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Precision studies of single molecular ions for fundamental physics

Precision molecular experiments provide a unique tool for measuring electroweak nuclear properties. Compared to atoms, certain molecules can offer more than eleven orders of magnitude enhanced sensitivity to symmetry-violating nuclear effects [Phys. Rev. Lett. 120, 142501], enabling precision tests of the Standard Model. Being able to trap the molecules of interest can significantly enhance the coherence time of the experiment and hence the measured signal. Therefore, ionic molecules offer a major advantage, as they can be trapped and manipulated using electric and magnetic fields. In this talk I will present a proof-of-principle experiment aiming to measure parity-violating nuclear properties of ^{29}Si, by trapping individual SiO^{+} ions in a Penning trap. The trap's strong magnetic field can bring molecular levels of opposite parity close to degeneracy, thus enhancing the sensitivity to parity-violating, nuclear spin dependent effects. The experiment is expected to measure the anapole moment of ^{29}Si with a relative uncertainty of 10%. Preliminary results and future perspectives will be discussed.

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