New Mesoscopic Modes Associated with Impurity Populations*

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Plasma collective modes associated with impurity populations in magnetically confined plasmas had been identified in Ref. [1] followed by relevant analyses. These modes had frequencies well below the cyclotron frequencies of the ion populations and could be classified as microinstabilities. The newly identified modes have frequencies close to the impurity cyclotron frequency, are electrostatic in the limit $k_\perp^2 d_i^2 \gg 1$ and involve significant magnetic field fluctuations [2], for $k_\perp^2 d_i^2 \leq 1$. Here $k_\perp$ is the transverse (to the magnetic field) mode number and $d_i = c/\omega_{pi}$ refers to the main ion population. A growth rate is found as a combined effect of the maximum impurity density gradient and of a particle (impurity) diffusion coefficient. The possible interaction with the lower frequency modes introduced in Ref. [1] is re-examined in this context. Relevant experiments [3] concerning transport of impurity and main ion populations are considered in relation to the presented theory.

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2. B. Coppi, S. Cowley, R. Kulsrud, P. Detragiache and F. Pegoraro, *Phys. Fluids* **29**, 4060 (1986).
3. C. Mazzotta, et al. Paper IAEA-CN-899 MFE, Fusion Energy Conference (I.A.E.A., Vienna, 2021).