THE PHYSICS COLLOQUIUM

Thursday 25 June 2026, 4:00 p.m.
Nijenborgh 4, Lecture Hall **5111.0080**

Quantum Defects in Solids: From Coherence and Spin–Photon Interfaces to Sensing Technologies

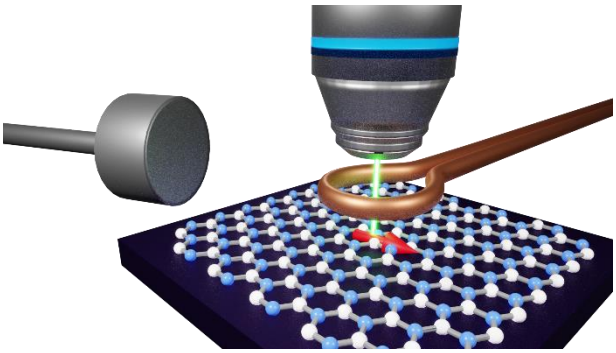
Carmem Gilardoni

Centro Brasileiro de Pesquisas Físicas, Brazil

The realization of quantum technologies relies on our ability to identify, control, and engineer quantum systems that simultaneously exhibit long-lived coherence, efficient optical interfaces, and compatibility with scalable device architectures. Solid-state spin defects have emerged as a particularly promising platform in this regard, enabling applications ranging from quantum communication to quantum sensing.

In this colloquium, I will discuss the development of quantum defects as building blocks for emerging quantum technologies. I will begin with work carried out during my doctoral research on transition-metal defects in silicon carbide, a technologically mature semiconductor that hosts optically active spins operating at telecom-compatible wavelengths. These defects provide a unique platform with an optical interface to both electronic and nuclear spin states, offering new opportunities for quantum networks and quantum memories. I will then introduce more recent studies of colour centres in hexagonal boron nitride, a van der Waals material that combines the advantages of atomically thin materials with optically addressable spin defects. In particular, I will present evidence for individual carbon-related defects that exhibit room-temperature spin coherence together with single-photon emission. Optical and microwave spectroscopy reveal spins with coherence times extending into the microsecond regime under ambient conditions, highlighting the potential of hBN as a platform for integrated quantum photonics and sensing.

Finally, I will discuss current efforts at the Brazilian Centre for Physics Research (CBPF) aimed at translating these advances into practical quantum technologies. These activities include the development of sensing platforms based on spin defects in hBN and diamond, studies of magnetic dynamics in nanostructured materials, and collaborations with researchers in chemistry and biophysics to develop on-chip spectroscopic tools. Together, these examples illustrate how advances in the understanding and control of quantum coherence are opening new opportunities for sensing, communication, and the exploration of complex physical systems.



Join us for coffee starting 3:30 p.m. Refreshments will be served after the lecture.
For more information contact the hosts: Marcos Guimaraes (m.h.guimaraes@rug.nl)
Website: https://www.rug.nl/research/fse/colloquia/physics-colloquia