Measurement of reaction cross section for ^{22}C

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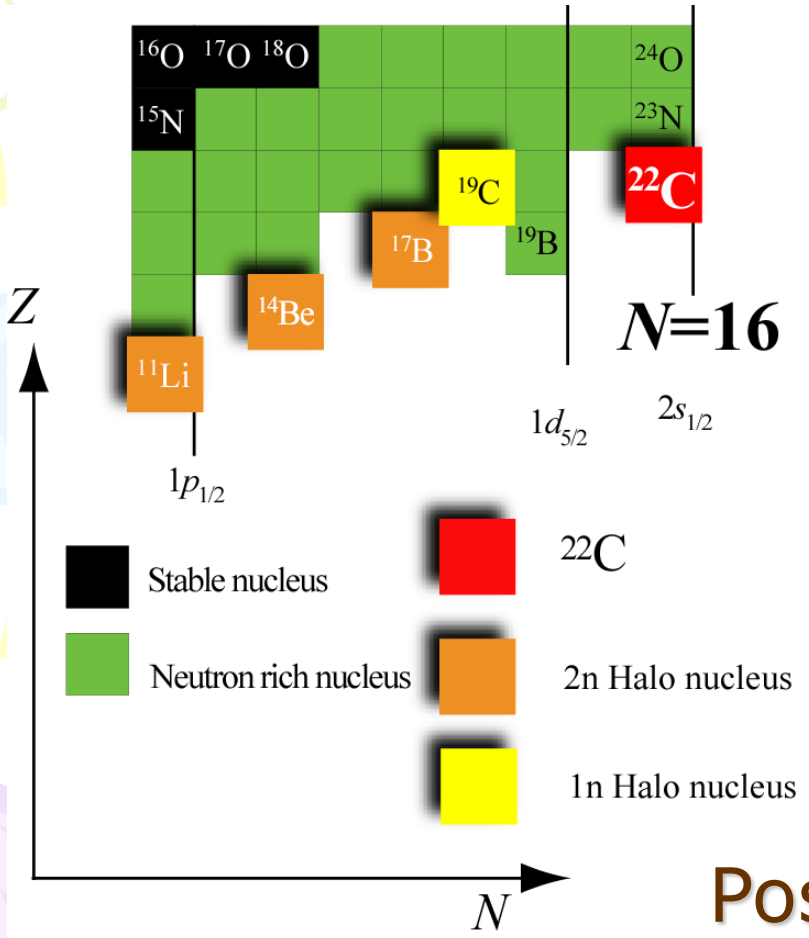
Motivation for ^{22}C



