SHE facility at RIKEN, construction, commissioning and present status[1)]

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for nSHE* Research Group Collaboration

RIKEN NiSHiNA CENTER

● Aim: synthesize a new superheavy element Z=119 via $^{51}V+^{248}Cm$ reaction

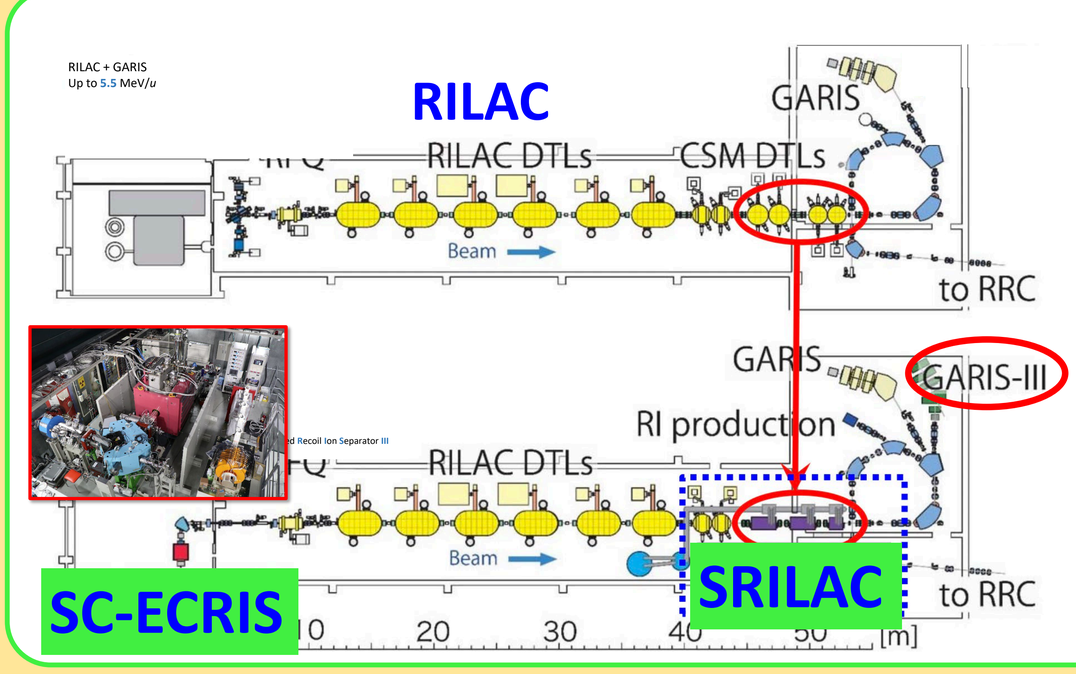
For this purpose, we constructed:

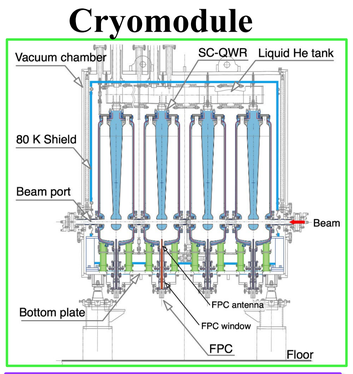
- ➢ Superconducting linear accelerator (SRILAC)
- ➢ New ECR Ion Source (SC-ECRIS)
- ➢ New gas-filled recoil ion separator GARIS-III

To achieve

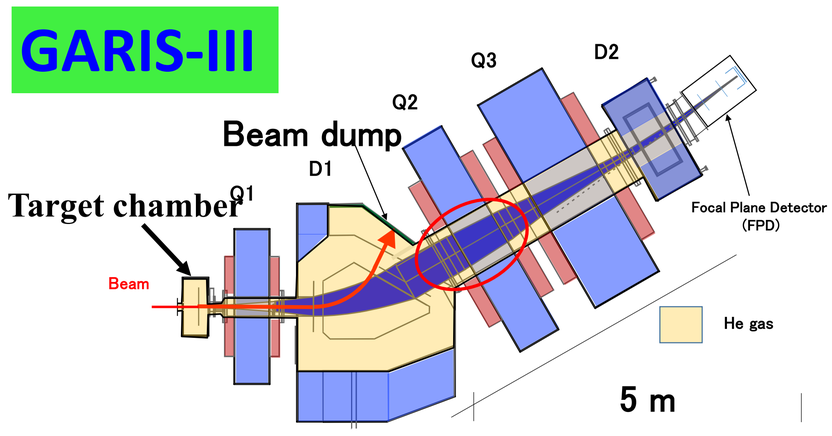
⇒ 5.5 → 6.5 MeV/u to enable hot-fusion reaction
⇒ increase ^{51}V beam intensity > a few pμA
⇒ suitable for hot-fusion reaction residues

