Formation of the large-amplified electric field due to the relativistic effects of the parametric instabilities of Alfven waves

Ryo Yoshitake[1]; Masahiro Hoshino[2]
[1] Earth and Planetary Sci., Univ of Tokyo; [2] Earth and Planetary Sci., Univ of Tokyo

In various astrophysical environments, because of their ubiquity, Alfven waves are known to have prominent part in energy transportation or energy dissipation and are thought to play important roles in many high energy astrophysical problems. Since Alfven waves are usually long wavelength and low frequency wave, many studies are done which treat them as MHD phenomena with solar wind parameters. However, we cannot adapt directory such theories to high energy astrophysical problems, because ordinary MHD model cannot deal with the electrostatic field or pair plasma, and these are essential with strongly relativistic plasma in high energy astrophysical objects. Of course, PIC or Vlasov simulations are available, but they needs vast amounts of computational resources and time and it is realistically impossible to apply these methods to a realistic astrophysical context.

Recently, we have developed a new relativistic plasma code based on two-fluid plasma model, which can treat above critical problems. Using this code, we investigated parametric instabilities of large amplitude circularly polarized Alfven waves in pair plasma, and by considering the relativistic effects, we found large-amplified longitudinal electric field brought by derived acoustic mode. In view of particle acceleration, such strong electric field can contribute to the generation of ultra high energy cosmic rays by such as the wakefield acceleration (e.g. Chen et al. 2002). Therefore, it is significant to survey these processes closely. In this presentation, we will show the effects of both decay and parametric instabilities. The difference between these processes, and these instabilities caused by the Alfven modes of highly relativistic regime will be also presented.