COLLOQUIUM

Adding Trapped Molecules to the Quantum Toolkit

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4:00 p.m. (coffee @ 3:30)

Because of their rich internal structure, trapped molecules offer great potential for precision spectroscopy, quantum information processing, and ultracold and field-controlled chemistry. Obtaining control over the rotational quantum state of trapped molecules, a prerequisite for most applications, has however presented a significant challenge. Using a single spectrally filtered broadband laser, we have optically cooled trapped AlH^+ molecules from room temperature to 4 Kelvins, corresponding to an increase in ground rotational-vibrational state population from 3% to 95%. We anticipate that the cooling timescale can be reduced from 100 milliseconds to a few microseconds and that the cooling efficiency can also be improved. Trapped AlH^+ is a good candidate for future work on quantum-controlled chemistry, coherent control and entanglement of rotational quantum states, non-destructive single-molecule state readout by fluorescence, single-molecule spectroscopy, and searches for time-variations of the electron-proton mass ratio.

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