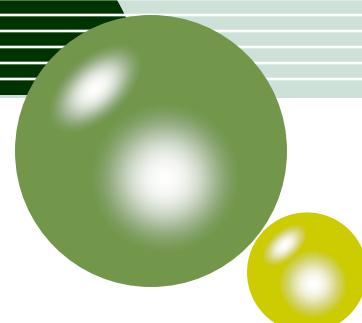




# **Study of High-Spin States in $^{49-51}\text{Ti}$**

**Center for Nuclear Study, University of Tokyo**

**Megumi Niikura**



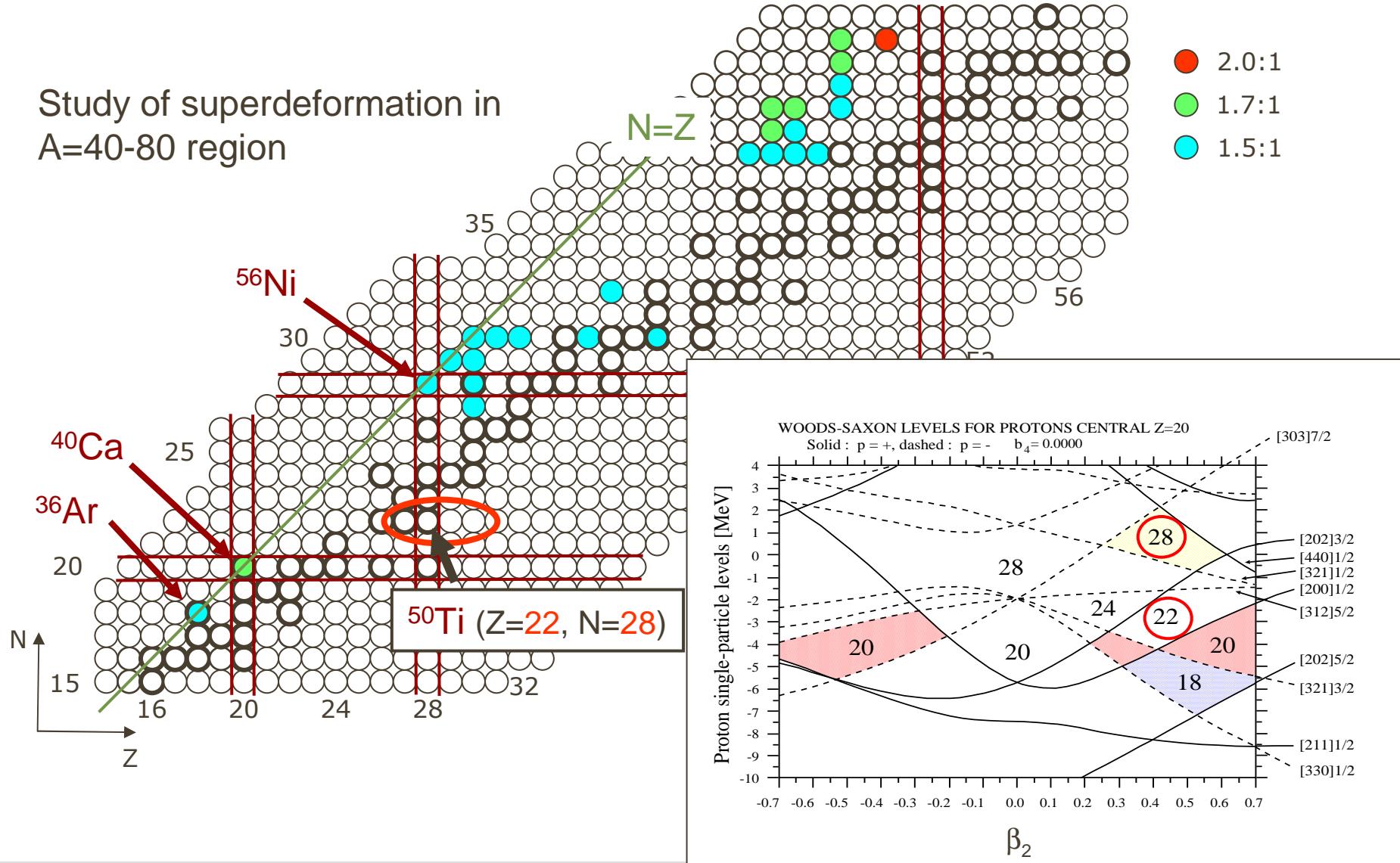
24th Jan. 2008

The 2nd LACM-EFES-JUSTIPEN Workshop

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# High-spin Study in Neutron-rich Nuclei

