The Hebrew University Center
for Nanoscience & Nanotechnology

Nano Seminar

Nonlinear light-matter interaction: from superconducting qubits to spins in diamond

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Abstract:

Cavity quantum electrodynamics (CQED) is the study of the interaction between matter and photons confined in a cavity. In the Jaynes-Cummings model the matter is described using the two-level approximation, and only a single cavity mode is taken into account. The interaction has a
relatively large effect when the ratio E/_ω between the energy gap E separating the two levels and the cavity mode photon energy _ω is tuned close to unity. The talk is devoted to the study of the light-matter interaction in the nonlinear regime using three different CQED systems. In the first experiment a Josephson flux qubit serves as a two-level system and a superconducting resonator as the cavity. We experimentally find that the cavity response exhibits higher order resonances (called superharmonic resonances) in the nonlinear regime when the ratio E/_ω is tuned close to an integer value larger than unity. In the second experiment the interaction between a spin ensemble of diphenylpicrylhydrazyl (DPPH) molecules and a superconducting resonator is explored in the region where $E/\_\omega \gg 1$. We find that the cavity response is significantly modified when the spins are intensively driven close to their Larmor frequency. Retardation in the response of the spin ensemble gives rise to effects such as cavity mode cooling and heating. In the third experiment the interaction between localized spins in diamond (nitrogen-vacancy and nitrogen substitutional) and a superconducting resonator is studied. We find that nonlinearity imposes a fundamental limit upon sensitivity of CQED-based spin detection.

Gathering & Refreshments at 10:50

Please contact Alexandra Bannych at 6584919 if you are interested in meeting the lecturer.

Tuesday, Nov 7th 2017, 11:00 at the Seminar Hall

Los Angeles Building, entrance floor.