中性子ハロー核^{6}Heのクーロンおよび核力分解反応

Coulomb&Nuclear breakup of Halo nuclei ^{6}He

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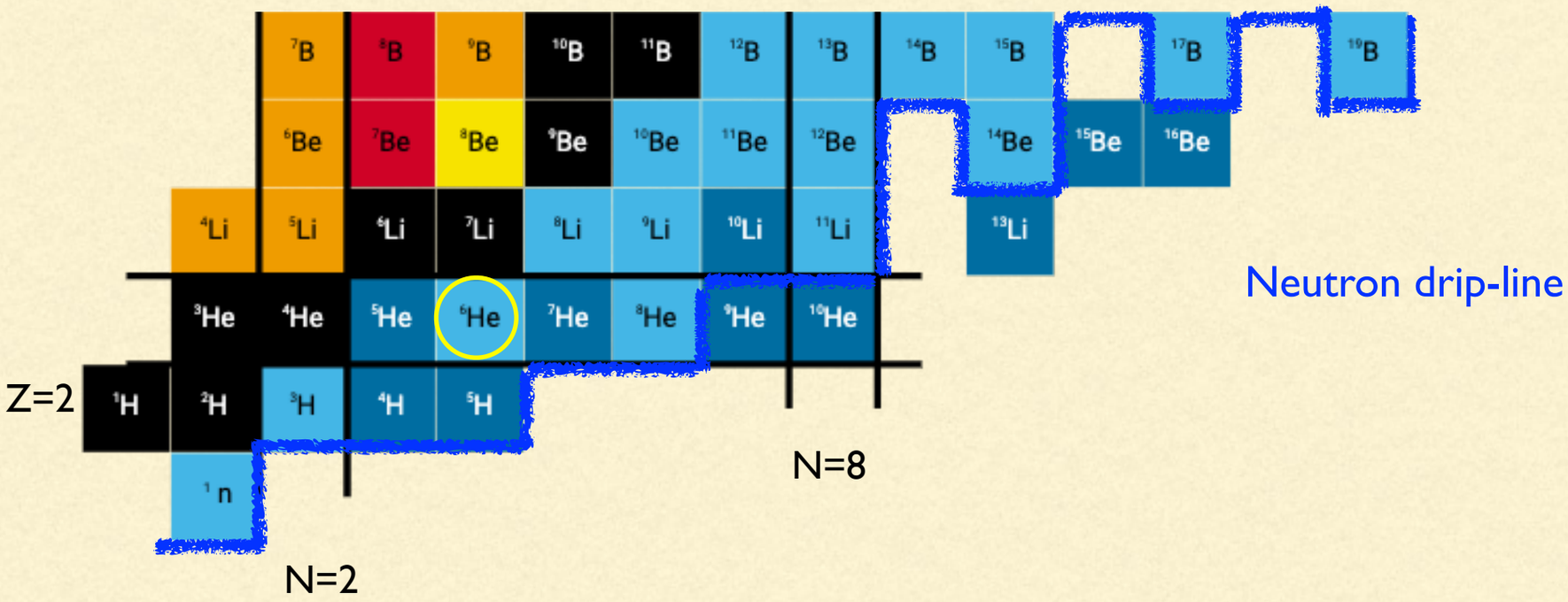
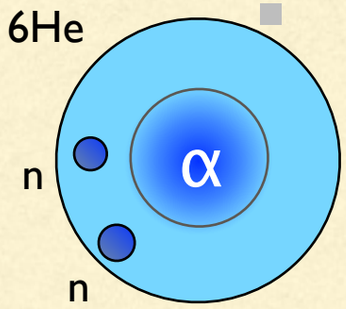
Neutron-rich ^{6}He



