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An Alternative to Laser Cooling

MARK RAIZEN, University of Texas at Austin

Laser cooling has been the standard approach for over thirty years for cooling the translational motion of atoms. While laser cooling is an extremely successful method, it has been limited to a small set of elements in the periodic table. The performance of laser cooling for those elements has saturated in terms of flux of ultra-cold atoms, density, and phase-space density. I report our progress towards the development of an alternative to laser cooling. Our approach relies on magnetic stopping of supersonic beams, an atomic coilgun. A recent advance is the experimental realization of an adiabatic coilgun which preserves phase-space density. Further cooling was demonstrated with a one-way wall, realizing the historic thought experiment of Maxwell's Demon. More recently, we showed how to apply this method to compress atomic phase space with almost no loss of atom number. Our approach is fundamentally different than laser cooling as it does not rely on the momentum of the photon, but rather the photon entropy. I will report on our experimental progress towards this goal, and describe future experiments that will be enabled by this work.