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**Quantum control of ultracold NaK polar molecules in optical traps**[1] MING LI, ALEXANDER PETROV, CONSTANTINOS MAKRIDES, SVETLANA KOTOCHIGOVA, Temple University — Selection of trapping conditions with ultracold molecules, where internal states experience identical trapping potentials, brings substantial benefits for the ultimate control of their internal degrees of freedom. Here we present our work on the control of NaK molecules, when they are subjected to both trapping laser light and external electric and magnetic fields. First, we calculated parallel and perpendicular polarizabilities using a coupled-cluster method at the CCSD level. This enables us to determine the differential Stark shifts of rotational levels of NaK as a function of orientation of external fields. The hyperfine and Zeeman structure of these rotational states was obtained using an effective spin Hamiltonian. We find that under the experimental conditions with NaK [1], the hyperfine sublevels of the $J = 1$ rotational state are significantly mixed by the trapping laser light so that the simplified model of Ref. [2] for "magic" conditions can not be applied. Adding a modest static electric field, however, can minimize the mixing of magnetic sublevels and make it easier to find "magic" conditions. [1] J. W. Park et al. Phys. Rev. Lett. 114, 205302 (2015) [2] B. Neyenhuis et al. Phys. Rev. Lett. 109, 230403 (2012)

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