High-precision reference-free measurements of soft x-ray transitions with a double crystal spectrometer

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Abstract

We present our results of x-ray transitions measurements from n=2 to n=1 in highly charged ions of argon using a double flat-crystal spectrometer [1]. The ions were produced in a plasma of an ECRIS (Electron-Cyclotron Resonance Ion Source). Two transitions in two different charge states of argon (He- and Be-like) have been measured with an accuracy better than 3 ppm [2]. The 1s2p $^1P_1 \rightarrow 1s^2\ ^1S_0$ transition measurement confirms the recent reference-free measurement of the Heidelberg EBIT (Electron-Beam Ion Trap) [3] while the $1s2s^22p\ ^1P_1 \rightarrow 1s^22s^2\ ^1S_0$ transition energy is the first reference-free measurement for a transition in an ion with more than two electrons. The natural widths have been also experimentally obtained by applying a fitting procedure to the experimental spectra that uses full Monte-Carlo simulated spectra and an experimental value for the Doppler broadening of the lines obtained in Ref. [4]. Both energies and widths are in agreement with the most advanced calculations. The accuracy in the ppm level provides tests of QED (Quantum Electrodynamics) and relativistic effects. It also provides accurate x-ray standards in narrow transitions of highly charged ions that can be used to calibrate instruments in this energy range.

The experiment setup, the most recent results and the current status of the experiment will be presented focused in the DCS working principle and in the planned measurements and setup updates.

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