Meta-Hierarchy Dynamics

Organized Session: Nov. 9th, 15:00am - 18:00am (JST)

Natural phenomena spanning a wide range of spatio-temporal scales and parameter domains have often been understood by separating into various "hierarchies" and connecting them in reductionistic manners. Fusion sciences explore multi-scale and multi-physics phenomena spreading over the spatio-temporal scale from the microscopic particle motions to the macroscopic fluid motions. In particular, the collective motion causes structure formations not only in the plasmas but also the materials facing plasmas. Even though the experimental, theoretical, and numerical studies have made great progress, a complicated issue has emerged in the practical facts that some phenomena cannot be simply separated into "hierarchical" structures. i.e., it is not enough to connect reduced elements, but it is required to integrate complex processes of the multi-scale and multi-physics phenomena.

The unit pursues “hierarchical” structures and their dynamics in “Turbulence and flows with inherent hierarchies”, “Local and global transport”, “Energy channels of electromagnetic fields and atoms and molecules under anisotropic velocity distribution”, and “Interactions between the peripheral plasma and the surface of matter”, as well as the physical modelling and universality exploration for multi-scale nature.

In the session, we overview the unit activities for tackling with the “hierarchical” structures in fusion science, especially focusing on the topics listed above. In addition, we discuss how the “hierarchical” structures have been handled and understood in multiple disciplines. Multi-physics phenomena in fusion science are reviewed by Prof. Yasuaki Kishimoto. Non-linear energy transports in space and fusion plasmas are presented by Prof. Yuto Kato. Multi-scale processes in softmatters are introduced by Prof. Ryoichi Yamamoto.

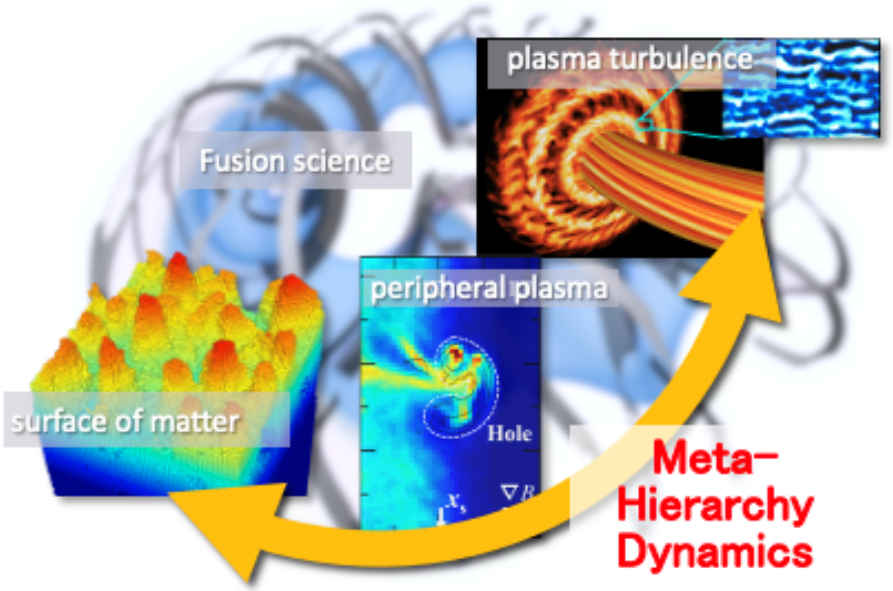

Figure 1. Scopes of the unit