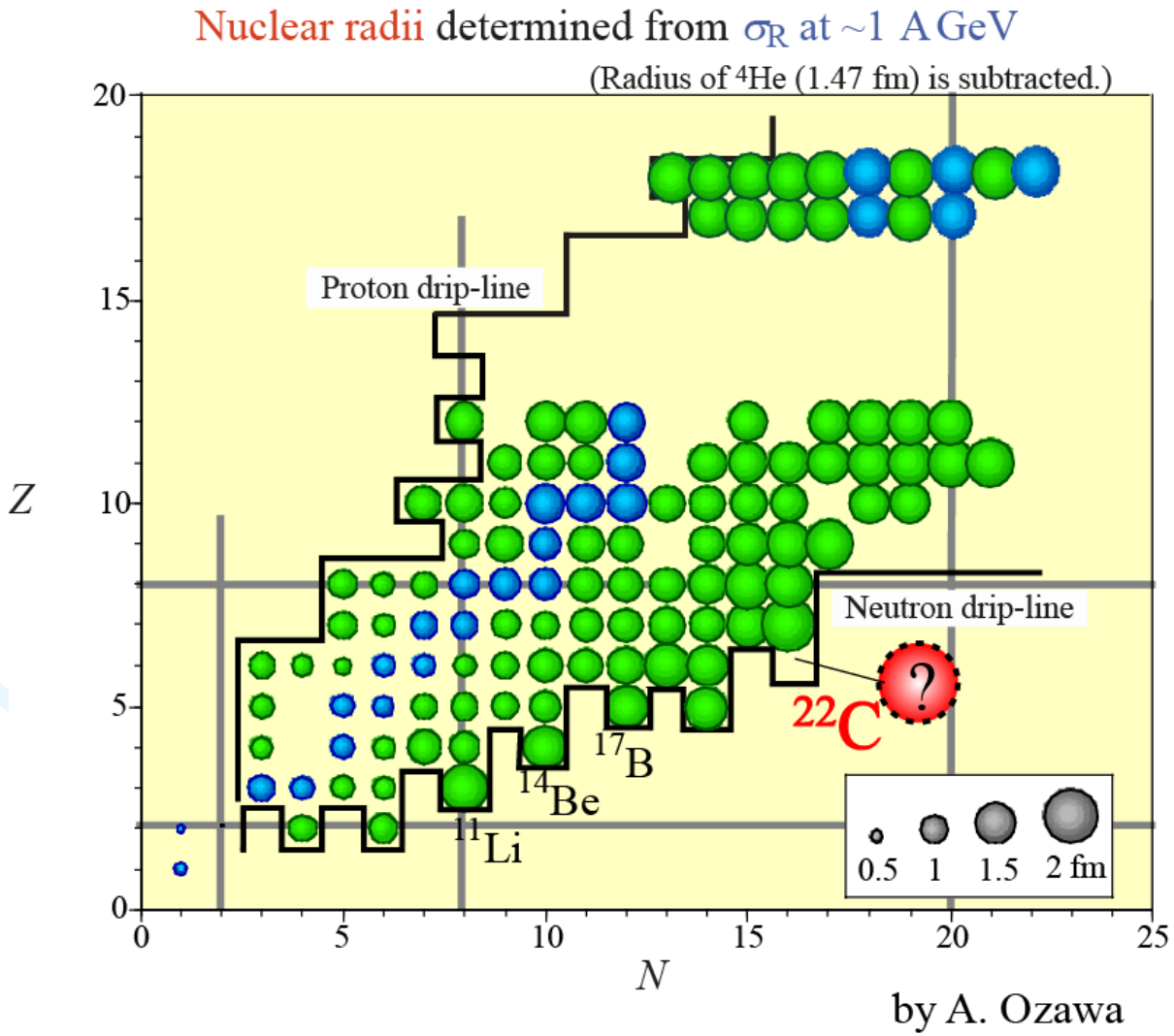
- Drip-line nucleus of C isotopes
- N=16 →s orbital domain?
  ^{14}Be: s 0.47±0.25
  (T.Suzuki et al. N.phys.A 658 (1999) 313)
  ^{17}B: s 0.5±0.1
  (Y.Yamaguchi et al. PRC 70 (2004) 054320)
- S_{2n}=0.4±0.9MeV (mass formula)
  ^{14}Be: S_{2n}=1.27 MeV
  ^{17}B: S_{2n}=1.39 MeV
  (G.Audi et al. N.phys.A 729 (2003) 337)

