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Controling Excited-State Ion-Atom Reaction[1] MING LI, ALEXANDER PETROV, SVETLANA KOTOCHIGOVA, Department of Physics, Temple University — We investigate the control of the charge-exchange reaction between a neutral atom and a ground-state ion via light-induced coupling to their excited molecular states. In particular, we focus on Ca atoms in a magneto-optical trap (MOT) reacting with an Yb^+ ion controlled by an additional laser that is red-detuned from the Ca ground to 4s4p(^{1}P) excited transition. Direct non-adiabatic charge-exchange reaction between an excited Ca atom and Yb^+ is limited by the Ca excited-state population in the MOT and the spontaneous decay of the excited atom. The additional laser, on the other hand, can efficiently transfer population from the ground-state potentials to excited potentials at shorter internuclear separations and enhance the charge-exchange reaction rate. The process relies on the extremely high density of states of the isotropic $-C_4/R^4$ induction and anisotropic C_3/R^3 charge-quadrupole potentials that govern the long-range molecular forces as well as the large transition dipole moment associated with the excited threshold. We theoretically demonstrate that the process, which can be controlled through changing laser detuning and intensity, can lead to enhancements of rate coefficients of the order of 10^{-10} cm^3/s.

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