RIKEN NiSHiNA CENTER
理化学研究所
仁科加速器科学研究センター

# Nishina School 2024
# Introduction of Program

Hironobu Ishiyama
RNC/RIKEN

*Nishina School 2024*
*RNC/RIKEN, July 25 – August 2, 2024*

★Participant

- Peking University (6 students + 1 supervisor)
- Seoul National University (5 + 1)
- University of Hong Kong (5 + 1)
- Philips Exeter Academy (senior high school in USA, 3 + 1)
- Saitama University (5)
- Rikkyo University (1 + 1)
- Tsukuba University (1)

26 students in total

★ Objectives

**Experimental nuclear physics**

★ Program 2023

**$^{12}$C(p, γ)$^{13}$N, $^{10}$B(p, αγ)$^{7}$Be, $^{27}$Al(p, pγ)(p, αγ), $^{9}$Be(p, γ) reaction experiments**

with training and lectures

# Objectives (for staff scientists)

1. **Educational research using RIKEN's accelerators**
2. **Establishment of a basic course on nuclear physics**
3. Collaborative development of detectors and other experimental apparatus for educational research
4. Joint seminars
5. Other educational research and programs agreed to by both parties

# Objectives

★ Introduction to **nuclear physics EXPERIMENTS**
on the site of the RI Beam Factory at RIKEN
- one of the world leading facilities in the field of nuclear physics
giving a **flavor** of research frontier

★ We **hope** you to enhance motivation toward nuclear research,
nuclear physics laboratories in your university

# Program 2024

Focus: **$^{12}C(p, \gamma)^{13}N$, $^{10}B(p, \alpha\gamma)^{7}Be$, $^{27}Al(p, p\gamma)(p, \alpha\gamma)$, $^{9}Be(p, \gamma)$ reaction experiments** with training and lectures

with proton beams

A typical nuclear reaction – “beam and target”
Nuclear resonant states
Nuclear astrophysics and/or nucleosynthesis

## <1st week>

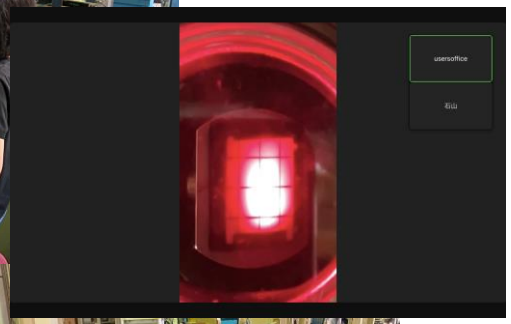
July 25: opening, introductions, network security,  2 lectures
July 26: RIBF Tours, 2 lectures,  2 training programs

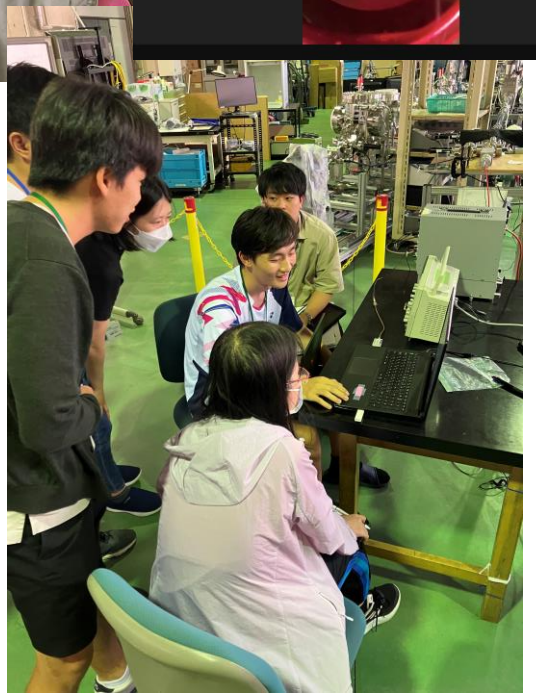
## <2nd week>

July 29: 2 lectures, group works for experiment (6 groups)
July 30: visiting to pelletron, group works for experiment
July 31: reaction measurements with proton beams
Aug. 1: auxiliary measurements, data analysis, preparation for presentation
Aug. 2: presentation by each group, summary, Farewell party

