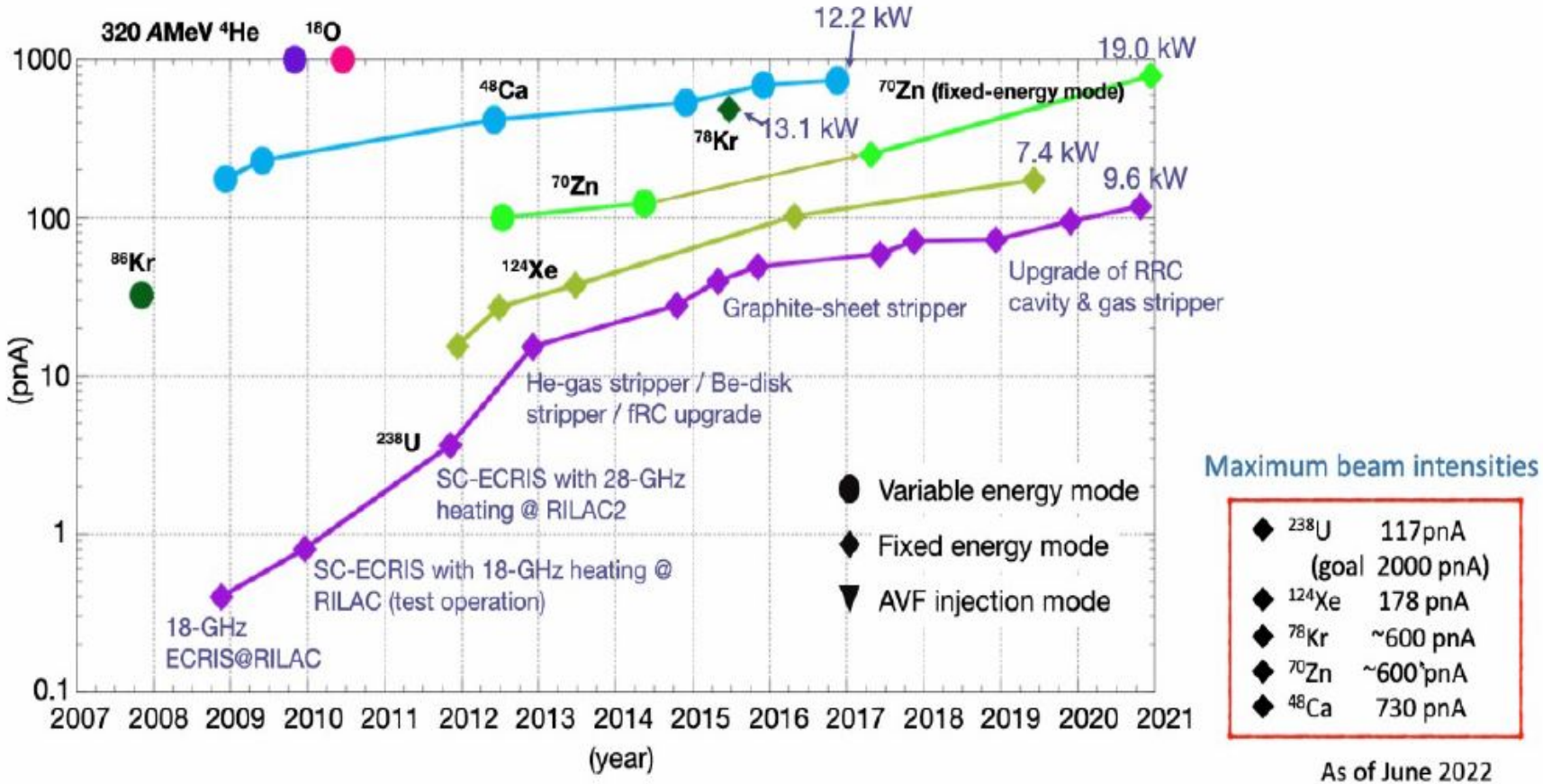
Demandes 2026 RIKEN + RCNP Osaka

1 Lifetime measurements
2 Nuclear moments
3 Mass spectrometry
4 Clustering away from stability
5 Wobbling mode

Primary beam intensity at RIBF



Maximum beam intensities

◆ ^{238}U	117pnA (goal 2000 pnA)
◆ ^{124}Xe	178 pnA
◆ ^{78}Kr	~600 pnA
◆ ^{70}Zn	~600 pnA
◆ ^{48}Ca	730 pnA

As of June 2022

Beam energies of the beams without explicitly indicated are 345 AMeV.

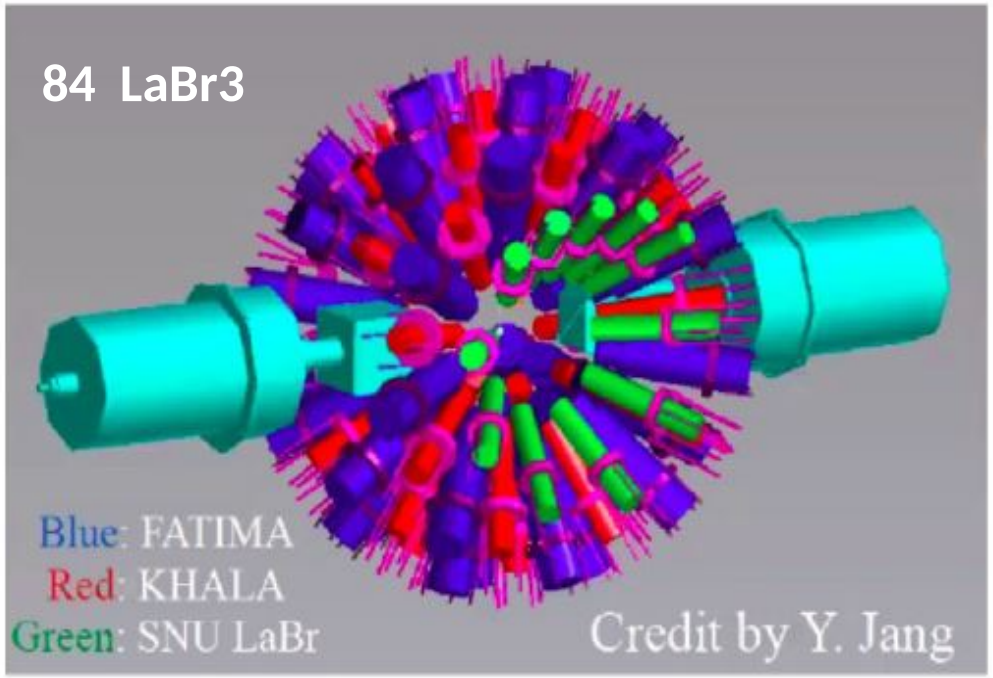
Courtesy of N. Fukunishi (RIBF Acc. gr.)