1. Investigation of Halo nature

- Unique structure
- Neutron-neutron correlation
- Cluster model calculation



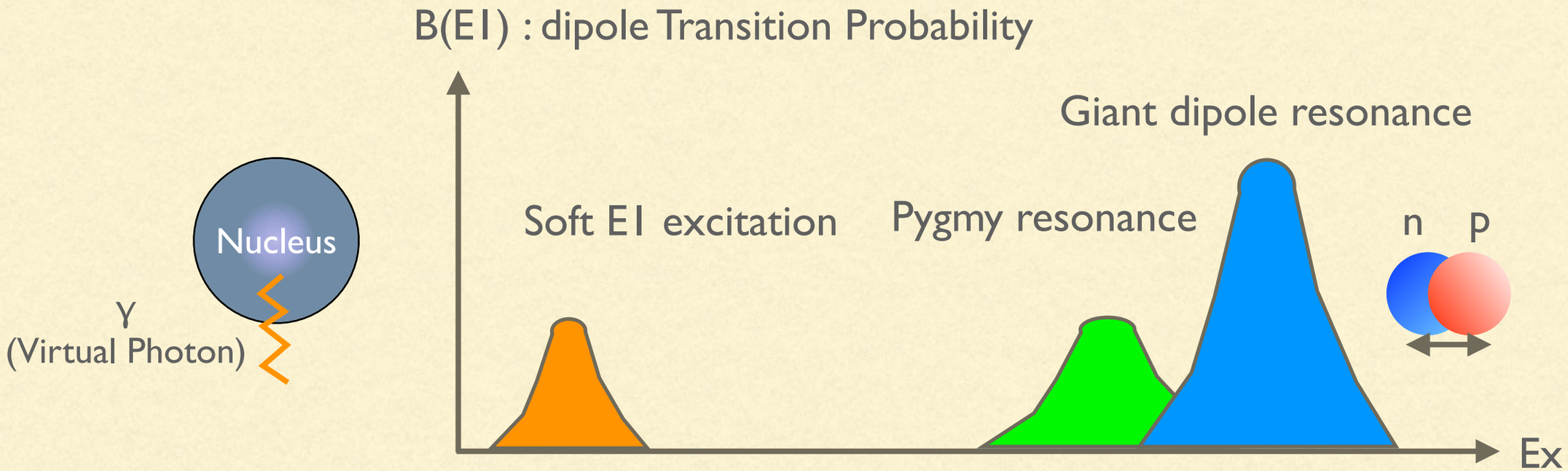
2n Halo

2. Establishment of ab-initio calculation

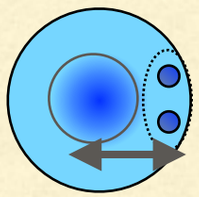
- Model independent
- Nucleon-nucleon Interaction

  →excited energy, E1 response
- Few-body system
  - ^{6}He → Good test case

Dipole responses of nuclei

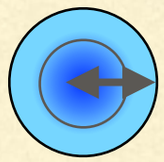


Soft E1 excitation



Core and valence
→characteristic to halo

Pygmy resonance



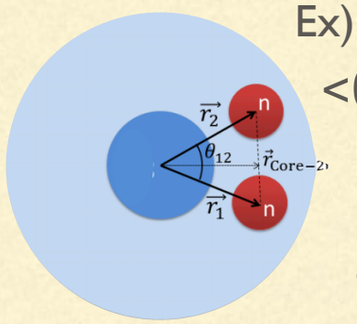
Core and neutron skin
→characteristic to skin nuclei

H. Esbensen et al., NPA 542(1992)310

Equivalent Photon Method

$$\frac{d\sigma_{CB}}{dE_x} = \frac{16\pi^3}{9\hbar c} N_{E1}(E_x) \frac{dB(E1)}{dE_x}$$

$$\begin{aligned} B(E1) &= \int_{-\infty}^{+\infty} \frac{dB(E1)}{dE_x} dE_x \\ &= \frac{3}{4\pi}\left(\frac{Ze}{A}\right)^2 \left\langle \vec{r_1}^2 + \vec{r_2}^2 + 2\vec{r_1}\cdot\vec{r_2} \right\rangle \\ &= \frac{3}{\pi}\left(\frac{Ze}{A}\right)^2 \langle r_{2n-Core}\rangle^2 \end{aligned}$$



Ex) ^{11}Li

$\langle\theta_{12}\rangle = 48\ ^{+14}_{-18}$ deg

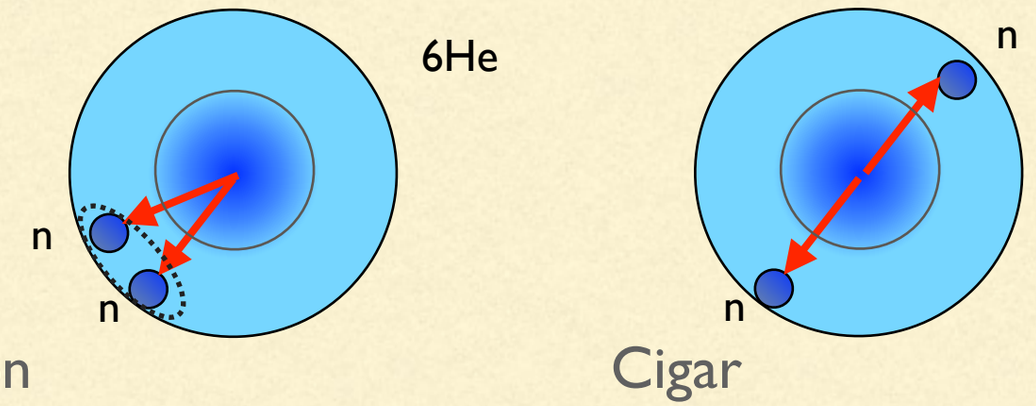
< 90 deg(non-correlation)

T. Nakamura et al., PRL96(2006)252502

Dineutron correlation in ^{6}He

- Spatial correlation of 2 valence neutrons
  - Dineutron or cigar ?

