Quantum Dynamics and Control in Diamond

N Bar-Gill[1,2]

[1] *Racah Institute of Physics, Hebrew University of Jerusalem, Jerusalem, Israel*
[2] *Institute of Applied Physics, Hebrew University of Jerusalem, Jerusalem, Israel*
Contact Email: nir.bar-gill@mail.huji.ac.il

The study of quantum coherence, dynamics and the development of novel quantum technologies has been a long-standing goal in quantum information science.

In this talk I will address these topics through the platform of nitrogen-vacancy (NV) spins in diamond, which have emerged over the past several years as well-controlled quantum systems, with promising applications ranging from quantum information science to magnetic sensing. I will first briefly introduce the NV center system, as well as the experimental methods used for measuring NVs and controlling their quantum spin dynamics. I will then detail our work in the context of quantum control for enhanced coherence and sensing.

I will present a general theoretical framework we developed for Hamiltonian engineering in an interacting spin system. This framework is applied to the coupling of the spin ensemble to a spin bath, including both coherent and dissipative dynamics. Using these tools, I will present our recent results on enhanced coherence in many-body spin systems, surpassing the current state-of-the-art and providing a path toward studies of disordered many-body spin problems and applications in quantum technologies, such as enhanced sensing.

Time permitting, I will also mention recent work on optimal quantum transport in dissipative, disordered spin systems, and extraction of correlation information using weak measurement approaches.