

Self-similar collisional processes in a plasma

Kharintsev S., Salakhov M.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The influence of speed-changing self-similar collisions on the spectral line shape is considered in terms of the classical Fourier integral theory. The self-similar mechanism of interference of scalar perturbations for phase shifts of an atomic oscillator is developed. The motion of a radiating dipole in a perturb gas is examined in the framework of the self-similar diffusion model. A general formula for the correlation function, which allows for a combined effect of speed-dependent Doppler and pressure broadening, is derived. In the Doppler regime this formula yields the self-similar Galatry profile and in the case when speed-changing collisions are neglected it leads to the self-similar Voigt profile. In the limiting case when the self-similar character of collisions is omitted these profiles become identical to the Galatry profile and Voigt profile respectively. It is shown that self-similar collisions are of important in a low and high pressure region for far infrared and radio lines. In general case spectral profiles broadened by the self-similar collision mechanism are asymmetric, the line shape depends on a type of the interference of scalar perturbations. In the Doppler regime self-similar collisions give rise to the additional spectral line Dicke-narrowing.