Study of superdeformation in  
A=40-80 region



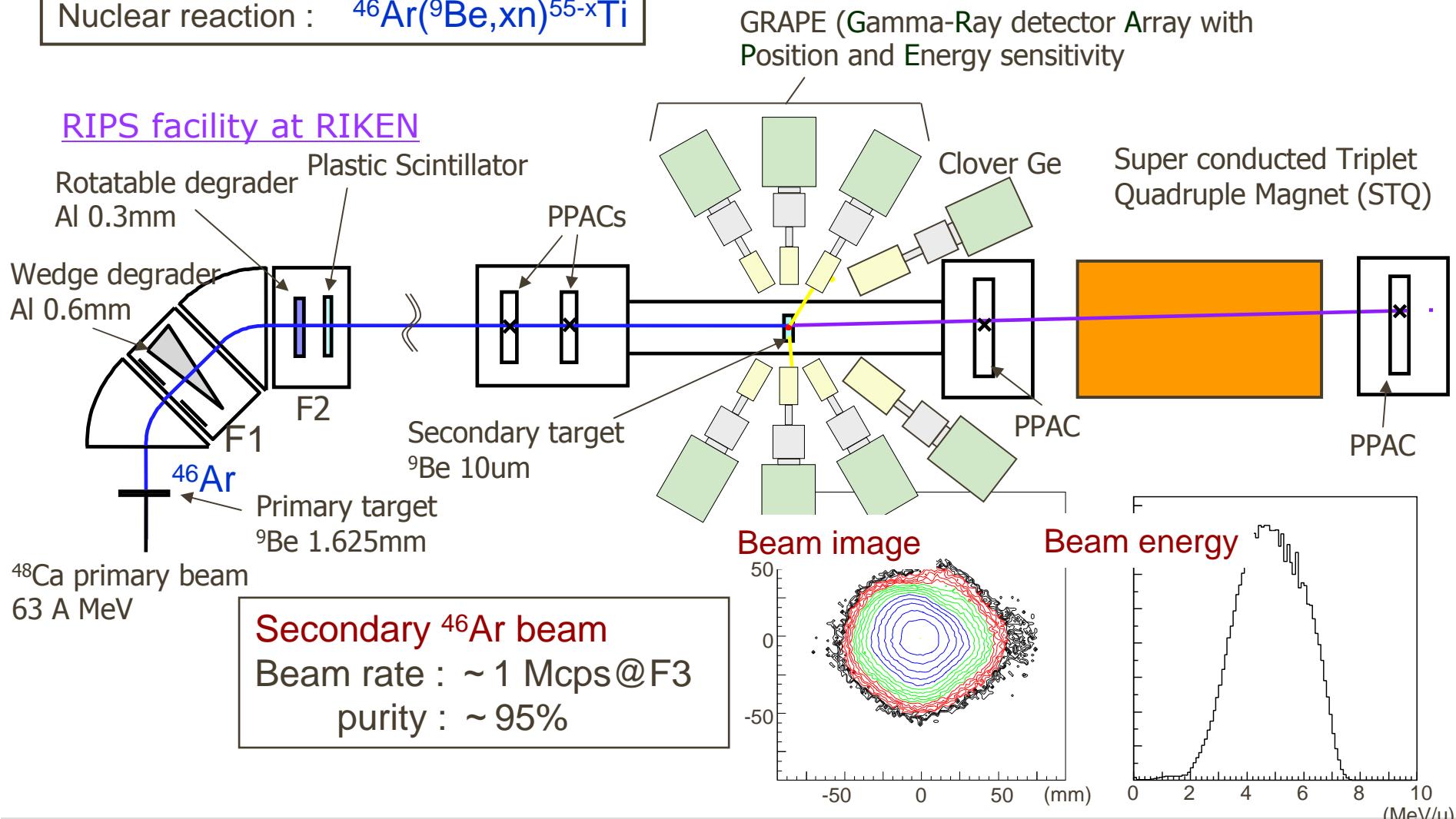
- **High-spin study by fusion-evaporation reaction.**
- **Stable isotope beam and target combination**
  - Proton-rich side
- **Using neutron-rich secondary beam**
  - High-spin study in neutron-rich nuclei

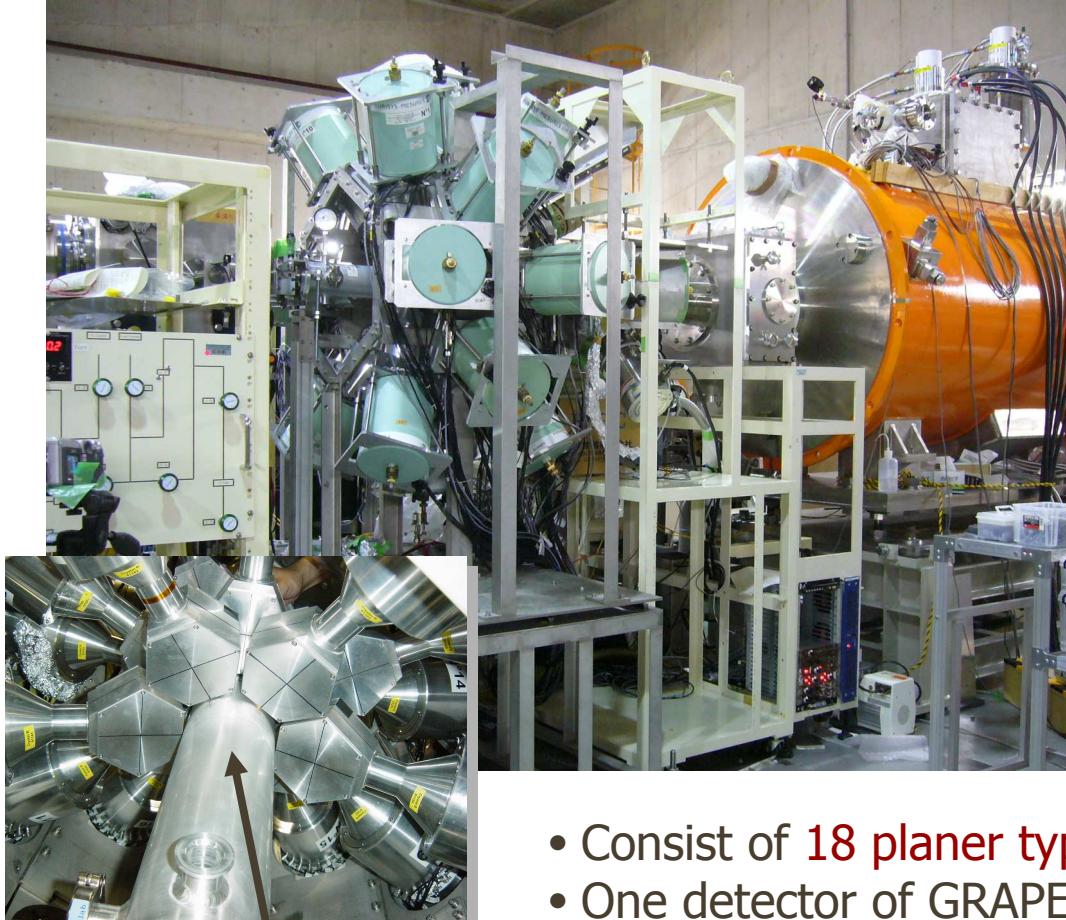


- **For fusion reaction by RI beam**
  - Production of low-energy RI beam
    - **RIPS**
  - High-efficiency and high-resolution gamma-ray detector
    - **GRAPE**

