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Peer Review

Review of: "Projectile Excitation to the 2s2p ^{3}P and ^{1}P Autoionizing States in Swift Collisions of He-Like Carbon and Oxygen Mixed-State ($1s^2$, 1s2s ^{3,1}S) Ion Beams With Helium"

Shinichirou Minemoto[1]

1. Tokyo University, Japan

The present manuscript describes theoretical and experimental studies of collision cross sections of He-like carbon and oxygen ions with He. Excitation of a few-electron system is a fundamental process for deep insight into basic quantum dynamics. The present work follows the preceding study by the same author (Ref. [1]: Laoutaris et al., PRA 109, 032825) and extends to 1s^2 and 1s2s 1S projectile states. The work contains suggestive information for future studies in many aspects, but I have several concerns as below.

1. In Figs. 1 and 2, the error bars are ~15-30% of the fractions, while the mean value at each energy seems to scatter within \pm 10%. It is usually the case that the mean values scatter with almost the same amount as the standard deviation of the data. Do the error bars include systematic errors together with statistical ones? It is better to explicitly show how the error bars are estimated.

2. The short lifetimes of 1s2p 1S states are on the order of the flight time to the target position. It means that the fraction of 1S states depends on the projectile energy. Is such an effect included in Fig. 2? The increase in fraction with the projectile energy, especially in the case of O^{6+}, seems to reflect the lifetime.

3. In Section III Theory, it would be kind for the readers to add a little more explanation of the essence of the calculation. The first paragraph of Sec. IIIA of Ref.[1] is easy to capture the calculation, while the present manuscript omits some concepts and is difficult to get the whole picture of the calculation.

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4. In Sec. IV A.2 Single excitation:

The authors describe "As can be seen, ...", but it is difficult to understand what we should see. It is kind for the readers to show what to see, e.g., "As can be seen in Fig.6&7", and to explicitly indicate, e.g., "blue triangles (Eq.(1)) for 3P and ...".

5. In the middle of Sec. IV A.2, "Q values" is not defined. It would be kind for non-specialists to add a brief explanation or the point of the Q value in Fig. 14.

6. The last sentence of Sec. IV A.2 is difficult to understand. It requires more explanation.

7. In Sec. IV A.3, the authors describe "double-excitation without spin-exchange appears to become more efficient than single-excitation with exchange". I suppose that, by inspecting the calculation deeply, one can estimate what is the main origin of this behavior. The readers will expect what is happening in the collision dynamics at higher energies.

8. In Sec. IV A.5, what exactly is "a different excitation mechanism"?

9. In Sec. IV B.1, the experimental data are compared to the calculated values at \theta = 0 degrees. In the experiment, the X-ray detector will have a finite area and will cover a finite angle. Is it sufficiently small to approximate the angle to 0?

10. In Sec. IV B.5, the authors discuss the parameter \beta > 0. However, the physical content of \beta is not given in the text, so the readers will not understand what can be discussed in this section. A brief explanation of its content or a possible future discussion is welcome for the readers.

Declarations

Potential competing interests: No potential competing interests to declare.