

**JSPS Core-to-Core Program**  
**FY2013 Implementation Plan (Project No. : 23002)**

Research Theme Non-equilibrium dynamics of soft matter and information  
 Duration of Project 1 April, 2013~ 31 March, 2016 ( 36 months)  
 Core Institution in Japan (Co-Chair) Graduate School of Science, Kyoto University  
( Prof. Shin-ichi Sasa )

**Implementing Organizations**

○ **Japan**

Japan	Core Institution	Graduate School of Science, Kyoto University	
	Co-Chair (name and title)	Shin-ichi Sasa, Professor	
	Cooperating Institutions	Univ. of Tokyo, Kyoto Univ., Tohoku Univ., Ochanomizu Univ., Chiba Univ., Kyushu Univ., Tokyo Metropolitan Univ., Waseda Univ., Nagoya Univ., Osaka Univ., Tokyo Institute of Technology	Number of Cooperating Institutions 11

○ **Partner Countries**

Germany	Core Institution	Heinrich-Heine University Dusseldorf	
	Co-Chair (name and title)	Hartmut Loewen, Professor	
	Cooperating Institutions	Max-Planck Institute Mainz, Heidelberg University, University of Konstanz, Fritz Haber Institute, University of Stuttgart, Ludwig-Maximilians University of Munich, University of Magdeburg, University of Bayreuth, Physikalisch-Technische Bundesanstalt, Forschungszentrum Jülich, University of Göttingen, Institute of Materials Physics in Space, Technische Universität Berlin	Number of Cooperating Institutions 13

France	Core Institution	Atomic Energy Commission	
	Co-Chair (name and title)	Hugues Chate, Senior Scientist	
	Cooperating Institutions	École Normale Supérieure, LPTMS, ESPCI, Institut Curie, Université Paris 6, Université Paris 7	Number of Cooperating Institutions 6

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

By performing the Integrated Action Initiative Project, to elucidate a rich variety of behaviors that soft matters exhibit has turned out to be really significant. Thus, our basic concept is to develop researches of systematic understanding of structure fluctuation and dynamics of soft matters. On the other hand, through the communication of the project, it has been recognized that information theoretical quantities naturally appear in the law of non-equilibrium fluctuations and that theoretical techniques for analyzing glassy dynamics are also useful in information sciences. In the Strategic Research Network Project, the research topics of information are explicitly placed on one side in addition to the topics of soft matters on the other side, and then these apparently unrelated topics are combined by researches with key concepts of non-equilibrium fluctuation and dynamics. As a result, new aspects in physics will be opened up.

During five years after the Strategic Research Network Project, a design principle of soft matters that exchange information will be constructed on the basis of the fundamental law of physics. This is obviously related to more general subjects on the physical description of biological functions. Toward the understanding of them, the long term project will progress with the synergy of matter and information by non-equilibrium.

## Results to the present

Up to September 24, 2013, seven researchers visited France and Germany as Joint researches, five as researches exchange, and nine as seminars. They did very fruitful communication with researchers Germany and France. In particular, as a result, one submit a joint paper, and a few researchers are now preparing joint papers. Furthermore, all the core members (at least one from the cooperating institutions) joined to the kick-off meeting held at Kyoto in April, 2013, where we confirmed our purpose of the project.

## Summary of FY 2013 Exchange Plan

### **Joint Research**

There are four groups, each of which addresses the joint research plan.

First, the soft matter group studies the cross coupling between internal degrees of freedom and transportation phenomena for various soft matters, theoretically and experimentally, with respecting features of three countries.

Second, slow dynamics group extracts a universal picture behind colloids, super-cooled liquids, and spin glasses with the key word slow dynamics as well as understanding of each phenomenon.

Third, the active dynamics group, theoretically and experimentally, studies nano-machines working at the single molecule level, active matter such as living cells, active colloids, granular matter, synchronization, waves, and pattern formation of chemical reactions, from the viewpoint of active dynamics.

Finally, the information dynamics group develops a statistical mechanical method for information processing, formulates non-equilibrium dynamics including information exchange, and considers rare-event sampling from non-equilibrium statistical mechanics.

### **Seminar**

Seminars are planned in Germany, France and Japan.

First, on June 10 – 13, 2013, in Warnemuende Germany, toward understanding of the control and design of complex chemical systems from macroscopic chemical reactors to one molecule reaction, remarkable achievement in theory and experiment are exchanged.

Second, on September 30 – October 11, Les Houches, France, lectures on the interface between information sciences and statistical physics, which has been developed recently, are planned by one member of the core institution in France. Ph D students and post-doc fellows will learn the frontier on the topics and also communicate with younger generation in France by presenting their research results.

Third, on October 21 -24, in Kyoto, Japan, the meeting on statistical mechanics with special attention to soft matter, information and non-equilibrium is planned with aiming at increasing communication among young researchers in the east Asia area and France and Germany.

### **Researcher Exchanges**

In order to develop the communication initiated so far and start new collaborations, Ph D students and young researchers visit France and Germany for 360 days as a whole. In particular, four students and five students, who stay in Germany and France over the one month, are the kernel of the communication among countries.