2024 accelerator issues solved
campaigns restarted but considerable backlog

1 Lifetime measurements

Lifetimes in ^{75,77}Cu with Idaten

International detector assembly
for fast-timing measurements of exotic nuclei
Commissioning June 2024

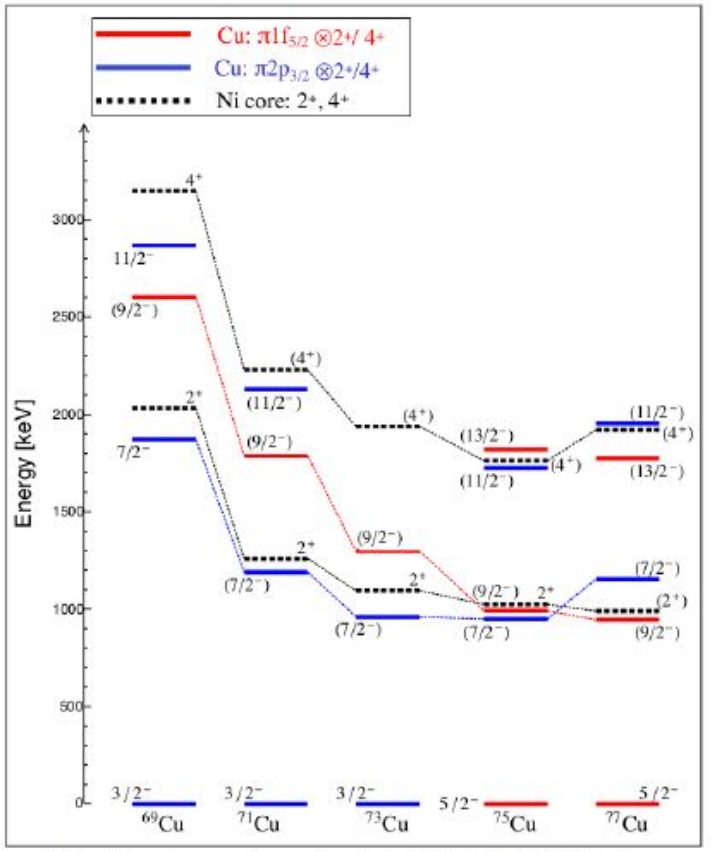


Lifetimes in ^{75,77}Cu
spokespersons: S. Franchoo & E. Sahin
Accepted

Collaboration with Oslo university, Riken, CENS Daejeon

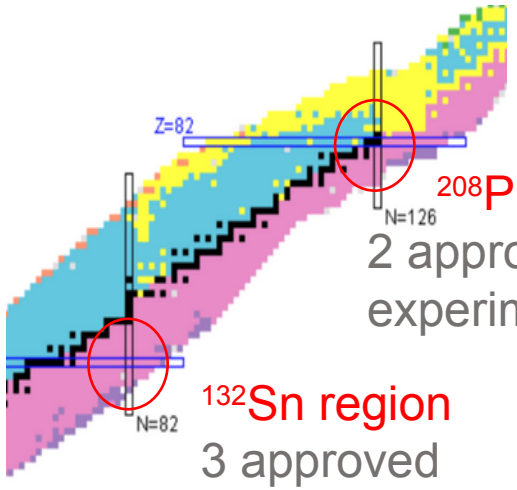
IJCLab:
S Franchoo, R Lozeva, A Astier, I Matea

Emergence of collectivity in copper isotopes: half-lives of particle-core vs intruder states in ^{75,77}Cu to provide missing link towards ^{79}Cu (PhD M Kaci, ICJLab, 2021-24)



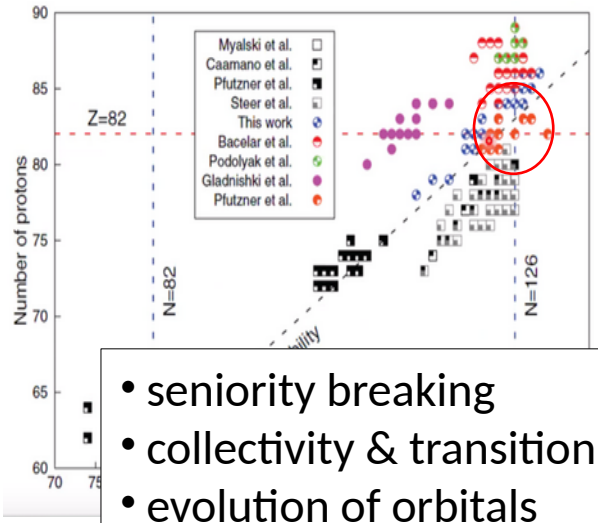
F Bello Garrote et al, PRC 102 (2020)

1 Lifetime measurements



^{208}Pb region
2 approved experiments

^{132}Sn region
3 approved



- seniority breaking
- collectivity & transition rates
- evolution of orbitals

Collaboration with IFIC Valencia, INFN Legnaro, Riken, CENS Daejeon

Isomer, lifetime and decay measurements around ^{132}Sn and ^{208}Pb with Idaten

IJCLab: S Franchoo, R Lozeva, A Astier, I Matea

- Lifetimes of short-lived states in the ^{208}Pb region
  spokespersons: A Morales, A Gottardo, R Lozeva
  Accepted
- Lifetimes of short-lived states in the ^{132}Sn region
  spokesperson: R Lozeva
  Accepted

Other related Idaten experiments
- Cd-Ag-Pd lifetime N~82 (7.5 d)
- ^{132}Sn decay & lifetime & mass N>82 (5 d)
- Isomers beyond N=126 ^{208}Pb region (5 d)

Request for 2026: 22.8 kE

^{75,77}Cu experiment 1x 3p 7d: 6.6 kE
A>132 & A>208 experiments 2x 3p 7d: 13 kE
collaboration workshop 2p 2d: 3.2 kE

