# Spintronics Research Network of Japan and Center for Spintronics Research Network of The University of Tokyo

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### BACKGROUND

Our spintronics research community in Japan submitted a proposal "Spintronics Research Infrastructure and Network" to the "Master Plan 2014, High-priority Largescale Research Plans" of the Science Council of Japan (SCJ), and it was accepted in March 2014. In total, 224 proposals were submitted to the SCJ, and 27 were accepted. The 27 proposals were examined by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of the Japanese Government, and 10 of them, including our proposal on spintronics, were accepted to the "Large-scale Scientific Research Projects - Roadmap 2014" in August 2014. This illustrates that researchers and laboratories in Japan have made remarkable contributions to the development of spintronics, and that spintronics is vitally important for the progress of science, engineering, and related industries. During this project, we established a Center for Spintronics Research Network (CSRN) in each of four base universities: The University of Tokyo, Tohoku University, Osaka University, and Keio University. These have allowed us to form a nationwide network connecting various research institutions in Japan. Through this network, we aim to promote collaborations among research groups and institutions, strengthen competitive power in research and industry for the development of technological innovations, and cultivate the next generation of young researchers and engineers. (see Fig. 1) In April 2016, the Spintronics Research Network of Japan (Spin-RNJ) was officially launched, and the CSRN was established in these four base universities<sup>1)-4)</sup>.

### **OVERVIEW**

The purpose of this project is to implement the "Spintronics Research Infrastructure and Network," which was accepted as one of the "Master Plan 2014, High-priority Large-scale Research Plans" of the Science Council of Japan (SCJ) and one of the "Large-scale Scientific Research Projects - Roadmap 2014" of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. Spintronics is an interdisciplinary field, in which innovative materials, devices, and systems are developed by introducing spin degrees of freedom for future electronics and information technology. This is a very important and rapidly developing field from the perspective of fundamental science and technological applications, and there is strong competition worldwide. One good example is the study of giant magneto-resistance (GMR) and its application to magnetic-field sensors used in hard disk drives: Prof. A. Fert and Prof. P. Grünberg were awarded the Nobel Prize in Physics in 2007 for their discovery of GMR. Use of spin, together with charge and light, is expected to lead to dramatic progress in information and communication technologies with low-power dissipation. It is also expected to strengthen existing industries and create new industries, and lead to less power consumption and a more environmentally friendly society. To meet these objectives, cross-disciplinary research is needed in fields such as physics, applied physics, electronics, magnetics, materials, chemistry, and information sciences. This kind of research will also lead to the creation of new scientific fields.



Fig. 1: Overview of the Spintronics Research Network of Japan (Spin-RNJ) and Center for Spintronics Research Network (CSRN) in each of four base universities: The University of Tokyo, Tohoku University, Osaka University, and Keio University.

In this project we established a Center for Spintronics Research Network (CSRN) at each of four base universities: The University of Tokyo, Tohoku University, Osaka University, and Keio University, and created a nationwide network connecting various research institutions in Japan including universities, national laboratories, and companies. Through this network, we aim to promote collaborations among research groups and institutions, strengthen competitive power in research and industry for the development of technological innovations, and cultivate the next generation of young researchers and engineers (see Fig. 1 and Fig. 2).

As well as the other three base universities, The Univer-



Fig. 2: Tasks and purposes of our Centers for Spintronics Research Network (CSRN) and Spintronics Research Network of Japan (Spin-RNJ).

sity of Tokyo has many world-leading researchers in spintronics, so it serves as the headquarters. We established the CSRN in the Graduate School of Engineering at the University of Tokyo (Fig. 3), and will continue to operate it in cooperation with the Graduate School of Science, the Institute of Industrial Science, and the Institute for Solid State Physics. We will also collaborate with other ongoing projects through individual researchers and research institutions, including overseas researchers and institutions.

The four base universities have the following general responsibilities: The University of Tokyo focuses on spintronics materials and devices; Tohoku University focuses on spintronics devices and integration; Osaka University focuses on design of spintronics materials and devices; and Keio University focuses on quantum spintronics.

The project has four specific objectives: 1) create a world-leading network connecting research laboratories and institutions; 2) promote collaborations to develop high-quality research, leading to technological innovations; 3) create new and interdisciplinary research fields incorporating physics, applied physics, electronics, magnetics, materials, chemistry, and information sciences, and thereby improve the competitiveness of current industries and create new industries; and 4) educate and elevate the next generation of young researchers and engineers, who will be international leaders in their fields.

## **KICK-OFF SYMPOSIA, STARTING ACTIVITIES**

In April 2016, the Spintronics Research Network of Japan (Spin-RNJ) was officially launched, and the CSRN was established in the four base universities. A kick-off symposium for the Spin-RNJ and CSRN was held at



**Fig. 3:** Engineering Building 2 of Graduate School of Engineering, The University of Tokyo, in the Hongo campus, in which an office and some of the labs in the Center for Spintronics Research Network are operating.



Fig. 4: Kick-off Symposium for the Spintronics Research Network of Japan (Spin-RNJ) and the Center for Spintronics Research Network (CSRN) at Takeda Hall in the Hongo/Asano Campus of the University of Tokyo on May 19, 2016. http://www.cryst.t.u-tokyo.ac.jp/SpintronicsCenter/

the University of Tokyo on May 19, 2016 (see Fig. 4 and http://www.cryst.t.u-tokyo.ac.jp/SpintronicsCenter/), and kick-off symposia for the CSRN at Tohoku University and Osaka University were held on May 25, 2016, and June 10, 2016, respectively. We co-organized the 9<sup>th</sup> International Conference on Physics and Applications of Spin-related Phenomena in Solids (PASPS-9), Kobe, August 8 - 11, 2016 (http://www.pasps9.org). We are grateful to the many people who attended these symposiums and conference and discussed an interesting range of issues. We will also co-organize and co-sponsor

- EU-JAPAN Workshop on Computational Materials Design and Realization for Spintronics, Moltronics, Quantronics, Superconductivity and Topotronics, Peter Grünberg Institute, Jülich Research Centre, Jülich, Germany, September 18-30, 2016.
- 21<sup>st</sup> Meeting on Physics and Applications of Spin-Related Phenomena in Semiconductors (PASPS-21), Hokkaido University, Sapporo, Japan, December12–13, 2016.

• International School on Spintronics and Spin-Orbitronics, Kyushu University, Fukuoka, Japan, December 16–17, 2016.

We will continue our efforts to fulfill our mission. Your continued support is greatly appreciated. (http://www.csrn.t.u-tokyo.ac.jp/)

The author wishes to thank Professors Hiroshi Katayama-Yoshida of Osaka University, Hideo Ohno of Tohoku University, Masafumi Shirai of Tohoku University, and Kohei M. Itoh of Keio University for their collaboration and contribution.

#### References

[1] Homepage of CSRN of the University of Tokyo: http://www.csrn.t.u-tokyo. ac.jp/

 [2] Homepage of CSRN of Tohoku University: http://www.csrn.tohoku.ac.jp/
[3] Homepage of CSRN of Osaka University: http://www.yoshidalab.mp.es. osaka-u.ac.jp/spintronics/hp/

[4] Homepage of CSRN (Spintronics Research Center) of Keio University: https://www.appi.keio.ac.jp/ltoh\_group/spintronics/



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