

4 - 17 Investigation of the Effective Charge State of 90 keV Proton in Hydrogen Plasma*

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Energy loss of proton in plasmas is a very important topic in the nuclear fusion. In our previous work, the energy loss measurement for 100 keV proton in the hydrogen plasma has been presented^[1], and the enhanced energy loss is attributed to the stronger Coulomb logarithm where the effective charge is thought to be 1. But in this work, we present a new experimental data of energy loss of 90 keV proton penetrating through the hydrogen plasma, in which the effective charge of proton cannot be chosen as 1.

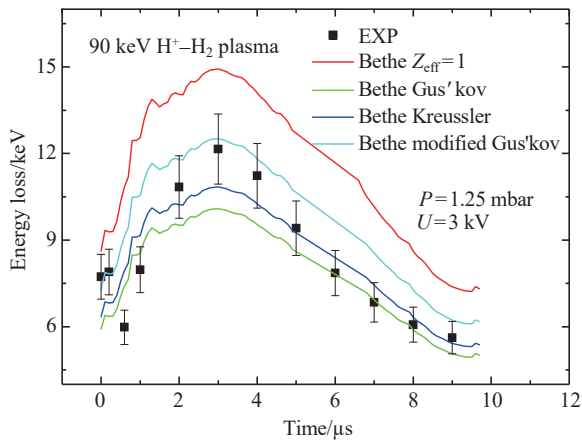


Fig. 1 (color online) Energy loss of 90-keV proton in hydrogen gas discharging plasma. Theoretical predictions are also shown for comparison.

Moreover, the modified Gus'kov model is used in the case of 100-keV proton incident, and a good agreement between experimental data and the theoretical prediction is achieved.

References

- [1] R. Cheng, X. Zhou, Y. Wang, et al., *Laser and particles Beams*, 36(2018)1.
- [2] R. E. Olson, A. Salop, *Phys. Rev. A*, 16(1977)531.

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The experiment was performed at the 320 kV ion-plasma interaction experimental platform and the proton beam penetrated through the hydrogen plasmas with a linear electric discharge in Z -pinch geometry. The ion energy was measured by a high-precision magnetic spectrum analyzer and the energy loss are shown in Fig. 1. It is found that, for $Z_{\text{eff}} = 1$, the theoretical prediction obviously overestimates the experimental results by a factor about 2^[2]. Two traditional empirical formulae (Gus'kov and Kreussler) are employed to estimate the effective charge, but they are failed to describe the experimental results. The value of Z_{eff} is extracted from the data fitting and its value is 0.92. Meanwhile, correspondingly the Gus'kov model is modified as:

$$\gamma = 1 - \exp[-1.31 \times Z^{-2/3} \times \langle |v - v_e| \rangle]$$