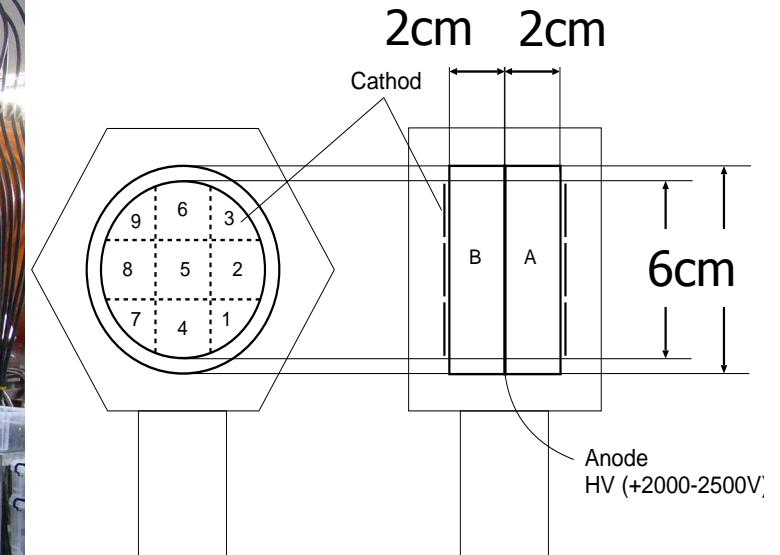
# Experimental Setup

Nuclear reaction :  $^{46}\text{Ar}(^{9}\text{Be},xn)^{55-x}\text{Ti}$





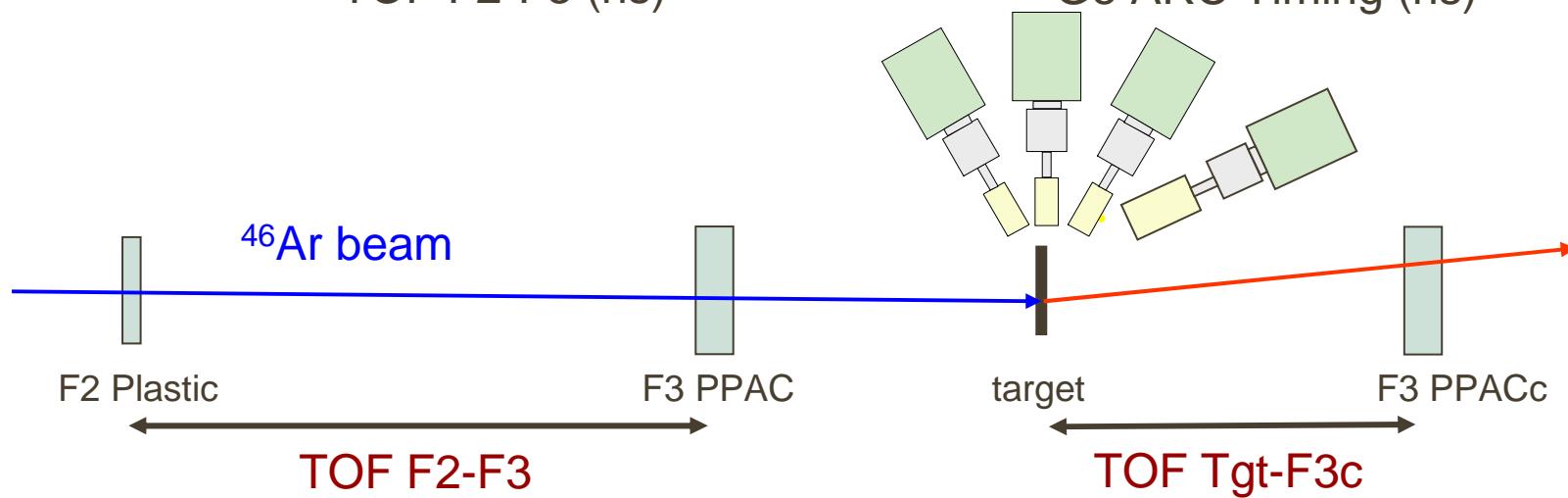
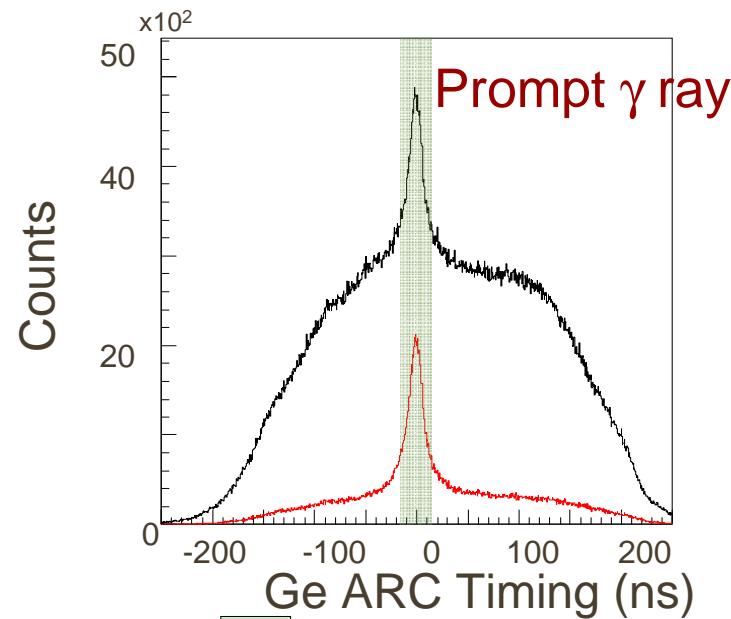
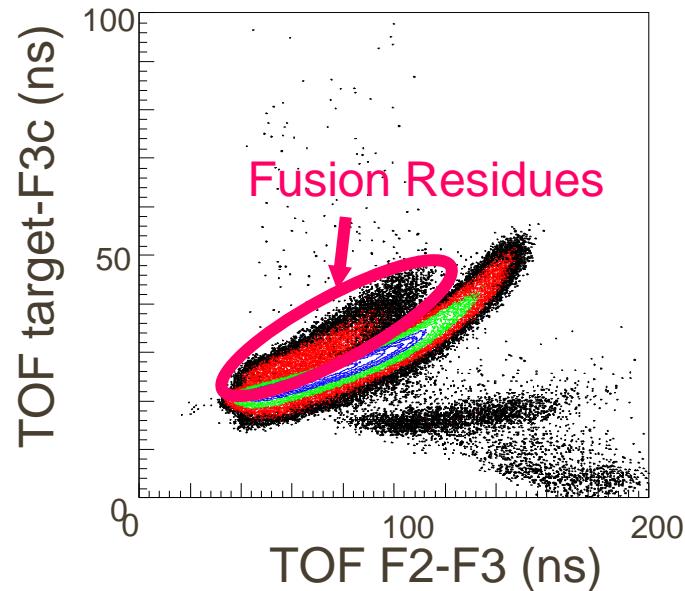
Secondary target



