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New directions in direct laser cooling and trapping of diatomic molecules MATTHEW STEINECKER, DANIEL MCCARRON, ERIC NORRGARD, EUSTACE EDWARDS, DAVID DEMILLE, Yale University — In recent years, tremendous progress has been made in laser cooling and trapping of molecules. With the achievement of a magneto-optical trap (MOT) for the diatomic molecule SrF,[1] a range of novel experiments employing ultracold molecules may be within reach. Here we present planned improvements to our SrF MOT apparatus, including plans for more efficient MOT loading, sub-Doppler cooling, loading into a conservative trap, and co-trapping of atoms. These and other improvements should allow increases in trapped molecule number, lifetime, and phase-space density. We illustrate some of the experiments that will be enabled by these improvements, such as studies of inelastic and reactive atom-molecule collisions at ultracold temperatures and investigations of sympathetic and evaporative cooling of SrF.

[1]J. F. Barry *et al.*, *Nature* **512**, 286–289 (2014).

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