

Development of Neutron Spectrometer for Novel Material Science at J-PARC

IMR neutron group is advancing a project to construct a new neutron spectrometer at J-PARC/MLF for future material science in Tohoku Univ. based on collaborations with faculties and institutes of Tohoku Univ., and KEK. This ICC-IMR project aimed at creating international collaborations which will develop into advanced material science using the Tohoku Univ. spectrometer in J-PARC. Based on discussions in international workshops and intervisitations supported by ICC-IMR, we succeeded in beginning international collaborations with leading scientists in neutron science, which shows the presence of IMR in neutron science to the world.

Neutron scattering is an indispensable probe for advanced researches of material science because of its unique advantages: observation of spins and light atoms, and, observation of spatial and time correlations of spins and atoms. Tohoku University, in particular IMR, is a center of excellence on material science by neutron scattering based on long-established researches in JRR-3 and top facilities in the world. The Tohoku Univ. neutron group, centering on IMR, aims at constructing a new spectrometer at J-PARC/MLF as a future plan of advanced material science. Figure 1 shows a rendering image of the proposed spectrometer which will be constructed at J-PARC. The instrument, named POLANO (POLarisation Analyses Neutron spectrOmeter), is characterized by observations of spins and hydrogens using polarised neutrons. The construction of POLANO has already been authorized by J-PARC Center. Though the importance of polarised neutrons for advanced materials science is commonly understood, facilities in which polarised neutron scattering experiments can be performed are limited even in

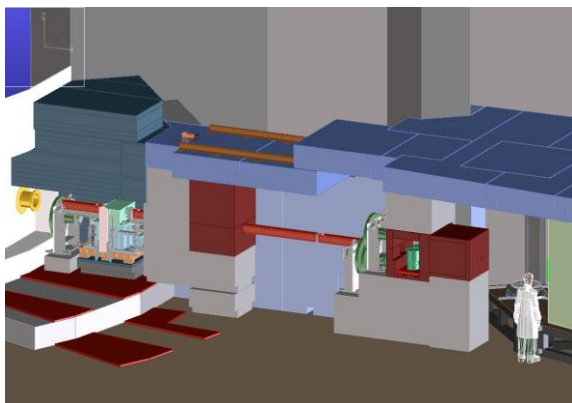


Fig.1 Rendering Image of Tohoku Univ J-PARC spectrometer, POLANO.

the world. Thus, POLANO will be used for international collaborative researches. This means that its design and concept should be discussed from global view points, to utilize this spectrometer in top material science in the world. Moreover, to develop ability of POLANO to the global level, it is definitely important to share experiences of leading scientists in the world. From these points, therefore, building of international collaborations for POLANO project is needed.

For this purpose, we obtained financial supports from ICC-IMR: 3.6M JPY in 2010FY and 2.1M JPY in 2011 FY, which were mainly used for organization of international workshops and intervisitations of scientists. During the two years term of this ICC-IMR project, we held two international workshops in IMR (Fig.2). One of the workshop, "Novel Material Science using Polarized Neutron -- Discussions for J-PARC Polarized Chopper Spectrometer Project by KEK-Tohoku Univ.", was held on 6~8-Jan-2011, which aimed at discussing roles and possibilities of polarised neutrons for future material science. The second workshop, "Novel Material Science by Neutron Scattering -Polarization Analysis & Cross-Correlation Method", was held on 18~19-NOV-2011, which aimed at discussing novel polarised neutron techniques to make technical breakthroughs. The second one was recognized as an official satellite meeting of 1st Asia-Oceania Conference on Neutron Scattering held in Tsukuba. For the workshops, we invited leading scientists of neutron facilities in the world: Dr. M. Hagen and Dr. M. Matsuda of Oak Ridge National Laboratory (USA), Dr. E. Lelievre-Berna of Institut Laue-Langevin (France), Dr. W.T. Lee of Bragg Institute (Austraria), Dr. S Rosenkrantz of Argonne National



Fig.2 One of the ICC-IMR workshops of this project held in IMR. Roles of polarised neutrons for advanced materials were discussed with leading scientists of neutron science.

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Laboratory (USA), Prof. J.G. Park of Seoul National University, Dr. I Zaliznyak of Brookhaven National Laboratory (USA), Dr. W.C. Chen of National Institute of Standards and Technology (USA). With the experts in the world as well as in Japan, we could discuss roles of POLANO and IMR intensively. All the presentations in the two workshops were printed and distributed by the support of ICC-IMR. Note that, based on discussions in the workshops, a novel technique of neutron scattering, “modified cross correlation method”, has been proposed and published [1].

Intervisitations of scientists are another important aim of this ICC-IMR project. Some Japanese members of this ICC-IMR project visited Oak Ridge National Laboratory and Institut Laue-Langevin, and discussed with experts of polarised neutron experiments. Ohoyama, who was the principle person of this project, had seminars in Oak Ridge National Laboratory (USA) on Sep-2010 and Korea Atomic Energy Research Institute (Korea) in Nov-2011 to describe details of POLANO project and activity of IMR in neutron science. As one of concrete results, Center of neutron science for advanced materials of IMR has made collaboration arrangement with Center for Korean J-PARC Users.

In summary, by the support of ICC-IMR, we have obtained fruitful results about international collaborations. Firstly, we have succeeded in building up collaborations with many leading neutron scientists in the world and in Japan, which will be quite important for the construction of POLANO and novel material science. Secondly, by the organization of the international workshops, IMR has been recognized as one of the world center of material science using polarised neutrons. In fact, in a summary talk in one of the workshops, sustained workshops on polarised neutrons in IMR were required by Dr. Kakurai of JAEA.

References

[1] K. Tomiyasu, M.Matsuura, H.Kimura, K.Iwasa, K.Ohoyama, T.Yokoo, S.Itoh, E. Kudoh, T.Sato, M.Fujita, Nucl. Instrum. Meth. Phys. Res. A **677** (2012) 89-93

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