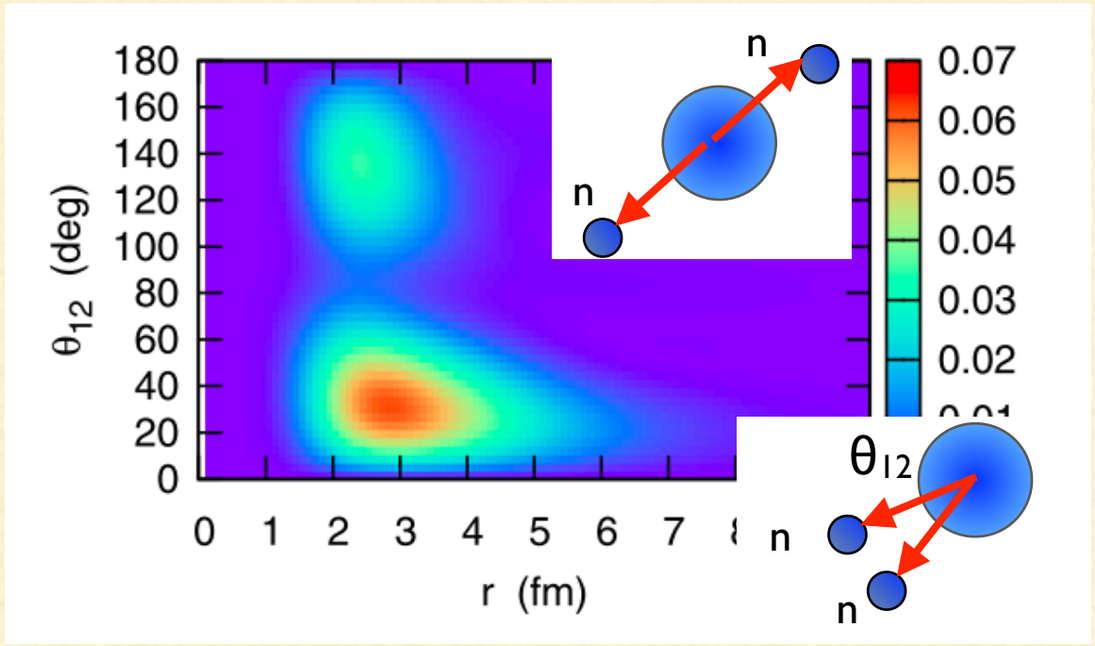
    → not observed directly



Dineutron　　Cigar

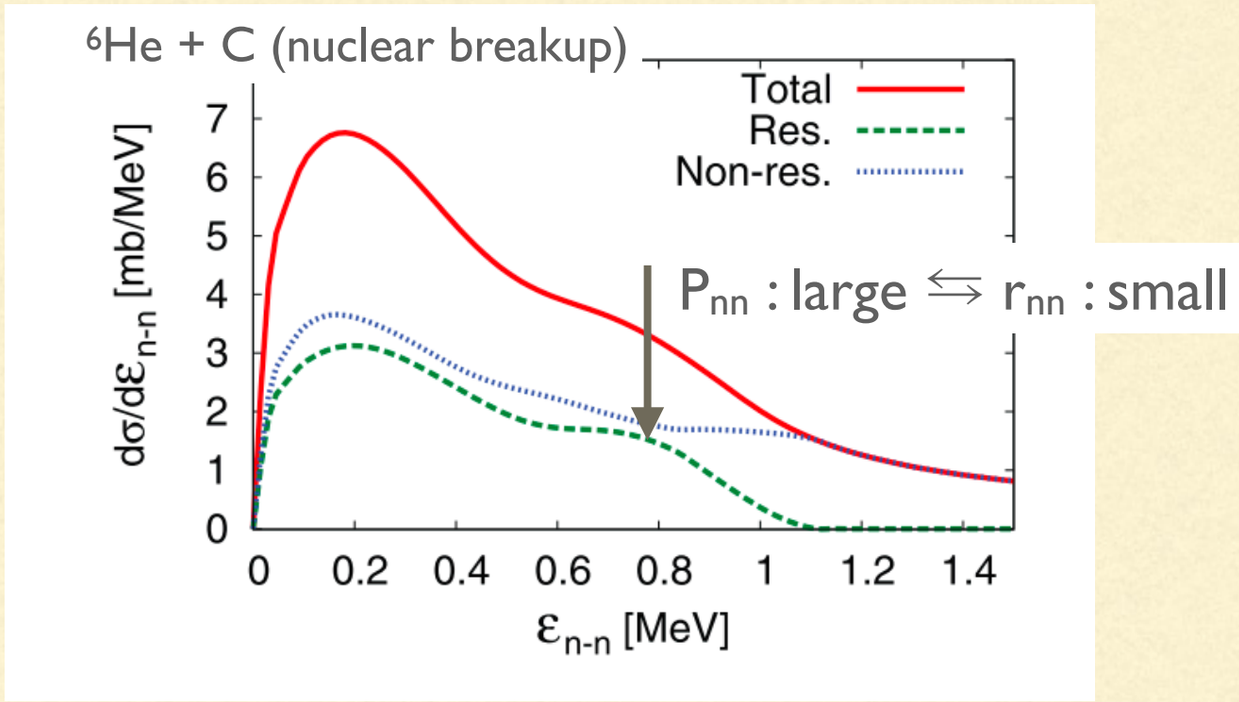
- Three body model calculation

  K. Hagino, H. Sagawa et al., Few-body. Syst. (2016) 57:185



- CDCC calc.　Y. Kikuchi et al., PRC 88, 021602R (2013)

