DAMOP10-2010-000398

Abstract for an Invited Paper
for the DAMOP10 Meeting of
the American Physical Society

Coupling Spin Ensembles to Micro Wave Photons[1]

JOERG SCHMIEDMAYER, TU-Wien

Presently quantum physics is confined to its separate worlds, separated by deserts of classical physics. For quantum physics to emerge from fundamental research, one of the main challenges is how to pool the advantages of the different quantum systems by linking them to each other and preserving the quantum nature also over the link. One has to be able to quantum interconnect the different domains. Here we will look into how to connect spin ensemble qubits to superconducting micro wave quantum circuits. The very small cavity volume, the strong enhancement of the near field and the long lifetime of the photon in a coplanar waveguide resonator (CPWR) is the crucial link. As an example I will discuss coupling an ensemble of 10^6 ultra-cold Rb atoms to the near field of a superconducting CPWR [1]. We show that one can achieve strong coupling between a single microwave photon and a collective hyperfine qubit state in the ensemble with $g_{eff}=2\pi$ 40 kHz. Even more favourable parameters can be achieved for the coupling collective states in an ensemble of NV centres in diamond. The talk will analyse the physics behind these hybrid "magnetic" cavity-QED systems and its prospects of experimental realization.

[1] Verdu *et al* Phys. Rev. Lett. **103**, 043603 (2009).

[1]Funded by the EU and the FWF through the Wittgensteinprize.