

EXPERIMENTAL INVESTIGATIONS OF NEGATIVE IONS

Karin Fritioff
Atomfysik
Fysik och teknisk fysik
Göteborgs Universitet
Chalmers Tekniska Högskola

Abstract

Negative ions are fascinating objects which can be found everywhere in our universe. They are fundamentally different from positive ions, but they have been studied far less. In this thesis I will present experiments investigating various aspects of negative ions. The work was performed both at the magnetic storage ring CRYRING in Stockholm and the Atomic Physics Laboratory at Göteborg University.

At CRYRING, negative ions were merged with electrons of a well defined energy. This enabled us to study electron-impact collisions over a wide energy range. We have measured electron-impact detachment and/or dissociation cross sections for H^- , S^- , Cl^- , CN^- , Cl_2^- and C_4^- . Apart from the general interest in the shape of these cross sections, multiple detachment was studied for the atomic anions and branching ratios of the different reaction channels were measured for the molecular anions. We further observed resonances due to the formation of doubly charged anions in the molecular systems. In another part of the ring, a laser beam interacted collinearly with the ion beam. Here we performed laser spectroscopy to measure the lifetimes of the ^2D excited term level in Si^- and the $^2\text{P}_{3/2}$ fine structure level in Te^- .

In the laboratory at Göteborg University I used a single pass setup for collinear laser spectroscopy. First, it was used to measure the electron affinity of K with high accuracy. Second, we developed a technique to enhance the selectivity of mass spectrometry by the use of the photodetachment process. A proof of principle experiment is presented in the thesis.

Keywords: negative ions, photodetachment, electron scattering, electron affinity, radiative lifetimes, accelerator mass spectrometry, electron-impact, dissociation, storage rings