Formation of the large-amplified electric field on the decay process of relativistic Alfven waves

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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 seems almost 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. In this presentation, we investigate parametric instabilities of large amplitude circularly polarized Alfven waves in pair plasma. By considering the relativistic effects, large-amplified longitudinal electric field brought by derived acoustic mode was found. In view of particle acceleration, we will discuss the possibility of such electric field contributing to the generation of high energy cosmic rays, in comparison with the wakefield acceleration (Chen et al. 2002). The difference between decay and modulational instability processes will also be shown.