Despite the fact that the world in reality is made out of a system of *discrete points*, the idea of “continua” has been successful in describing various phenomena due to the interaction at the molecular level. In this sense, the analysis of high temperature plasmas, whose mean free path can be much longer than that of the characteristic system length, can be a good touchstone for us to revisit and examine to what extent the fluid description can be valid.

In this course, an emphasis will be put on the fundamental aspects of continua and fluid dynamics [e.g. the relation between discrete particle system and “ensemble averaged” continua (Lagrangian versus Eulerian variables), what the conservative properties are in dissipation-less fluids (Euler’s equation), roles of dissipation, roles of compressibility, wave and instabilities in fluids].

Advanced topics, such as conformal mapping, boundary layer theory, nonlinear waves [Burgers’, Korteweg-de Vries (KdV), and nonlinear Schroedinger equation], shock waves, for example, are discussed. Approximately 25% of the material will cover magneto-fluids.

**教學目標/Goals**

Introduce the concept of continua and discuss its application to the physical sciences and engineering.

**授課課程大綱明細/Course Outline**

1. Introduction to mechanics of continua. Connection of fluid models with kinetic theory (derivation from Boltzmann’s equation). BBGKY hierarchy. CGL and Landau fluids.
2. Properties of inviscid-ideal fluid (Euler’s equation). Kelvin’s circulation theorem.
3. Viscous fluids (Navier-Stokes system).

**Grading:** Homework (50%) Exams (50%)

**Reference book**
