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Title: Nuclear spin - environmental interactions in semiconductor systems

Abstract:
The constituent atoms of many semiconductors, such as GaAs, have non-zero nuclear spin. It becomes a noise source of electron spin qubit. On the other hand, nuclear spins with a long decoherence time are a good candidate to study spin coherence. Moreover, measurements based on nuclear spins unveil many important electron spin features of semiconductor quantum systems. In this presentation, two topics will be presented for nuclear spin - environmental interactions in semiconductor systems.

First, nuclear spin systems are exposed to electron spin environment in quantum Hall regime. The change in nuclear spin system is probed by using $\nu = 2/3$ spin phase transition, which is a sensitive measure of nuclear polarization and its spatial distribution. The unique and strong many-body interaction appears between electron and nuclear spin systems when nuclear spins are exposed to $\nu = 2$ canted spin state in bilayer GaAs quantum wells.

Secondly, the noise spectrum influencing nuclear spin decoherence is experimentally determined by using a multiple π-pulse sequence. It is theoretically confirmed that signal relaxation rate of 2τ-interval π-pulse sequence in a long time limit reflects noise spectrum, $S(1/4\tau)$. [T. Yuge et al. PRL 107, 170504 (2011)] This multiple π-pulse technique is applied in conventional NMR to measure noise spectra of nuclear spins in GaAs and Si. The $1/f^2$ noise appears due to nearest-neighbor nuclear spin interaction and white-noise-like background can be explained by interaction between nuclear spins and conductive carriers.

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