Thomson Scattering in Inhomogeneous Plasmas: The Role of the Fluctuation-Dissipation Theorem

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Abstract—A self-consistent kinetic theory of Thomson scattering of an electromagnetic field by a non-uniform plasma is derived. We show that not only the imaginary part, but also the time and space derivatives of the real part of the dielectric susceptibility determine the amplitude and the width of the Thomson scattering spectral lines. As a result of inhomogeneity, these properties become asymmetric with respect to inversion of the sign of the frequency. Our theory provides a novel and unique method of a remote probing and measurement of electron density gradients in plasma [1]; this is based on the demonstrated asymmetry of the Thomson scattering lines.

Keywords—non-equilibrium fluctuations, FDT, Thomson scattering

[1] V.V. Belyi, “Thomson scattering in inhomogeneous plasma: The Role of the Fluctuation-Dissipation Theorem,” Scientific Reports, 8:7946, 2018. (DOI:10.1038/s41598-018-25339-6)