

**JSPS Core-to-Core Program**  
**FY2014 Implementation Plan (Project No. :22001)**

Research Theme Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasma  
Duration of Project from April 1, 2012 to March 31, 2015 (36 months)  
Core Institution in Japan (Co-Chair) Graduate School of Frontier Sciences, University of Tokyo  
(Yasushi Ono)

**Implementing Organizations**

○ **Japan**

Japan	Core Institution	Graduate School of Frontier Sciences, University of Tokyo	
	Co-Chair (name and title)	ONO Yasushi, Professor	
	Cooperating Institutions	Advanced Institute of Science and Technology Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency National Astronomical Observatory Japan  National Institute for Fusion Science Kyoto University	Number of Cooperating Institutions  5

○ **Partner Countries**

United States	Core Institution	Princeton Plasma Physics Laboratory, Princeton University	
	Co-Chair (name and title)	JI Hantao, Principal Research Physicist	
	Cooperating Institutions	University of Wisconsin University of Washington University of Chicago Swarthmore College University of New Hampshire University of Alabama Stanford University George Mason University University of California, Los Angeles	Number of Cooperating Institutions  9

Italy	Core Institution	Padova University	
	Co-Chair (name and title)	MARTIN Piero, Professor	
	Cooperating Institutions		Number of Cooperating Institutions
			0

United Kingdom	Core Institution	Culham Laboratory	
	Co-Chair (name and title)	GRYAZNEVICH Mikhail, Principal Research Physicist	
	Cooperating Institutions	University of London	Number of Cooperating Institutions
			1

Germany	Core Institution	Max-Planck Institute for Solar System Research	
	Co-Chair (name and title)	SOLANKI Sami K., Director	
	Cooperating Institutions		Number of Cooperating Institutions
			0

Spain	Core Institution	Astrophysical Institute of Canary Islands	
	Co-Chair (name and title)	BUENO Javier Trujillo, Director	
	Cooperating Institutions		Number of Cooperating Institutions
			0

### Objectives of Research Exchange (including the five years after the project finishes)

We started the international joint COE program for magnetic reconnection/ self-organization based on the past ten years' progress in laboratory merging experiments and their expanding collaborations. Its emphasis is on international and interdisciplinary collaborations among laboratory experiments, observations and theories/ simulations of Japan, US, UK, Italy, Germany and Spain to solve their key physics such as a significant reconnection heating and active control of self-organization by beam injection. Our goal is to complete an interdisciplinary and international research field of magnetic reconnection/ self-organization for elucidating their physics and applications by use of joint-researches, exchanges and education of young scientists.

## Results to the present

The MAST (UK) - TS (U.Tokyo) collaboration successfully measured 2D contours of ion and electron temperatures: significant ion heating in the downstream and localized electron heating at the X-point during the reconnection and their triple-peaked temperature profiles after the reconnection by means of the 2D Doppler tomography (moved from U. Tokyo) and the 2D Thomson scattering measurements. The laboratory-theory (simulation) collaboration successfully elucidated the physics of reconnection heating and the MST(USA)-RFX(Italy)-AIST-TS(Japan) collaboration controlled magnetic reconnection/ self-organization using NBI, gas and ice pellet injections. On-site self-organization study of solar physics started the multi-wavelength spectroscopic analyses and extended the laboratory-simulation of light-bridge into that of plasmoid formation. Based those results, we wrote over 70 original papers (Astrophys. J., Phys. Plasmas etc.) in addition to about 20 invited talks. The outstanding progress is that we COE members wrote a series of tutorial papers “Overview and Prospect - Frontier Researches in Magnetic Reconnection - ” (94 pages) in J. Plasma Fusion Res. Vol.89, No.11 and 12 (2013) and also a series of original and mini-review papers in the special issue “Advances in Magnetic Reconnection Research in Space and Laboratory Plasmas – Part II” of Physics of Plasmas Vol.20, No.6 (2013), as summaries of our recent reconnection/self-organization researches. We also published another tutorial paper of our solar light-bridge simulation experiments in the Astronomical Herald as a new research trend of solar physics. Our three core meetings: MR, IPELS, Hinode and the first plasma school are now top quality meetings in the field of magnetic reconnection, self-organization and solar observation. In 2013, IPELS 2014 and Hinode 7 made stimulating discussions successfully among 100 and 200 attendants, publishing the mentioned special issue of Physics of Plasmas. Our international and interdisciplinary joint-researches encouraged young students and scientists to study abroad timely in the most suitable institutes. Our young CMSO Seminars and organized schooling system help them to make successfully the international and interdisciplinary joint-research, causing their winning several student’s prizes (IEEJ etc). The plasma schools significantly contributed to the interdisciplinary plasma education for undergraduate, young graduate students and also to extending our international and interdisciplinary joint-researches to the other Asian countries through over 40 plasma school attendees from China, Korea and Taiwan.

## Summary of FY 2014 Exchange Plan

### **Joint Research**

Joint kinetic studies of magnetic reconnection and self-organization among TS-4, UTST, MRX, MRX, RFX and MAST experiments, solar/ space observations and theory/ PIC simulations (All members).

Joint-application study of reconnection heating at TS-4, UTST and MAST (Japan, UK, USA).

Joint lab.-theory-observation studies of energy conversion process of reconnection/ self-organization (All members).

Joint lab.-theory-observation study to bridge the magnetic reconnection to the self-organization (All members).

Joint “plasmoid” experiments for fast reconnection/ heating physics in lab.-theory-observation at TS-4 (USA, Japan)

Joint active control experiments of self-organization/ reconnection by beam/ pellet/ gas injections at MST, RFX, TS-4 and UTST (USA, Italy, Japan)

Joint lab.-theory-observation researches of solar self-organization physics (UK, Spain, Germany, Japan).

The mentioned joint researches will be used for our “Free-Style Study Abroad” program to encourage young scientists to study abroad timely in the most suitable institutes and to promote our collaborative researches.

### **Seminar**

MR2014 (Magnetic Reconnection in Laboratory and Space (May 2014).

Hinode 8 Conference (Nov. 2014).

Young CMSO Seminars (July, Nov. 2014, Mar. 2015).

### **Researcher Exchanges**

Invited talks at 40th COSPAR Scientific Assembly, Fusion Energy Conference 2014, 56<sup>th</sup> annual Meeting of American Physical Society, 4th East Asia School and Workshop on Laboratory, Space, Astrophysical Plasmas, Exploratory Plasma Research Workshop EPR 2014 etc.