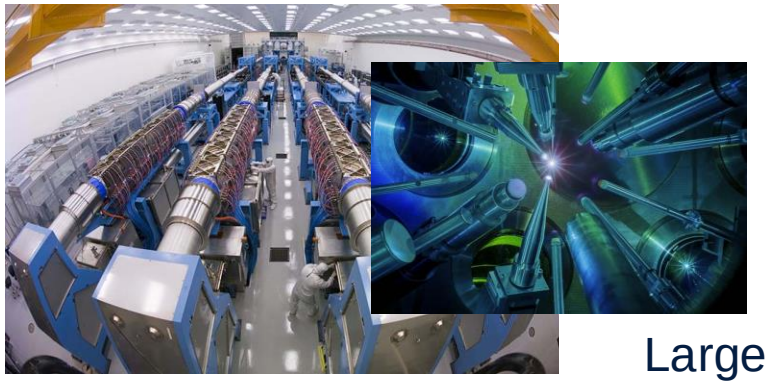
Central Facilities Work

Synchrotrons



X-ray free electron lasers

Neutron sources



Large laser facilities

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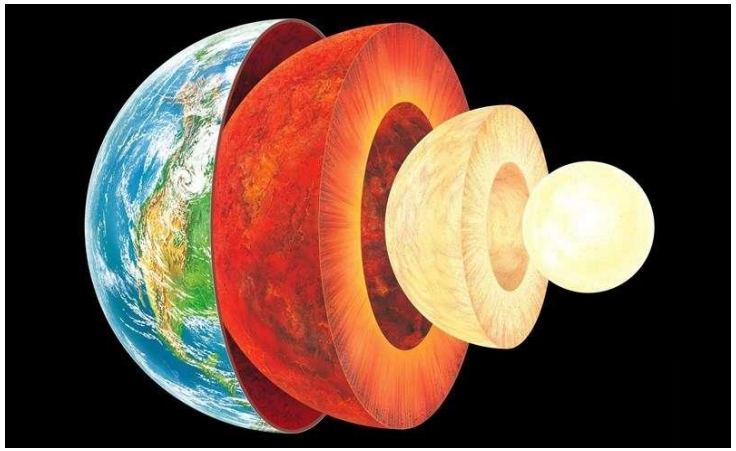
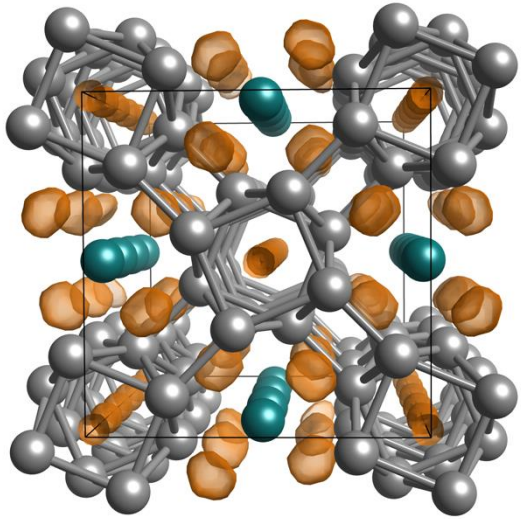
Extreme Conditions Physics

Multi-megabar pressures

- Static compression
  - Diamond anvil cells
- Dynamic compression
  - Laser-induced shock waves