Possible existence of halo

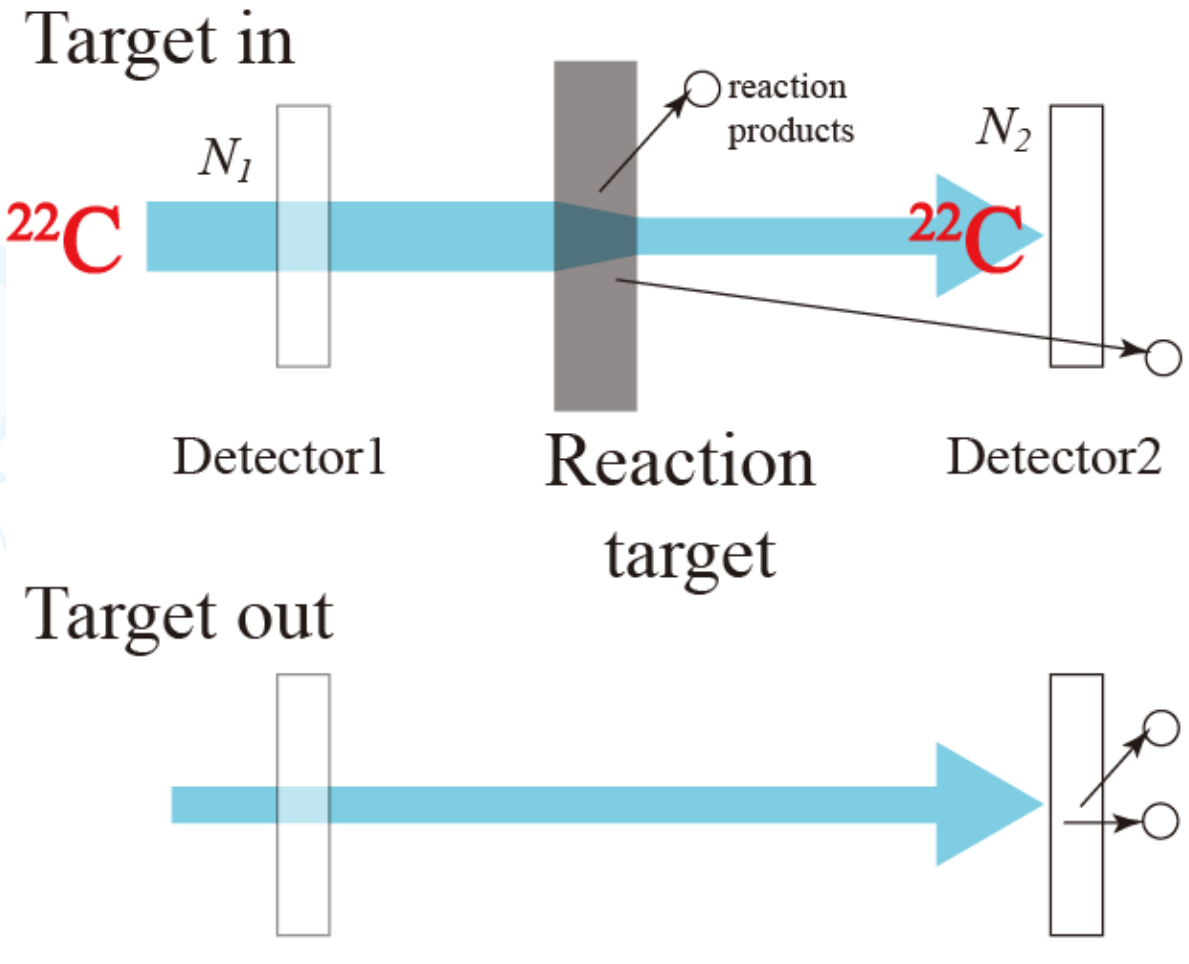
↓

Reaction cross section measurement

Measurements



Transmission method

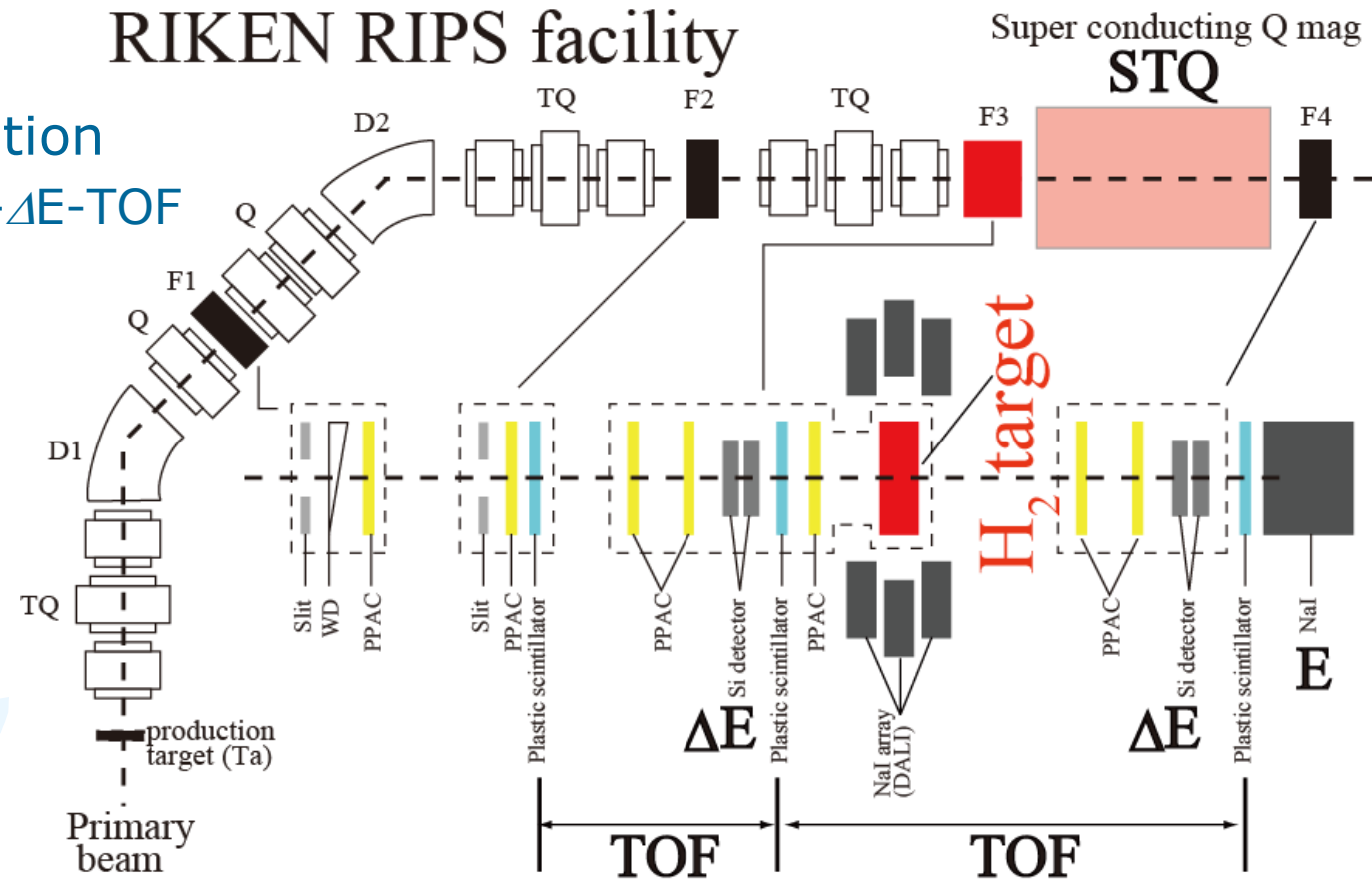


$$\sigma_R = -\frac{1}{t}\ln\left(\frac{N_1}{N_2}\right)$$

Setup

- Primary beam ^{40}Ar 63A MeV ~100pnA
- Production target Ta 333mg/cm^2
- ^{22}C intensity 0.003cps

- Particle identification
  - Before target: Bρ-⊿E-TOF
  - After : E-⊿E-TOF



Act for low intensity
(22C intensity: 0.003cps)

- Reaction-rate improvement
  - Liq.H2 target Reaction. rate is 3 times as much as C target (with the same energy loss)

- Acceptance improvement
  - TOF spectrometer 2 times Bore radius compared with previous one.
  - Liq. H2 target → reducing multiple scattering
  - 130mmφSSD, 5inchφNaI, large detectors

