K-shell excitation of hydrogen-like and helium-like uranium in relativistic collisions

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Synopsis In this contribution, we present an experimental and theoretical study of the proton- and electron-impact excitation processes in relativistic collisions of hydrogen- and helium-like uranium ions with gaseous targets. State-of-the-art calculations which treat both processes within the relativistic framework, provide a good agreement with the experimental data. Moreover, our experimental results clearly demonstrate the importance of including the generalized Breit interaction in the electron-impact excitation calculations.

We have studied the K-shell excitation of H- and He-like uranium (U^{91+} and U^{90+}) in relativistic collisions with gaseous targets by observing the x-rays emitting during the subsequent de-excitation process. The experiments were conducted at the ESR storage ring of the GSI accelerator facility in Darmstadt, Germany. The measurements were performed with a recently developed multi-phase target at different collision energies. This enabled us to explore the proton- (nucleus-) impact excitation (PIE) as well as the electron-impact excitation (EIE) processes in the relativistic collisions. Up to now, most of the experimental studies of the EIE process, which playes a prominent role in various types of laboratory and astrophysical plasmas, have been performed with the electron beam ion trap (EBIT) devices limited, to the mid-Z regime [1,2]. In this work, we have extended the EIE studies to the heaviest H- and He-like ions (U^{91+} and U^{90+}). The large fine-structure splitting in uranium allowed us to unambiguously resolve excitation to different fine-structure levels of the L-shell. Moreover, information about the population of different magnetic sublevels has been obtained via an angular differential study of the decay photons. The experimental results are compared with state-of-the-art relativistic calculations including excitation mechanisms due to both protons (nucleus) and electrons, providing a good agreement and emphasizing the importance of the generalized Breit interaction (GBI) in the EIE process [3,4].

References

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