Planetary interiors



Materials science

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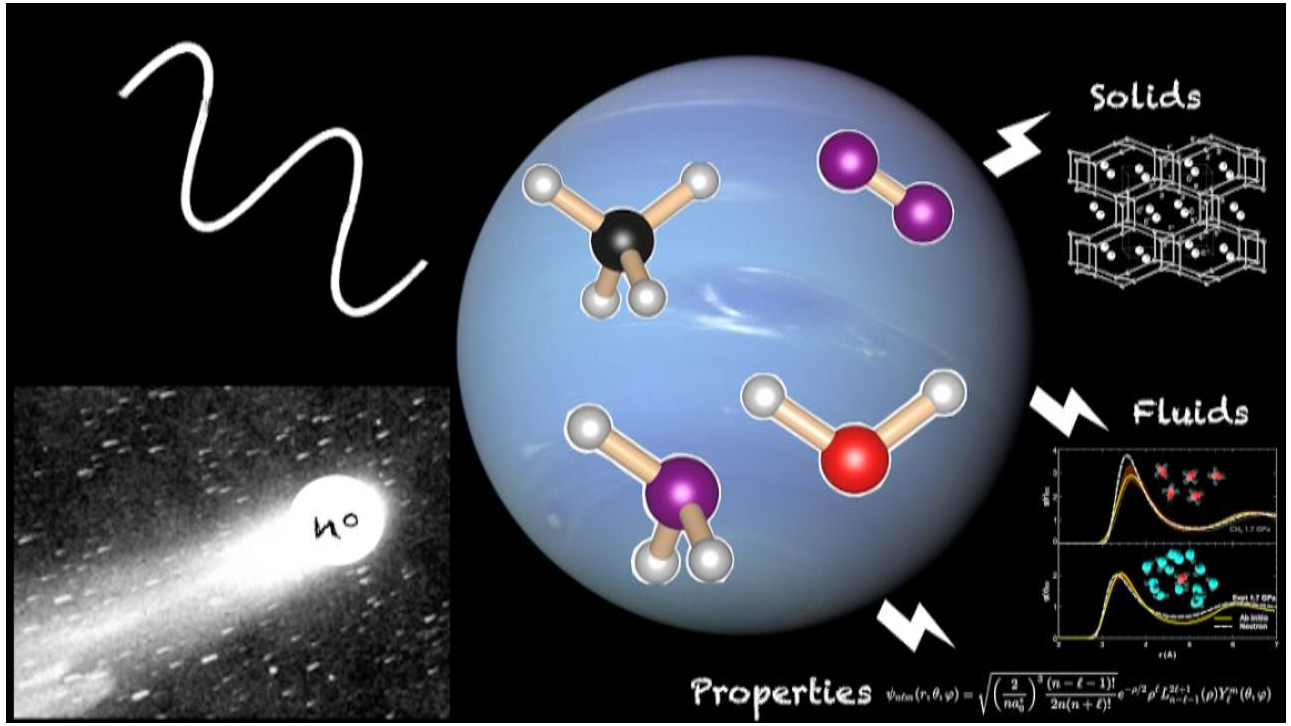
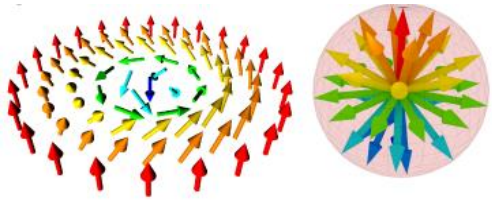
Extreme Conditions Physics

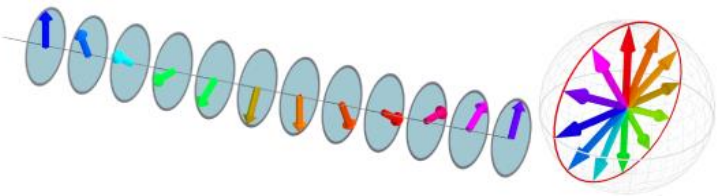
High-pressure chemical physics



- Technological impact
  - Novel gas hydrates
  - Hydrogen Storage
  - Carbon Sequestration
- Fundamental science
  - Miscibility
  - Planetary Mineralogy
  - Abiogenesis