- Consist of **18 planer type Ge**, 2 Clover and 1 coaxial Ge.
- One detector of GRAPE have two Ge crystals.
- By using **pulse shape analysis**, position resolution is 5mm.
- Total efficiency is about **4%** for 1MeV  $\gamma$  ray.

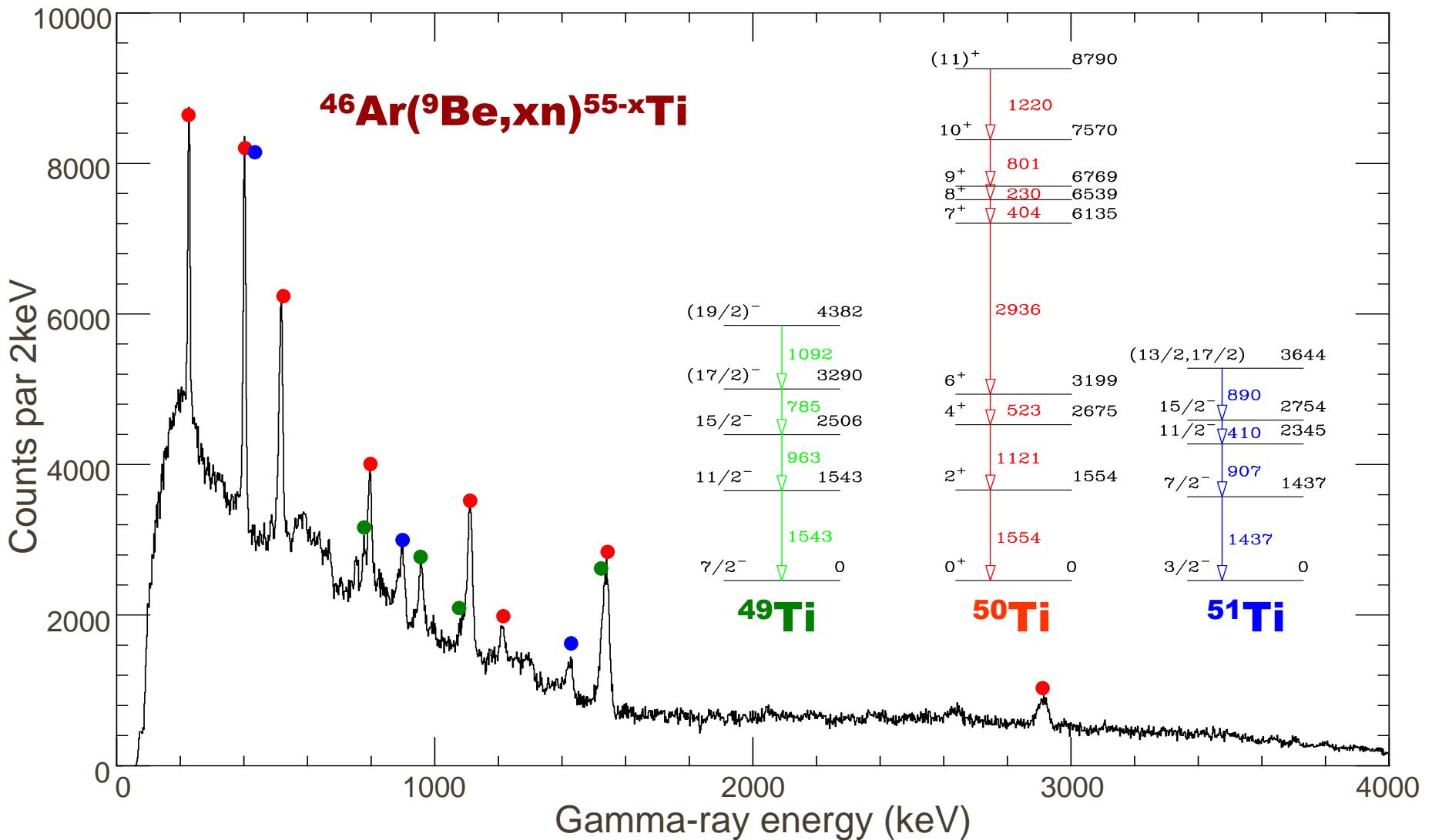
C<sub>NS</sub>

# Fusion Event Identification

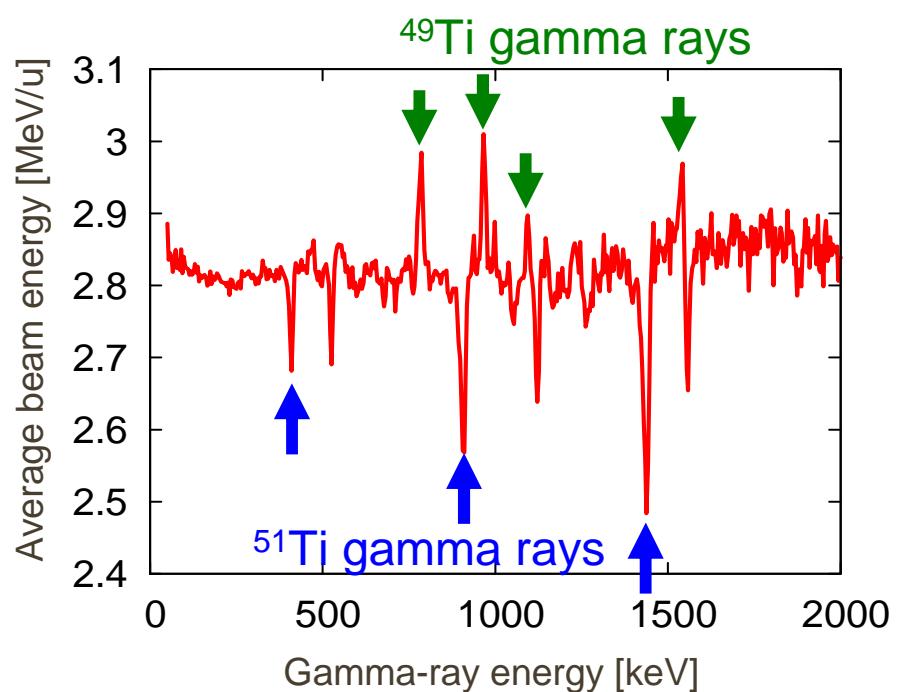
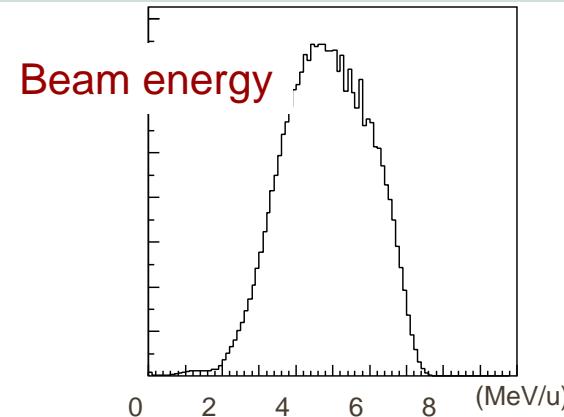
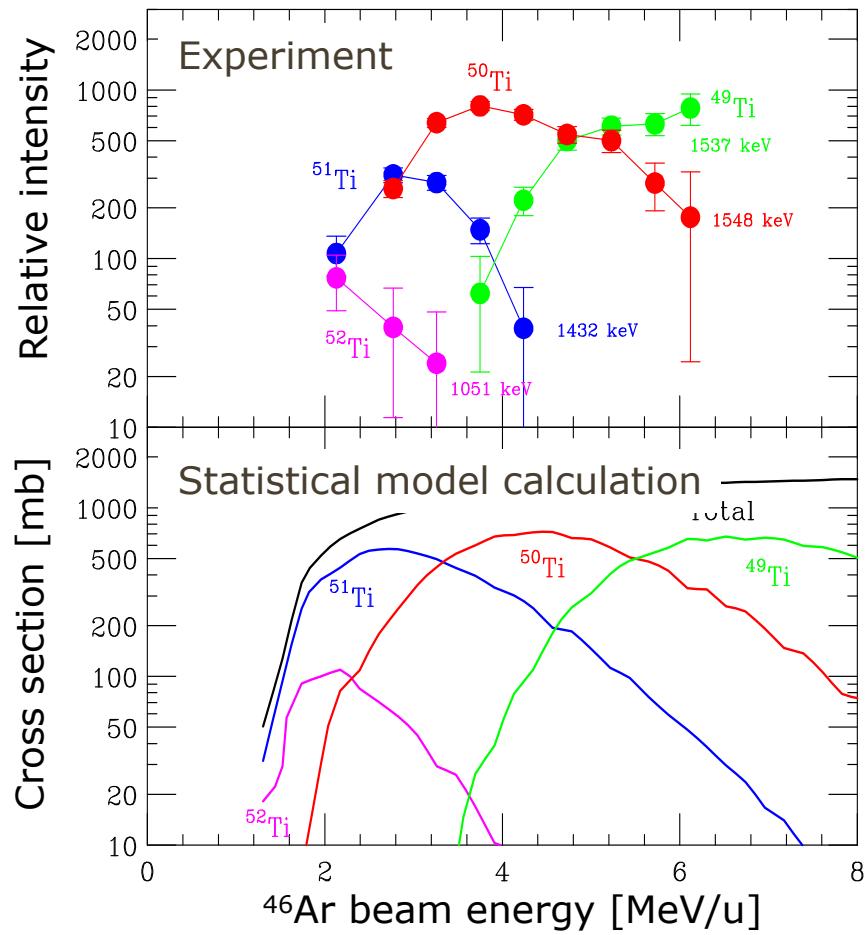


