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Series of singlet and triplet S-wave doubly-excited states of C^{4+} below the N=2 threshold of C^{5+}

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Synopsis The doubly-excited resonances of both the singlet and triplet S-wave series of C^{4+} at energy below the N=2 threshold of C^{5+} were determined by us, using an accurate Harris-Nesbet variational calculation of electron-C^{5+} scattering. The widths of many of these resonances were obtained for the first time by us. Graphical presentations of these resonances were also given explicitly.

The series of singlet and triplet doubly-excited states $^1S^e$ and $^3S^e$ of C^{4+} at energy below the N=2 excitation threshold of C^{5+} were determined by us, employing an accurate Harris-Nesbet variational calculation [1] of phase shifts of electron-C^{5+} scattering. The procedure to obtain the positions and widths of these doubly-excited-state resonances were described in detail by us elsewhere [2]. Accurate positions and widths were obtained by us for these doubly-excited-state resonances of the series, including those lying very close to the threshold whose widths, especially those of the triplet b-series, are usually very small and whose positions are also adjacent to each other and should, thereby, be fairly difficult to determine with accuracy. Most of these widths were obtained with high accuracy for the first time by us.

We obtained the greatest number of singlet as well as triplet S-wave doubly-excited states below this N=2 excitation threshold. For the singlet S-wave doubly-excited-state resonances, we succeeded in determining the positions and widths of up to eleven of the a-series, $^1S^e(2,na)$, with n=2, 3, …, 12 and of up to ten of the b-series. For the triplet S-wave doubly-excited-state resonances, we were able to obtain the positions and widths of up to nine of the a-series, $^3S(2,na)$ with n=3, 4,…, 11 and of eight of the b-series, $^3S^e(2,nb)$, with n=3, 4, …, 10. We were also able to, with our method of calculation, present all these doubly-excited-state resonances (singlet as well as triplet) in graphical forms explicitly. This possibility helps in confirming the definite existence of these doubly-excited-state resonances. The results of this work indicate that the method of calculation employed by us for the determination of these doubly-excited states of the helium-like ionic atoms, even with Z=6 in this case, is still quite effective.

Complete results of this work, including the explicit graphical presentations of these doubly-excited-state resonances, will be shown at the conference with discussion.

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References

[1] R. K. Nesbet 1988 *Variational Methods in Electron-Atom Scattering* (Plenum, New York)
[2] See for example, T. T. Gien 2010 *J. Phys.B:At. Mol. Opt. Phys.* **43** 025202 and other references therein.

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