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Spin dynamics and Feshbach resonances in ultracold ion-atom collisions. DARIUSZ WIATER, MICHAL TOMZA, University of Warsaw — Cold hybrid ion-atom systems are a promising platform for fundamental research in quantum physics [1]. The successful cooling of the Yb+ ion to the quantum regime has opened up new theoretical and experimental perspectives [2]. Here, we present theoretical studies of the spin dynamics for ion-atom collisions in systems consisting of Yb+ or Ba+ ion and Li atoms. We employ multichannel quantum scattering theory to reproduce measured spin-changing rate constants and their energy dependence. As a result, the singlet and triplet scattering lengths for ion-atom interactions are assigned. Next, we identify experimentally accessible Feshbach resonances in the mentioned systems and predict their properties. Control of both elastic scattering and related cooling rates, as well as inelastic spin-changing collisions, with the magnetic field is proposed and investigated to guide ongoing experimental efforts. Ion-atom Feshbach resonances in analogy to well-established techniques for neutral systems will be an important tool to manipulated ultracold ion-atom mixtures.

[1] Tomza et al, Rev. Mod. Phys. 91, 035001 (2019)
[2] Feldker et al, Nature Physics, doi:10.1038/s41567-019-0772-5 (2020)

Dariusz Wiater
University of Warsaw

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