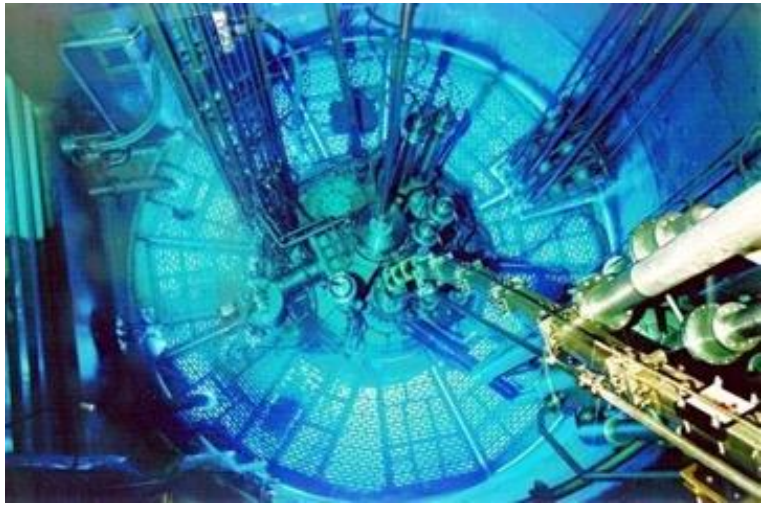
Quantum Ordering





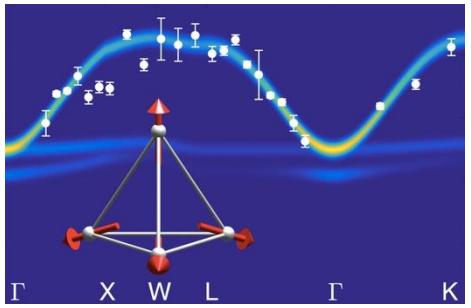
Research Areas

- Non-conventional superconductivity
- Complex Magnetism, quantum criticality
- Ferroelectric Semiconductors
- 2D materials



Experimental Techniques

- Crystal growth
- Low temperatures (10 mK) and high magnetic fields (17 T)
- Scattering and transport measurements
- Central facility work (UK, Europe, USA).



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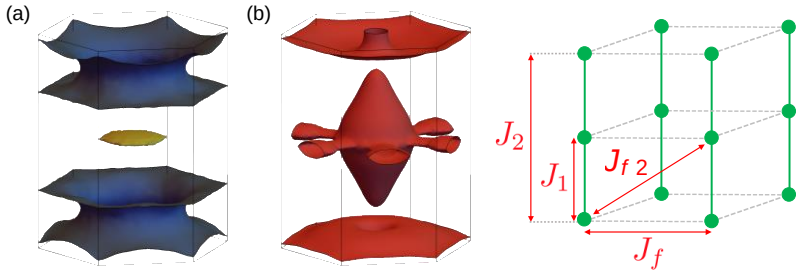
Quantum Ordering

Computation and theory

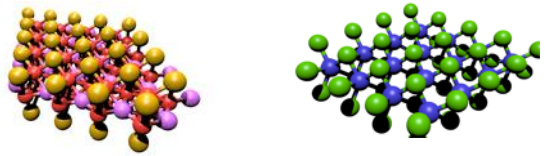
Electronic structure calculations

- Exotic magnetism, superconductivity



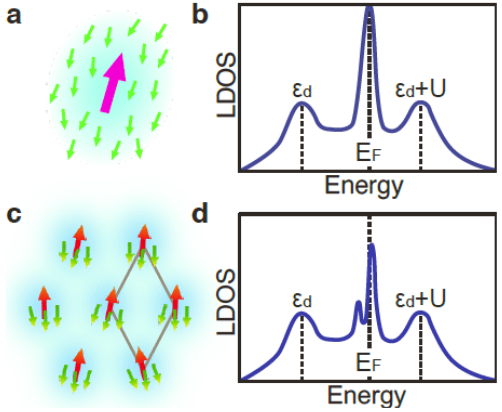
Atomistic spin dynamics modelling

- 2D materials/magnets
- Optical and excitonic properties
- Functional materials for energy-efficient applications
- Make smart devices smarter



