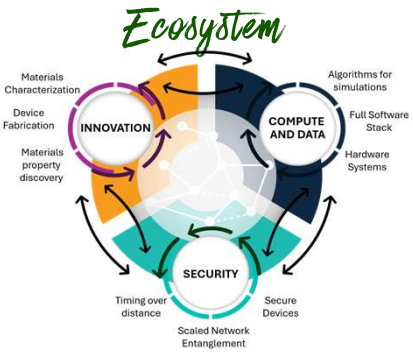
Heterogeneous Quantum Systems – DRD Cross-cutting Initiative

Initiative Leads: Ben Lawrie (MSTD) & Gilles Buchs (CSED)

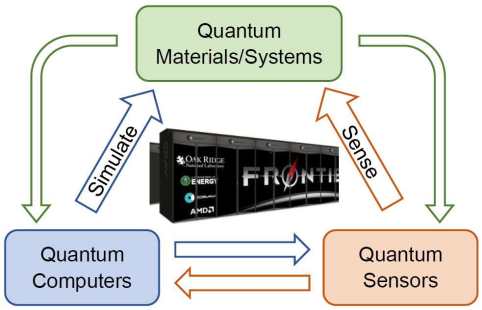
Laboratory Directed Research & Development

LDRD.ORNL.GOV



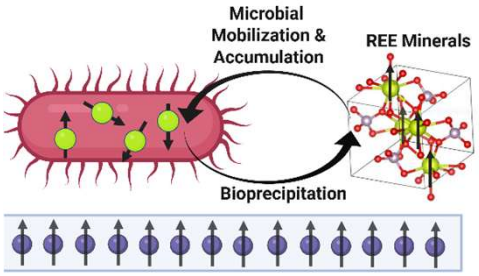
Codesign of Entanglement-Enhanced Quantum Sensing protocols (FY25; PI: Yan Wang)

Leveraging electron-nuclear spin entanglement for programmable quantum sensors with quantum algorithms enacted on NV centers in diamond and other in-house and commercially available (QCUP) platforms.



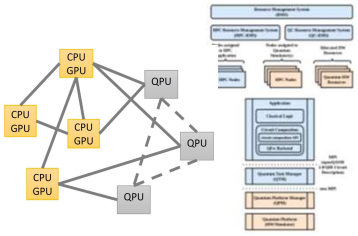
Interfacing Quantum and Biology: Critical Materials Sensing (FY26; PI: Brian Sanders)

Aims to develop a quantum sensing platform for sensitive REE detection in complex biological environments using single and ensemble spin-based quantum sensors.



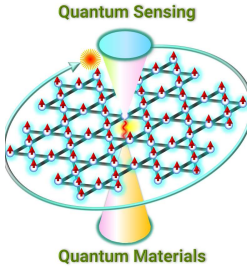
Software Framework for Integrated HPC/QC (FY25; PI: Daniel Claudino)

Focused on a software framework and HW platform for integrated hybrid HPC+QC with a test use case for fragment molecular orbital methods applied to a molten salt cohesion energy problem.



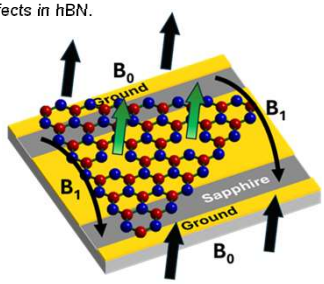
Quantum Sensing of Entangled Chiral Excitations (FY26; PI: Hu Miao)

Aims to advance macroscopic and microscopic quantum sensing probes to uncover long-range entangled chiral excitations in correlated materials.



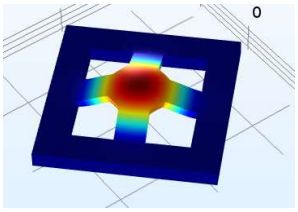
Advancing Energy Solutions Through Quantum Sensing(FY26; PI: Ivan Vlassiouk)

Aims to build a scientific foundation for robust and universal quantum sensing platform using optically accessible spin defects *in hBN*.



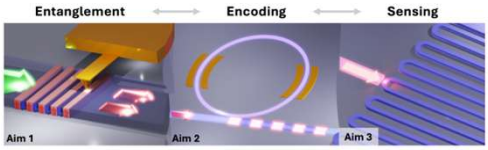
Optomechanical Devices for Quantum Transduction (FY26; PI: Claire Marvinney)

Provides a foundation for rf-optical quantum state transduction with optomechanical devices.



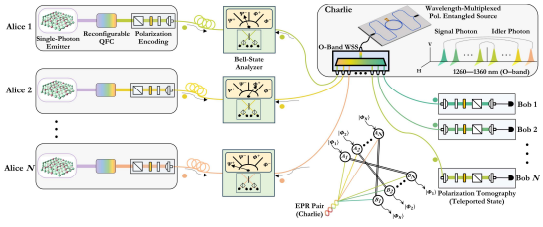
Nonlinear Quantum Materials for Lab-to-Fab for Monolithic Integrated Quantum Photonics (FY25; PI: Kyle Kelley)

Focused on the precise control of optical nonlinearities in AlN, high-speed electrical modulation in BaTiO3, and state-of-the-art on-chip single photon detection in helium-patterned NbN nanowires for scalable entanglement distribution across a variety of platforms.



Reconfigurable Quantum Networking with Wavelength Multiplexed Single-Photon Emitters (FY25; PI: Jiafeng Cui)

Aims to interface heterogeneous solid-state and photonic quantum nodes through quantum frequency conversion.



Towards National Scale Quantum Classical Optical Communications (FY25; PI: Joseph Chapman)

Provides a foundation for a future national-scale quantum satellite network and astronomical quantum applications through the development of a ground station for long-range quantum networking.

Translational research efforts leveraging new control of materials to advance quantum technologies and leveraging emerging quantum hardware for quantum simulations of materials, chemistry, and biology.

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