ジャイロ運動論的シミュレーションコードの双極型磁場配位への拡張

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Extension of a gyrokinetic simulation code to dipolar geometries

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A variety of space plasma phenomena in the Earth's magnetosphere are related to magnetized plasma instabilities, such as the kinetic-ballooning instability and the trapped-particle driven instability, and share common physics processes with magnetic fusion plasmas. The gyrokinetic equations have been widely used in theoretical and numerical studies on micro-scale (or kinetic) dynamics of fusion plasmas. Therefore, it is natural to consider application of the gyrokinetics to space plasmas as well.

We have developed the GKV code [1] for studying drift wave turbulence and zonal flows in tokamak and helical plasmas, and has extended the code to dipolar geometries. The initial result for the ring dipole configuration shows destabilization of a drift wave in the inner side of the torus. Figure shows the eigenfunction along the field line, the eigenfrequency and the linear growth rate of the ion temperature gradient mode in the zero beta limit. In the dipole configuration case, thus, that a stronger instability drive is found near by the Earth side boundary. This is attributed to the assumption of a constant pressure along the field line. We are currently extending the theoretical and numerical models to incorporate the non-uniform pressure distribution, and are applying the gyrokientic code to shear Alfven wave resonance.

[1] T.-H. Watanabe and H. Sugama, Nucl. Fusion 46, 24-32 (2006).