

ASPIRE Joint Technical Training Workshop

DIAMONDQTECH & Creation of Exotic Quantum Materials

Workshop Background and Objectives

ASPIRE promotes international research collaboration and the development of globally active early-career researchers. The “DIAMONDQTECH” and “Creation of Exotic Quantum Materials” programs share a commitment to advancing quantum science and technology while fostering the next generation of researchers through technical training and interdisciplinary exchange.

Building on previous technical training activities, this joint workshop brings the two ASPIRE communities together. It introduces the fundamentals and applications of diamond nitrogen-vacancy (NV) centers and provides an overview of spintronics-related research. The workshop is designed to connect foundational knowledge with emerging research directions and to encourage interaction across fields and institutions.

Lecturers

Professor Fedor Jelezko Director, Institute of Quantum Optics Ulm University, Germany <i>Lectures 1 and 2: Diamond NV centers</i>	Professor Takafumi Sato WPI-AIMR (Advanced Institute for Materials Research) Tohoku University, Japan <i>Lecture 3: Nano- and spin-resolved spectroscopy</i>
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Technical Training Program

LECTURE 1	From Defects to Qubits: Fundamentals of Diamond NV Centers This lecture introduces the basic physics of nitrogen-vacancy (NV) centers in diamond. Topics include the electronic structure and spin properties of NV centers, optical spin initialization and readout, spin manipulation using microwave fields, and the principles underlying quantum sensing. The lecture is intended to provide participants with a foundational understanding of diamond-based quantum technologies.
LECTURE 2	Quantum Sensing with NV Centers: Applications and Future Frontiers Building on the fundamentals introduced in Lecture 1, this session focuses on practical applications of diamond NV centers. Topics include quantum magnetometry, thermometry, electric field sensing, nanoscale imaging, and emerging applications in life sciences, materials science, and industrial diagnostics. Recent advances and future prospects of NV-based quantum sensors will also be discussed.
LECTURE 3	Nano- and Spin-Resolved Spectroscopy of Quantum Materials This lecture introduces advanced photoemission spectroscopy for probing spin and electronic states in quantum materials. While diamond NV centers access local magnetic fields in real space, angle-resolved photoemission spectroscopy (ARPES) provides complementary momentum-resolved information. Particular emphasis will be placed on nanoscale electronic-structure measurements and spin-resolved ARPES at NanoTerasu, with topological quantum materials as representative examples.

Message to Participants

This workshop offers students and early-career researchers an opportunity to learn directly from leading researchers and to explore connections among diamond quantum sensing, quantum materials, and spintronics. **Participants are encouraged to ask questions, join the discussions, and exchange ideas with the lecturers and fellow researchers.**

We look forward to welcoming you to the workshop and to building new international and interdisciplinary connections through ASPIRE.



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Adopting Sustainable Partnerships for Innovative Research Ecosystem