Electron loss from highly charged ions in high-energy collisions with light atoms

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Synopsis Electron loss from H-like highly charged ions in collisions with light atoms is theoretically investigated. We focus our attention on those collision velocities where any reliable data for loss cross sections are absent. The total, single and double differential cross sections of electron loss in collisions with equivelocity electrons, protons as well as with hydrogen and helium atoms are calculated.

Electron loss from ions colliding with atoms is one of the basic processes studied by atomic physics. In the present work we consider electron loss from hydrogen-like highly charged ions in relativistic collisions with hydrogen and helium in the range of impact velocities $v_{min} \leq v \leq v_{max}$ (v_{min} and v_{max} correspond to the threshold energy ε_{th} for electron loss in collisions with a free electron and to $\approx 5\varepsilon_{th}$, respectively) where any reliable data for loss cross sections are absent. Within this velocity range the loss process is characterized by large momentum transfers and corresponding cross section can be evaluated from equivelocity collisions with protons and electrons. We use a fully relativistic treatment and consider loss process for wide range of ions from Ne^{9+} to U^{91+} [1].

In Fig. 1 we present the total cross sections for electron loss from $Fe^{25+}(1s)$ and U^{91+} (1s) in collisions with equivelocity electrons, protons as well as with atoms of hydrogen and helium. In order to compare theory and experiment the available experimental data [2-5] for these ions also depicted in Fig. 1. In the lower panel the open circle with error bars is the total cross section for electron loss from 405 MeV/u $U^{90+}(1s^2)$ colliding with H_2 measured in [2] (which we scaled to collisions of hydrogen-like uranium with atomic hydrogen by diving their result by 4). All the other experimental data, shown in this figure, were measured for electron–ion collisions and are taken from [3] ($Fe^{25+}(1s)$, ★), [4] (U^{91+} (1s), ■) and [5] (U^{91+} (1s), •).

The obtained results allowed us to perform a comparative analysis of electron loss from highly charged ions in high-energy collisions with various atomic particles.

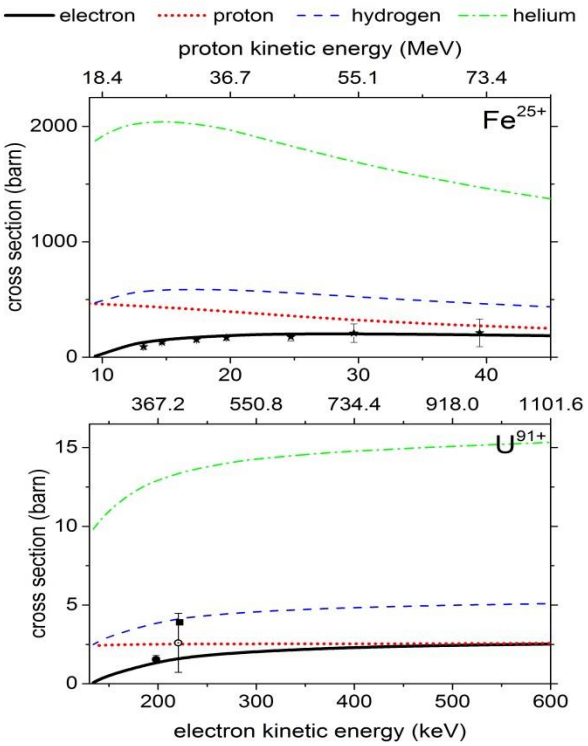

Figure 1. The total cross sections for electron loss from $Fe^{25+}(1s)$ and U^{91+} (1s) in collisions with equivelocity electrons (solid curves), protons (dotted curves) as well as with atoms of hydrogen (dashed curves) and helium (dash-dot curves).

References

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