QuanTalks

IISc Quantum Technologies Initiative (IQTI) Seminar Series

Title: Quantum sensing and coherent control of individual atoms and molecules on surfaces

Speaker: Dr. Aparajita Singha,
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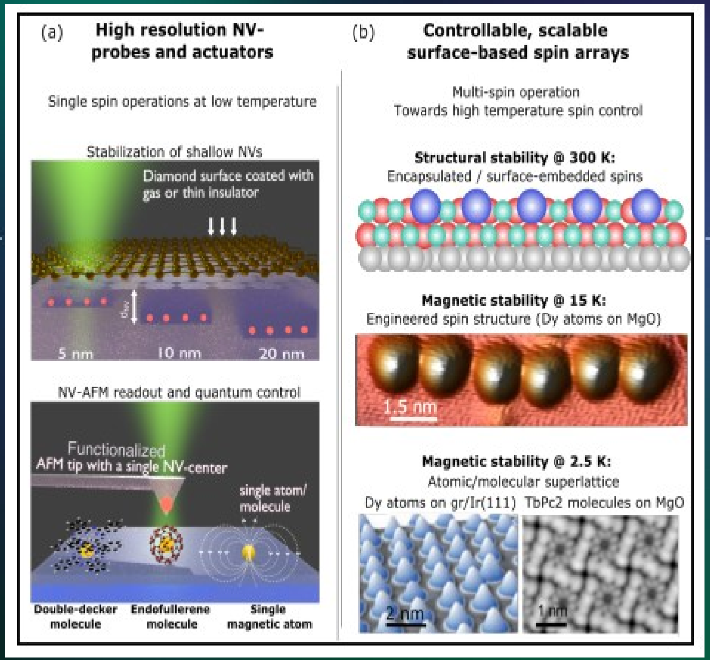
Abstract: Controlling individual atoms and molecules at their native spatio-temporal limit has an indispensable appeal that has driven fundamental research for decades, leading to technological leaps ranging from nanoelectronics to information processing. Recently, a new avenue has emerged for nanoscale quantum bits made of individual surface-supported lanthanide atoms and molecules. The large magnetic moments, strong intra- as well as interatomic electron correlations, and long-term quantum coherence in these systems altogether offer a myriad of new exciting possibilities across molecular magnetism and quantum computing research.
The research effort in my group is devoted to manoeuvre quantum properties of such smallest building blocks of matter, especially by probing them in the least invasive manner. Addressing their individual spin state is a daunting task. So far, only scanning tunneling microscopy (STM) with subatomic spatial resolution is capable of achieving this, albeit being highly invasive and limited with the scope of operational temperature (<4 K). Atomic force microscopy (AFM) with novel colour center probes (NV) has the potential to overcome these, given their unparalleled magnetic sensing capability, high-fidelity optical readout, and broad operational range of temperature. However, this currently suffers from insufficient resolution (tens of nm) mainly due to fluorescence quenching in so-called shallow NVs. In my group, we combine controlled surface-chemistry with AFM-based manipulation techniques to resolve these issues. Our approach surpasses the current capabilities of STM in this context, while simultaneously broadening the scopes of scanning NV-magnetometry for addressing solid-state spin qubits. In particular, our aim is to target quantum architectures made of lanthanide single spins either surface-adsorbed or -embedded as 2D lattice, for realizing stable qubit arrays operating at 77 K or higher.



Venue
Physics Department Auditorium, IISc

Date & Time
Monday, 10th October 2022, 3 30 PM (IST)

Meeting Link: Click here to join the Webinar

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Biography: Dr. Aparajita Singha is an experimental condensed matter physicist who is deeply interested in spin-physics. Her research journey started as an assistant at the Niels Bohr Institute, Copenhagen (Denmark). Shortly after that she joined EPFL Physics graduate school (Switzerland) as a PhD student. Most of her PhD and Postdoctoral phase was devoted to understand complex adatom-substrate and adatom-adatom interactions in such systems, which were instrumental in the discovery of surface-supported single atom magnets. During her postdoctoral phase in Seoul, such single atom magnets were used in a prototypical surface-based quantum architecture using a newly setup ESR-STM in the newly built IBS center (QNS, South Korea). In 2020, she joined the Max Planck Institute for Solid State Research, Stuttgart (Germany) as a group leader. After securing the prestigious Emmy Noether grant and NEXUS award from the Carl Zeiss foundation, she became a PI at the graduate school of quantum materials and IMPRS, as a joint endeavor between the MPI-FKF and University of Stuttgart. Currently, her Emmy Noether group is devoted to develop an advanced magnetometry tool that allows us to probe and manipulate atomic-scale spin systems in a noninvasive manner across a broad range of operational temperature.

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