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Cold collisions of oriented molecules E. ABRAHAMSSON, T.V. TSCHERBUL, R.V. KREMS, Dept. of Chemistry, University of British Columbia, Vancouver, B.C., Canada — Orienting molecules with dc electric fields is a versatile technique for studying the mechanisms of inelastic collisions and chemical reactions. Here, we use rigorous quantum theory of collisions in electromagnetic fields [1,2] to study the electron spin relaxation of magnetically trapped $^2\Sigma$ and $^3\Sigma$ molecules oriented by electric fields. We demonstrate that inelastic collisions of CaD($^2\Sigma$) and ND ($^3\Sigma$) molecules can be manipulated by varying the strength of the dc electric field as well as the relative orientation between the electric and magnetic fields. The increase of the energy gap between the ground $N = 0$ and the first excited $N = 1$ rotational levels results in suppression of the spin relaxation at a collision energy of 1 K [1,2]. We also demonstrate that electric fields inhibit rotational relaxation of $^2\Sigma$ molecules [2]. Our results show that (1) sympathetic and evaporative cooling of $^2\Sigma$-molecules in a magnetic trap may be facilitated by applying electric fields and (2) electric fields may induce nonadiabatic transitions in collisions of $^2\Sigma$ molecules with open-shell atoms [2]. The latter result indicates that chemical reactions between atoms and molecules in a magnetic trap can be effectively manipulated by dc electric fields. [1] R.V. Krems and A. Dalgarno, J. Chem. Phys. 120, 2296 (2004); [2] T.V. Tscherbul and R.V. Krems, Phys. Rev. Lett. 97, 083201 (2006); J. Chem. Phys. 125, 194311 (2006).

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