Geodesic Acoustic Modes and geodesic oscillations of the ion temperature in a tokamak

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Geodesic Acoustic Modes (GAM) are linear eigen-modes of poloidal rotation in toroidal systems. They are supported by compressible part of the diamagnetic current which is balanced against radial inertial current. Both electron and ion pressure contribute to the diamagnetic current. In the standard fluid theory and in neglect of the ion pressure anisotropy one obtains the following expression for the standard GAM frequency , where  is the ion thermal velocity, is the ratio of the electron to ion temperatures, and  is the curvature radius (e.g. major radius of the tokamak). In the next order, one has the dispersive corrections related to the ion finite Larmor radius , ion sound Larmor radius , and higher order toroidal effects : , where  is the dimensionless coefficient determined by the ion and electron temperatures. It is shown here that in addition to the standard Geodesical Acoustic Modes (GAM) oscillations, there are exist additional low frequency radially propagating mode corresponding to fluctuations of the mean (poloidally averaged) ion temperature: , where  is some dimensionless coefficient. Radial propagation of the ion temperature mode is supported by the ion (radial) heat flux, while the restoring force is created by the radial current due to the ion inertial drift related to fluctuations of ion pressure. The structure of the global GAM and radial propagation is studied numerically with the MHD and gyrokinetic theory.

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