Towards Laser Cooling of Negative Ions

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Ultra-cold negative ions could be used in a wide field of applications, since other negative ion species could be cooled sympathetically by loading them in the same trap [1]. To date laser cooling of negative ions has never been demonstrated experimentally, because most atomic negative ions are weakly bound systems without bound excited states. There are few exceptions with opposite-parity excited states that allow electric dipole transitions [2]. We want to demonstrate the first laser cooling of atomic anions. In order to identify suitable candidates we study them by high-resolution laser spectroscopy. Previously the transition frequencies and transition cross-sections of various Os isotopes have been determined [3]. The Einstein A coefficient of the relevant transition was found to be low $A \approx 330\ \mathrm{s}^{-1}$. In addition, the Landé g factors of the ground and excited state as well as the Zeeman splitting have been determined experimentally [4, 5].
Since it has been theoretically predicted that La^- is a promising candidate for laser cooling [2, 6], we are now studying La^- by infrared laser photo-detachment spectroscopy. For spectroscopy laser beam and ion beam are superimposed collinearly and the neutrals from two-photon detachment are counted. In this report we will present first measurement results (Fig. 1).

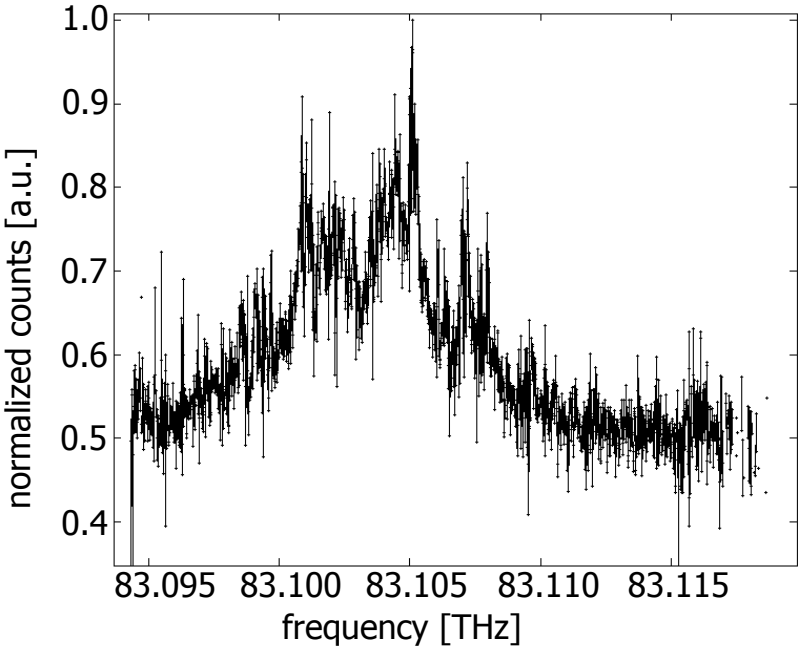

Figure 1: *Neutralized La atom counts from two-photon detachment of a La^- beam vs. laser frequency. Preliminary data.*

References

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