- Exp. Efficiency ~10 times

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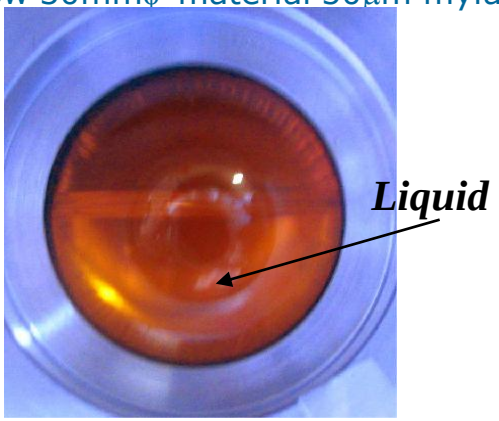
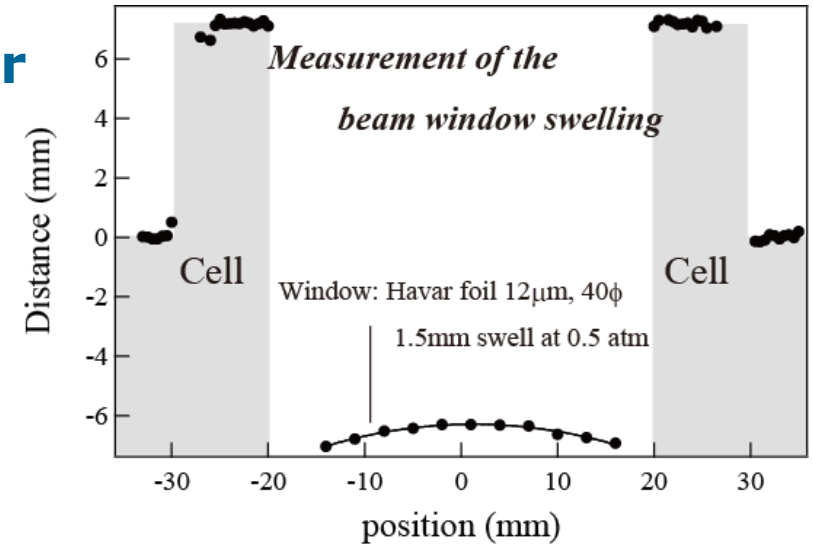
Window 30mmϕ material 50μm mylar case



N. Aoi et al. RIKEN Accel. Prog. Rep 38, (2005) 176

Liquid H_2 target

- Merit
  - **High reaction rate**
  - **Sensitive to neutron matter**

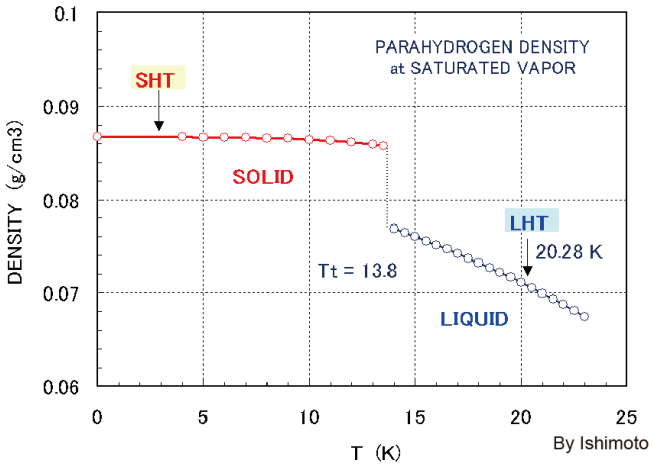


Reaction rate: ~3 times as much as ^{12}C target with the same E loss

Spec: Size 40mmϕ, 200mg/cm^2 (~2.7cm)

Beam window foil: havar foil 12um (small swelling)

