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Magnetically tunable Feshbach resonances in Li + Yb(³P_J)

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Many groups have now succeeded in producing alkali-metal dimers in high-lying vibrational states by either magneto- or photoassociation, and a few of these species have already been transferred to their absolute ground states. The alkali-metal dimers all have singlet ground states and there is considerable interest in extending molecule formation to molecules with doublet ground states, such as those formed from an alkali-metal or other closed-shell atom and an alkaline-earth atom. Żuchowski *et al.* [1] have shown that such systems can have magnetically tunable Feshbach resonances due to very weak couplings caused by the distance dependence of the hyperfine coupling. The resulting Feshbach resonances are very narrow [2, 3], but have nevertheless attracted the attention of several experimental groups worldwide.

The Li+Yb system has particularly narrow resonances when the atoms are in their ground states, with widths predicted to vary from a few microgauss to a few milligauss depending on the Yb isotope [2]. However, ultracold Yb can also be prepared in its metastable ³P₂ state which has a radiative lifetime of over 15 s [4]. Atoms in P states are anisotropic, so the interaction of Yb(³P₂) with Li(²S) introduces additional couplings that are expected to produce broader resonances that can be used for molecule formation (as originally suggested by Hansen *et al.* [5]). In this poster, I will discuss our efforts [6] in understanding the feasibility of this approach.

[1] P. S. Żuchowski, J. Aldegunde and J. M. Hutson *Phys. Rev. Lett.* **105**, 153201 (2010)

[2] D. A. Brue and J. M. Hutson *Phys. Rev. Lett.* **108**, 043201 (2012)

[3] D. A. Brue and J. M. Hutson *Phys. Rev. A* **87**, 052709 (2013)

[4] A. Yamaguchi *et al. Phys. Rev. Lett.* **101**, 233002 (2008)

[5] A. H. Hansen *et al. Phys. Rev. A* **87**, 013615 (2013)

[6] M. L. González-Martínez and J.M. Hutson *Phys. Rev. A* **88**, 020701(R) (2013)

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