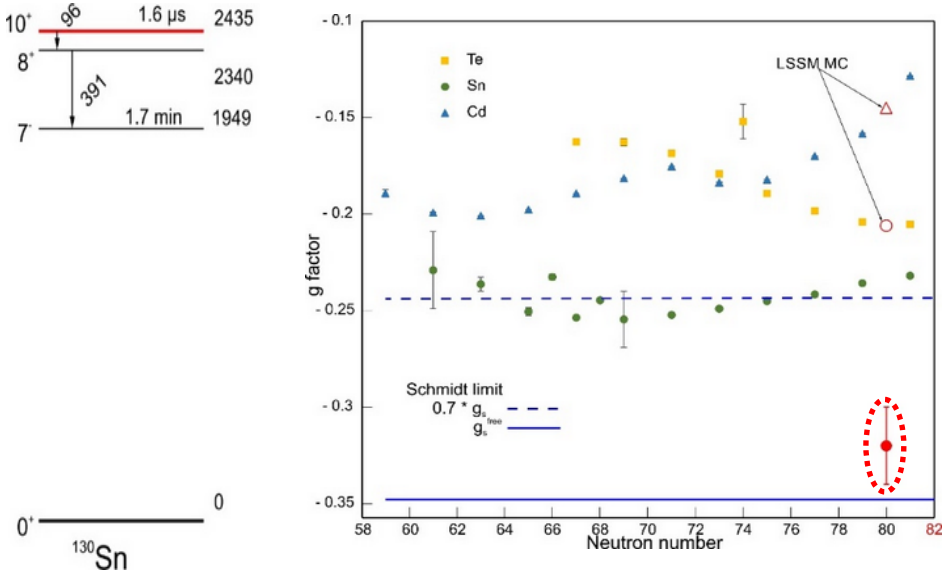
2 Nuclear moments of isomeric states

Collaboration with the group of H Ueno since 2008

Y Ichikawa, ..., G Georgiev et al, Nature Physics 8, 918 (2012)
Y Ichikawa, …, G Georgiev et al, Nature Phys. 15,321 (2019)
F Boulay, …, G Georgiev, …, R Lozeva et al, PRL 124, 112501(2020)

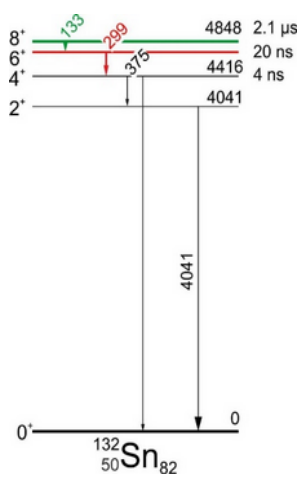
IJCLab:
G Georgiev, F Spee

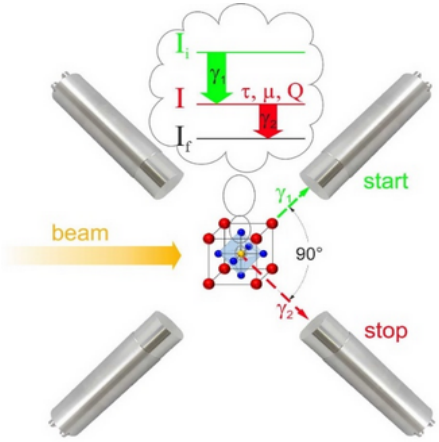
TDPAD of 1.6 µs 10^+ isomer in ^{130}Sn
(2019, spokesperson G Georgiev)



TDPAC of 20 ns 6^+ isomer in ^{132}Sn
(2022, spokesperson G Georgiev)

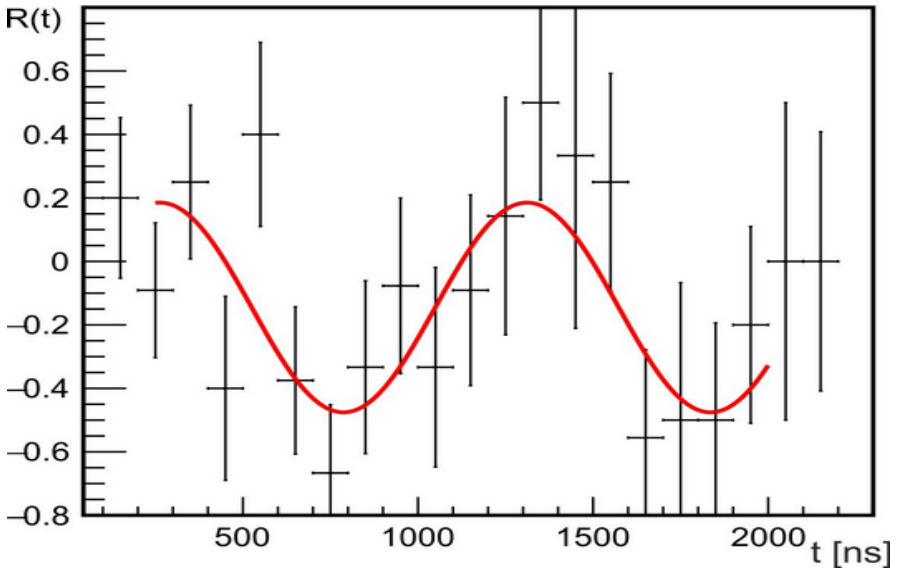
- First application of TDPAC in projectile-fragmentation – access to ns isomers
- $LaBr_3$ detectors (collaboration IFIN-HH)





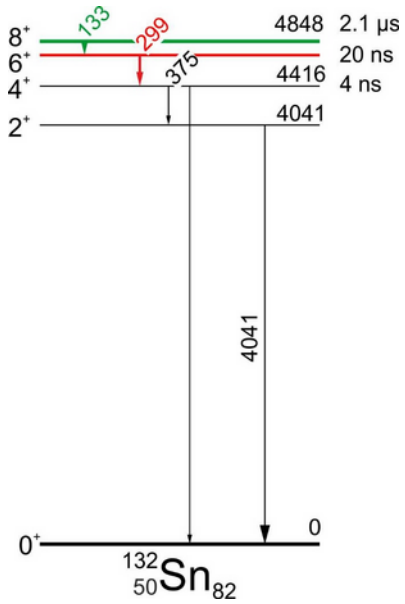
Request for 2026: 4.2 kE
missions for data analysis 1p 10d
new proposal at PAC Riken 1p 3d