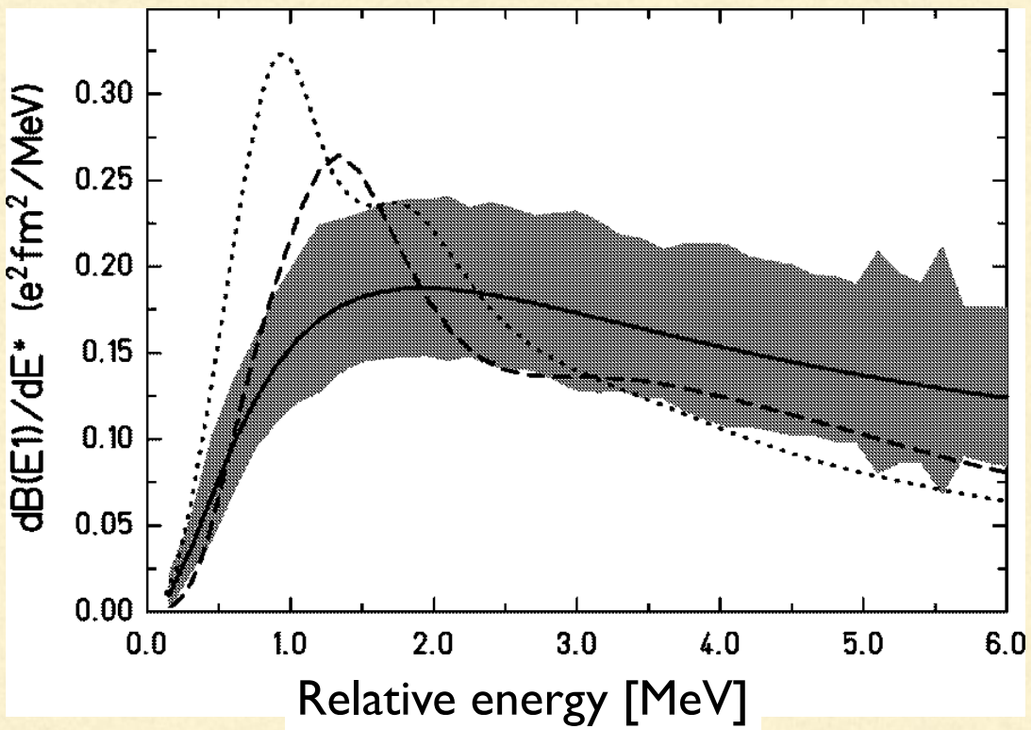
  → 2+ state : dineutron correlation?



