Recent activities of the User Liaison and Industrial Cooperation

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The essential mission of the User Liaison and Industrial Cooperation (ULIC) Group is to maximize the research activities of RIBF by attracting users in various fields with wide scopes. The ULIC Group consists of two teams plus one sub-team. The User Support Team provides various types of support to visiting RIBF users. For this purpose, the User Office was set up in 2010. The Industrial Cooperation Team supports potential users in industries who use the heavy-ion beams for application purposes or for accelerator-related technologies other than basic research. Fee-based distribution of various radioisotopes produced by the AVF cyclotron is also one of the important missions. The produced radioisotopes are distributed to researchers in Japan for a charge through the Japan Radioisotope Association. The Public-relations and Outreach Sub-team supports various outreach activities of Nishina Center.

Fig. 1. Photograph of present ULIC members in the Cyclopedia hall.

User Liaison Team

The RIBF User Liaison Team was established in 2006, immediately before the first physics experiment with the new RIBF facility was conducted in 2007. In order to facilitate and promote efficient and fruitful use of the RIBF, the RIBF User Liaison Team takes charge of many important activities that play key roles in the facility operation. One of the important tasks is to organize international Program Advisory Committee (PAC) meetings, PAC for nuclear physics (NP-PAC) and for material and life science (ML-PAC), to review experimental proposals submitted by RIBF users. The first NP-PAC meeting was held in February 2007, and 32 proposals requesting 550 days of facility use were reviewed there. In the 10 years since then, 17 NP-PAC meetings were held, and 339 proposals requesting 3408 days of beam time were reviewed in total. These numbers clearly show the outstanding demand and importance of the facility in the science community.

Another important task is to manage the RIBF beam-time operation. Beam-time schedule planning, announcement to users and contact from users, schedule change, cancellation, collecting experiment completion reports, and so on are handled by the RIBF User Liaison Team. The Machine Time Committee Meetings are organized regularly every month, and all the important decisions and reports regarding beam-time operation are made there.

Providing support to the RIBF users is also an important task of the RIBF User Liaison Team. In 2010, the RIBF Independent User program started, which allowed a new style of participation for RIBF users in RIBF experiments. Before this program started, all users had to belong to a laboratory or a research group in RIKEN, and thus, the research outcome belonged, in principle, to RIKEN, rather than the users' institutes. But the RIBF Independent User program changed this situation; once a user becomes an RIBF Independent User, he/she can officially claim that the research outcome belongs to the home institute. However, support from the facility is limited for such users; e.g., no financial support is provided for stay. Thanks to this program, international collaborative researches at RIBF have been promoted significantly.

The RIBF Users Office (Fig. 1) was established to provide services and information required for RIBF Independent Users to take part in RIBF experiments. All procedures, such as registration as an RIBF Independent User, reservation of on-campus accommodation, issuance of a radiation badge, and initial lectures for an individual as a radiation worker and as a facility user, can be completed at the RIBF Users Office. At the end of the fiscal year 2016, 330 RIBF users, including 251 from foreign institutes, were registered as RIBF Independent Users. Now, more than half of the RIBF experiment participants are RIBF Independent Users.

Other than the functions stated above, the RIBF User Liaison Team supports the RIBF operation in many aspects, such as support for the RIBF Users Group, arrangements for the RIBF ULIC Symposia

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and mini-Workshops, user orientation at the beginning of each fiscal year, regular summer school for international students, and facility tours of visitors. The RIBF User Liaison Team has always strived to provide support to users so that good research activities can be conducted together, and this objective will remain unchanged in the future.

Industrial Cooperation Team

The industrial cooperation team handles two fee-based non-academic activities: the utilization of heavy-ion beams by the industry and distribution of radioisotopes. The utilization of the ion beams was started in November 2009 when a new project, "Promotion of applications of high-energy heavy ions and RI beams," was approved as a grant-in-aid program of MEXT "Sharing Advanced Facilities for Common Use Program." In this project, RIKEN Nishina Center (RNC) opened a part of the RIBF facility to users including private companies. The users were to pay a beam-time fee and exclusively possess the results and intellectual properties obtained through the use of RIBF. New users with proposals intended to make novel industrial use of ion beams were able to apply for trial use with a reduced fee. A program advisory committee, industrial PAC (In-PAC), was newly set up in December 2009 to review the proposals in terms of their feasibility, possibility of contribution to the general society, and advantage of using the RIBF over other facilities. The MEXT program was terminated in 2010, but RNC continued this facility-sharing program. Thus far, the In-PAC has met six times and approved twelve proposals, four of which were trial proposals and others were fee-based utilization. They include accelerator mass spectroscopy, wear diagnostics of machine parts with implanted RI-tracer nuclei, and irradiation test of space-use semi-conductors. The team also handles fee-based distribution of radioisotopes in collaboration with the Japan Radioisotope Association (JRIA). According to a Material Transfer Agreement (MTA) between JRIA and RIKEN, JRIA mediates the transaction of the RIs and distributes them for a fixed fee to users. The project was started in October 2007 with Zn-65 and Cd-109. Y-88 was added in February 2009 and Sr-85 in April 2015. These RIs are produced by the RI Applications Team with proton and deuteron beams from the AVF cyclotron. The accumulated number of shipments and radioactivity up to March 2017 are listed in Table 1.