10^+ isomer in ^{130}Sn – November 2024



- ion rate ~200 pps
- beam purity ~85%
- isomeric ratio (2n removal) = **0.2 %**
  a needle in a haystack!
- consistency between 96 keV and 391 keV transitions
- amplitude 0.33(9) equals 3 σ
  is this enough?
- under analysis by F Spee at IJClab

^{132}Sn 6^+ moment from 8^+ isomeric decay – December 2024



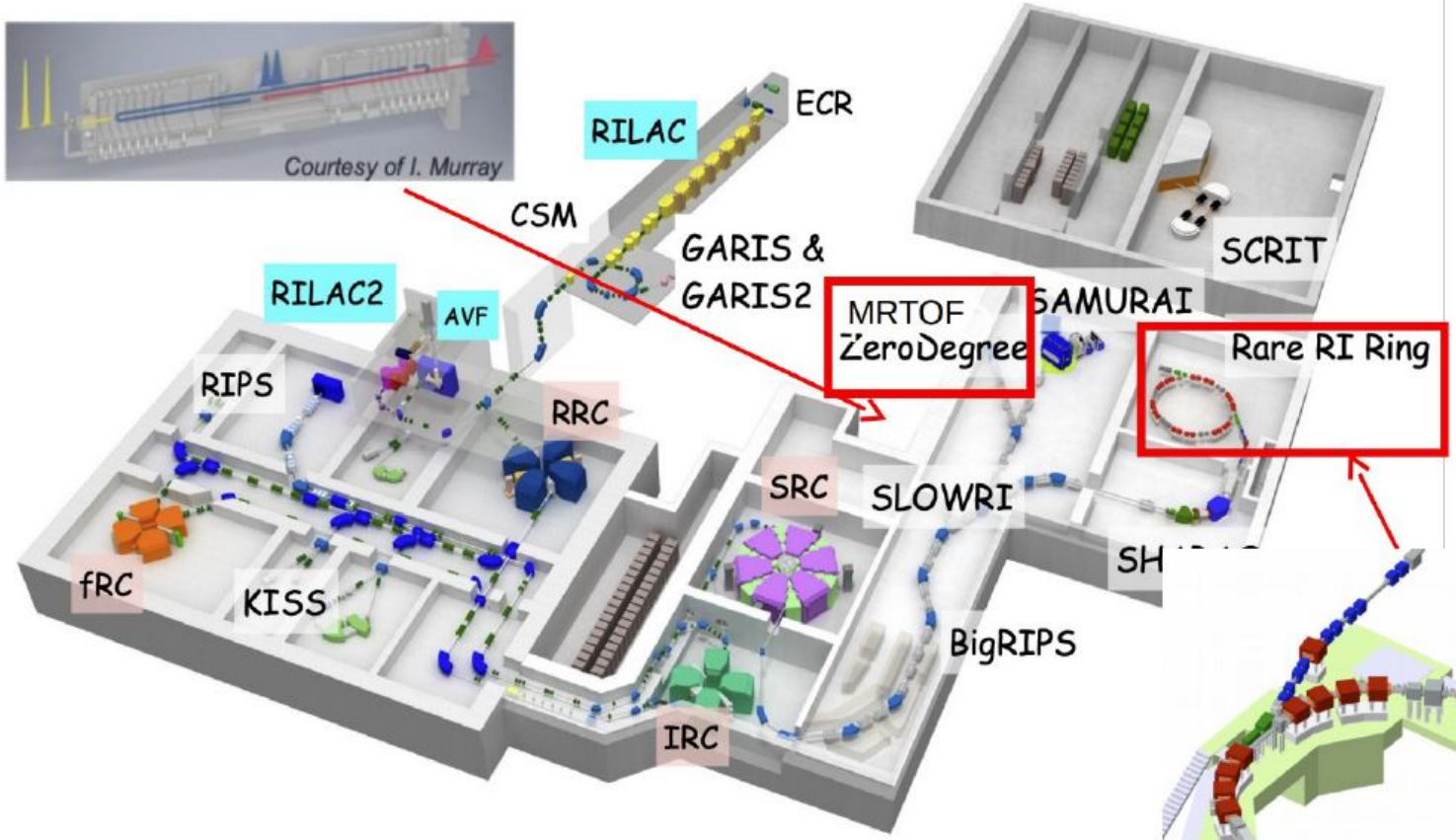
- ^{132}Sn secondary beam 90 000 pps over 48 h
- 2 Ge LEPS + 2 $LaBr_3$ detectors
- Implantation in SnFe host B_{hf} ~ -8T
- beam energy from 166 MeV/u down to 130 MeV/u
  (to reduce prompt flash)
- limited by γ-ray count rates
  (5 kpps/Ge; 20 kpps/$LaBr_3$)
- under analysis by F Spee at IJClab

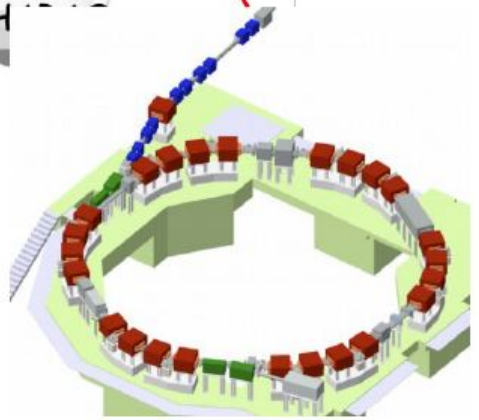
2 Nuclear moments of isomeric states

Collaboration: IJCLab, Riken, CAS/IMP, ELI-NP/IFIN, ITT Ropar, U Complutense

3 Mass spectrometry with Rare-RI Ring (R3)

Mass measurement devices @RIKEN





- Measurements based on time-of-flight at **low energy (MRTOF)** and **high energy (Ring)**
- **Advantages:**
  - MRTOF:
    → higher precision (< 10^{-7})
  - Ring:
    → faster measurement (< 1 ms)

