Interplay between MHD and turbulence in plasma

Katsumi Ida

National Institute for Fusion Science, Toki, Japan

Interplay between MHD and turbulence is interesting topics in magnetically confined plasma and solar plasma. The fast reconnection of magnetic field in the solar flare is well known but the mechanism is not well understood. Turbulence in the current sheet is a strong candidate to explain the fast reconnection in solar flare is one of the mystery in solar flare [1,2]. In magnetically confined plasma, MHD instability and electrostatic turbulence have been studied independently. No coupling between the electrostatic turbulence and MHD instability is assumed. However, recently the experimental observations below suggest the coupling and interplay between MHD and turbulence in magnetically confined toroidal plasmas. 1) Turbulence spreading into the magnetic island [3]. 2) Self-organized change in topology and turbulence in magnetic island [4]. 3) Flow damping by stochastic magnetic field [5]. 4) Trigger mechanism for the MHD bursts [6]. 5) Impact of MHD bursts on the ion velocity distribution and potential [7,8]. 6) Turbulence exhausts at the MHD burst event [9]. In this plenary talk, the experimental evidence of the interplay between MHD and turbulence in toroidal plasma is presented. For example, in the heat pulse experiment in DIII-D tokamak plasma, the heat pulse propagates earlier than heat pulse at the X-point but later at the O-point of the magnetic island. This is due to that the turbulence is spreading from the X-point to O-point of the magnetic island faster than the heat pulse determined by the transport time scale inside the magnetic island. A self-regulated oscillation of the topology and transport inside the magnetic island is observed due to the interplay between the MHD and turbulence.

References

[1] K. Shibata and S. Tanuma, Earth Planets Space 53, (2001) 473.

[2] N. Nishizuka and K. Shibata, Phys. Rev. Lett. 110, (2013) 051101.

[3] K.Ida et. al., Phys Rev Lett 120 (2018) 245001.

[4] K.Ida et. al., Sci. Rep. 5 (2015) 16165.

[5] K.Ida et. al., Nature Communications 6 (2015) 5816.

[6] K.Ida et. al., Sci. Rep. 8 (2018) 2804.

[7] K.Ida et. al., Sci. Rep. 6 (2016) 36217.

[8] K.Ida et. al., Phys Plasmas 24 (2017) 122502.

[9] K.Ida et. al., Nucl Fusion 58 (2018) 112008.