# Nishina School 2023

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Nishina School aims at introducing nuclear physics research to Asian university students who are in the process choosing their field of study. In 2023, after a three-year hiatus due to the Covid-19 pandemic, the 14th Nishina School was held from July 27 to August 4. Students and supervisors from Peking University, the University of Hong Kong, Seoul National University, Rikkyo University, and Saitama University participated in Nishina School this year. In addition, high school students from Philips Exeter Academy, USA, along with their teachers, participated in most of the school programs. Figure 1 shows all 23 students and School staff members.


Fig. 1. Participants of Nishina School 2023.

The School began with self-introductions of the students. The first week was mostly dedicated to lectures and training on several subjects related to a nuclear reaction experiment performed in the second week of the School. The lectures covered a few fundamental topics for research, including overviews of nuclear physics and nuclear astrophysics, as well as methods of radiation measurements. Other lectures were dedicated to radiation safety and network security. The training sections included electronic-pulse propagation and radiation detection, covered the detectors, electronics, and data acquisition system to be used in the experiment in the following week.

During the second week, the program focused on a reaction experiment using a proton beam from the Pelletron accelerator at RIKEN Nishina Center. The students were divided into six groups, each overseeing six different types of measurements. Each group was assisted by a mentor, a young RNC researcher. They began designing the experiment evaluating the feasibility of measurements such as estimating of $\gamma$-ray yields, setting up detectors around the reaction target, and determining the conditions of beam exposure based on their considerations. After completing the experiment, they analyzed the experimental data obtained and finally made presentations their results. The students studied the low-energy $^{12}$C$(p,\gamma)^{13}$N, $^{10}$B$(p,\alpha\gamma)^{7}$Be, $^{27}$Al$(p,\gamma)^{28}$Si, or $^{9}$Be$(p,\gamma)^{10}$B reaction, related to nucleosynthesis in the Cosmos.

The proton beam with an energy of 2 MeV bombarded a C, BN, Al or Be target, stopping the protons to provide thick target yield of those reactions. The $\gamma$ rays emitted from each reaction were measured with a NaI detector. Figure 2 shows an example of a measured $\gamma$ ray spectrum from the $^{9}$Be$(p,\gamma)^{10}$B reaction.

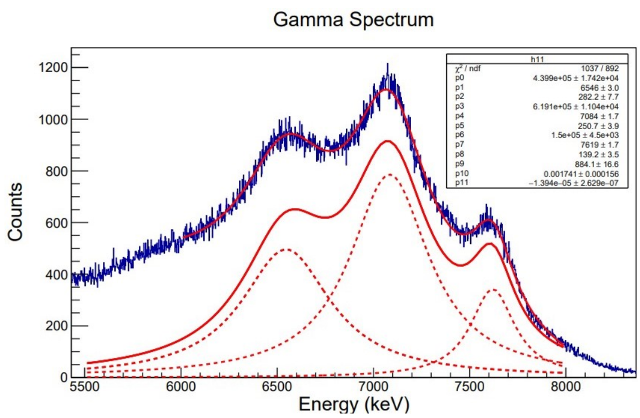


Fig. 2. Example of the $\gamma$-ray spectrum obtained for the "in-beam" measurement of the $^{9}$Be$(p,\gamma)^{10}$B reaction with a 2-MeV proton beam.

In this case, single and double escape peaks were observed owing to the high energy of $\gamma$ rays, approximately 7–8 MeV. The six groups were finally able to extract reaction cross sections, which reproduced previous literature values well within several 10% error.

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