PI R3: IJCLab

3 Mass spectrometry with Rare-RI Ring (R3)

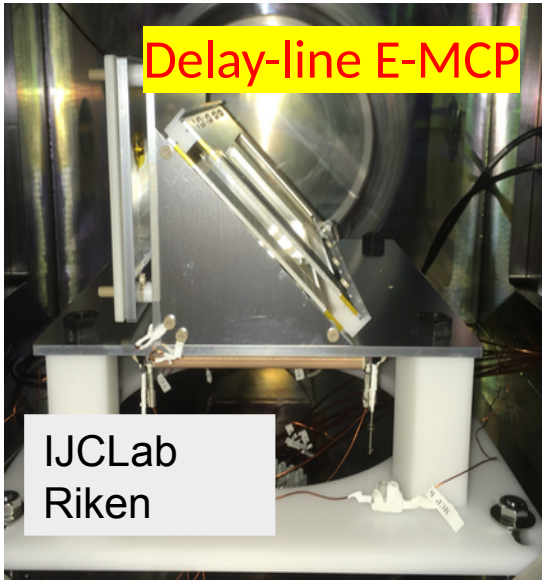
G Hudson-Chang
PhD 2021-25 Surrey U
Direction: Z Podolyak
& S Naimi

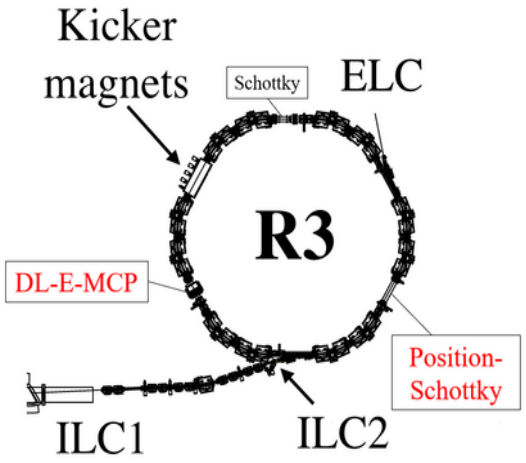
- Articles publiés :
  . Hudson-chang et al, CPC, STORI'24 (2025)
  . Sanjari et al, CPC, STORI'24 (2025)
  . Abe et al, NIMA 1072 (2025)
  . Hudson-chang et al, NIMA 2024 (2024)
  . Nagae et al, PRC 110 (2024)

- Propositions acceptées (grade A):
  . Décroissance 2γ des ions multichargés ^{72}Ge,^{72}Kr,^{68}Se prévue en 2026
  . Mesure de masse dans la region du ^{210}Pb, prévue en 2026
  . Mesure de masse N=Z pour le rp-process (dépend du faisceau du Xe)

- Test nouveau détecteur Schottky (nov. 2025)

Collaboration with
Riken, GSI, U Surrey





Request for 2026: 6.7 kE
missions for 2x 2p 7d

IJCLab:
S Naimi, postdoc

Commissioning fin 2025 de deux nouveaux détecteurs de position dans R3 (première mondiale menée par IJCLab)

4 Clustering far from stability

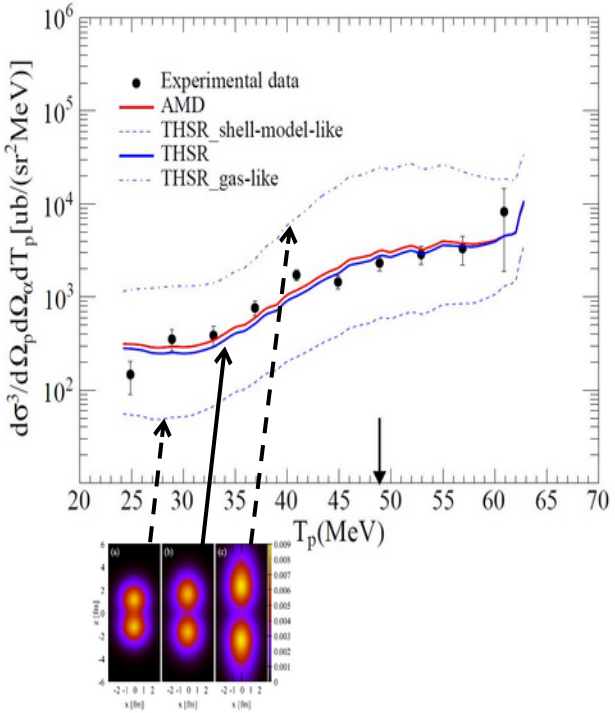
Clustering in n-rich isotopes and multineutron systems from (p,pX) cluster knockout reactions

IJCLab: M Assie, D Beaumel, S Franchoo, V Girard-Alcindor, F Hammache, I Stefan, , T Zanatta Martinez (PhD)

Samurai experiment (spokesperson D Beaumel)

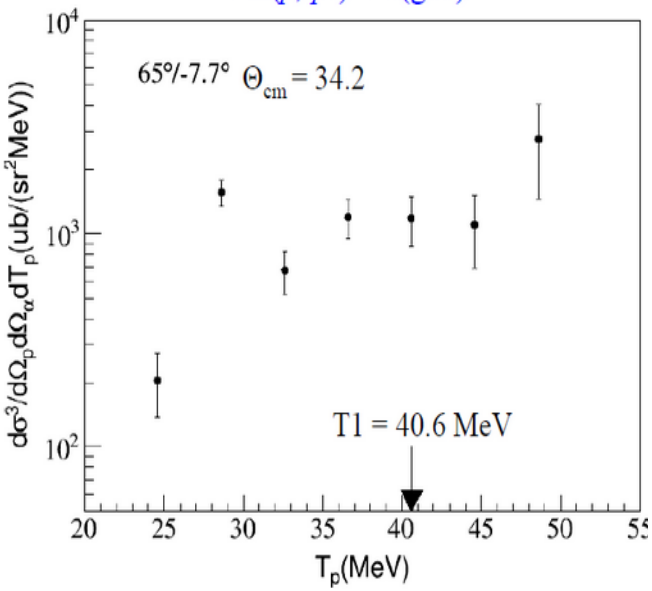
^{10,12,14}Be(p,pα) at 150 MeV/u

- cluster structure of neutron-rich Be isotopes
- first spectrum of the 6-neutron system