The team also develops technologies related to the utilization of RI beams. Under a collaboration with the University of Tokyo and private companies, we have developed a new method for real-time wear diagnostics of industrial materials using RI beams as tracers. As we can provide two intense RI beams of Be-7 and Na-22 and implant them near the surface of a metallic machine part while controlling its depth, one can distinguish the wear-loss rate of both interacting parts at the same time. Another method is the Gamma-ray Inspection of Rotating Object (GIRO), which intends to evaluate the wear-loss in a running machine with the imaging of gamma-ray source distribution.[1)] This is based on the same principle as the medical PET systems but is simpler and less expensive. Both methods led to patent applications.

Public-relations and Outreach Sub-team

This sub-team was established in 2010, to promote the publicity of RNC.

The RNC website, which introduces the organization and its research activities, was renewed in 2010 to the present form (`http://www.nishina.riken.jp`). This website also plays an important role in providing information to researchers who visit RNC to conduct his/her own research.

Various brochures introducing the organization and the studies performed at RNC have been produced. The brochures named "Your body is made of star scraps" explaining element synthesis in the universe and "Introduction of RIBF Facility" in a cartoon style for children are among them.

During the past 7 years, 23 conference/symposium posters connected with RNC were prepared on the request of organizers. For general purpose, a special poster featuring the nuclear chart has been prepared for distribution. In commemoration of the discovery of nihonium, brochures and posters dedicated to the ceremony were made. A 3D video to explain (RIBF's) accelerators and the research at RIBF won the Category Excellence Award at the 2012 Science and Technology Video Festival. Many of these can be seen on RNC website.

In April 2012, the permanent exhibition hall (RIBF Cyclopedia) located at the entrance hall of the RIBF building was set up. Explanatory illustrations on nuclear science, research at RIBF, RIBF history, a 3D nuclear chart built with LEGO blocks, and a 1/6-size GARIS model (GARIS: key apparatus for the synthesis of nihonium) are displayed to help understanding through visual means. To show an actual size of the Superconductive Ring Cyclotron (flagship accelerator), a part of the SRC magnet and liquid He vessel are drawn on the carpet of floor and on the wall, respectively. An enlarged photograph of Dr. Yoshio

Table 1. The accumulated number of shipments and radioactivity for fee-based distribution up to March 2017.

Nuclide	Zn-65	Cd-109	Y-88	Sr-85
Shipments	90	33	6	1
Activity (MBq)	496.2	204.15	5.03	1

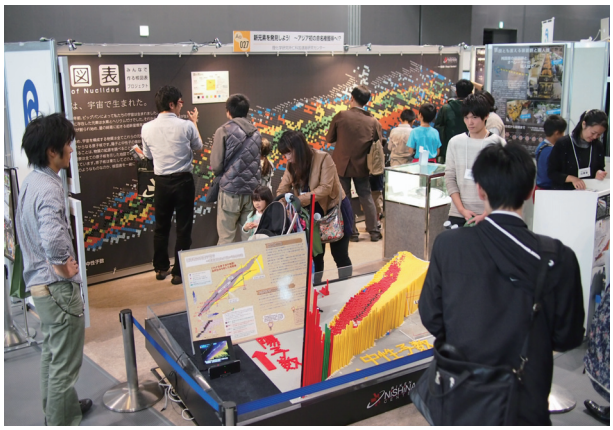

Fig. 2. RIKEN Nishina Center booth in Science Agora 2013. In front is a 3D nuclear chart built with LEGO blocks.

Nishina sitting on his second cyclotron (60-inch), taken in 1939, is also printed on the wall.

A laboratory tour for visitors guided by a researcher is organized. Typically, it takes about 40 min. The number of tours per year is about 150, and the number of visitors is about 2000.

In 2010, 2012, 2013, 2015, and 2016, the sub-team opened an exhibition booth of RNC to introduce the latest research activities on the occasion of the "Science Agora" organized by Japan Science and Technology Agency. It attracted nearly 1000 visitors and received the Science Agora Award in 2012 and 2013. Figure 2 is a snapshot taken at the booth in Science Agora 2013.

From time to time, the sub-team is invited to participate in scientific events by MEXT, Wako city, and Nissan global foundation. One attraction targeting children is the hands-on work of assembling "Iron-beads" to create a nuclear chart or a shape of nihonium. Note that most of above products, such as websites, materials, and events, are designed and/or created by Mr. Narumasa Miyauchi, a member of the sub-team.

Last but not the least, some of the above activities were carried out in collaboration with the Public Relations Office of RIKEN.

Reference

1) T. Kambara, A. Yoshida, H. Takeichi, Nucl. Instrum. Methods Phys. Res. A **797**, 1 (2015).