Atomic cross section in collision between hydrogen atom, carbon and lithium ions with hydrogen atom

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The hydrogen atoms generated by ion recombination on the fusion reactor's wall and other plasma-facing components [1-5] play a significant role in the beam emission spectroscopy (BES), which is an active plasma diagnostic tool used for density measurements in fusion research [1]. The cross sectional data of H-H atom collisions act as raw data for BES modeling. Besides hydrogen atoms, the impurities such as carbon, lithium, oxygen, deuterium, and tritium have existed in the plasma edge area [4, 5]. As comprehensive studies, the interactions of carbon and lithium ions with neutral hydrogen atoms were also investigated [4, 5], where carbon composites are used in first wall tiles [6-8] and lithium ions were used as a potential solution to solve the fusion reactor diverter heat flux. The ionized lithium ions can form a highly radiative layer of plasma, thus could significantly reduce the heat flux to the diverter surfaces [4, 9]. This work is created toward developing a theoretical description of inelastic interactions such as ionization and excitation processes that can give the total cross section accurately. In addition it is also contribute to creating a database for total cross sections as raw data for the BES modeling [10].

Classical calculations for determining atomic collision cross sections have received a great deal of interest in the past 20 years. There was a great revival of the CTMC calculations applied in atomic collisions involving three or more particles [2-5]. The CTMC method is a non-perturbative method, where classical equations of motions are solved numerically [2-5]. For a better description of the classical atomic collisions, the quasi-classical trajectory Monte Carlo model of the Kirschbaum and Wilets (QCTMC) improves the results of the standard CTMC model [3-5].

We present ionization, excitation, and electron capture cross sections in collisions between hydrogen atom, carbon and lithium ions with hydrogen atoms. We found a reasonably good agreement between classical results and the previously obtained experimental data.

References

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