Abstract:

Nanoscale magnetic fields contain rich information about the structure, organization and physics of matter. At a close enough look, almost any material or device generates a magnetic stray field, even if often minute: Examples range from magnetically ordered materials, like ferromagnets and antiferromagnets, to superconducting materials, to currents flowing in conductors, to electronic and nuclear spins in molecules and biological matter. Our group is developing new experimental probes for imaging tiny magnetic fields with nanometer spatial resolution.
In this talk, I will discuss our progress with scanning diamond magnetometers in pursuit of this goal. Diamond magnetometers rely on a single spin defect in a probe tip (a nitrogen-vacancy center) and exploit concepts of quantum metrology to reach very high       sensitivities. In a first part of the talk I will discuss instrumental challenges in the fabrication of diamond probes and their integration into scanning probe microscopy (SPM) systems. In the second part I will present illustrative examples of applications in nanoscale magnetism, including the imaging of antiferromagnetic domains and domain walls and the flow of currents in graphene devices. I will conclude with an outlook on simultaneous imaging of electric and magnetic fields in multiferroics.