Previous measurement of ^{6}He

- ^{6}He

T. Aumann et al., PRC 59 (1999)

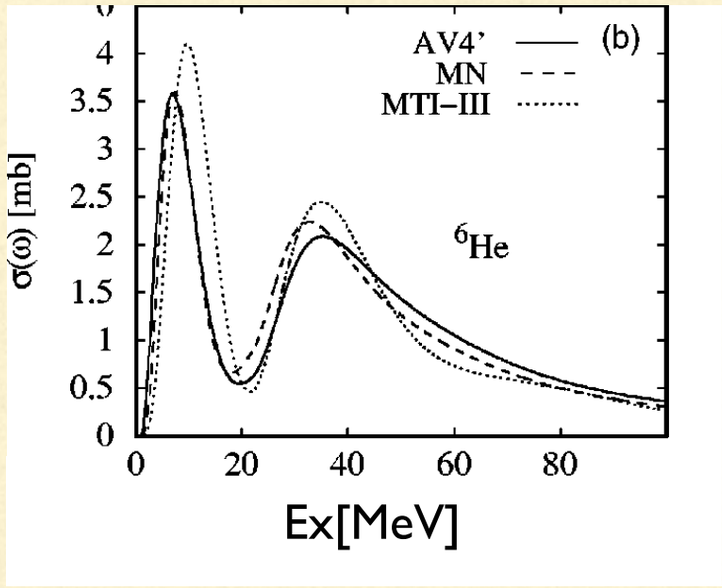


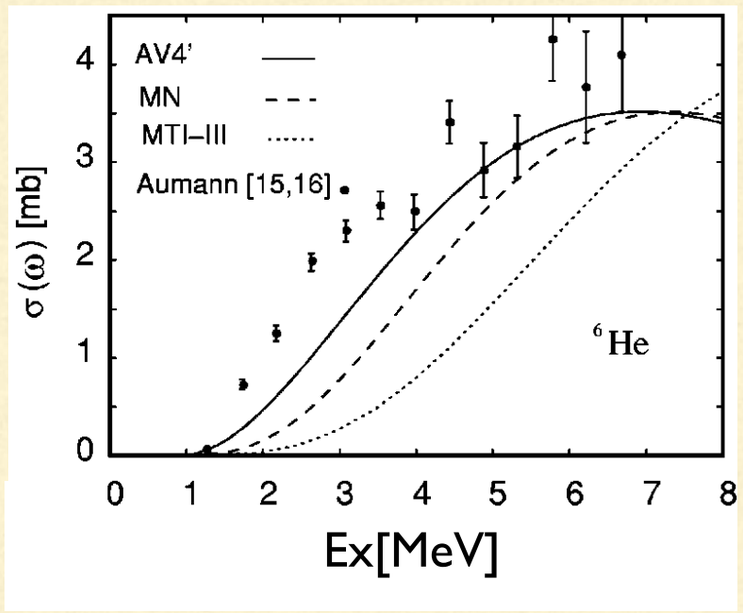
- Large experimental uncertainty
- Only low energy region

→ fail to compare to the theoretical model

ab-inito calc

S. Bacca et al., PRC 69 (2004)





High precision & wide energy range data

Experimental Setup

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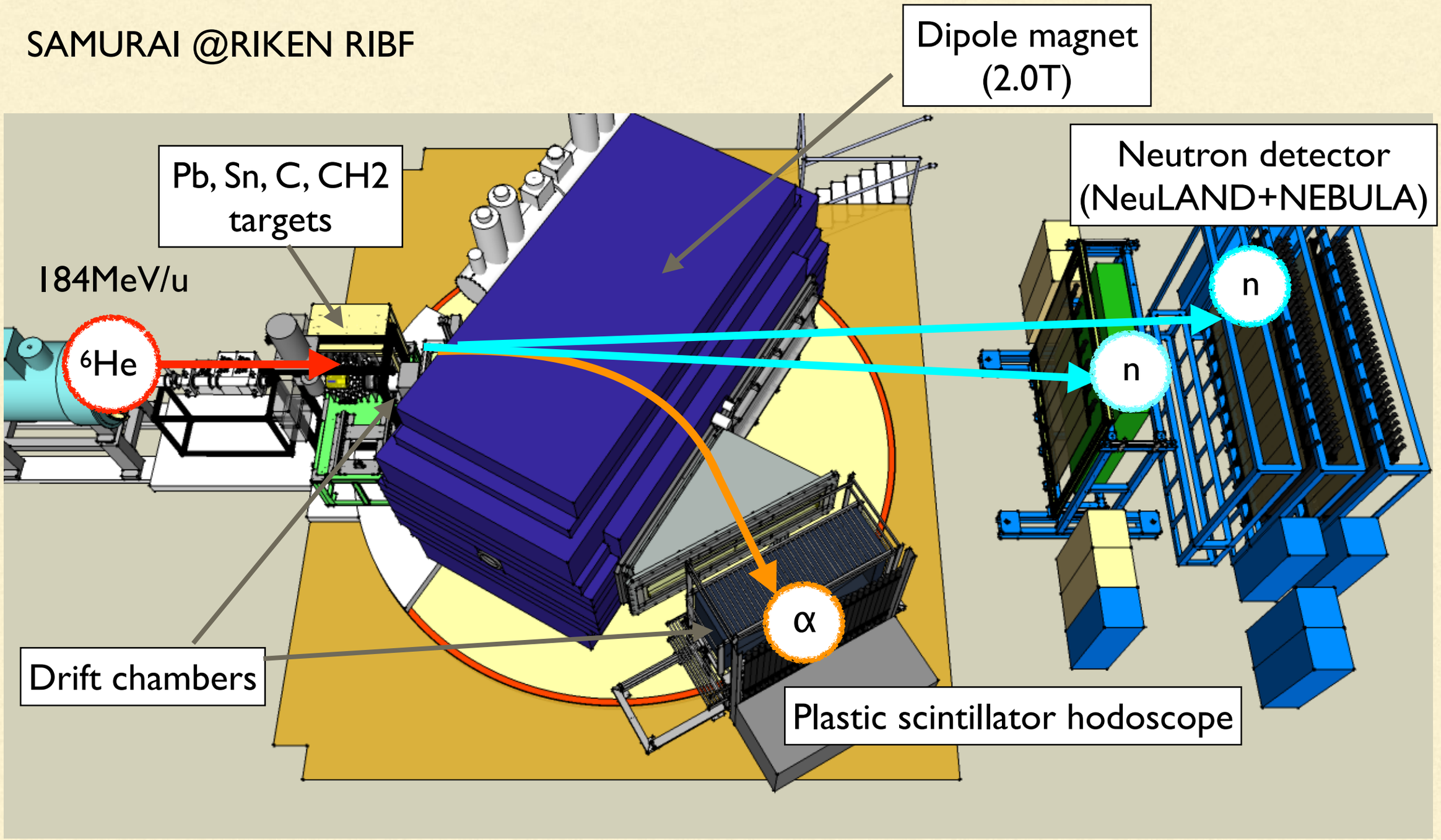
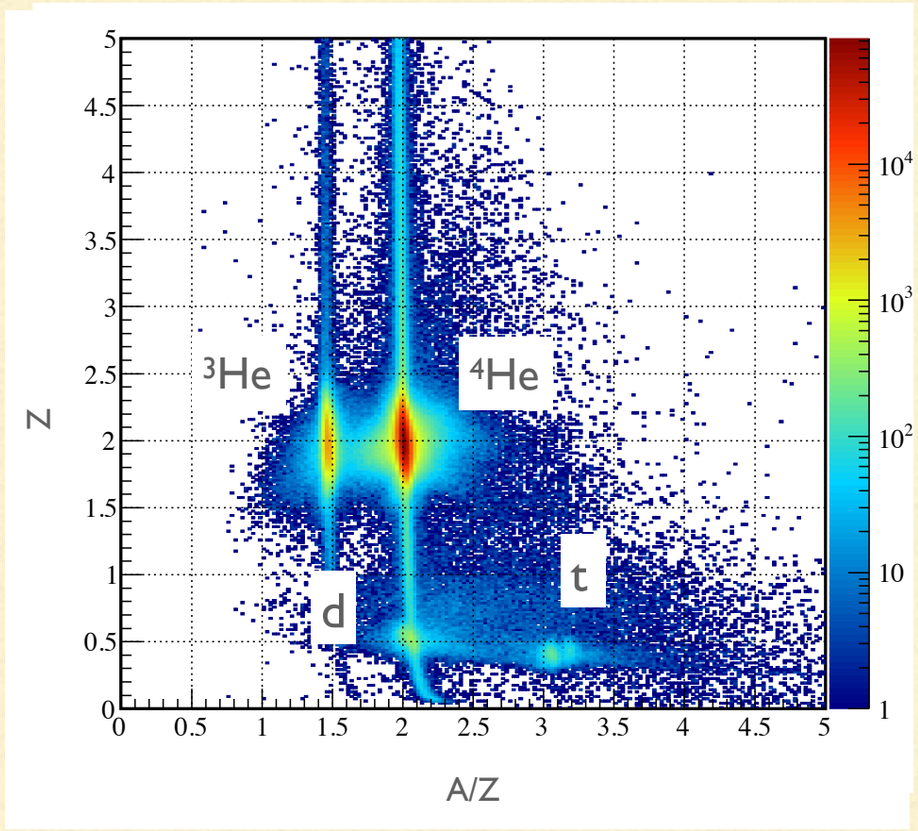


