Title: Spin Noise Spectroscopy as a tool for detecting neutral atoms and magnetic fields

Saptarishi Chaudhuri, Raman Research Institute

Abstract:

I shall talk about non-invasive detection of spin coherence in a collection of Raman-driven cold atoms using dispersive Faraday rotation fluctuation measurements, which opens possibilities of probing spin correlations in quantum gases and other similar systems. We can measure various atomic, magnetic and sub-atomic properties as well as perform precision magnetometry using Spin Noise Spectroscopy (SNS) in an atomic ensemble and show that it has better resolution than typical absorption spectroscopy in detecting spectral lines. I shall also describe the development and performance of an atomic magnetometer (AM) utilizing the Raman-driven spin noise spectroscopy (RDSNS) technique. Being an all-optical setup, this instrument is largely immune to interference with stray radio frequency fields and has the potential to be miniaturized and field deployable.

Further, I shall show a minimally perturbative detection method, based on RDSNS to directly probe the local density of a cloud of cold atoms in real time. Unlike traditional fluorescence and absorption imaging techniques, this approach does not require stochastic photon scattering from trapped atoms, thereby leaving the cold cloud unperturbed. The data can be collected in MHz refresh rate, allowing for near real-time detection. This detection protocol is particularly advantageous for probing systems that lack inherent symmetry and can have important application in the domain of neutral atom based quantum computing platforms.