

X-ray spectra from plasmas with high-energy electrons: kappa-distributions and electron-electron bremsstrahlung

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Shocks, turbulence and winds all influence the electron velocity distribution in hot plasmas, exciting lower-energy electrons and generating a high-energy tail with approximately a power-law shape. This effect, often modeled via a kappa distribution, can affect both the line and continuum X-ray spectrum emitted by the plasma. Hahn & Savin (2015) proposed a Maxwellian decomposition to generate the rate coefficients of kappa distributions. The AtomDB atomic database collects the astrophysical plasma emission data relevant to X-ray emission from collisionally ionized, optical thin astrophysical plasmas with temperature 10^4 hot Maxwellian plasma, can also emit via an electron-electron (e-e) bremsstrahlung, a process not previously included in the AtomDB. I will present the kappa model, the comparison between our kappa results for the charge state distribution and spectra of oxygen to those from KAPPA package with the ion data available within CHIANTI atomic database (Dzifcakova et al. 2015), and the application of AtomDB after added e-e bremsstrahlung to the temperature gradients, as well as the total spectra from the post-shock regions of an accreting magnetic cataclysmic variable (CV). After using the updated APEC model to calculate the X-ray spectra from a numerical post-shock accretion region model of a magnetic CV, we can find the difference for total emissivity with and without e-e bremsstrahlung. We compare the oxygen charge state distribution and spectra to the results from the KAPPA package and find the caution has to be taken when de-composing Maxwellian rate for kappa-distributed coefficients when plasma temperature approached to the boundaries of $[10^4, 10^9]$ K and the kappa less than about 15.

[1] Hahn, M., & Savin, D. W., ApJ **800**, 68 (2015).

[2] Smith, R. K., Brickhouse, N. S, ApJ **556**, 91 (2001).

[3] Dzifcakova, E. et al., ApJS **217**, 14 (2015).