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Simulations of Energetic Particle Driven Geodesic Acoustic Mode in 3-dimensional LHD Equilibrium

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The first simulation results of energetic particle driven geodesic acoustic mode (EGAM) in 3-dimensional LHD equilibrium are presented. MEGA[1], which is a hybrid code for energetic particles interacting with a magnetohydrodynamic fluid, is used for the simulations.

The equilibrium data is based on LHD shot #109031 and generated by HINT2 code. The simulation parameters are also based on the same shot. The energetic particle velocity distribution is slowing-down type with charge exchange, and pitch angle distribution is Gaussian type.

The simulated EGAM frequency is 61 kHz in the linear growth phase, and chirps up in the nonlinear phase. This is the same as the experimental observation[2]. The mode amplitude v_θ increases with the growth rate γ/ω_{EGAM}=19%. The mode is located near the magnetic axis, and the v_θ oscillation looks like a combination of m/n=0/0 (strong), 1/0 (medium) and 2/10 (weak) components, as shown in Fig. 1. The m/n=2/10 components exists due to the LHD configuration, because there are 10 twists in LHD. This is different from the tokamak case, where the v_θ oscillation looks like a combination of m/n=0/0 and 1/0 components. The mode number of pressure perturbation is m/n=1/0, which is similar with the tokamak case. The pressure perturbation rotates poloidally in the nonlinear phase, and the rotation direction changes with time. This rotation is caused by the convection of EGAM, because the phase of pressure time derivative $\partial P/\partial t$ and the phase of v_θ are the same. In the linear growth phase, the mode does not propagate radially, and in the saturated phase, the mode propagates inward.

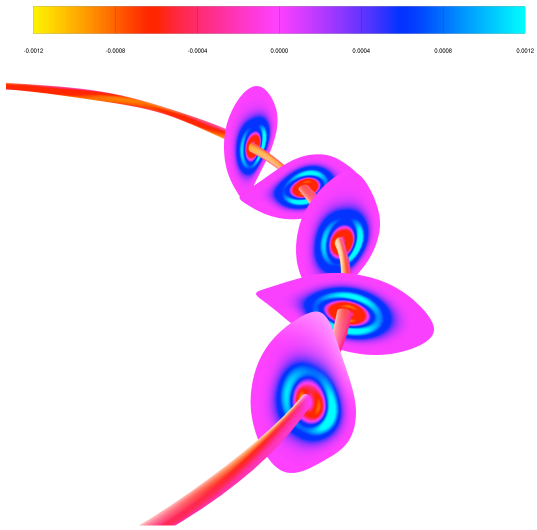

Fig. 1 The v_θ oscillation looks like a combination of m/n=0/0 (strong), 1/0 (medium) and 2/10 (weak) components.

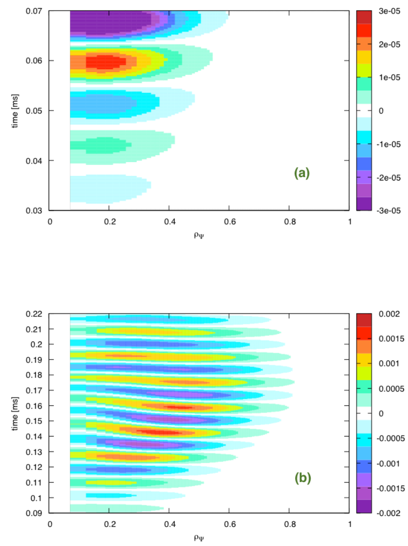

Fig. 2 The radial location and time evolution of the mode amplitude of v_θ. It does not radially propagate in the linear growth phase; (a), and propagates inward in the nonlinear phase; (b).

Reference:
[1] Y. Todo, *Phys. Plasmas* **13**, 082503 (2006).
[2] M. Osakabe, T. Ido, K. Ogawa et al, *25th IAEA Fusion Energy Conference*, St. Petersburg, Russia (2014).