# Nishina School 2023




usersoffice

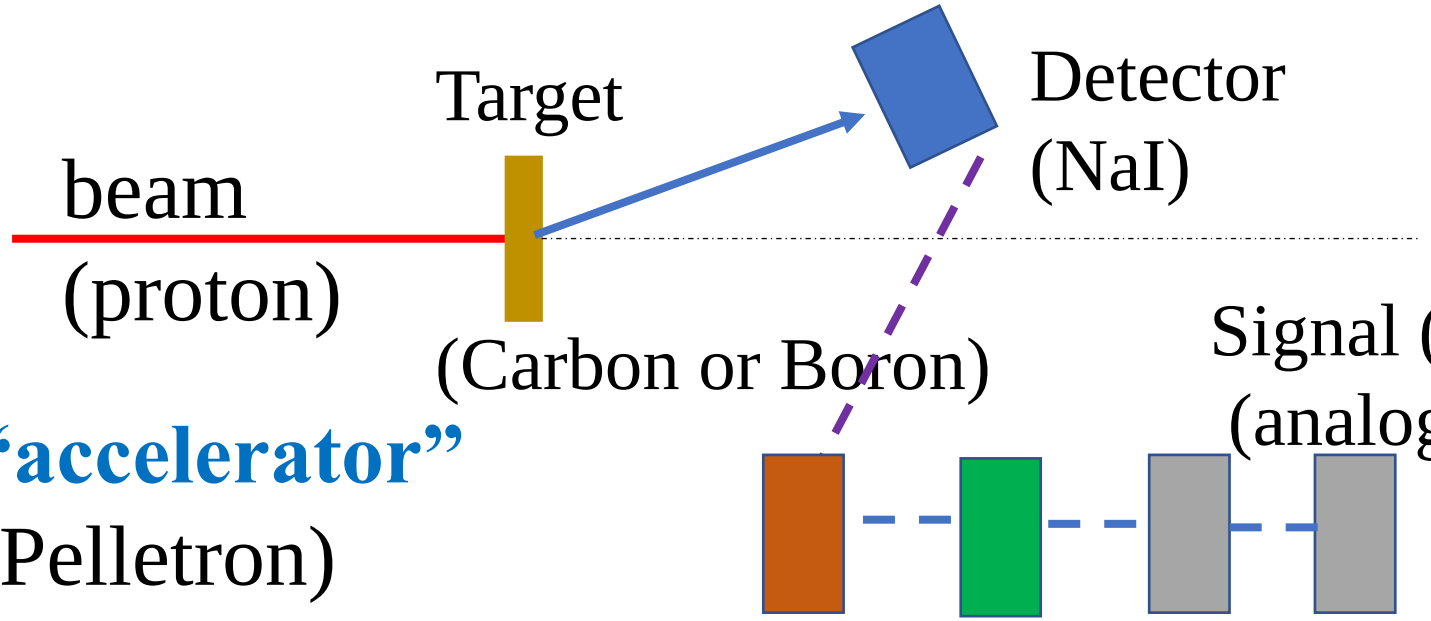



Spectrum Analysis


Compound Equation
$N_\gamma = N_b \times N_t \times \int d\sigma/d\Omega \times d\Omega \times \varepsilon \times P_\gamma$
gamma rays captured (#)
protons delivered (#)
cross section (barns)
decay branching ratio: 1 for us
efficiency (%)

