

**JSPS Core-to-Core Program**  
**FY2009 Implementation Plan (Project No. :18005 )**

Research Theme     New Developments of Arithmetic Geometry, Motive, Galois Theory, and  
    Their Practical Applications    

Duration of Project     From April 1, 2008 to March 31, 2011     ( 36 months)

Core Institution in Japan (Co-Chair)     Hiroshima University      
(Makoto Matsumoto, Professor)

**Implementing Organizations**

○ **Japan**

Japan	Core Institution	Hiroshima University	
	Co-Chair (name and title)	Makoto Matsumoto, Professor	
	Cooperating Institutions	University of Tokyo Kyoto University Nagoya University Tohoku University	Number of Cooperating Institutions
			4

○ **Partner Countries**

USA	Core Institution	Duke University	
	Co-Chair (name and title)	Richard Hain, Professor	
	Cooperating Institutions		Number of Cooperating Institutions
			0

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

France	Core Institution	Universite de Paris-Sud	
	Co-Chair (name and title)	Jean-Marc Fontaine, Professor	
	Cooperating Institutions	Universite de Rennes Ecole Normale Superieure Universite Paris 13	Number of Cooperating Institutions
			3

Canada	Core Institution	University of Montreal	
	Co-Chair (name and title)	Pierre L'Ecuyer, Professor	
	Cooperating Institutions		Number of Cooperating Institutions
			0

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

The objectives of this project are: 1. to develop modern pure mathematics, 2. to extract applicational ideas from the futile soil of pure mathematics, from classical to most advanced ones, and develop these ideas to the level of practical computer programs, such as cryptography and pseudorandom number generations, and 3. to feed back the requirements or mathematical questions from the practitioner to pure mathematicians. This project develops modern mathematics such as arithmetic geometry, Galois theory, Motive theory, and at the same time gathers feedbacks from practitioners to pure theorists, and contrives new methods in practical applications such as communication theory, cryptography and random number generations. We establish lasting relationships between the joining institutes.

### Results to the present

In 2006-2008, the project jointly organized seven conferences in France, Italy and Canada, 14 conferences in Japan. A number of international joint research results were published or accepted, such as non-injectivity of pro-ell completion of Torelli group in the relative pro-ell mapping class groups, and fast jumping ahead of linear random number generators.

SFMT, SIMD oriented Mersenne Twister random number generator program, is being delivered via a homepage. The codes are downloaded more than 15000 times.

### Summary of FY 2009 Exchange Plan

#### **Joint Research**

Richard Hain, Gregory Perlstein, Tomohide Terasoma, and Makoto Matsumoto are jointly working on the Galois representations and mixed hodge structure of relative completion of the mapping class groups. Nobuo Tsuzuki, Chiarellotto, and Caro are working on arithmetic aspects on p-adic differential equations. Pierre L'Ecuyer, Hiroshi Haramoto and Makoto Matsumoto are working on user friendly testing of random number generation.

#### **Seminar**

The project jointly organizes five conferences in Gunma, Tokyo, Hiroshima (twice), and Kagoshima in Japan, and four conferences in France. They are on arithmetic geometry, modular forms and p-adic Hodge theory, motives, number theory with practical view points.

#### **Researcher Exchanges**

In the above-mentioned conferences, a number of Japanese researchers visit the member countries, and foreign members visit Japan. Ph.D students are going to give talks at conferences. E.g., Shin Harase is going to give a talk in Belgium on random number generation.