Beryllium ion collisions and free-free transition in H plasma

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In the first part, we will present the studies of state-selective single electron capture, excitation and ionization processes in collisions of H^+-$Be^+(1s^22l)$ and Be^{3+}-$Li(1s^22s)$ [1], by using the quantum-mechanical molecular orbital (QMOCC) and the two-center atomic orbital close-coupling (TC-AOCC) methods in a broad energy range. The total, *n*-shell and state-selective electron capture, excitation and ionization cross sections are calculated with large expansion MO and AO basis sets. In the overlapping energy range the results of electron capture and excitation processes of the two sets of calculations for the main channels agree very well.

In the second part, the free-free absorption Gaunt factors in Hydrogen plasmas are studied by taking into account the plasma screening in the Debye model [3]. It is found that the values of the free-free Gaunt factors for different Debye screening lengths for a given initial electron energy and absorbing photon energy, generally lie between those of the pure Coulomb field and field-free case. However, the Gaunt factors can show dramatic enhancements (broad and narrow resonances) in the vicinities of the critical screening lengths, these enhancements of the Gaunt factors can be significantly higher than their values in the unscreened (Coulomb) case over a broad range. The temperature averaged Gaunt factors are also presented.

The reported results should be useful in the kinetic modeling and diagnostics of edge plasmas in present magnetic fusion experiments, as well as in the current ITER design, in which beryllium is used as first wall material.

1. L. Liu *et al.* (2019, to be submitted)
2. J. Y. Wu, Y. Wu, Y. Y. Qi, J. G. Wang, R. K. Janev, and S. B. Zhang, *Phys. Rev. A* **99**, 012705 (2019)