Inclusive cross section

T. Aumann et al., PRC59(1999)3

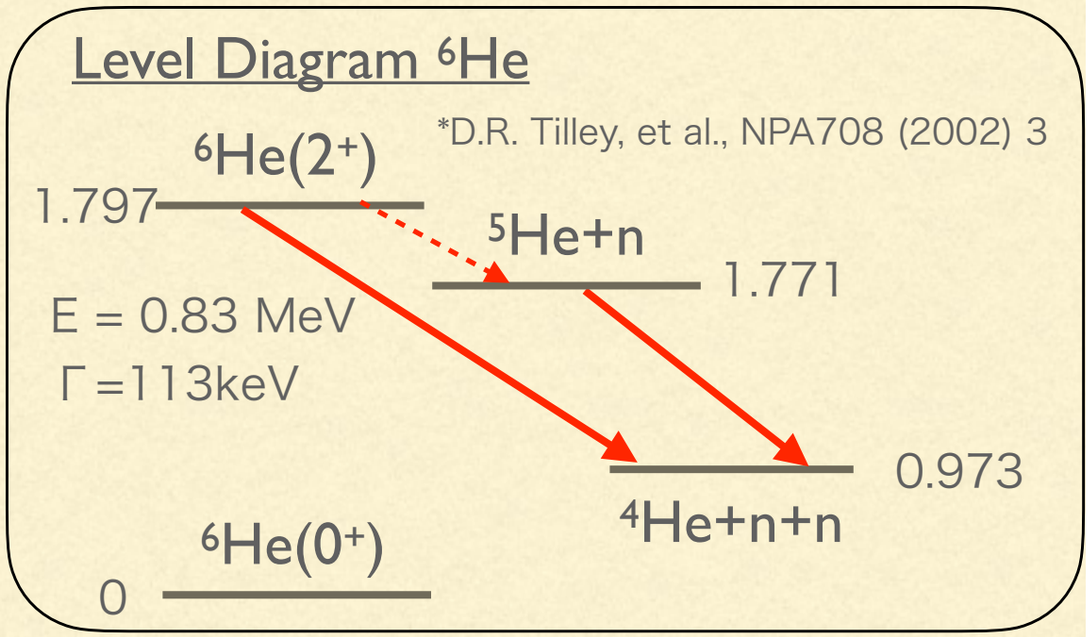
Particle ID (C target, ^{6}He beam gated)