C  
NS

# Single Gamma-ray Spectrum

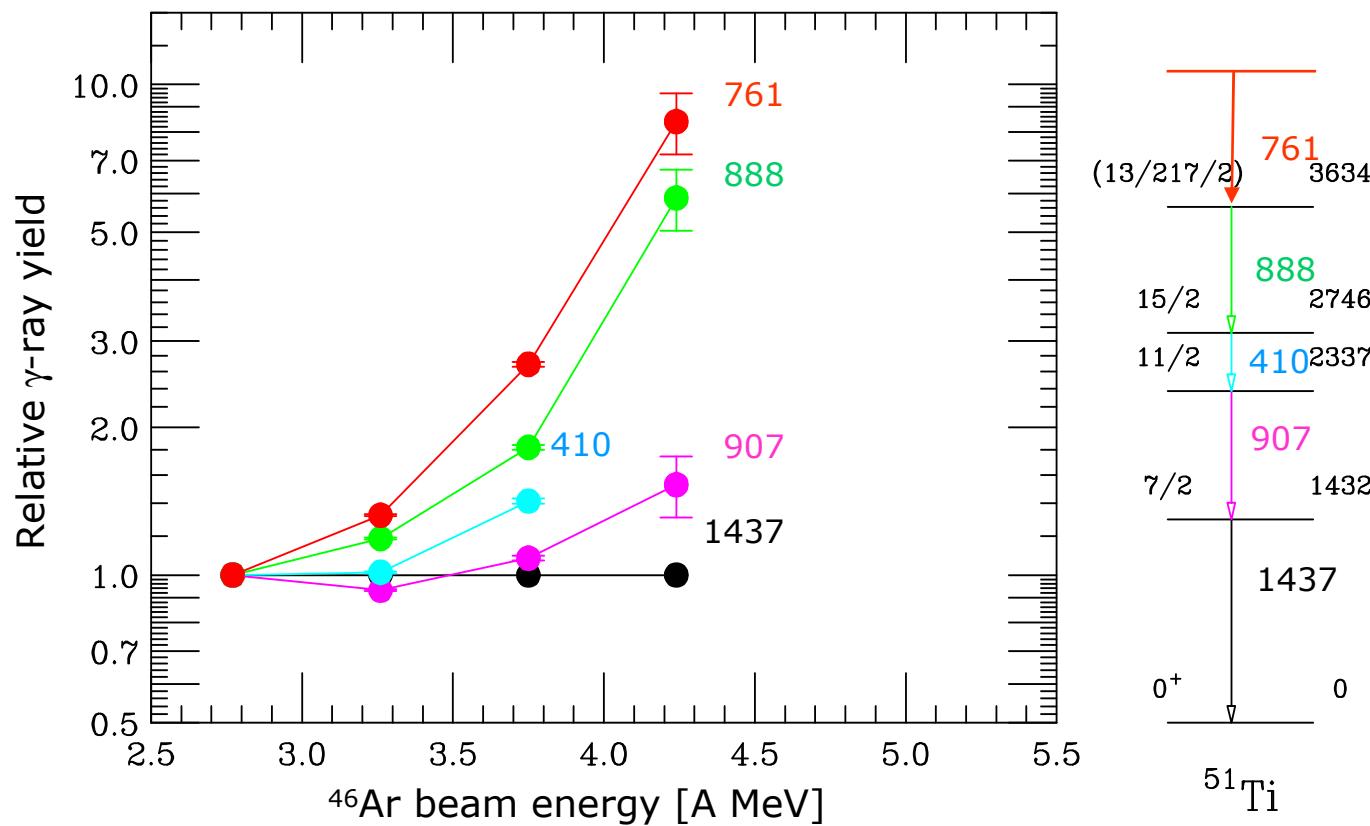


# Excitation Function Analysis



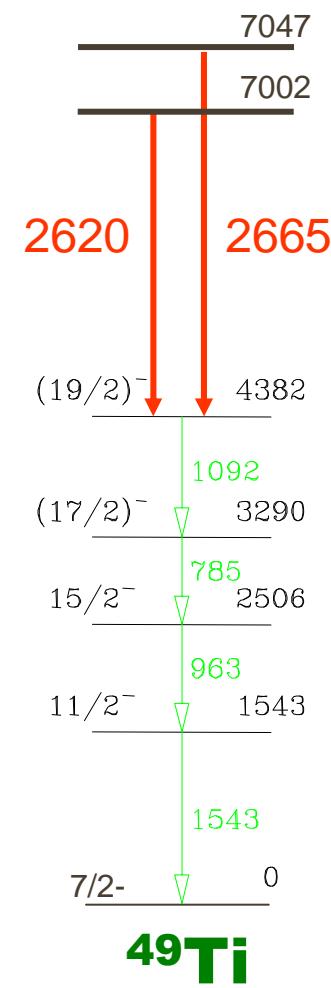
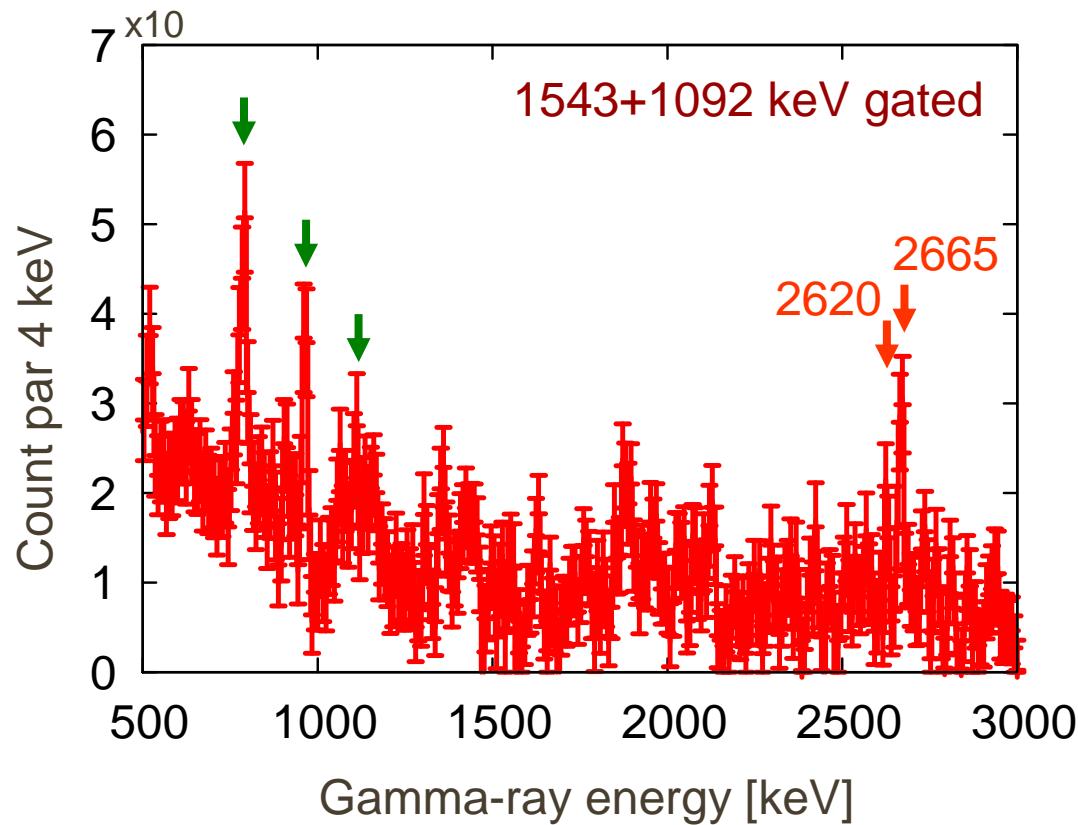
# Relative $\gamma$ -ray yield

As incident beam energy increases, larger angular momentum can brought into the system and consequently a relative population of higher spin states will increases.



