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**Linear Theory of n=0 Geodesic Acoustic Mode** H.V. WONG, H. BERK, T. ZHOU, IFS, Univ. of Texas at Austin — The n=0 geodesic acoustic mode (GAM) has been observed in JET and D- III D experiments, and it is frequently accompanied with pronounced fast frequency chirping. A numerical investigation with the CASTOR code reveals that a global GAM mode arises if the continuum geodesic frequency has a local maximum as a function of radius. The global GAM properties are characterized by: a very small upward frequency shift from the continuum, a radially localized electrostatic component with poloidal numbers m=0,1 and with magnetic coupling to a nonlocalized m=2 component. Here we develop an analytic MHD theory of this n=0 global GAM in a toroidal plasma with r/R taken as order the square root of beta, with beta small. In the analysis we choose to start from the MHD quadratic form (with inertial terms) , we take the mode to primarily have a density perturbation and we find that the magnetic perturbation in the localization region of the mode to be one order of beta smaller than the density perturbation, though this component extends throughout the plasma. Indeed we verify that the existence of a linear global mode requires that the continuum GAM profile have a maximum as a function of radius. The theory shows that the frequency of the global GAM eigenmode is shifted from the maximum continuum GAM frequency, $\Omega_{Gm}$ by $\delta\omega = a(\beta r_{Gm})^2 \partial^2 \Omega_{Gm}/\ \partial r^2$, where we developed an asymptotic matching scheme to determine the constant a. We found precise agreement of the asymptotic method with the numerical results for a specific q-profile in the high aspect ratio, low beta plasma.

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