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Nonlinear Theory and Simulation of Energetic Particle-induced Geodesic Acoustic Mode GUOYONG FU, Princeton University — Intense axisymmetric density fluctuations were recently observed in DIII-D neutral beam-heated reversed shear plasmas [1]. The instability was identified by analytic theory as the energetic particle-driven GAM or EGAM [2]. The DIII-D experiment also revealed several important nonlinear features of EGAM including a significant second harmonic of the density fluctuation and a clear radial propagation of the mode [3]. In this work, the nonlinear self-interaction of energetic particle-driven geodesic acoustic mode is studied analytically [4] and numerically via hybrid simulation. It is shown that a second harmonic of plasma density perturbation is generated mainly by the convective nonlinearity of both thermal plasma and energetic particles. Near the mid-plane of a tokamak, the second-order plasma density perturbation is negative on the low field side with its size comparable to the main harmonic at low fluctuation level. These analytic results have been confirmed by nonlinear hybrid simulation of EGAM using the parameters and profiles of the DIII-D experiments. The analytic and numerical results are consistent with the experimental observation in DIII-D [3].

[1] R. Nazikian et al., Phys. Rev. Letts. 101, 185001 (2008). [2] G. Y. Fu, Phys. Rev. Letts. 101, 185001 (2008). [3] R. Nazikain et al., Transport Taskforce Workshop, San Diego, April 6-9, 201. [4] G.Y. Fu, J. Plasma Physics, DOI:10.1017/S0022377810000619, (2010)

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