# A typical scheme of reaction experiments

Nuclear reaction study with energetic beams

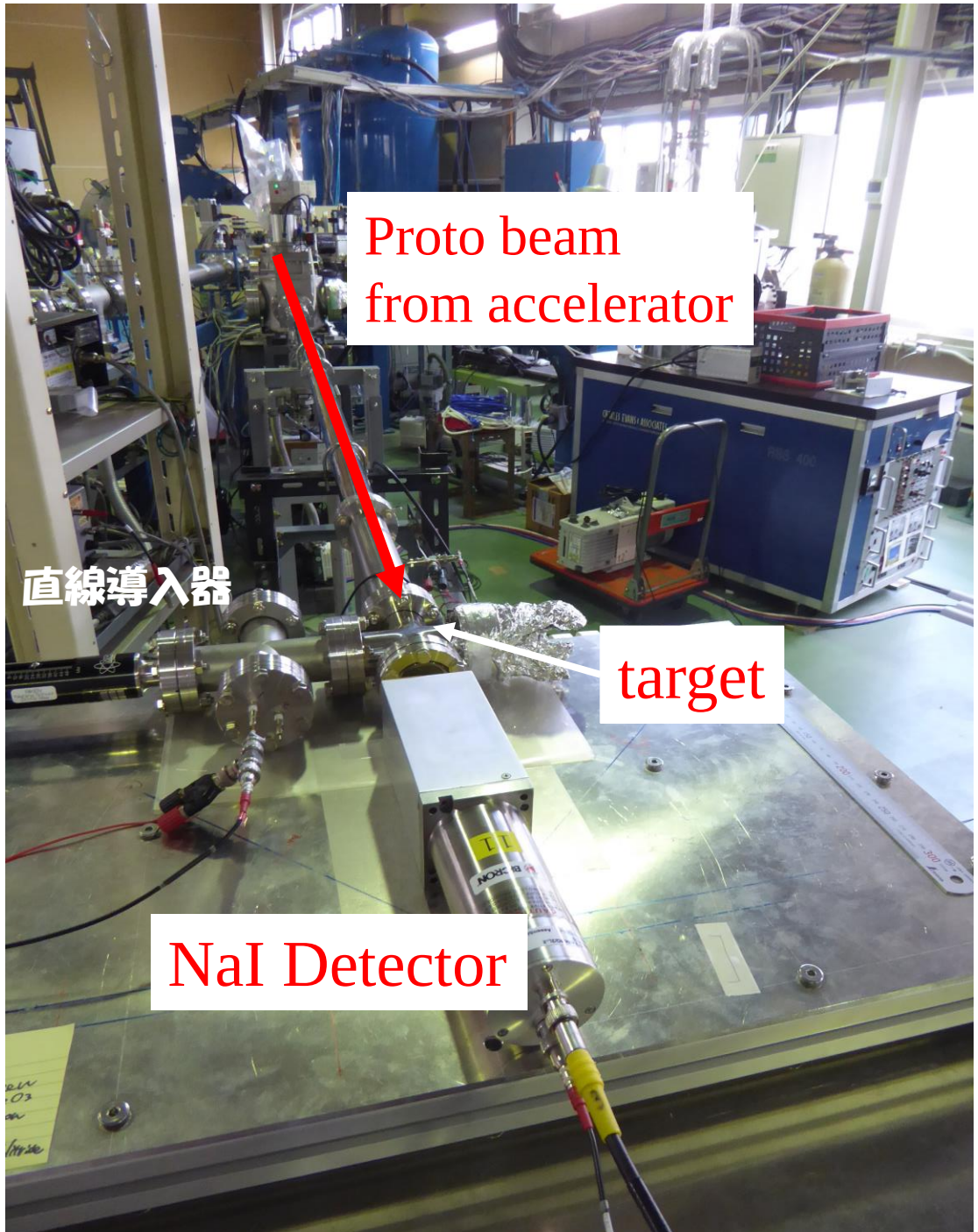


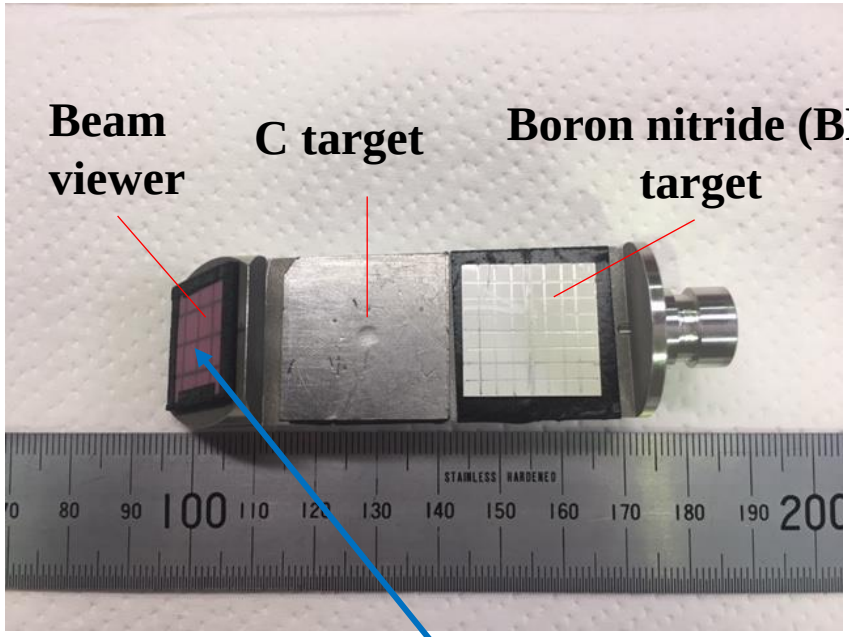

**“beam and target”**
Since Rutherford scattering

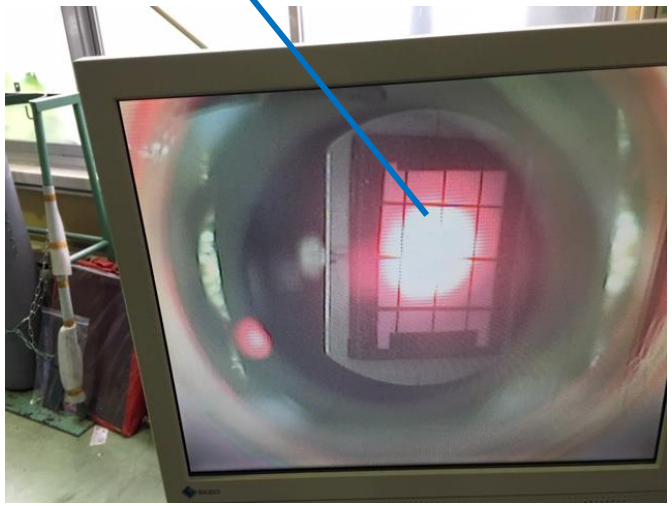
Signal (information) processing
(analog – digital – data – **knowledge**)

**“accelerator”**
(Pelletron)

Amplitude, time, … ⇒ energy, speed, PID, …
⇒ cross section
structure of nucleus
nucleosynthesis in stars


Proto beam
from accelerator
直線導入器
target
NaI Detector


Beam
viewer
C target
Boron nitride (BN)
target
STAINLESS HARDENED
80
90
100
110
130
140
150
160
170
180
190
200



