The NV center in diamond: a versatile quantum technology

Ania Bleszynski Jayich,[1] A. Jenkins,[2] D. Bluvstein[1], S. Meynell[1], S. Baumann[1], Z. Zhang[1]

[1]Physics Department and Materials Research Lab, University of California Santa Barbara, Santa Barbara CA, 93106

The nitrogen vacancy (NV) center in diamond is an atomic-scale defect that exhibits remarkably coherent quantum properties in a uniquely accessible way: at room temperature, in ambient conditions, and even immersed in biological environments. NV centers are being explored for a variety of quantum technologies, including quantum sensing and quantum information processing. In this talk, I introduce the physics and materials science behind the success of the NV center and I highlight some of the major achievements of NV-based quantum sensors, the most advanced of NV-based technologies. I present a versatile NV-based imaging platform where we have incorporated an NV center into a scanning probe microscope and used it to image vortices in superconductors [1], skyrmions in thin film magnetic multilayers, and conductivity on the nanoscale [2].

I also outline the challenges facing the widespread use of NV centers in quantum applications, including spin decoherence [3] and charge state instabilities near interfaces. Using the NV center as a quantum probe of its local environment, we have identified several of the microscopic mechanisms responsible for reduced quantum functionality of near-surface NV centers, thus guiding the ongoing development of quantum control techniques and materials design, pushing towards the ultimate goal of NV-based single nuclear spin imaging.

[1] M. Pelliccione *et al, Nature Nanotechnology* **11**, 700 (2016)

[2] A. Ariyaratne *et al, Nature Communications* **9**, 2406 (2018).

[3] B. Myers *et al, PRL* 118, 197201 (2017).