T dependence of H2 density



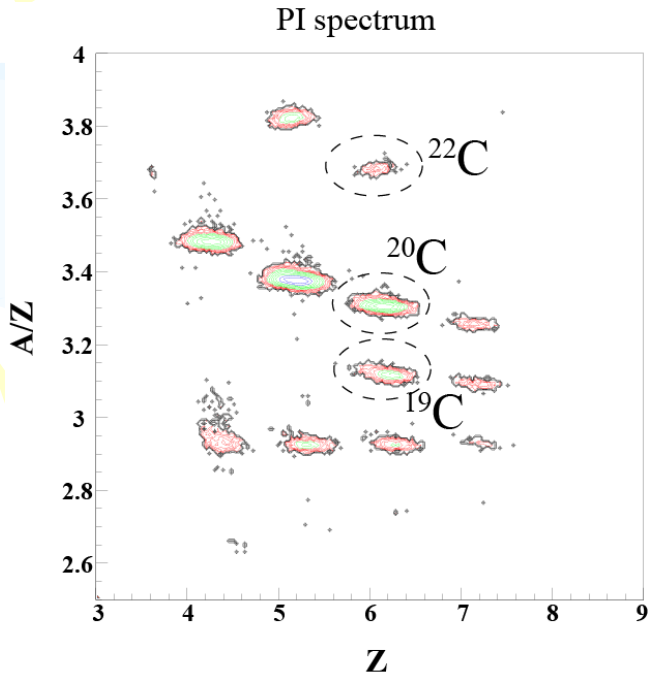
Goal: 1% thickness accuracy of Liq.H2

Thickness: 0.3mm accuracy
by Laser distance meter

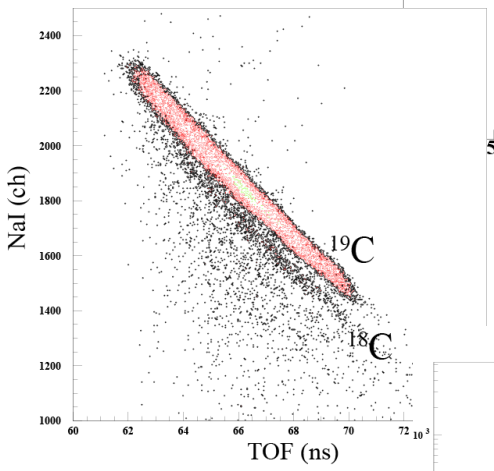
Temperature: 0.6K
by Heater controller

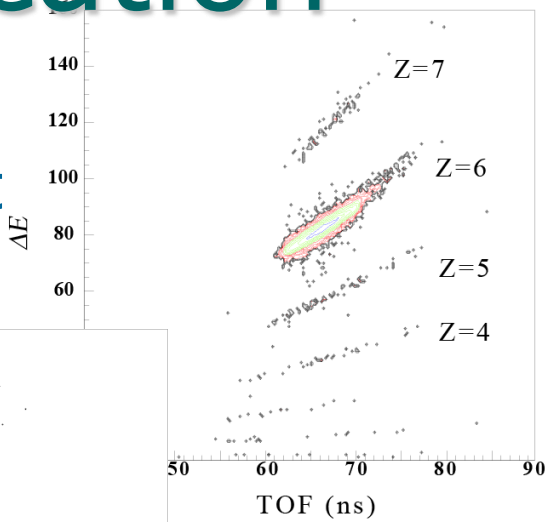
Particle identification

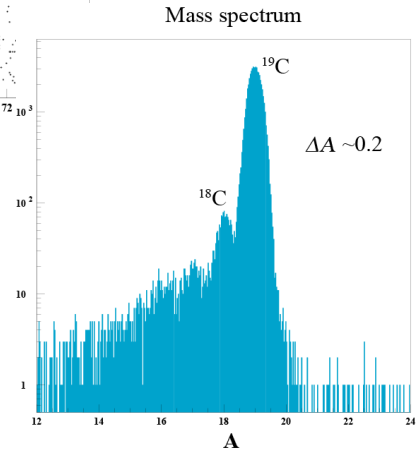
Before target



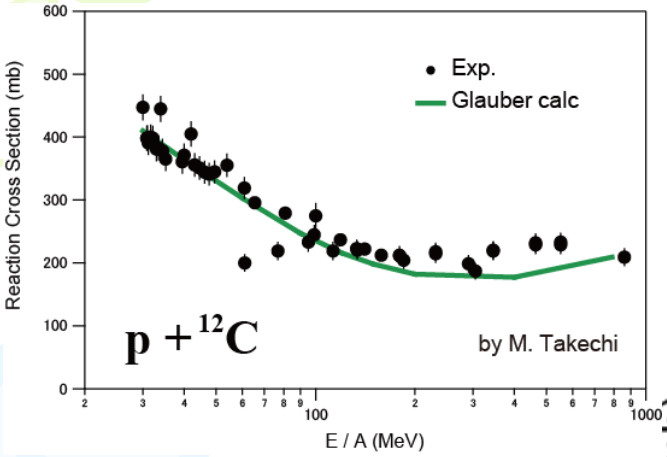
After target

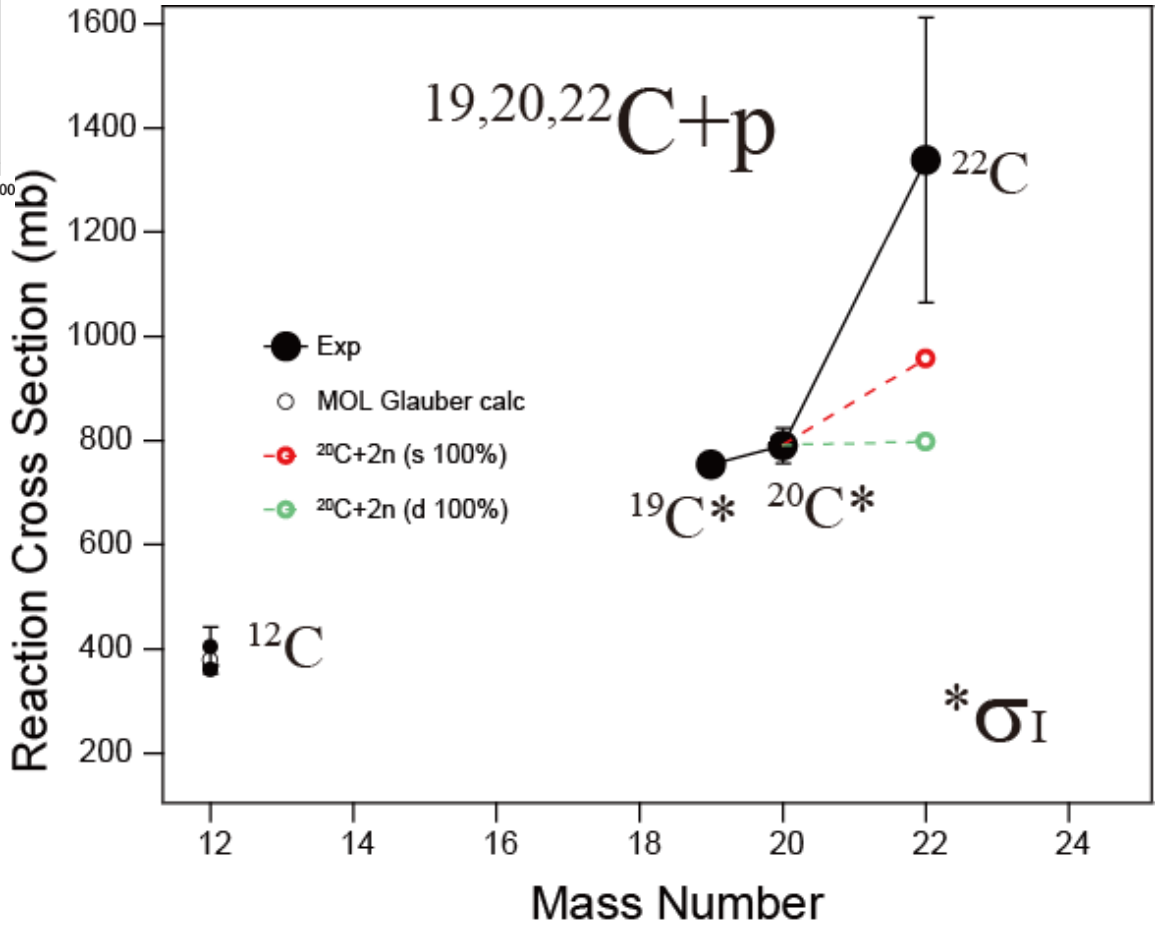






Result


Reaction Cross Section (mb)
E / A (MeV)
Exp.
Glauber calc
p + 12C
by M. Takechi


19,20,22C+p
22C
Exp
MOL Glauber calc
20C+2n (s 100%)
20C+2n (d 100%)
19C*
20C*
12C
*σI
Reaction Cross Section (mb)
Mass Number

In RIBF

- Old facility ^{40}Ar 100pnA, ^{22}C 0.003cps
- Primary beam ^{40}Ar → ^{48}Ca (×10)
- Beam current 200pnA (×2)
- Thick production target (×10)
- Liq.H2 reaction target thickness (×4~5)
- 1000 times statistics

Summary

- we measured ^{19,20,22}C + p at ~40A MeV.
- We applied Liq.H_2 target and TOF spectrometer against the low intensity beam.
- ^{22}C is suggested to have a larger radius than that of ^{19,20}C
- Statistics should be improved in future experiment at RIBF facility.