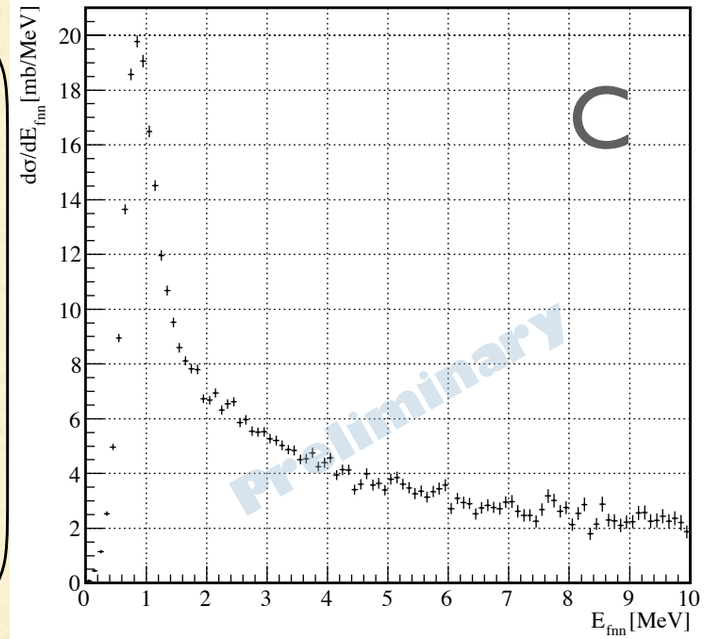


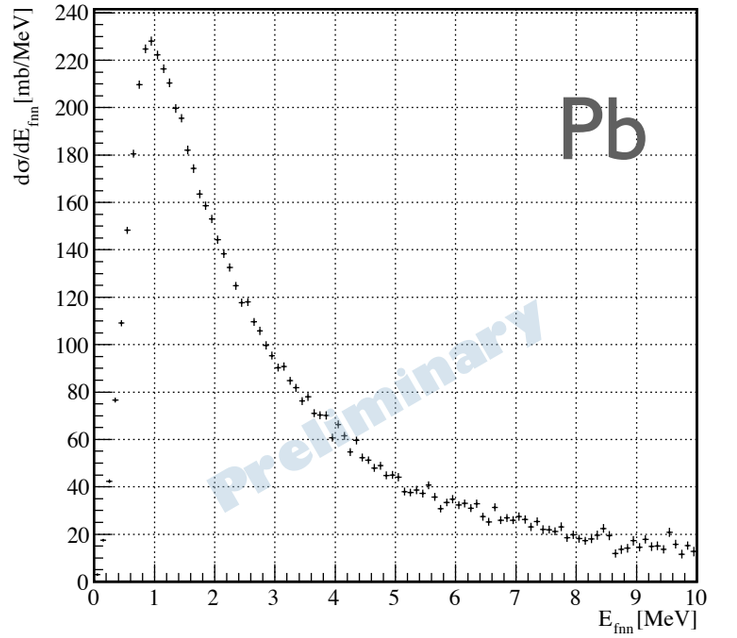
	σ(^{6}He->^{4}He) [mb] @184MeV/u	Previous Work[1] @240MeV
Pb	1101(47)	1150(90)
Sn	709(47)	
C	224(5)	190(18)
p	67(10)	

- Systematic error：FDC detection efficiency fluctuation
- σ(Pb)/σ(C) = 5.0(2)
  → Coulomb component dominant
- σ(Sn)/σ(C) = 3.2(2)
  →Coulomb/nuclear component

