Effects of non-Maxwellian electron distribution functions on properties of hot under-dense gold plasmas

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A lot of studies in plasma physics are performed assuming that the electron distribution functions (EDFs) are Maxwell-Boltzmann distributions. However, this assumption appears to be not valid in various situations. For example, solar flares or laser-produced plasmas at ultra-high intensities are known as media where the EDFs are characterized by overpopulated high-energy tails compared to Maxwell-Boltzmann distributions [1, 2]. Another example is the laser-produced plasmas where the inverse Bremsstrahlung process is the dominant heating mechanism. In this case, it has been predicted that the EDFs can be described as super-Gaussian distribution functions [3]. Recently, such flat-top electron distributions and their effects on crossed beam energy transfer and on the laser heating have been measured [4, 5].

In the present study, the effects of non-Maxwellian EDFs on properties of hot under-dense gold plasmas are numerically investigated in conditions existing in laser-heated hohlraums. The EDFs are assumed to be super-Gaussian distribution functions which are used both in a collisional-radiative atomic kinetic model to compute the atomic state populations and to evaluate spectral emissivities. Calculations are done for a 10 mg/cc gold plasma at electron temperatures ranging from 0.3 to 4 keV and including, or not, a radiation field described by a Planckian distribution with a radiative temperature equal to 100 or 300 eV. The effect of the super-Gaussian exponent on the charge state balances and on the relative intensities of the N-, M-, and L-shell emission spectra are presented.

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