# Ionization of rubidium by electron impact

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**Synopsis** The cross sections for ionization by electron impact of rubidium 5s shell have been calculated by the Classical Trajectory Monte Carlo method. The kinetic energy of the projectile is in the range between 5 and 1000 eV. We compared our results with other theoretical and experimental data.

We have many experimental investigations of the ionization process by electrons and other charged particles from the beginning of the twentieth century. Rubidium is an important element in laser physics, but only a limited number of theoretical studies has been reported. It is interesting to calculate ionization cross section by electron impact for this element and to test theoretical models.

The classical treatment of various collision problems has been quite successful to obtain ionization cross sections. In particular the Classical Trajectory Monte Carlo (CTMC) method is widely used [1]. It is a non-perturbative method and hence all the interactions between colliding particles can be taken into account exactly within the framework of the classical dynamics.

We describe the collision system as a three-body model: the projectile, an atomic electron (e-), and the remaining rubidium ion ($Rb^+$). The target atom is modeled like a tiny solar system, in which the electron moving on Kepler orbit around the nucleus. We investigated the ionization cross sections for rubidium using two models. In the first model, the effective static target nucleus charge is used and Coulomb force acts between the colliding particles. In this case we calculate the effective charge of the valance electron by the Slater's rules. In the second approach we represented the rubidium atom with Garvey model potential. The two parameters of the potential, $\xi$ and $\eta$, represent quantum mechanical effects by taking into account of the independent particle model.

The binding energy of the rubidium 5s shell valence electron is 0.1504 a.u. (4.1912 eV) based on the theoretical data of the ionization energy. The mass of Rubidium atom is 156918.88 a.u. For the first model, the corresponding effective nuclear charge is taken to be $Z_{eff} = 2.2$. In the model 2, the parameters of the Garvey type potential are chosen as $\xi = 0.1686$ and $\eta = 0.1619$.

Figure 1 shows the ionization cross sections of Rb 5s shell by electron impact. While the data of CTMC with the static potential are in agreement with the calculations with Lotz's formula [2], the CTMC results using the Garvey model potential during the simulations are in agreement with the binary encounter approximation (BEA) and with the results published in Ref. [3].

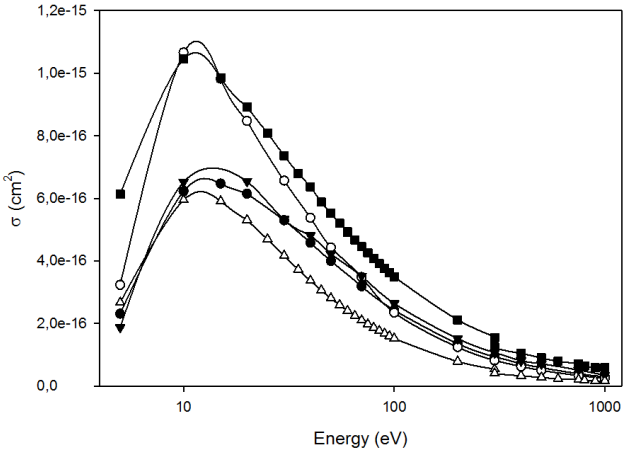


**Figure 1.** Electron-impact ionization cross sections of rubidium 5s shell. Open circle: present conventional CTMC results using the effective static target nucleus charge, solid inverse triangle: present CTMC results with Garvey-type model potential, open triangle: present BEA simulation, solid square: semi-empirical formula of Lotz [2], solid circle: simulation from Ref. [3].

## References

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