

New methods for quantum control of polar molecules for symmetry-violation searches

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“Precision measurements of time-reversal symmetry violation in molecular systems provide stringent tests of new physics beyond the Standard Model. I will report our experimental progress towards measuring the nuclear magnetic quadrupole moment using polyatomic $^{173}\text{YbOH}$ molecules. In addition, I will present our recent proposals for advancing the quantum control of molecules and thus improving the T-violation searches. These new methods include Rydberg atom-assisted sympathetic slowing and cooling [1], Rydberg atom-assisted quantum logic control and entanglement generation [2], as well as a new quantum entanglement-enhanced measurement protocol [3].

[1] CZ et al., Sympathetic cooling and slowing of molecules with Rydberg atoms, *Phys. Rev. Lett.* 132, 033001 (2024)

[2] CZ and M. R. Tarbutt, Quantum Computation in a Hybrid Array of Molecules and Rydberg Atoms, *PRX Quantum* 3, 030340 (2022)

[3] CZ et al., Quantum-Enhanced Metrology for Molecular Symmetry Violation using Decoherence-Free Subspaces, *Phys. Rev. Lett.* 131, 193602 (2023)”

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