SFB/TRR 21 - Seminar

8. Januar 2016, Stuttgart

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Investigation of highly correlated negative ion resonances in photo-detachment and electron scattering processes

In the field of electron atom interactions, alkali metal atoms are frequently chosen targets for detailed experimental and theoretical studies, owing both to their relative theoretical simplicity and to the relative ease with which they can be handled experimentally. The heavier targets, like rubidium, cesium, or francium allow for the exploration of relativistic effects, which are too small to be easily observed in lighter atoms.

For the electron Cesium system, two multiplets of narrow shape resonances (with widths of a few meV) are of particular interest. We have shown [1] that these resonances are influenced by both (two electron) core polarization and relativistic effects. The former convert the 3PoJ negative ion states from bound states to resonances. The latter add fine structure splitting and finite auto-ionization widths to 3PeJ states that in LS coupling are strictly uncoupled to the adjacent continuum. Our calculations predict the same resonances to occur in Rb and Fr [2].

We have identified and characterized a large number of scattering resonances in elastic, inelastic, angle-differential, and total electron-scattering cross sections for Rb, Cs, and Fr (atomic) targets. Our results for 3Po and 3Fo shape resonances and 3Pe, 1Po, and 1D0 Feshbach resonances of Rb-, Cs-, and Fr- negative ions are in agreement with available experimental data [2]. We have calculated the 3Se and 1Se scattering lengths in ultraslow collisions of electrons with ground state Rb, Cs, and Fr atoms. These calculations are based on a new relativistic effective range theory that allows us to extrapolate eigenphases that are provided by Dirac R-matrix calculations to zero energy [3]. Recently, our scattering lengths have contributed to the prediction of a new class of highly excited, trilobite-shaped states of Rb2 dimers [4].

[1] U. Thumm and D.W. Norcross, Phys. Rev. Lett. 67, 3495 (1991) C. Bahrim and U. Thumm, Phys. Rev. A61, 022722 (2000) C. Bahrim, I. I. Fabrikant, and U. Thumm, Phys. Rev. Lett. 87, 123003 (2001) C. Bahrim, I. I. Fabrikant, and U. Thumm, Phys. Rev. A 68, 063405 (2003) [2] C. Bahrim, U. Thumm, and I.I. Fabrikant, Phys. Rev. A 63, 042710 (2001) C. Bahrim and U. Thumm, Phys. Rev. A 64, 022716 (2001) [3] C. Bahrim, U. Thumm, and I.I. Fabrikant, J. Phys. B 34, L195 (2001) [4] C. H. Greene, A. S. Dickenson, H. R. Sadeghpour, Phys. Rev. Lett. 85, 2458 (2000)

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