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Magnetic-island-induced ion temperature gradient mode

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In tokamaks, the formation of magnetic islands is inevitable due to magnetohydrodynamic instabilities near low order rational q surfaces, such as tearing modes, error-field induced reconnection and locked modes. Thus micro-instabilities that result in plasma turbulent transport may be excited in the equilibrium magnetic field with islands rather than in usual sheared magnetic field. Therefore, the conventional theories of micro-instabilities need to be revisited in such a new magnetic configuration.

In this work, characteristics of ion temperature gradient (ITG) instability in the presence of a magnetic island are investigated numerically using a gyrofluid model. It is shown that when the magnetic island is wide enough to produce a broad distribution of rational surfaces near the O-point region, the ITG perturbations at these rational surfaces form a radially global-type eigenmode with a fast growth rate, which is referred to as the magnetic-island-induced ITG (MITG) mode.[1] Moreover, the magnetic island also causes both radial and poloidal mode couplings, which play a stabilizing role.[2]

[1]Z. X. Wang, J. Li, Y. Kishimoto, and J. Q. Dong. Phys. Plasmas 16, 060703 (2009).

[2]Z. X. Wang, J. Li, J. Q. Dong, and Y. Kishimoto, Phys. Rev. Lett. 103, 015004 (2009).