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Searching for New Physics Using Laser-Cooled Polyatomic Molecules ARIAN JADBABAIE, Caltech, IVAN KOZYRYEV, Harvard University, AVIKAR PERIWAL, NICKOLAS PILGRAM, NICHOLAS HUTZLER, Caltech — The large, internal electromagnetic fields of polarized molecules make them a powerful platform for precision measurement searches of physics beyond the standard model (BSM). While previous BSM searches have been performed with cold beams of diatomic molecules, which were able to probe TeV energy scales, laser-cooled molecules offer orders of magnitude improvement in measurement time, with the potential to increase sensitivity to PeV scales. Unfortunately, laser-coolable diatomic species lack easily polarizable parity doublets. Such so-called internal co-magnetometer states are a prerequisite for significantly enhanced systematic error rejection. Conversely, certain polyatomic molecules, such as linear tri-atomics or symmetric tops, exhibit both internal co-magnetometers and electronic structures favorable to laser-cooling, making them ideal candidates to extend the frontier of precision measurement searches. We propose combining laser-cooling and cryogenic buffer gas cooling of YbOH to search for new hadronic and leptonic physics at the PeV scale. Laser-cooled, easily polarized molecules also have applications in fields beyond precision measurement, such as quantum information, many-body quantum dynamics, and ultracold chemistry.

Arian Jadbabaie
Caltech

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