Model Hamiltonian studies

- Non-Fermi liquids, Kondo physics



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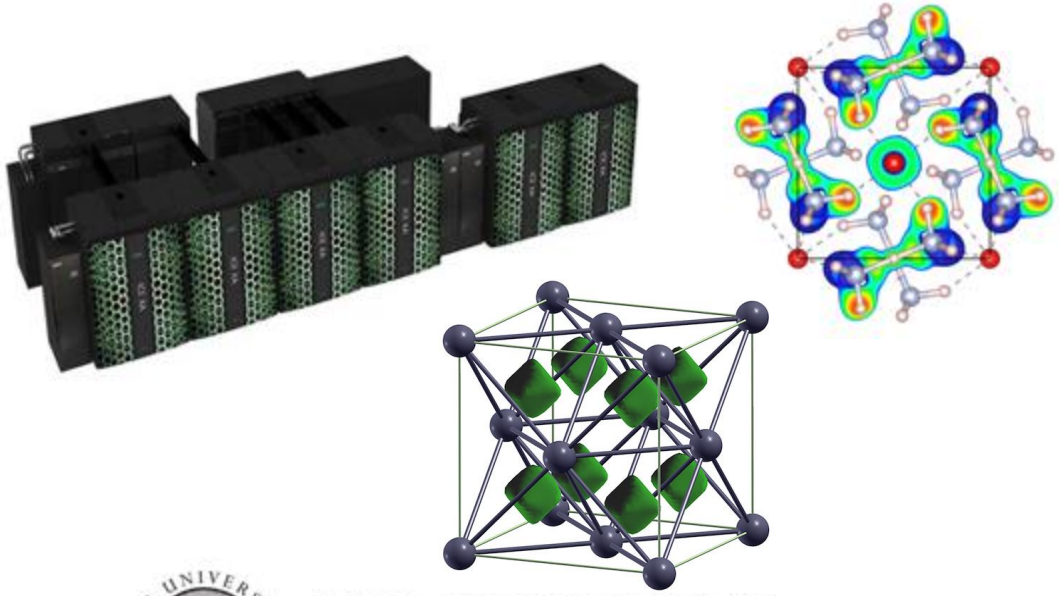
Computational Materials Science

Electronic structure calculations

- High pressure: new states of matter
- High temperature: planetary interiors



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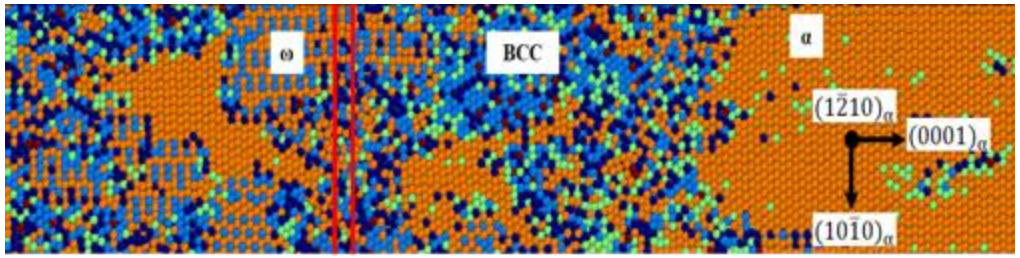
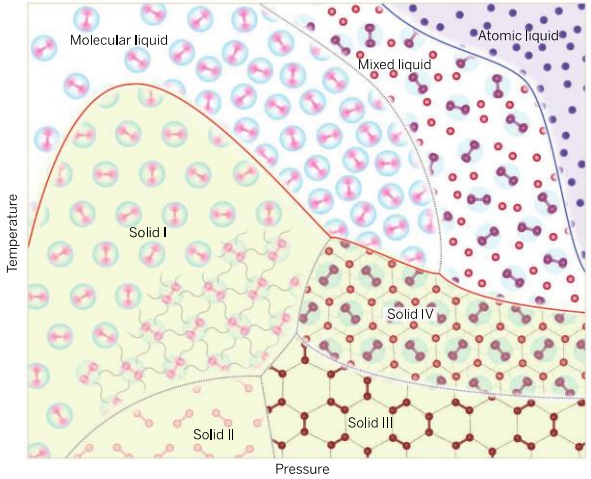
Machine learning

- Interatomic force fields
- Phase transitions, phase diagrams





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