Visible M1 transition of the ground state and CRM of W^{26+} - W^{28+} ions

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Tungsten (W) is one of the major candidates for divertor or wall material in the next generation magnetic confinement fusion reactors due to its favorable properties. Tungsten atoms will be introduced into plasmas and they will act as impurity ions. Although the heavy ion impurities may cause a serious radiation power loss, their visible line emissions may still helpful for diagnostics of the core and edge plasmas owing to their low opacities[1]. Accurate atomic data of energy levels and transition properties relevant for such line emission are indispensable for the precise measurement of plasma properties. In the present work, we carry out an elaborate non-empirical theoretical calculation for the electronic structures and the M1 transition properties of W^{26+} to W^{28+} ions as well as a simple CRM for EBIT plasma was developed.

Multi-configuration Dirac-Fock (MCDF) method is a widely used ab-initio method to carry out a relativistic calculation for many electron atoms or ions. The effect of electron correlations can properly be evaluated by choosing a suitable set of basis which consists of the orbitals and excitations among those orbitals. We employ the GRASP code for our present calculation[2,3]. We have carried out an MCDF calculation for the ground state multiplets of W^{26+} and W^{27+} ions[4,5] and the first excited state of W^{28+} ions. The Breit interaction was estimated in low frequency limits and the vacuum polarization effect was evaluated by perturbation. In the framework of a restricted active space (RAS) on the MCDF procedure, the visible M1 transitions of W26+ to W28+ have been calculated. We have obtained a good agreement with experiment in Tokyo-EBIT[4] and Shanghai permanent magnet EBIT[5] . The disagreement of the theory with the experiment is only about 0.03eV, which is about 1% of the experimental transition energy.

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