Ionization, Total and state selective charge exchange cross sections in fusion related collision systems

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The standard three-body classical trajectory Monte Carlo (CTMC) model is a well-known classical treatment for modelling atomic collisions [1]. But due to the lack of quantum features in the standard model, the CTMC model is not able to describe accurately the cross sections mostly at lower impact energies when the quantum mechanics characteristic is dominant. Therefore, we developed a three-body quasi classical trajectory Monte Carlo (QCTMC) model taking into account quantum feature of the collision system, where the Heisenberg correction term is added to the standard classical Hamiltonian of the collision system to mimic the Heisenberg uncertainty principle [2-10].

We present ionization, total and state selective charge exchange cross sections in collisions between fully stripped ions with Hydrogen atoms at the impact energies between 5-200 keV/amu by using CTMC and QCTMC models. We found that our QCTMC model remarkably improves the obtained cross sections, especially at lower projectile energies. Our results are very close and are in good agreement with the previously obtained quantum-mechanical results. Our model with simplicity can time efficiently provide accurate results where maybe the quantum mechanical ones become complicated. Therefore, our model should be an alternative way to calculate accurate cross sections providing the same results as the quantum-mechanical approaches [2-10].

Keywords： quasi classical trajectory Monte Carlo model, ionization, charge exchange

References

[1] K. Tőkési and G. Hock, Nucl. Instrum Meth. Phys. Res. B**86** 201 (1994).

[2] I. Ziaeian and K. Tőkési, Atoms **8** 27 (2020).

[3] S.J.A. Atawneh and K. Tőkési, Atoms **8** 31 (2020).

[4] I. Ziaeian and K. Tőkési, EPJD J. **75** 138 (2021).

[5] S.J.A. Atawneh and K. Tőkési, J. Phys. B: At. Mol. Opt. Phys. **54** 065202 (2021).

[6] S. J. A. Atawneh and K. Tőkési. Nucl. Fusion. **62** 026009 (2021).

[7] I. Ziaeian and K. Tőkési, Sci. Rep. 20164 (2021).

[8] I. Ziaeian and K. Tőkési, Atomic Data and Nuclear Data Tables **146** 101509 (2022).

[9] S.J.A. Atawneh and K. Tőkési, Atomic Data and Nuclear Data Tables **146** 101513 (2022).

[10] S. J. A. Atawneh and K. Tőkési. Phys. Chem. Chem. Phys. **24** 15280 (2022).

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553 research article in referred journals or volumes

4 book chapter

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