【Grant-in-Aid for Scientific Research(S)】

Science and Engineering (Mathematical and physical sciences)

Title of Project：Integrated Research on Dynamic Response and Transport in Turbulent Plasmas

S-I. Itoh

(Kyushu University, Research Institute of Applied Mechanics , Professor)

Research Area：Mathematical and Physical Science

Keyword：Plasma Science

【Purpose and Background of the Research】

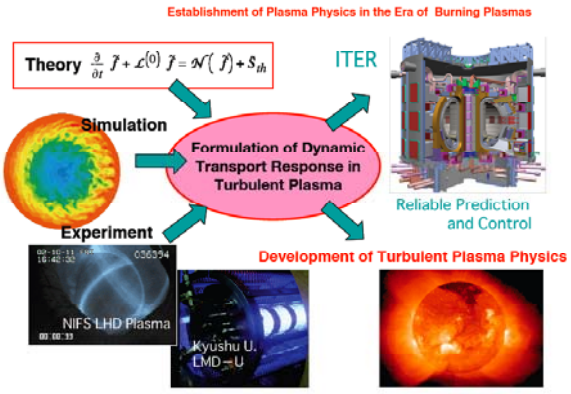
To control and to predict the properties of the magnetically confined plasmas, the worldwide researches have been vitally carried out toward realizing a burning plasma in International Tokamak Experimental Reactor (ITER). According to the recent achievement, the new concept is being established that the mesoscale fluctuating structure such as zonal flows and streamers coexist with microscale fluctuations, so as to regulate the turbulent transport. The new concept makes it enable to explain the changes in structure and transport occurring in much faster time scale than diffusive one. It is necessary to manage the dynamic changes in transport for control the burning plasma state, thus, the understanding of dynamic transport response should be mandatory. The purposes of this projects are i) to complete the paradigm shift from linear, local, deterministic view to nonlinear, non-local, probabilistic one, ii) to develop and advance the physics of turbulent plasma iii) to understand the mode dynamics and nonlocal transport phenomena, and iv) to clarify the dynamic transport phenomena in the magnetically confined plasmas to provide a concrete base to control the burning plasma in ITER.

【Research Methods】

In the preceding Specially-Promoted-Research project (2004-2008), 'Research on Structural Formation and Selection Rule in Turbulent Plasmas', the integrated research method of experiment, theory, and simulation, or e-science, has established the new paradigm of turbulent plasmas. By further developing this method, we try to formulate the physical processes of formation of spatio-temporal structure and dynamic response and transition, and to find the unique laws of non-local and dynamic turbulent transport far from thermal equilibrium.

【Expected Research Achievements and Scientific Significance】

The research on transport barrier in magnetically confined plasmas have led to the understanding of structural formation observed in nature, such as solar tachocline, i.e., the internal solar layer exhibiting a discrete change in angular momentum. This project aiming at understanding the dynamic response of turbulent plasma should give a large impact to a wide range of modern physics and make a large contribute to understanding the modern astronomical observations in the universe. Particularly, it should be possible to accelerate the researches to controlling ITER, and to improve the prediction precision of nuclear fusion reactors to large extent. For example, to investigate the inference of the timescale and lifetime of sudden collapses with the correlation between the envelope modulations of microscopic fluctuations provides a method to predict or forecast the occurrences of such sudden collapses. These expected achievements will give a significant contribution to the coming nuclear fusion researches.



【Publications Relevant to the Project】

*Transport and Structural Formation in Plasmas, K. Itoh, S-I. Itoh, A. Fukuyama, Bristol, Institute of Physics Publishing, 1999

* Plasma and Fluid Turbulence, A. Yoshizawa, S-I. Itoh, K. Itoh, Bristol, Institute of Physics Publishing, 2002

* P. Diamond, S-I. Itoh, K. Itoh, T.S. Hahm, Plasma Phys. Control. Fusion **47** R35 (2005)

*S-I. Itoh, K. Itoh Plasma Phys. Control. Fusion **43** 1055 (2001)

【Term of Project】 FY2009-2013

【Budget Allocation】 163,900 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.riam.kyushu-u.ac.jp/sanny/

s-iitoh@riam.kyushu-u.ac.jp