Higher-order contribution in the resonance recombination of electron-ion interaction

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Synopsis Due to the correlation between different quantum states, such high-order correlation in the electron-ion resonance recombination can not be resolved in those published state-of-art calculations. Wherever such correlation effect is embodied in the resonant recombination spectroscopy, and were measured on electron beam trap to benchmark theory recently. In this abstract, we theoretically investigate the high-order contribution in the total resonance recombination for carbon-like iron, and it is found to be significant.

Resonance recombination plays a major role on the ionization equilibrium of collisional plasmas [1], and further the temperature diagnostic for the plasmas. Sine about 10 years ago, serial calculations for dielectronic recombination have been done with the state-of-the-art method, that significantly improve the ionization equilibrium data used extensively by astronomical community [2]. Beyond the well-known DR, resonant recombination processes also involve higher-order (HO) correlations, that is, two or even three bound electrons can be simultaneously excited by the resonantly captured electron in trielectronic or even quadruelectronic recombination (TR or QR). However, such HO process are weak and difficult to be decomposed in experiments and theories. By using advanced forced evaporate technology, Beilmann *et al.* [3] disintegrated such HO processes in K-L intershell recombination and found it to be prominent relative to the corresponding DR by comparing their line strength.

In this work, we make a detailed investigation to the HO contributions for carbon-like iron ion including L-L plus L-M, K-L inter- and intra-shell resonant recombinations. We found that such HO contributions are partly included in published Maxwellian-averaged DR rate coefficients. In the state-of-the-art calculation, it is very difficult to disintegrate the TR and/or QR from DR channels. So a decomposition procedure is developed and applied to carbon-like iron ion, and found such K-L intershell HO contribute about ∼35-40% in total resonant recombination rates, and the L-L intrashell plus L-M intershell HO occupies about up to 40% for photoionized plasma zone (at temperatures of 20–70 eV).

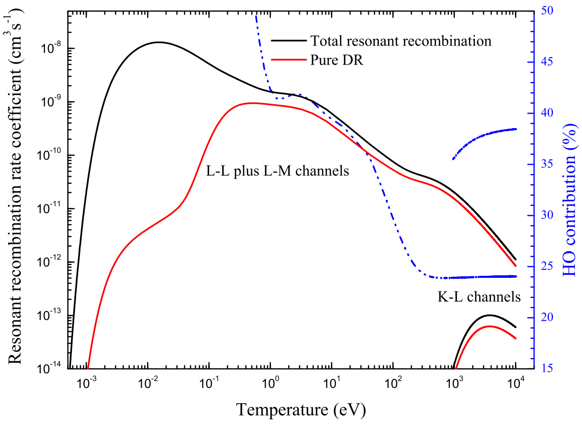

Figure 1. Resonant recombination rate coefficients with and without HO contribution from K-L intershell and L-L intrashell plus L-M intershell cases.

References

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