Abstract Submitted
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Direct laser cooling of a diatomic molecule[1] EDWARD SHUMAN, JOHN BARRY, DAVE DEMILLE, Yale University — We have experimentally observed transverse laser cooling of the polar, diatomic molecule strontium monofluoride (SrF) using the $X^2\Sigma^+ \rightarrow A^2\Pi_{1/2}$ optical cycling scheme previously demonstrated [1]. In general molecules are not amenable to direct laser cooling because their vibrational and rotational degrees of freedom typically lead to high branching probabilities into a large number of unwanted sublevels. Our scheme takes advantage of SrF's highly diagonal Franck-Condon factors which suppress vibrational branching. We eliminate rotational branching by employing a quasi-cycling $N = 1 \rightarrow N' = 0$ type transition in conjunction with magnetic field remixing of dark Zeeman sublevels. One complication of this scheme is that the large number of $X^2\Sigma^+$ ground levels in this system leads to a photon scattering rate which is a factor of 3.5 smaller than that of a comparable two-level system. The reduced scattering rate requires that the cooling region be significantly longer than that typically used in atomic systems.

[1] E. S. Shuman, J. F. Barry, D. R. Glenn, and D. P. DeMille, Phys. Rev. Lett. 103, 223001 (2009).

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