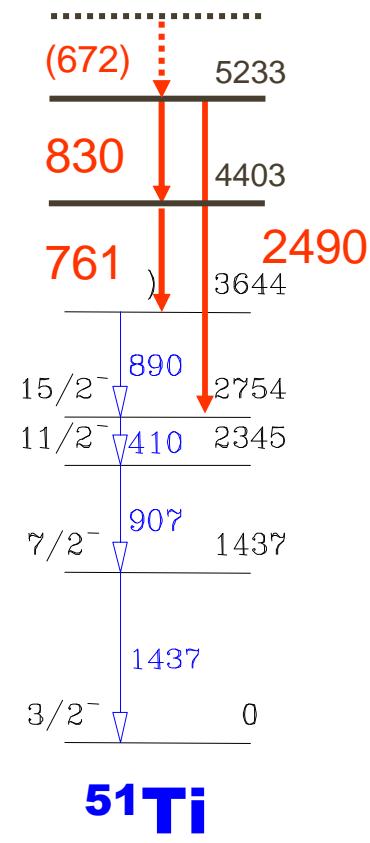
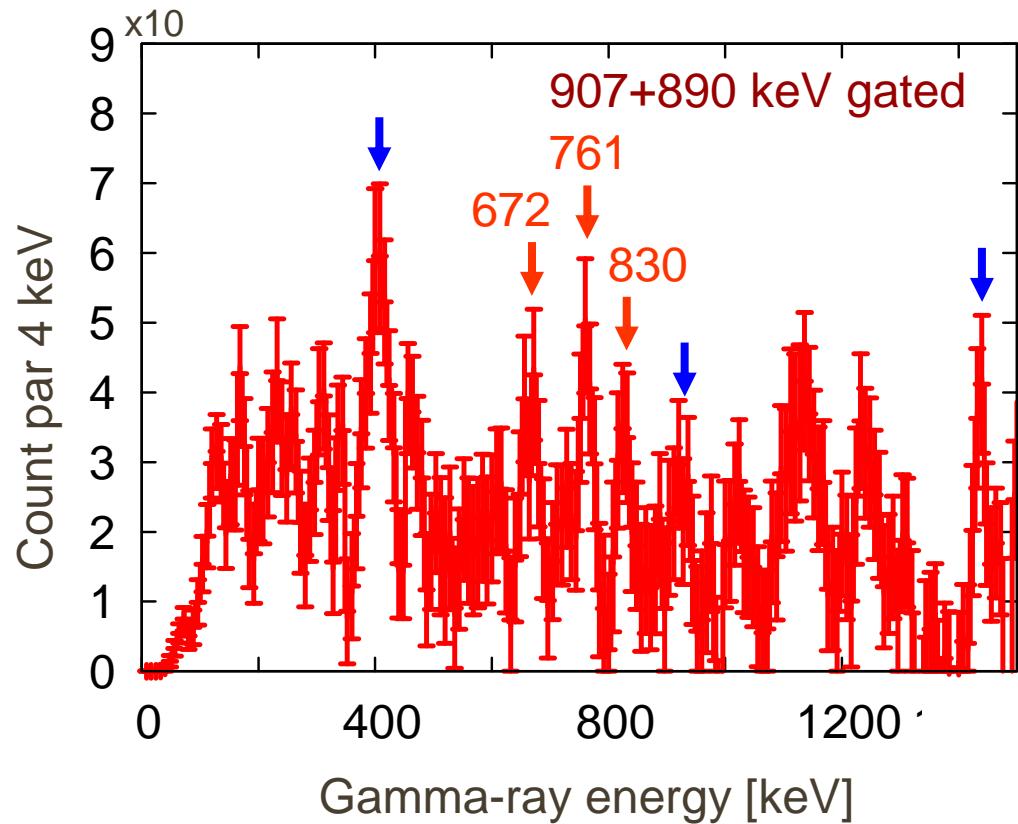
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# $\gamma$ - $\gamma$ coincidence analysis ( $^{49}\text{Ti}$ )



