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Heteronuclear mixtures: From Efimov effect to heavy Fermi polarons

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Mixtures of different atomic gases with largely different masses are particularly suited to observe the Efimov effect, a series of three-body bound states obeying a universal scaling law [1, 2]. Indeed, these few-body states have been observed in a thermal mixture of ^{6}Li and ^{133}Cs [3]. Considering this mixture now at much colder temperatures and in the limit where Cs atoms act as impurities in a degenerate Fermi sea of Li, the system can be described as quasi-particles known as Fermi polarons. Extending the work of [4], we predict that signatures of the Efimov effect still persist in this scenario where it manifests itself as resonances in the induced impurity interactions at the positions where the Efimov states would cross the scattering continuum [5].
Currently we are working towards the experimental observation of heavy Fermi polarons in the Li-Cs mixture. Besides the aforementioned connections to Efimov physics, this platform enables studies of Anderson orthogonality catastrophe [6]. Most prominently, a universal power law is expected in the real-time response revealed e.g. by Ramsey spectroscopy on the impurity atoms [7]. Our system, being close to the infinitely heavy impurity limit, allows for an extended time window of observability.
To this end, we are working - among other technical aspects - on optimising the sympathetic cooling scheme to obtain a spin-polarized Fermi gas of Li deep in the degenerate regime with a few thermal Cs impurities. We hope to be able to report first spectroscopy results (in frequency and time domain) in September.

References

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4. Sun, M. & Cui, X. Efimov physics in the presence of a Fermi sea. Phys. Rev. A 99, 060701 (2019).
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Short bio (50 words) or link to website

I studied physics at Heidelberg university with a focus on quantum many-body physics, first theoretically during my Bachelor's then also experimentally during my Master's degree. Currently I am working as PhD student in the group of Lauriane Chomaz and Matthias Weidemüller on mixtures of ultracold gases of Lithium and Caesium.

Relevant publications (optional)

1. Enss, T. et al. Scattering of two heavy Fermi polarons: Resonances and quasibound states. Phys. Rev. A 102, 063321 (2020). [https://link.aps.org/doi/10.1103/PhysRevA.102.063321]
2. Tran, B. et al. Fermions Meet Two Bosons—the Heteronuclear Efimov Effect Revisited. Brazilian J. Phys. 51, 316–322 (2021). [http://dx.doi.org/10.1007/s13538-020-00811-5]
3. Welz, K. et al. Anomalous loss behavior in a single-component Fermi gas close to a p-wave Feshbach resonance. Phys. Rev. A 107, 053310 (2023). [https://link.aps.org/doi/10.1103/PhysRevA.107.053310]

Career stage

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