Quantum computing with magnetic insensitive states

Alex Retzker[1], Martin Plenio[1], Christof Wunderlich[2], Anders Varon[2], Michael Johanning[2], Ingo Baumgart[2], and Naula Timoney[2]

[1] *Universitaet Ulm, Albert-Einstein-Allee, 89081 Ulm, Germany*

[2] *Department Physik, Naturwissenschaftlich-Technische Fakultät, Universität Siegen, 57068 Siegen, Germany*

Trapped ions employing laser light have provided successful demonstrations of the basic elements of a quantum information processor (QIP). Despite these successes, scaling these technologies to achieve large scale universal QIP or more specialized quantum simulations remains challenging. The use of easily controllable and stable microwave sources instead of complex laser systems on the other hand promises to remove fundamental obstacles for scalability. An important remaining drawback in this approach, also shared by laser-based QIS, is the necessary use of magnetic sensitive states which is shortening coherence times considerably and the need to create large stable magnetic gradients in microwave based schemes. In this talk I will present a novel theoretical approach based on dressing magnetic sensitive states with microwave driving that addresses both issues and I will explain the experimental realization of the basic building blocks of this scheme to show that these dressed states are long-lived and permit fast quantum logic. This changes decisively the prospect of microwave-driven ion trap QIP and offers a new route to extend coherence times for all systems that suffer from magnetic noise such as neutral atoms, NV-centres and quantum dots.

[1] arXiv:1105.1146