強磁場下の無衝突磁気リコネクションによる運動論的アルヴェン波の不安定化

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destabilization of kinetic Alfven wave driven by collisionless magnetic reconnection with strong guide field

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Magnetic reconnection is a fundamental physical mechanism that leads to conversion of magnetic energy to kinetic energy, topological change of magnetic field lines, and self-organization in space and laboratory plasmas. In collisionless plasmas, it is considered that two fluid or kinetic effects play essential roles in production of the reconnection electric field in the diffusion region. It is also suggested that the electron inertia effect or the anomalous resistivity become more important than particle orbit effects.

We have carried out numerical simulations of the collisionless magnetic reconnection with the strong guide field by use of the gyro kinetic model [1], where we have found that the reconnection electric field forms the beam electrons at the X-point. The liner dispersion relation in a limit of plane waves suggests that the kinetic Alfven wave can be excited by the beam when the beam velocity exceeds the Alfven speed.

To investigate the beam instability in the field configuration via the magnetic reconnection, it is necessary to reveal the structure of a total distribution function during the reconnection. We have developed the full-f reconnection model with the nonlinear term of the electric field acceleration and have carried out a numerical simulation by use of the new model, where the shifted Maxwellian distribution function of electrons is formed at the X-point during the magnetic reconnection. In addition, by use of this simulation result, we have also analyzed the beam instability of the kinetic Alfven wave in the X-point configuration formed during the magnetic reconnection.

[2] A. Ishizawa and T.-H. Watanabe, Physics of Plasmas 20, 102116 (2013)