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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Seminar über Quanten-, Atom- und Neutronenphysik (QUANTUM)

June 23, 2022 at 2 p.m. c.t.
Lorentz-Raum (05-127)

Assoc. Prof. Dr. Hartmut Häffner
University of California, Berkeley, USA

Coupling of Ions & Test of Nonlinear Extension to Quantum Mechanics

I will discuss two experiments recently completed at UC Berkeley.

In the first, we couple two ions via image charged induced in a 0.6 mm long wire to each other. While the efforts were aimed at establishing the much needed interface between individual quantum processors, the coupling can be used to cool, control and detect particles not accessible laser control and are thus relevant for precision metrology as recently shown by the BASE collaboration for cooling (anti)protons.

In the second set of experiments, I will discuss a test of a nonlinear extension to quantum mechanics. Already in the early 80's, S. Weinberg and others were wondering whether the laws of nature at the quantum scale are nonlinear (Ann.Phys. (N.Y.), 194, 336-386 (1989)). Interest dropped rapidly when it was shown that those extensions violate causality. However, recently Kaplan and Rajendran (arXiv:2106.10576 [hep-th]) managed to add nonlinear and state-dependent terms without violating causality. Interestingly this extension rendered the existing experimental tests ineffective. I will discuss why a quantum mechanical object tied to a macroscopic object (such as an ion trap) provides a more stringent test to Rajendran and Kaplan's hypothesis and present experimental bounds ruling it out at the 1E-11 level.

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