Gyrokinetics for high-frequency modes in tokamaks

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Gyrokinetics for high-frequency modes in tokamaks is developed. It is found that the breakdown of the invariants by perturbed electromagnetic fields drives microinstability. The obtained diamagnetic frequency, ω^*, is proportional to only the toroidal mode number rather than transverse mode numbers. Therefore, there is no nonadiabatic drive for axisymmetrical modes in gyrokinetics. Meanwhile, the conventional eikonal *Ansatz* breaks down for the axisymmetrical modes. The ion drift-cyclotron instability discovered in a mirror machine is found for the first time in the toroidal system. The growth rates are proportional to ρ_i/L_n, and the slope changes with magnetic curvature. In spherical torus, where magnetic curvature is greater than that of traditional tokamaks, instability poses a potential danger to such devices. © *2012 American Institute of Physics*. [http://dx.doi.org/10.1063/1.4737108]