# Positronium formation in positron-hydrogen collisions in Debye plasma

**Jia Ma**[*1], **Yuancheng Wang**[†2], **Yongjun Cheng**[§], **Yajun Zhou**[‡], **and Heng Wang**[*]

[*] College of Science, Shenyang Aerospace University, Shenyang, 110136, China
[†] College of Physics Science and Technology, Shenyang Normal University, Shenyang, 110034, China
[§] Natural Science Research Center, the Academy of Fundamental and Interdisciplinary Science, Harbin Institute of Technology, Harbin 150080, China
[‡] Institute of Atomic and Molecular Physics, Jilin University, Changchun, 130012, China

**Synopsis** Positronium (Ps) formation cross sections ($n$=1, 2) in positron-hydrogen collisions for various Debye lengths from the Ps formation thresholds to 40 eV are calculated using the screening approximation model, taking account of the influence of the plasmas screening on the Coulomb potentials and the structures of target states and Ps states. The influence of considering modified bound-state wave functions and eigenenergies for the Ps by the screened Coulomb potential on the Ps formation process is investigated.

Positronium formation is a special rearrangement process in positron-atom collision. Recently, the effects of Debye plasmas on this Ps formation process have received attention from many atomic physics research groups (see, e.g. Refs. [1, 2, 3] and references therein).

Screening approximation model was applied to investigate positron scattering on the hydrogen atom in Debye plasma, where interesting features were observed with the reduction of Debye length $D$ [4]. In this work, Ps formation process is further investigated with the screening approximation model with the inclusion of the modified structure of Ps. Ps formation cross sections ($n$=1, 2) are calculated for various Debye lengths from the Ps formation thresholds to 40 eV. Consistent point is obtained with the previous calculation [4] that the effect of screening causes an enhancement in the values of the Ps formation cross sections at low energies. However, the increase is not substantial as the previous results in which the modified structure of the Ps in Debye plasmas was not taken into consideration.

In figure 1, a comparison is displayed between the previous results [4] and the present results. We observe that the inclusion of the modified structure of the Ps causes a reduction in the value of Ps formation cross section. Moreover, the value decreases increasingly as the screening length decreases. That is, it reduces the values of the Ps formation cross section at low energies and this influence is enhanced as the screening effect increases, whereas it can not counteract the enhancement of the Ps formation by the Debye screening. The screened Coulomb potential always increases the values of the Ps formation cross sections at low energies.

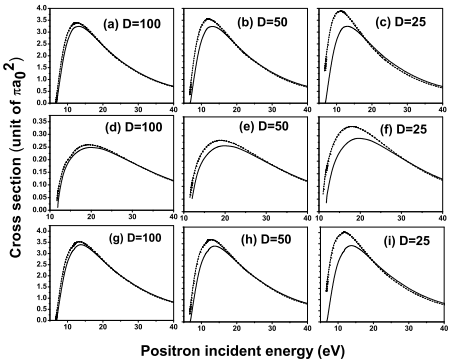


**Figure 1**. A comparison of positronium formation cross sections under different Debye lengths between the previous calculations [4] (dashed lines) and the present calculations (solid lines) with the inclusion of the modified structure of the Ps. (a)-(c): Ps ($n$=1) formation cross sections; (d)-(f): Ps ($n$=2) formation cross sections; (g)-(i): Ps ($n$=1+2) formation cross sections.

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[1]E-mail: majia@sau.edu.cn
[2]E-mail: rickywangyc@aliyun.com