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Laser Cooling of Diatomic Metal Monohydrides for Producing Ultracold Hydrogen[1] IVAN KOZYRYEV, REES MCNALLY, TANYA ZELEVINSKY, Columbia University — Despite a tremendous progress in laser technology in recent years, direct laser cooling of the most prevalent atomic species of chemical and biological interest including hydrogen, carbon, oxygen, and nitrogen still remains out of reach. However, many diatomic and polyatomic metal-ligand radicals can support optical cycling on the metal-localized valence electron, potentially enabling concomitant laser cooling of diverse constituents [1]. We will describe our progress on laser cooling and trapping of barium monohydride (BaH) molecules as a precursor for producing ultracold atomic hydrogen using optical methods. Despite a low recoil velocity (2.7 mm/s) and a relatively slow scattering rate (10^6 s^{-1}), we were able to use 1060 nm laser light exciting the $X \rightarrow A$ electronic transition to reduce the transverse velocity spread of the cryogenic buffer-gas beam of BaH, characterizing the cooling dynamics and benchmarking theoretical estimates. A large atomic mass mismatch between the BaH constituents will be highly beneficial for future kinetic cooling of hydrogen to ultracold temperatures using precision photodissociation of trapped molecules [2]. [1] Kozyryev et al., ChemPhysChem 17, 3641 (2016). [2] I. C. Lane, PRA 92, 022511 (2015).

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