

Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Measurement of the Magnetic Interaction Between Two Electrons SHLOMI KOTLER¹, NITZAN AKERMAN, NIR NAVON², YINNON GLICKMAN, ROEE OZERI, Weizmann Institute of Science — In this talk we will report on the first measurement of the magnetic interaction between two electronic spins. While the dipolar magnetic interaction between different spin systems, such as an electron and its nucleus or several multi-electron spin complexes, were experimentally studied, the magnetic interaction between two isolated electronic spins was never observed. We will explain why the Coulomb exchange forces on the one hand, and magnetic field noise on the other hand, make the electron-electron magnetic interaction measurement a challenging one. This challenge was resolved by the use of Quantum Information techniques. In our experiment, we used the ground state valence electrons of two $^{88}\text{Sr}^+$ ions, co-trapped in an electric Paul trap and separated by more than two micrometers. We measured a weak, millihertz scale, magnetic interaction between their electronic spins, in the presence of magnetic noise that was six orders of magnitude larger than the respective fields the electrons apply on each other. Spin dynamics was restricted to a Decoherence Free Subspace where a coherent evolution of 15 seconds led to spin-entanglement. Finally, by varying the separation between the ions, we were able to recover the inverse cubic distance dependence of the interaction.

¹Current position: National Institute of Standards and Technology, Boulder, CO.

²Current position: Cambridge Laboratories, UK.

Shlomi Kotler
National Institute of Standards and Technology

Date submitted: 27 Jan 2014

Electronic form version 1.4