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Enhanced radiative recombination of U^{92+} ions with cooling electrons for the K-shell

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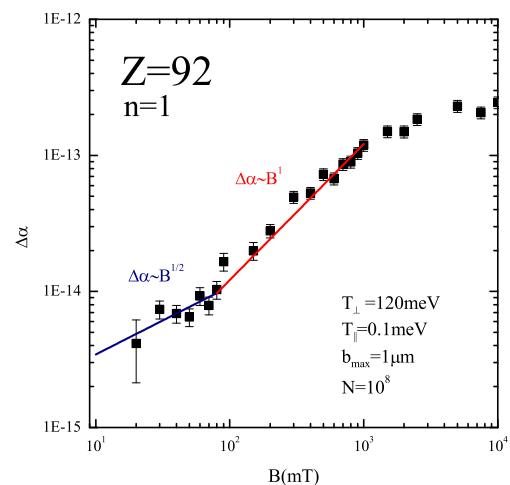[7]Institute of Physics, Jagiellonian University, 31-007 Cracow, Poland

Synopsis Observed enhancement of K-shell radiative recombination (RR) of bare uranium ions with cooling electrons is interpreted in terms of of distant transverse collisions in magnetized electron-cooler plasma described within the semiclassical geometrical model (SGM), which was recently proposed. The Monte Carlo simulations based on the proposed approach explains the enhancement measured in RR of U^{92+} ions with cooling electrons for the K-shell.

Recently we have proposed [1] new interpretation of the RR enhancement using the developed semiclassical geometrical model (SGM) which adopts the standard quantum mechanical RR cross sections to introduce a simplified concept of fully "absorbing" RR sphere. Within this model we demonstrate that the enhancement of the RR is caused by "transverse' collisions with impact parameters in the μm range, with cut-off value depending on a strength of the guiding B-field in the electron cooler.

The proposed SGM model reproduces the scaling of the RR excess rates observed at experiments at the TSR [2] and, moreover, predicts strong enhancement for low n-states, which was observed in our x-ray experiment on RR for the K-shell [3]. It should be noted that for stronger magnetic fields this model predicts linear dependence on the B-field, i.e. $\Delta\alpha \propto B$, which was suggested in earlier experiment at the GSI [4] (see Fig. 1). For a better description of the RR enhancement we have performed the Monte Carlo simulations based on the SGM approach which predicts more realistic B-field dependence and impact parameter cuf-off. It is important to note, that the absolute value of the RR enhancement predicted by the SGM is close to the observed one for the K-shell [3]. Additionally, the Monte Carlo simulations involving the angular distributions of x-rays demonstrate that the proposed approach describes well the RR enhancement measured in x-ray experiment on recombination of U^{92+} ions with cooling electrons.

Figure 1. The B-field dependence of the excess of the total RR rate in the magnetized electron cooler as obtained using the Monte-Carlo simulations based on the SGM model.

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