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Abstract for an Invited Paper
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Novel light traps for studying ultracold atoms and molecules

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We will begin with a brief review of the physics of cooling and trapping of atoms and molecules. We will then specialize the discussion to include two experiments in which unusual traps have been realized. In the first experiment, a pulsed optical dipole force trap, loaded from a magneto-optical trap (MOT) is used to confine atomic rubidium (Rb). The trap has been constructed with a mode-locked Nd:YAG laser. We have made a comparative study of pulsed vs. continuous wave operation of the trap. We will discuss results of our investigation and extension of this study to include the free electron laser at Jefferson Lab. In the second experiment, we are investigating the interaction between ultracold Rb atoms and ultracold, metastable argon (Ar*) simultaneously confined in a dual species MOT. We will report on recent measurements of the inter-species trap loss coefficients and on studies of Penning and associative ionization in the MOT using a modified residual gas analyzer as a detector. We will also discuss photoassociative spectroscopy of the Rb-Ar* complex and prospects for producing and spatially confining ultracold, ground state RbAr, a weakly-bound van der Waals molecule. Research supported by the NSF, ONR, KOSEF, Jefferson Lab, and Old Dominion University.