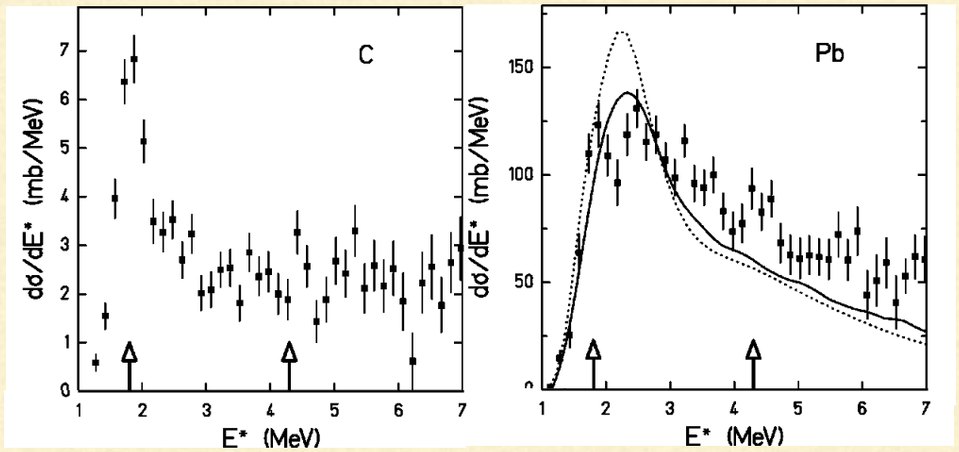
Relative Energy of ^{4}He+2n

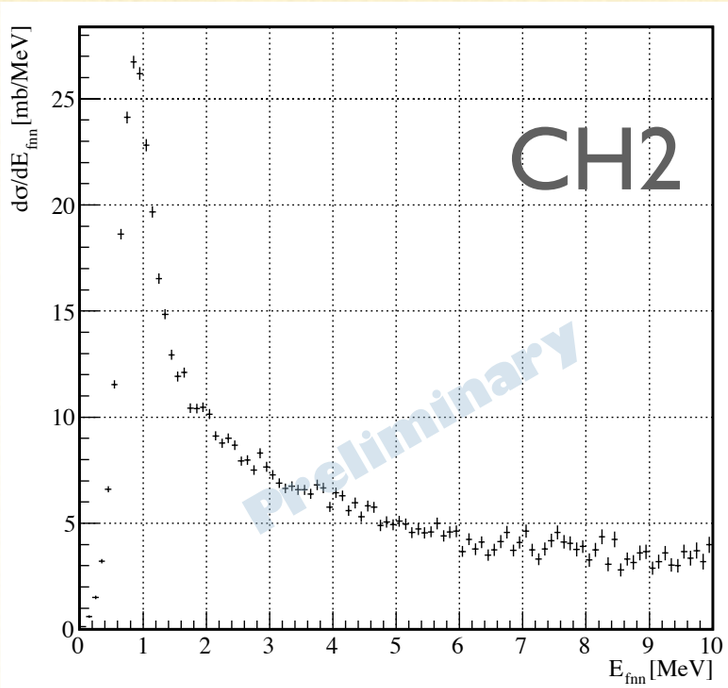


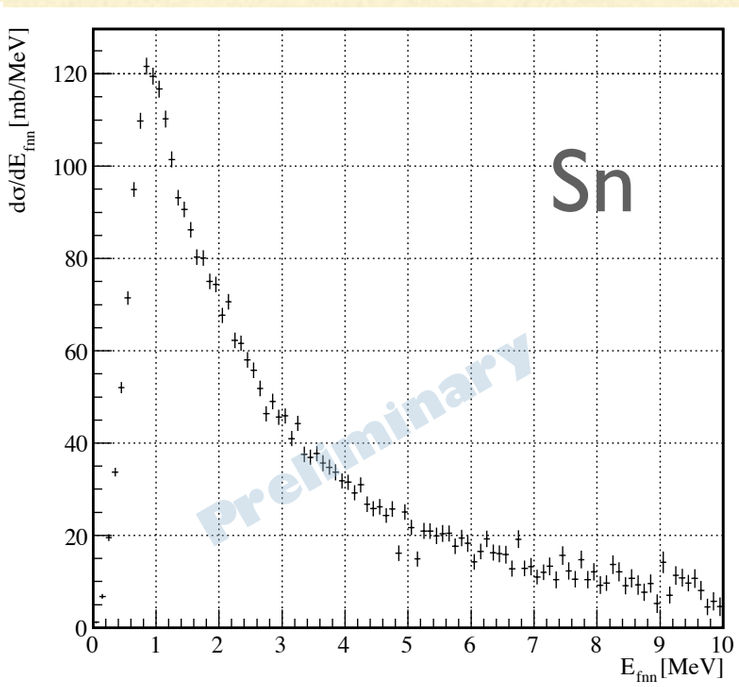




T. Aumann et al., PRC59(1999)3







- CH2：2^+ sharp peak→Nuclear breakup
- Sn：Competing Colomb/Nuclear component

Summary

- Coulomb&Nuclear breakup of Two-Neutron Halo nucleus 6He
  - Clarification for Halo nature, n-n correlation
  - Establishment of ab-initio calc.
- Inclusive cross section σ(^{6}He →^{4}He)
- Relative Energy spectra ^{6}He
- Decay mode of ^{6}He(2^{+}) state

<u>Outlook</u>

- Extraction of B(E1) strength
- Exploring the decay mode & nn-correlation in ^{6}He
- Comparison to model/theoretical calculation
  - Nuclear force
  - Possible existence of di-neutron

Collaborators

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