7th Asia-Pacific Conference on Plasma Physics, 12-17 Nov, 2023 at Port Messe Nagoya

Hall magnetohydrodynamics in relativistically strong mean magnetic field

Yohei Kawazura
Frontier Research Institute for Interdisciplinary Sciences, Tohoku University
e-mail (speaker): kawazura@tohoku.ac.jp

Magnetically dominated relativistic plasmas are ubiquitous in the universe, such as pulsar and black hole magnetospheres, coronae of accretion disks, and jets from active galactic nuclei. Understanding the properties of the turbulent fluctuations in these systems is important as it is a possible mechanism to create high-energy particles. Nonetheless, there are not so many models that can describe relativistic turbulent fluctuations, especially at short wavelength regimes.

Here, we present a magnetohydrodynamic (MHD) model that describes small amplitude fluctuations with wavelengths comparable to ion inertial length when the background magnetic field is relativistically strong. We impose reduced MHD approximation to relativistic Hall MHD [1,2]. Our new equations are identical to the non-relativistic Hall Reduced Magnetohydrodynamics[3], with the exception of a few constants that account for the relativistic corrections. This means that all the properties of kinetic Alfvén turbulence and ion cyclotron turbulence in the non-relativistic Hall regime are likewise valid in the relativistic regime.

References
[1] Y. Kawazura, Physical Review E **96**, 013207 (2017).
[2] Y. Kawazura, G. Miloshevich, and P. J. Morrison, Physics of Plasmas **24**, 022103 (2017)
[3] A. A. Schekochihin, Y. Kawazura, and M. Barnes, Journal of Plasma Physics **85**, 905850303 (2019).