Fundamental studies of negative ions
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Production and neutralisation

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There are many applications of negative ions: Beams of negative ions are used for heating in fusion reactors, and they are pivotal in Accelerator Mass Spectrometry (AMS). Further, H^- plays a decisive role for the opacity in the infrared spectrum in the solar atmosphere. Negative ions are, however, also of considerable interest from a fundamental point of view. The binding energy of a negative ion is about an order of magnitude smaller than its corresponding atom. The extra electron does not experience the Coulomb force from the nucleus at large distances. Instead, core polarization induced by the extra electron stabilizes the ion. The correlated motion of the electrons require theoretical models that go beyond the independent particle approximation, and experimental investigations of the structure and dynamics of negative ions can hence lead to an increased understanding of many-electron effects.

I will present experiments conducted in a 6 keV ion beam apparatus. Essentially any negative ions can be produced either in a cesium sputter negative ion source, or in a plasma ion source followed by charge transfer in a cesium vapor. The beam is mass analyzed in a sector magnet and thereafter directed into a UHV chamber where the interaction between negative ions and laser light is investigated. The laser light is produced in a OPO laser systems that can deliver continuously tunable light over the whole visible and near infrared wavelength regions. Various detector are used to detect the final product in the photodetachment process.

I will show how these types of experiments can give detailed information about the fundamental properties of negative ions [1]. I will also show how it can be used to measure the fraction of excited state negative ions produced in the ion source. I will further describe how an ion beam can be isotoptically filtered by making use of the Doppler effect [2]. The experimental results will, wherever possible, be compared with recent theoretical studies.

References

[1] The electron affinity of phosphor**,** P. Andersson, A. Lindahl, C. Diehl, L. Rogström, D.J. Pegg and D. Hanstorp, accepted by J. Phys. B **40** (2007) 4097.

[2] Laser photodetachment mass spectrometry, J. Sandström, P. Andersson, K. Fritioff, D. Hanstorp, R. Thomas, D. J. Pegg and K. Wendt, Nuclear Instrum. Methods B, **217**, (2004) 513.

Topic: **Other negative ion sources**

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