Global Initiative for Academic Networks (GIAN)

Under the aegis of MoE

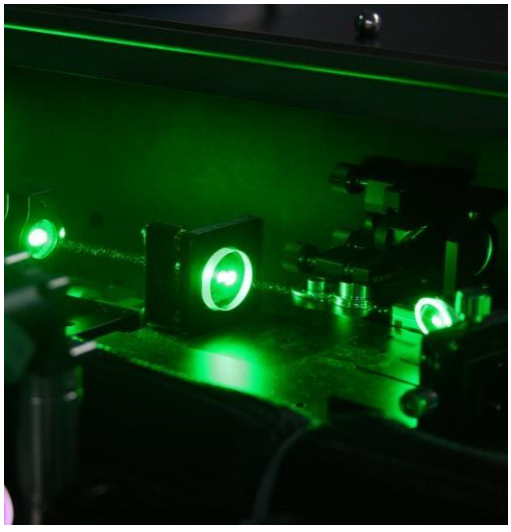
Color centers in diamond as solid-state artificial atoms for quantum technologies

October 6 – 10, 2025 at IISER Mohali

Overview

Color centers such as vacancies in alkali halide crystals have been extensively studied from the 30s. These defects can be created by irradiation or doping. The nitrogen-vacancy (NV) color center in diamond was identified in 1965 as a luminescent point defect with an electron spin structure in the ground state. It then received a lot of attention after the discovery in 1997 that it can be isolated as an individual quantum system inside the solid-state matrix. Its remarkably stable photoluminescence even at room luminescence makes this system an efficient and practical single-photon source. Its electron spin can be addressed and coherently manipulated using a combination of optical and microwave excitations. The understanding of the NV center physical properties, in parallel with remarkable progresses in diamond material fabrication, has now led to a broad range of applications for the development of quantum technologies.

In this GIAN course, we will explain why a color center can be considered as an artificial atom embedded in a solid-state matrix and I will highlight the differences with a true atom in vacuum. I will then describe the properties of two main defects in diamond: the NV center and the SiV center. I will finally focus on the electronic spin properties of the NV center and its application to magnetic sensing. We will also demonstrate some of the key measurements with NV color centers, in particular, its fluorescence and Optical Detection of Magnetic Resonance in a custom-built setup to provide a unique theory and hands-on-training experiments.



Faculties

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ENS, Cachan, France

&

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Objectives

- To expose the participants to new emerging frontier on creation, formalism and applications of color centers in diamond for quantum technologies
- To build a solid foundation of the Physics of color centers in diamond and demonstrate their potential for emerging quantum sensing, magnetometry, and single-photon sources;
- To strengthen the theoretical concepts by laboratory demos and hands-on experiments on measurements and sensing with NV centers. This is a very attractive and novel aspect of the course design;
- To give a broad overview of emerging frontiers of quantum technologies with color centers.

Lecture Topics & Hands-On Experiments

- **Color centers as artificial atoms in a solid-state matrix: structural/electro/optical properties**
- **Two color centers in diamond: NV center and the SiC center**
- **Quantum sensing of magnetic field using NV centers**
- **Emerging applications and challenges**
- **Experiment: NV detection, Imaging & ODMR measurement**

Who should apply

- ❑ Students: Masters, B. Tech, M. Tech and PhD students
- ❑ Postdoctoral scholars
- ❑ Faculties & Scientists from academic Institutions, technical Institutions.
- ❑ Quantum Startups

Fees**

❑ Foreign Participation	USD 100
❑ Faculties and Startups	INR 3000+GST
❑ Postdocs and PhD	INR 2000+GST
❑ UG/PG students	INR 1000+GST

** Accommodation may be provided on prior request and subjected to availability on separate payment basis.
** The fees include academic materials only.

Registration Link: Please E-mail to *kpsingh@iisermohali.ac.in*

Local Coordinator: Dr. Kamal P. Singh

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