



# A QUANTUM OF MATTER

## Overview of Color Center Research at FBK: From Diamond to Silicon Carbide

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**Wednesday February 4 - 14.30**  
**Aula A104 – Polo Ferrari (Povo 1), Povo**

Color centers in wide band gap semiconductors are a key building block for quantum photonics and sensing. In this talk, I will present an overview of the activities of our group at FBK, historically focused on the fabrication and characterization of diamond color centers, with ion beam implantation as the core enabling technology. Our approach primarily relies on focused ion beam (FIB) implantation to achieve deterministic control over the spatial localization, depth, and density of optically active defects. We demonstrate the controlled creation of single-photon emitters and emitter clusters, namely silicon- and germanium-vacancy (SiV and GeV) centers, with nanometric spatial accuracy. Using both focused and broad-beam technologies, we also engineer shallow color centers extending into the near-surface regime, including NV centers, which are crucial for sensing applications. I will further present the integration of color centers within photonic microstructures, enabling enhanced light-matter interaction and efficient photon extraction. To complete the overview, beyond defect creation, we exploit ion-beam-induced collateral effects, such as lattice amorphization and graphitization upon thermal annealing, as functional tools for diamond integration. Furthermore, we exploit FIB processing of thin diamond lamellae, tailored for scanning probe and nanothermometry applications. Overall, our work establishes focused ion beam irradiation as a versatile and deterministic tool for engineering both quantum emitters and functional architectures, paving the way toward scalable diamond-based quantum technologies. I will conclude the talk by briefly mentioning our first preliminary results on color center fabrication in silicon carbide.

### Who is Rossana Dell'Anna?

Rossana Dell'Anna coordinates the Spectroscopy Group at the Sensors and Devices Center of Fondazione Bruno Kessler (FBK), contributing to materials engineering and quantum-device development. She is also PI of the Raman and SPM Laboratory at FBK. She previously led the Materials Characterization Group, managing multidisciplinary surface and nanocharacterization activities. She holds a PhD in Physics from the University of L'Aquila, with a background in numerical simulation of condensed matter systems. Her research focuses on quantum photon emitters in diamond and wide-bandgap materials, as well as on light- and ion-matter interaction for technological applications.

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**A Quantum of Matter** is a series of events dedicated to the research in Physics of Matter that is carried out in the **Physics Department of the University of Trento**. The goal of **A Quantum of Matter** is to develop synergies and collaborations between research groups: for this reason, the seminars will focus not only on the results obtained, but also on the techniques employed by the groups and on the possible research themes that could be developed in partnership, leaving plenty of room for exchange of opinions and discussion.

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