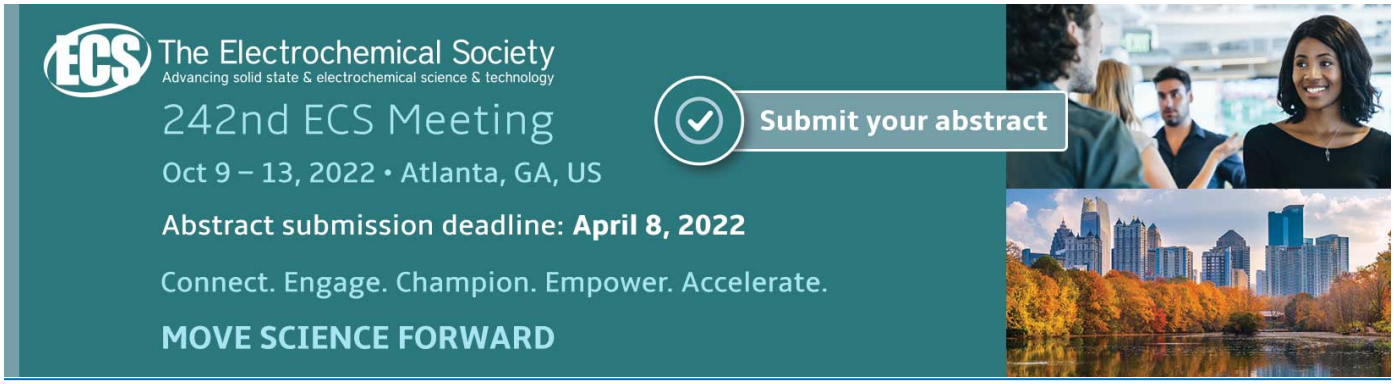
Dielectronic Recombination in He-like, Li-like and Be-like Yttrium and KLM Resonances



Journal of Physics: Conference Series **388** (2012) 062037 doi:10.1088/1742-6596/388/6/062037

Dielectronic Recombination in He-like, Li-like and Be-like Yttrium and KLM Resonances

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Synopsis DR rate coefficients for He-like, Li-like and Be-like Yttrium ions and KLM resonances are calculated using MCBP approximation.

Dielectronic recombination (DR) is the dominant electron-ion recombination process in many astrophysical and laboratory plasmas. DR rate coefficients are needed for determining both the level populations and the ionization balance of plasmas over a wide range of electron densities and plasma timescales. Accurate DR rate coefficients are essential for the reliable spectral diagnosis of non-equilibrium laboratory and astrophysical plasmas. Here we present calculations for DR rate coefficients for Yttrium ions in He-like, Li-like, and Be-like electron configurations. Calculations were performed both for the ground and the metastable initial levels within the multiconfiguration Breit-Pauli (MCBP) approximations using kappa-averaged relativistic wavefunctions including mass-velocity and Darwin operators in the solution of the radial equations as implemented in the AUTOSTRUCTURE code [1]. Both $\Delta n = 0$ and $\Delta n = 1$ core excitations involving 1s and 2s subshells were included within the temperature range of $(10^4 - 10^{10})K$. For $\Delta n = 0$ core transitions, l and n values of the spin orbitals capturing the incoming electron were explicitly included up to 6 and 25, respectively. For $\Delta n = 1$ core transitions, l and n values of the spin orbitals capturing the incoming electron were explicitly included up to 7 and 20, respectively. For higher values of n in both cases, up to 1000, the bound Rydberg orbital is approximated by a zero-energy continuum orbital utilizing quantum-defect theory [1]. AUTOSTRUCTURE produces raw autoionization and radiative rates which are post-processed to obtain the final-state level-resolved and total DR rate coefficients. Maxwellian-averaged total DR rate coefficients are shown in Figure 1 a. Resonances in Fig. 1 b, c and d result from the autoionizations of $1s2l3l'$, $1s2s2l3l'$, and $1s2s^22l3l'$ configurations associated with the $\Delta n = 1$ core transitions during the capture of electrons by He-like, Like-like and Be-like Yttrium ions, respectively, with l=0-1 and l'=0-2.

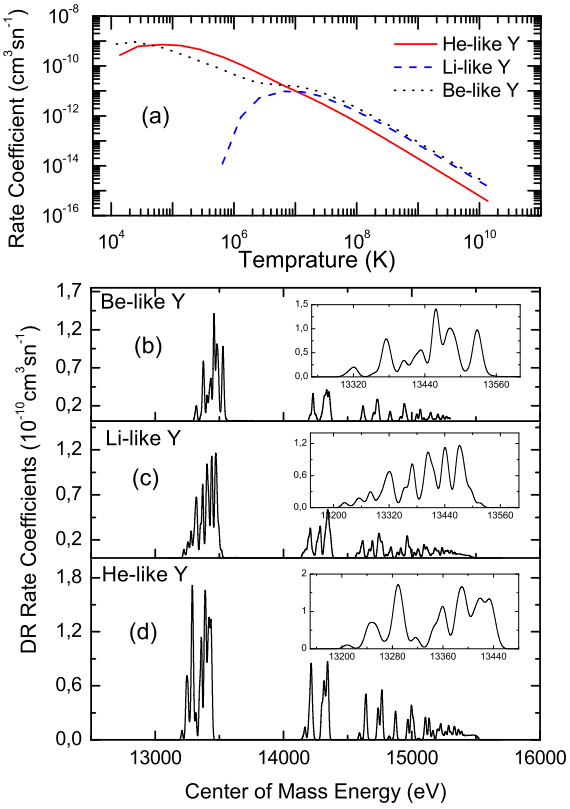

Figure 2. Maxwellian-average rate coefficients for He-like, Li-like, and Be-like Yttrium ions(a). (b)-(d) show the resonances resulting from the autoionizations of the $1s2l3l'$, $1s2s2l3l'$, and $1s2s^22l3l'$ for He-like, Li-like, and Be-like Yttrium ions, respectively.

References

[1] Badnell, N. R., OMullane, M., Summers, H. P., et al. 2003, Astron. and Astrophys., 406, 1151.

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