Towards atomic anion laser cooling

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Laser cooling is an established technique used to create positive or neutral ensembles at sub-kelvin temperatures. This result has not yet been achieved for negative ions. We conduct experiments on the few atomic anions in which a strong electric-dipole transition has been predicted. Most atomic anions show only few, if any, bound excited states, strongly reducing the number of species theoretically suitable for laser cooling [1]. In addition to gathering information on these particular atomic species, our research pursues an appealing technique to cool any negative-ion species by sympathetic cooling in a shared trapping volume [2].

Starting from the preliminary results of other groups [3] we performed high-precision spectroscopic studies on Os^- and La^- [4,5]. We measured the transitions frequencies with vastly improved precision to address fundamental questions about hyperfine structure, cross-sections and the Zeeman effect, all with a view to laser cooling an atomic species in a Penning or a Paul trap. Our results indicate La- as a promising candidate.

Currently we are modifying our apparatus to attempt the laser cooling of an ensemble of La^- ions in a linear Paul trap. In this talk, the spectroscopy results will be presented and an outlook on the cooling technique will be given.

References

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