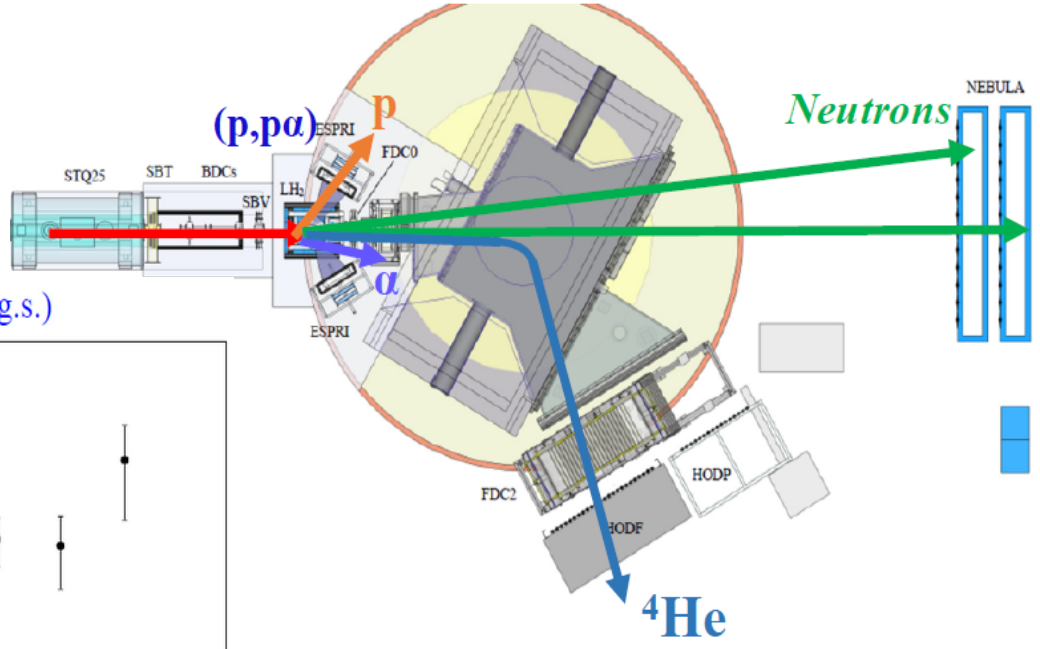


Validation of molecular structure in ^{10}Be

P Li, D Beaumel et al, PRL 131 (2023)



Large triton production from surface of ^{14}Be



First data on the 6n system

PhD O Nasr, IJCLab

Collaboration: **IJCLab, Riken**, CEA Saclay, Hong Kong U, Kyoto U, Kyushu U, LPC Caen, NIPNE, RCNP, Titech, Tohoku U, TU Darmstadt

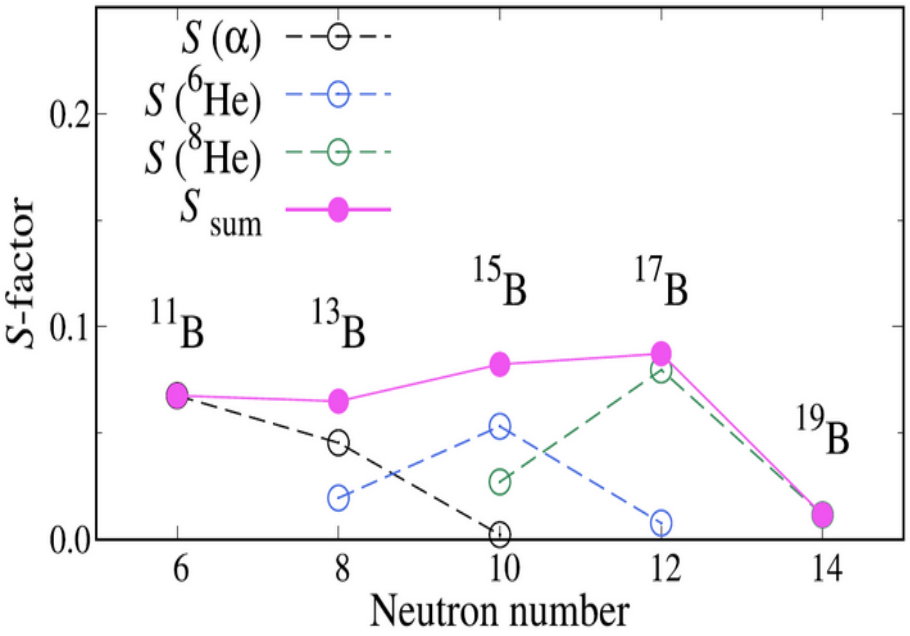
New Samurai proposal on ^{11,13,15}B(p, pX) at 200 MeV/u

Evolution of α-clustering towards the dripline

- S(α) rapidly decreases from ^{11}B to ^{15}B to nearly 0

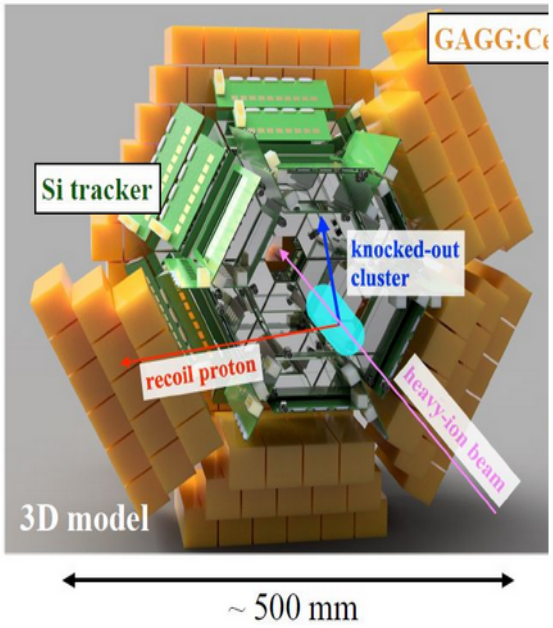
Neutron-rich clusters dominate in n-rich boron

- ^{6}He would dominate over other clustering in ^{15}B
- triton clustering: AMD calculations by M Kimura
- study cluster breakup effects (t, ^{6}He)



TOGAXSI (戸隠) telescope

A new detector array for *inverse-kinematics* cluster and nucleon knock-out reaction experiments under construction.



picture T Uesaka

Commissioning + first experiment this June 2025

New proposal on (p,pX)B with Togaxsi
Spokespersons: P Li (Fudan U) & D Beaumel (PAC December 2025)