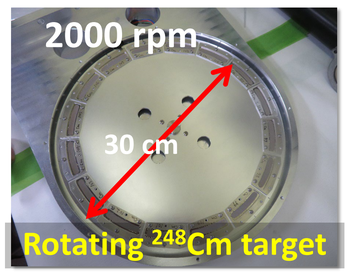
● SRILAC+SC-ECRIS+GARIS-III Commissioned by 2020



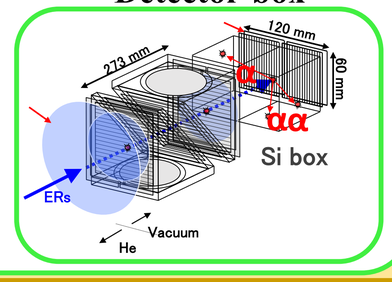


GARIS-III



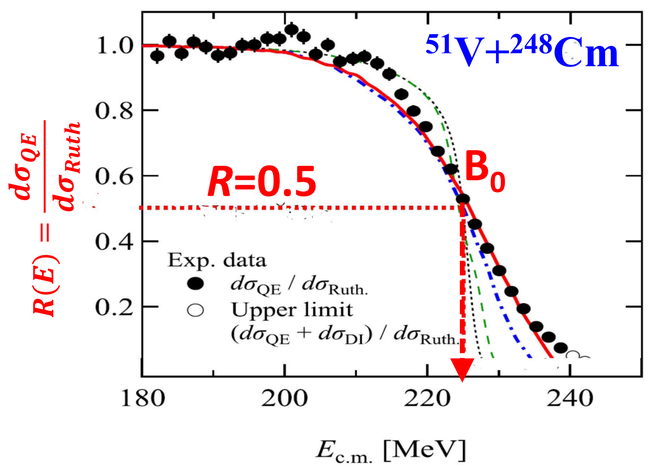


Detector-box



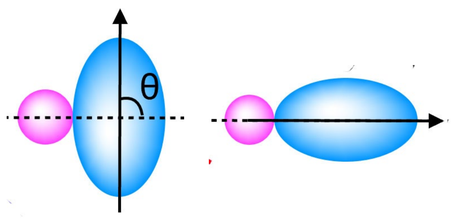
● Optimal ^{51}V beam energy E_{opt}

➢ Quasielastic barrier distribution measurement



M. Tanaka et al., J. Phys. Soc. Jpn. 91, 084201 (2022).

B_0 = 225.6(2) MeV
B_{side} = 233.0(2) MeV

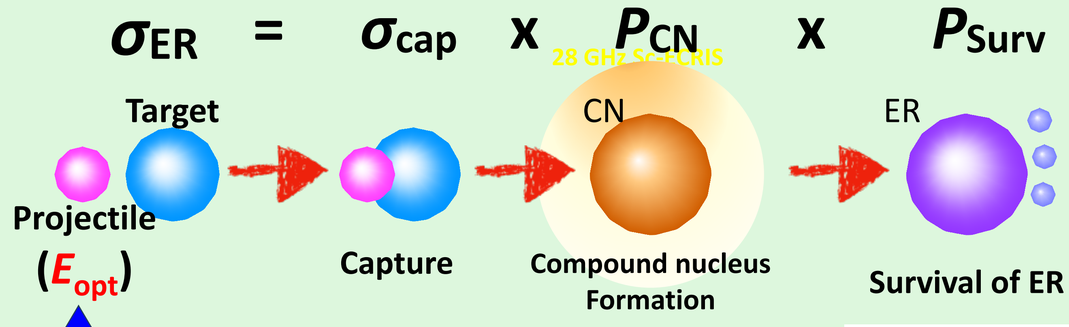


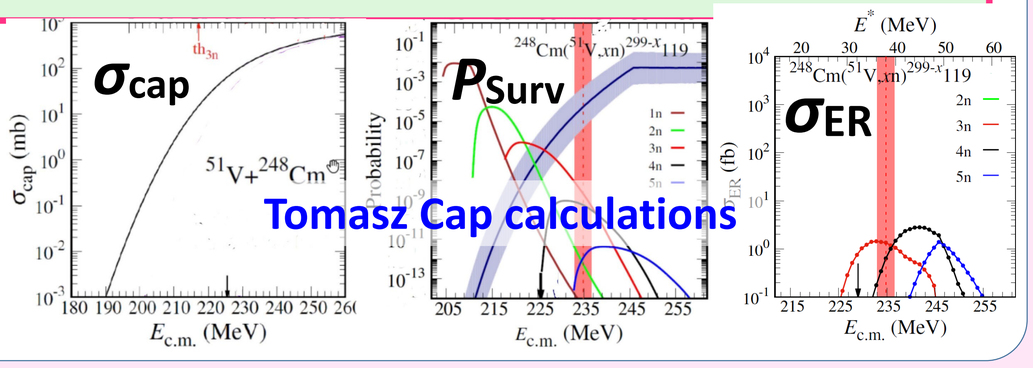
ΔE_{corr} = +3.5 MeV

$E_{opt} = B_{side} + 1/2 \times \Delta E_{corr}$
= 234.8 MeV

Expected cross section: σ(119)= 2~20 fb !!!

$\sigma_{ER} = \sigma_{cap} \times P_{CN} \times P_{Surv}$





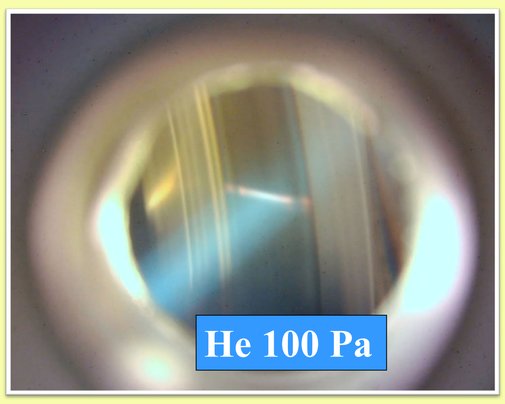
Tomasz Cap calculations

● Present status

- ➢ Measurement is going-on steadily
- ➢ SRILAC provides 3 pμA: no problem

