Despite the fact that the liquid state of matter is of fundamental importance in our life, our physical understanding of it is far behind those of the gas and solid states. In our laboratory we are aiming at drawing a unified physical picture covering the following seven unsolved fundamental problems on liquids and soft matter, focusing on the commonality of their spatio-temporal hierarchical structures. We expect our study will bring new developments not only in the physics of liquids and soft matter, but also in their applications.

◆ Thermodynamic and kinetic anomaly of water and water-like liquids
◆ Mechanism of liquid-liquid transition in a single-component liquid
◆ Mechanism of liquid-glass transition
◆ Relationship between a hierarchical structure of liquid and its crystallization
◆ Nonlinear flow behavior of glassy liquids and granular matter and the mechanism of flow instability and fracture
◆ Roles of hydrodynamic interactions on the dynamics of soft and bio-matter
◆ Phase transition dynamics and pattern evolution in soft and bio-matter