POWER-LAW DISTRIBUTION FUNCTIONS IN HOMOGENEOUS PLASMAS

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Variety of insitu measurements in space plasmas point out to an intermittent formation of distribution functions with elongated tails and power-law at high energies. Power-laws form ubiquitous signature of many complex systems, plasma being a good example of a non-Boltzmann behavior for distribution functions of energetic particles. Particles, which either undergo mutual collisions or are scattered in phase space by electromagnetic fluctuations, exhibit statistical properties, which are determined by the transition probability density function of a single interaction, while their non-asymptotic evolution may determine the observed high-energy populations. It is shown that relaxation of the Brownian motion assumptions leads to non-analytical characteristic functions and to a generalization of the Fokker Planck equation with fractional derivatives that result in power law solutions parameterized by the probability density function. Fractional Fokker-Planck equation is an outstanding tool for obtaining information about variety of physical systems