Request for 2026: 11.8 kE
missions for 4p 14d

5 Wobbling mode

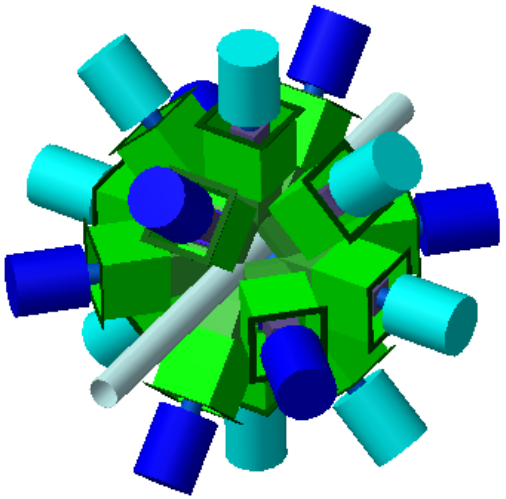
Linear polarisation in ^{137}Sm,^{137}Pm: search for wobbling bands at RCNP Osaka

In-beam γ spectroscopy via the reaction ^{36}Ar+^{105}Pd

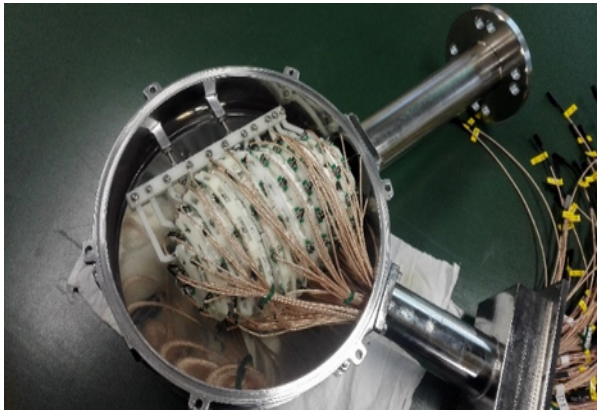
Spokespersons: S Guo and C Petrache

Accepted

IJCLab:
A Astier, C Petrache



CAGRA: 16 clovers
High efficiency ~ 5%
8 clovers @ 90°:
best sensitivity for linear polarisation
Fast digital DAQ system:
High trigger rate for
3-fold coincidences ~20k/s



IMP Lanzhou CsI ball to select emission channel

Pluri-annual program on lanthanides
Related program at iTHemba Labs on wobbling mode in Ce and Ba

Request for 2026: 6.5 kE
mission for 3p 7d

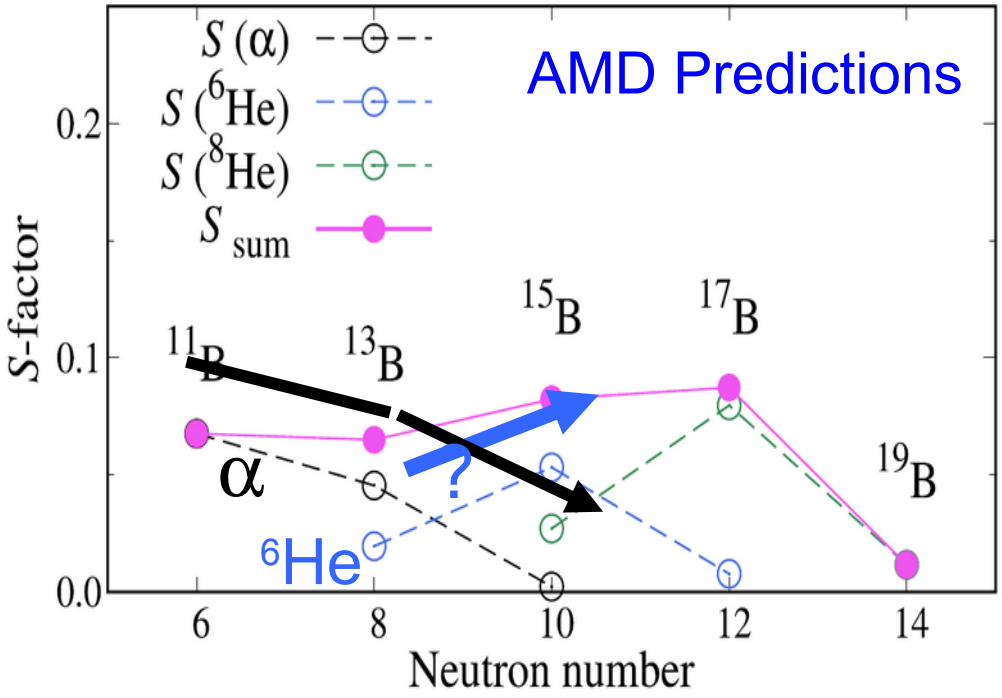
Collaboration with IMP Lanzhou & RCNP Osaka

Programme	Installation	Request (kE)
Lifetimes	RIKEN	22.8
Nuclear moments	RIKEN	4.2
Mass measurements	RIKEN	6.7
Clustering	RIKEN	11.8
Wobbling mode	RCNP	6.5
	TOTAL	**52**

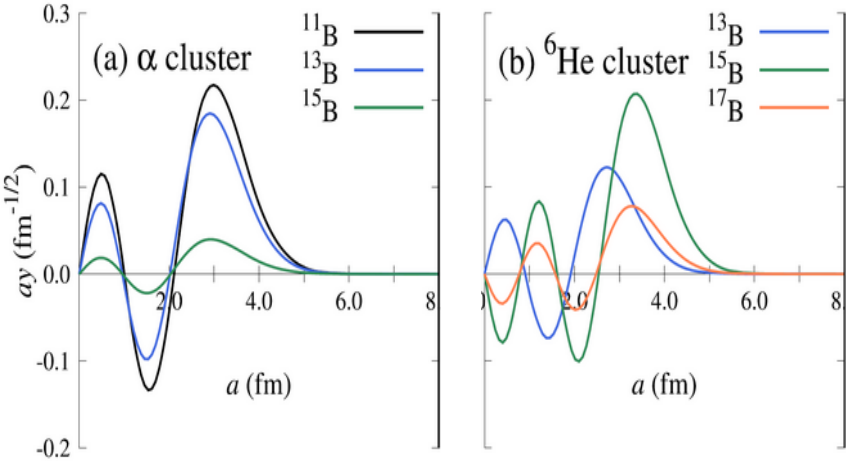
contribution IRP France-Japon 10-15% ?

