Gyrokinetic simulation studies of fast ion precession driven drift instability in reversed shear plasmas

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A new instability driven by resonance between electron drift wave and reversed precession of trapped fast ions in a reversed magnetic shear plasma has been found[1] from a local stability analysis using gyrokinetic equations in toroidal geometry[2,3] under a fusion reactor condition. This new instability occurs when the temperature gradient of fast ions peaks sufficiently compared to the density gradient at long wavelength regime. Strongly negative magnetic shear plasmas are more favorable for the new instability and the linear growth rate is linearly proportional to the temperature gradient of fast ions which is related to the free energy source of the instability. The new instability is identified from linear gyrokinetic simulations using GKW code[4] and results are in broad agreement with predictions from the local analytic theory.[5] In addition, nonlinear gyrokinetic simulation research is ongoing. It is shown that turbulence driven by the new instability can be sustained at a finite nonlinear saturation level. Properties of the turbulence are investigated by analyzing nonlinear mode coupling, particle and energy transport.

References

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