Development and Universality of the Research on Non-equilirbruim and Extreme State of Plasmas
1. Introduction
非平衡極限プラズマ研究の展開と普遍性
1. はじめに

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Here we introduce the recent development of the research of extremely non-equilibrium plasmas. This area of research covers almost all of plasmas in laboratory and nature. The main emphasis of this symposium is that the varieties in the phenomenology diverse plasmas, being generated by quite different production schemes, are organized under general physics point of view. In addition, by organizing pheneomenologies along the principles of plasma physics, the advancement in one area can induce solution in other area of research.

Background

Research of plasmas is basic to the modern science, civilization and industry, and will be the origin of future progress. In particular, the study of the extremely-nonequilibrium plasmas has the impact in advancing the central issue of modern physics and has possibility to accelerate the scientific innovation. Study of plasma turbulence leads the understanding of complex behaviour of plasmas in laboratory and in nature. The coupling between plasmas and intense light fields generates the high energy density state, that make possible the metal silicon and super diamond, etc. The dynamics variation of heat flux and/or the control of fluctuation provides new freedom in manipulating the state of matter. This is the time to develop the research to unify the physics progresses that have been established in the past for various types of plasmas.

Non-equilibrium properties

Non-equilibrium properties of plasmas are characterized by, e.g.,

Spatial inhomogeneity,
Deviation from equi-partition,
Selective excitation of fluctuation,
Cross-scale interaction of fluctuations,
Interferences between different time scales (violation of time-scale separation),
Deviation from Arrhenius law,
and others.

Focus of this symposium

In this symposium, we choose the issue of time scales: Focusing at the mixing of the time scales is the key to understand the universal feature in phenomenologies in different type of plasmas. Figure 1 illustrates the keywords and subjects of in talks. Elementary processes that are highlighted in this symposium are:

Fast dynamical change (i.e., the change is faster/as-fast-as the relaxation time),

Dynamics in phase space that introduces time-scale mixing,

Change of state of matter that is realized by the change that is faster than the relaxation in solid state,

Fast change of heat flux (in comparison with the diffusive relaxation of energy),

Realization of structure through selective generation of fluctuating fields.

Presentations explain a few key issues in the list, and are chained to each other.

While each presentation treats different plasmas from phenomenological point of view, they are linked tightly with others when organized along the elementary issues in the nonequilibrium plasmas.

The programme is as follows.

1. Introduction (Kimitaka Itoh)

2. New transport picture in turbulent plasma introduced by novel measurements of turbulence (Shigeru Inagaki)

3. Ion temperature gradient driven turbulence with strong trapped ion resonance (Yusuke Kosuga)

4. High-energy density materials; its dynamics and phase transitions (Norimasa Ozaki)

5. Break

6. Complex interactions between high flux plasma and materials (Shin Kajita)

7. Development of a method to synthesize functional nanopowder using modulated induction thermal plasmas with a high production rate (Yasunori Tanaka)

8. Analysis of coupling between nanoparticles and radicals using perturbation of radical density in reactive plasmas (Kazunori Koga)

9. Summary (Satoshi Hamaguchi)

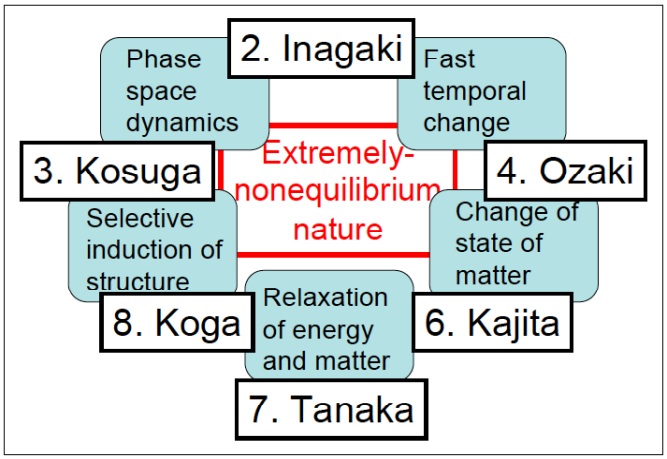

Figure 1: Key concepts, which are highlighted in the symposium, and relation with presentations (2-7).

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