BACKUP SLIDES

Predicted cluster structure of boron isotopes



Cluster wave function



H.Motoki et al. Prog. Theor. Exp. Phys. **2022** 113D01

Y. Chazono et al. Phys. Rev. C 106, 064613 (2022)

S. Ogawa et al. Phys. Rev. C 108, 024604 (2023)

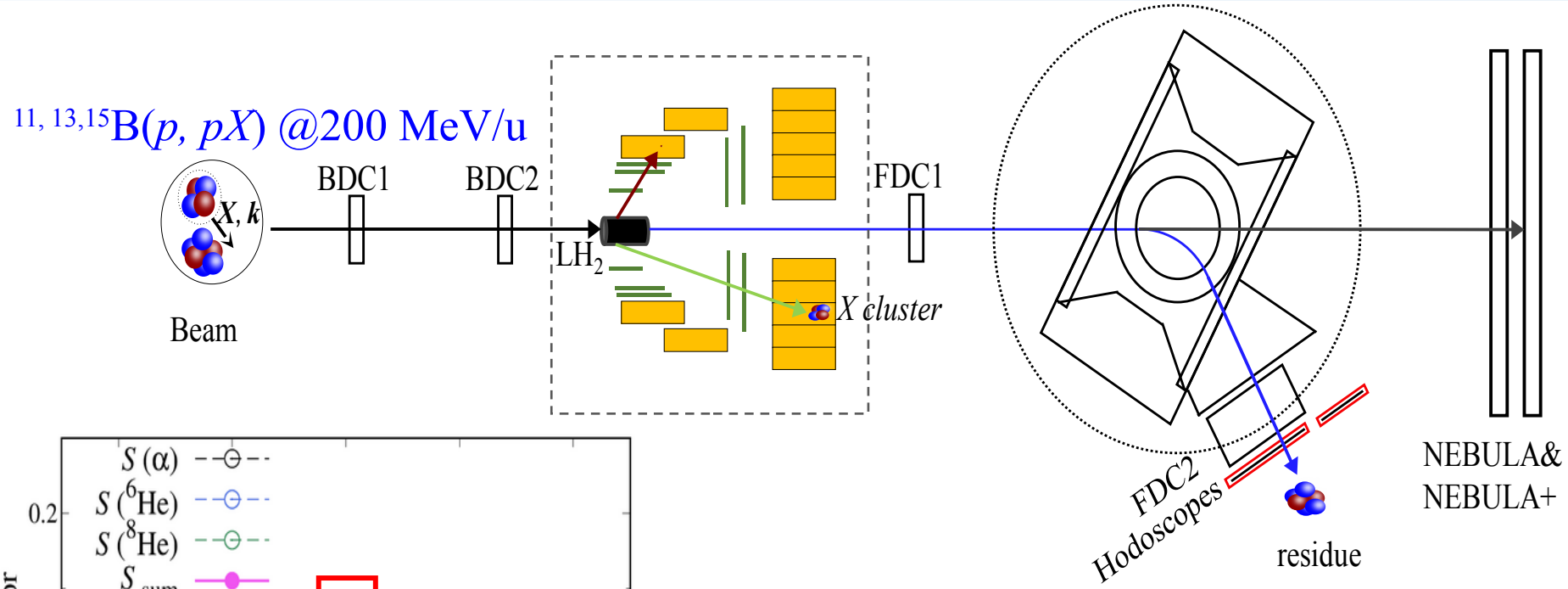
α-clustering evolution towards the dripline

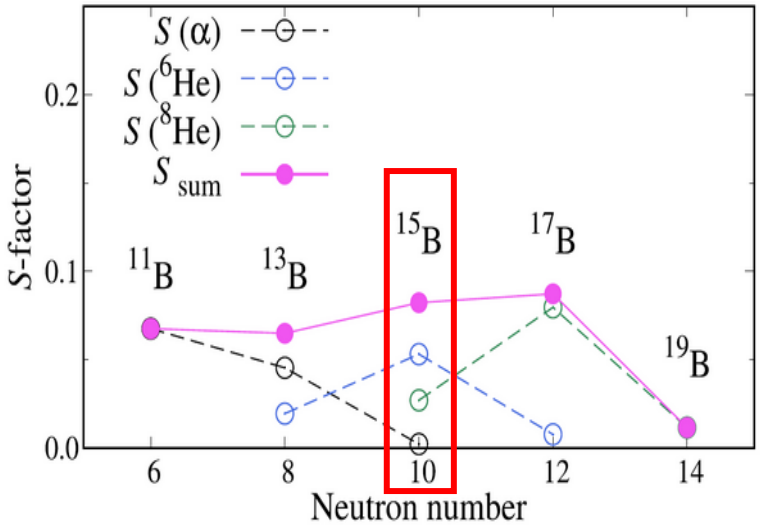
- Amplitude of α cluster w.f. in B < that in Be
- S(α) rapidly decreases from ^{11}B to nearly 0 in ^{15}B

Neutron-rich clustering: triton and ^{6}He

- ^{6}He dominates over other clustering in ^{15}B
- Triton clustering : AMD calc. (M. Kimura)
- Cluster breakup effects (*t*, ^{6}He)

Samurai Proposal - B(*p*, *pX*) @200 MeV/u





Beam Time Request

- 1 day for ^{11}B, 1.5days for ^{13,15}B
- 0.5 days for alpha beam
- **TOTAL : 4.5 days**

Reaction channels	S-factors	σ_{DWIA} (μb)	Production Rate(s^{-1})	Yield Per Day
^{11}B(*p*,*pα*)^{7}Li	0.07	22.60	0.911	78737
^{13}B(*p*,*pα*)^{9}Li	0.05	8.94	0.349	30134
^{15}B(*p*,*pα*)^{11}Li	0.01	0.31	0.012	1018
^{13}B(*p*,*p*^{6}He)^{7}Li	0.02	0.53	0.005	412
^{15}B(*p*,*p*^{6}He)^{9}Li	0.06	2.40	0.027	2325
^{13}B(*p*,*pt*)^{10}Be	1.0	91.53	5.000	431992
^{15}B(*p*,*pt*)^{12}Be	1.0	250.03	14.074	1215960