Control of chemi-ionization by quantum-state preparation

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Ultracold mixtures of different atomic species are used to obtain dense samples of ultracold molecules which may feature long-range and anisotropic interactions. Such interactions allow for new physics and chemistry studies in a regime purely dominated by quantum effects. To achieve the co-trapping of ultracold atoms, reactive collisions must be efficiently suppressed.

As a first step towards co-trapping of Li and metastable He, my group at the University of Freiburg has studied and controlled the chemi-ionization of ultracold Li by He in the metastable 2^1S_0 and 2^3S_1 states. We have observed a strong suppression (enhancement) of chemi-ionization for non-spin-conserving (spin-conserving) reaction channels after all-optical electron-spin-state preparation of both atomic species [1]. The ionization rate also decreases when Li is laser-excited to the $2^2P_{1/2,3/2}$ states [2] and when He is laser-excited to the $2^3P_{0,1,2}$ states [3], respectively. In this talk, I will explain the underlying mechanisms.

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References

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[2] Dulitz K, Sixt T, Guan J, Grzesiak J, Debatin M and Stienkemeier F 2022 *Phys. Rev. A* **102** 022818

[3] Sixt T, Chung T, Stienkemeier F and Dulitz K 2023 *J. Phys. Chem. A* doi: 10.1021/acs.jpca.3c00431