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Sympathetic cooling of molecules with laser-cooled atoms[1]

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Cooling molecules through collisions with laser-cooled atoms is an attractive route to ultracold, ground state molecules. The technique is simple, applicable to a wide class of molecules, and does not require molecule specific laser systems. Particularly suited to this technique are charged molecules, which can be trapped indefinitely, even at room temperature, and undergo strong, short-ranged collisions with ultracold atoms. In this talk, I will focus on recent efforts to use the combination of a magneto-optical trap (MOT) and an ion trap, dubbed the MOTion trap, to produce cold, ground state diatomic charged molecules. The low-energy internal structure of these diatomic molecules, e.g. the electric dipole moment and vibrational, rotational, and Ω-doublet levels, presents a host of opportunities for advances in quantum simulation, precision measurement, cold chemistry, and quantum information. Excitingly, recent proof-of-principle experiments have demonstrated that the MOTion trap is extremely efficient at cooling the vibrational motion of molecular ions.

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