# 6 groups for experiment

$^{12}C(p, \gamma)^{13}N$ exp. (in-beam), Ep = 2 MeV
$^{12}C(p, \gamma)^{13}N$ exp. (activation), Ep = 2 MeV
$^{10}B(p, \alpha\gamma)^{7}Be$ exp. (in-beam), Ep = 2 MeV
$^{10}B(p, \alpha\gamma)^{7}Be$ exp. (activation), Ep = 2 MeV
$^{27}Al(p, p\gamma)\&(p, \alpha\gamma)$ exp. (in-beam), Ep = 2 MeV
$^{9}Be(p, \gamma)^{10}B$ exp. (in-beam), Ep = 2 MeV

| University | Name | Group # | Year | Reaction |
|---|---|---|---|---|
| Peking University | WANG, Cheng | 1 | 4th | 10B in-beam |
| Seoul National University | KIM, Giwan | 1 | 4th | |
| Saitama Univ. | YASUDA, Ibuki | 1 | 4th | |
| Phillips Exeter Academy | ZHANG, Shiqiao | 1 | HS | |
| Peking University | ZHOU, Kaijie | 2 | 4th | 10B Activation |
| University of Hong Kong | CHAN, Hoi Yat | 2 | 2nd | |
| Tsukuba Univ. | KOBAYASHI, Hayato | 2 | 4th | |
| Phillips Exeter Academy | JIA, Sophia | 2 | HS | |
| Peking University | MEI, Wencong | 3 | 4th | 27Al |
| Seoul National University | PARK, Chaeun | 3 | 3rd | |
| University of Hong Kong | AARONS, Cynthia | 3 | 4th | |
| Saitama Univ. | IWAMOTO, Rei | 3 | 4th | |

| | | | | |
|---|---|---|---|---|
| Peking University | LI, Shichang | 4 | 4th | 9Be |
| Seoul National University | LEE, Jeseok | 4 | 4th | |
| University of Hong Kong | LAU, Tsun Yu | 4 | 3rd | |
| Saitama Univ. | NISHIZAWA, Satoru | 4 | M1 | |
| Phillips Exeter Academy | UNVER, Altan | 4 | HS | |
| Peking University | CHEN, Shaojie | 5 | 4th | 12C In-beam |
| Seoul National University | SONG, Yeonjae | 5 | 3rd | |
| University of Hong Kong | FUNG, Chiu Wah | 5 | 3rd | |
| Saitama Univ. | TOMIOKA, Nao | 5 | M1 | |
| Peking University | CAO, Yuhang | 6 | 4th | 12C Activation |
| Seoul National University | CHUNG, Haeun | 6 | 3rd | |
| University of Hong Kon | CHENG, Nai Ming | 6 | 3rd | |
| Rikkyo Univ. | NEZU, Yu | 6 | 4th | |
| Saitama Univ. | WATANABE, Kouhei | 6 | M1 | |

| target | In-beam | Activation |
|---|---|---|
| 12C | Yano | Jacky |
| 10B | Marco | Fu Chaoyi |
| 27Al | TikTsun, Sixan Zha | ---------- |
| 9Be | Yoshida | ---------- |

# Some notes

**Be careful:**

high-voltage, radiation, …  Follow the instructions.
in general, we less protected than in our daily life
from damages…
forbidden – use of “ pier to pier” (P2P) file sharing software

**Note taking** #log-note for each group

**Discussion in the team**

Network connection : through “guest” with pass wd: rikenwlanguest
Our web page: https://indico2.riken.jp/event/4874/

# Personal for Nishina School 2024

## Lectures, Training and experiments

Zaihong Yang(PKU), Senon Choi (SNU), Chaoyi Fu (HKU) , Karen Lassey (Exster)
Shunji Nishimura, Kanenobu Tanaka, Hidetada Baba, Tokihiro Ikeda,
Hiromi Sato, Takao Kojima, Tadaaki Isobe, Daisuke Suzuki, Marco Rosenbush,
Sun Iimura,  Asahi Yano, Leong Wang Chung (Jacky), Sixian Zha,
Ryosuke Yoshida, TikTsun Yeung (Marco), Yukiko Kojima

## Logistics and …

Asako Takahashi, Emi Saito, Tomomi Okayasu, Yu Naya, Iiida Kazue Sasaki,
Takaaki Orii, Saori Konami

Hideki Ueno & Tohru Motobayashi (adviser),
Hironobu Ishiyama (school master)
Hiroyoshi Sakurai (RNC director)