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Heavy Particle Mode as the Signature of the I-Regime* T. ZHOU, B. COPPI, MIT — Key features [1] of the I-Regime investigated by the Alcator C-Mod can be explained by the excitation of a new heavy particle (e.g. impurity) mode [2] at the plasma edge. This mode involves both density and magnetic fluctuations. The impurity is treated as collisional. Considering a plane geometry, the dispersion relation has a unstable root for $\eta_i \equiv (dT_i/dr)n_i/(T_i dn_i/dr) > 2/3$ and $dn_I/dr > 0$. The marginal stability point is reached for a maximum dn_I/dr such that $\omega^I_{**} = \omega_{IA} = \omega$, where $\omega^I_{**} \equiv ck_y T_I(dn_I/dr)/(ZeBn_I)$ and $\omega_{IA} \equiv (5/3)k^2 T_I/m_I$. The instability condition is $\omega^I_{**} < \omega_{IA}$. $\mathrm{Re}\,\omega/\omega^{\mathrm{I}}_{**} > 0$ indicates that the mode phase velocity(v_{ph})is in the electron diamagnetic direction, a feature consistent[3]with the observation that the plasma spontaneous rotation is in the ion diamagnetic direction. This predicted direction of v_{ph} has been confirmed by the experiments. The impurity flux evaluated from the quasi-linear theory is $\langle \hat{n}_I \hat{v}_{Ex}\rangle = n_i\langle \widehat{T}_i \hat{v}_{Ex}\rangle/(ZT_i) \simeq -n_i(dT_i/dr)/(ZT_i k^2 v_{thi}\lambda_i)\,[1-2/(3\eta_i)]\cdot\langle|\hat{v}_{Ex}|^2\rangle > 0$ for $\eta_i > 2/3$, where λ_i is the effective main ion mean free path. This shows that both the main ion thermal energy and the impurity are transported outwards. These features are consistent with a mode with frequency $\sim 200\,kHz$ observed in the I- Regime and with the fact that impurities are confined at the edge in this regime. *Sponsored by the DOE. [1] E. Marmar, B. Lipschultz, A. Dominguez, et al., Bull. Am. Phys. Soc. **54** (2009) 97 [2] B. Coppi, H. Furth, M. Rosenbluth and R. Sagdeev, Phys. Rev. Lett. **17** (1966) 377-379 [3] B. Coppi, Nucl. Fusion **42** (2002) 1-4

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