

Collective Modes Associated with Rarefied Populations of Heavy Nuclei*

B. Basu and B. Coppi

MIT

Plasmas in which low density populations of heavier nuclei than those of the main population are a frequent occurrence [1] and an important case is that of “impurities” whose cyclotron frequencies, Ω_I , differ from that, Ω_i , of the main population. Ω_I “frequency” modes are found to be sustained by the impurity density gradient. In the limit of “short” transverse wavelengths ($k_{\perp}^2 d_i^2 > 1$ where $d_i = c/\omega_{pi}$) these modes are nearly electrostatic while in the relatively long wavelength limit ($k_{\perp}^2 d_i^2 \ll 1$) they involve significant magnetic field fluctuations [2]. The relevant transverse phase velocities are in the direction of the local impurity diamagnetic velocity and produce a transport of this population across the magnetic field. Growth rates are found which depend on pre-existing thermal energy transport processes for the same population such as those associated with the excitation of the lower frequency “impurity drift modes” introduced in Ref. [3]. A programmed immission of non-reacting minority populations is suggested in order to increase the total reactivity of a fusion burning plasma column, for instance, by conditioning the spatial density profiles [1] of the reacting populations.

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