- ➢ Largest difficulty is lifetime of ^{248}Cm target
  - ✓ $^{248}Cm_2O_3$ (~0.5 mg/cm²)+ backing foil(1~3 μm)
  - ✓ Fabricate by molecular plating method
  - ✓ Backing material: C, Be, Ti, Mo,,,
  - ✓ Severe envr. ~10 W /1pμA (ΔE=10 MeV)
  - ✓ ≥ 800 °C, evaporate in a instant.
  - ✓ → rotating wheel (15-30 cmϕ, 2,000 rpm)
  - ✓ Lifetime depends on BI, backing material, etc.
  - ✓ Wanted: backing material (heat/rad) !
  - ✓ Recovery $^{248}Cm_2O_3$ + fabrication ⇒ >6 weeks

Snapshots



Please visit Poster ID:12 of Pierre Brionnet

- Most comprehensive data on fusion reaction
- $^{51}V+^{159}Tb$ reaction
- QE data for B_0
- Excitation func. for xn-, pxn, αxn channels

1) H. Sakai, H. Haba, K. Morimoto, N. Sakamoto, Eur. Phys. J. A 58, 238 (2022).
*nSHE Research Group Collaboration : RIKEN, ORNL, UTK, Kyushu U., IPHC, Niigata U., RCNP, Saitama U., Tohoku U., JAEA, Yamagata U., IMP, ANU, U. Warsaw