# Steric proficiency of polar $^2\Sigma$ molecules in congruent electric and magnetic fields

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## Abstract

We examine the eigenenergies, spatial orientation, and alignment of polar $^2\Sigma$ molecules subject to congruent static electric and magnetic fields. In the presence of a magnetic field only, certain pairs of Zeeman states with opposite parity intersect. Introducing a congruent electric field connects such states, thereby creating avoided crossings and a first-order Stark effect which can strongly orient the states. Since this effect, termend "steric proficiency," operates over a narrow range of magnetic field strengths, with amplitude determined by the electric dipole interaction, it should find use both for state selection and as a diagnostic tool for assigning spectral transitions. Other aspects are illustrated by strategies suggested for some prospective applications. These include a way to test whether formation of the $A^2\Sigma^+$ excited electronic state of NaO in the Na + $O_3$ reactions results from the orientation dependence of electron transfer, and techniques to enable the ground $^2\Sigma^+$ states of RbO and CsO, produced by reacting $NO_2$ with alkali atoms, to be loaded into a magnetic trap.