Manipulating Molecules via Combined Static and Laser Fields

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Abstract

Interaction of the strong electric field of an intense laser beam with the anisotropic polarizability of a linear molecule creates pendular states, superpositions of the field-free rotational states, in which the molecular axis librates about the field direction. Angular motion in the low-lying pendular states is thereby restricted by a double-well potential, governed by the laser intensity. The pendular energy levels occur as pairs of opposite parity, with separations corresponding to the frequency for tunneling between the wells. If the molecule is polar or paramagnetic, introducing a static electric or magnetic field connects the nearly degenerate pendular levels and thus induces strong pseudo-first order Stark or Zeeman effects. This can be exploited in many schemes to control and manipulate trajectories.