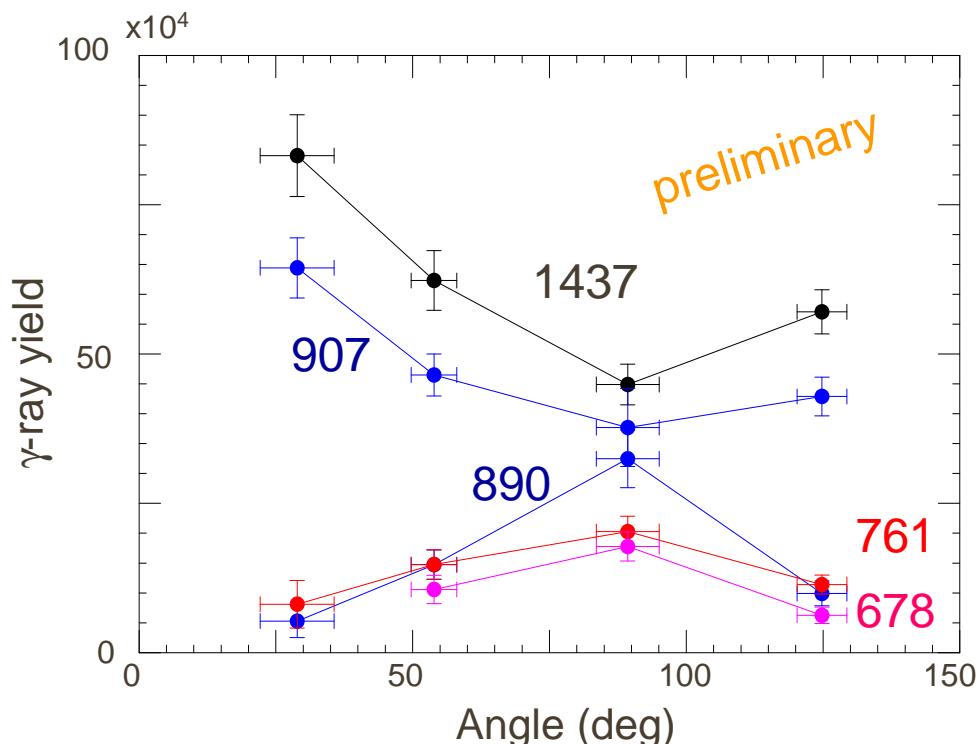
C<sub>NS</sub>

# $\gamma$ - $\gamma$ coincidence analysis (<sup>51</sup>Ti)

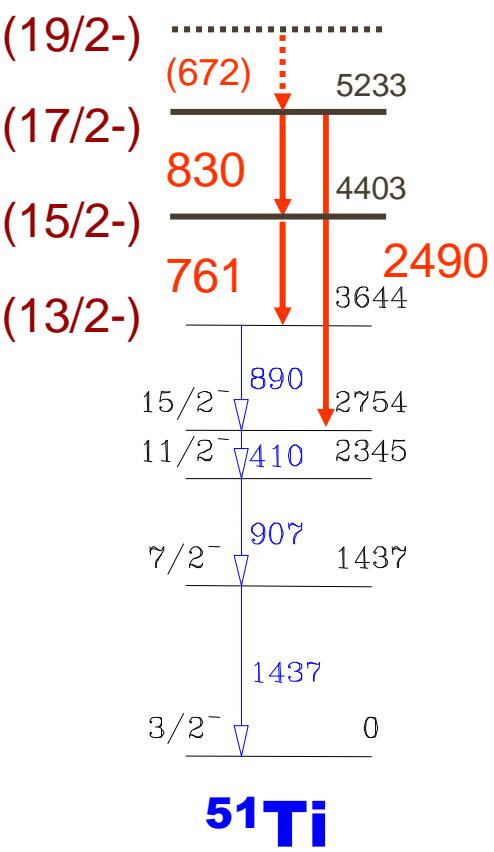


C<sub>NS</sub>

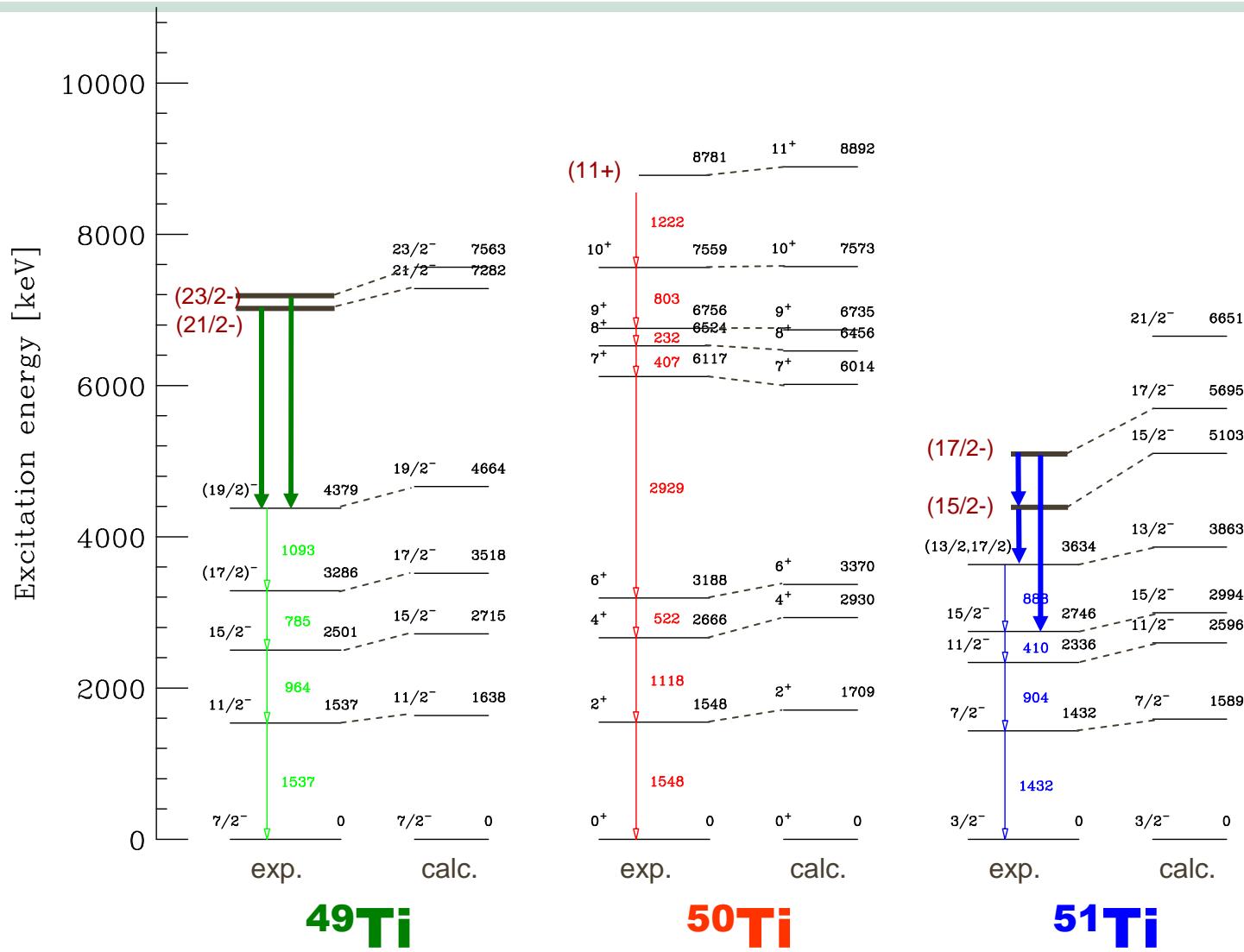
# Angular Distribution



preliminary



# Level Scheme and Shell Model Calculation



Shell model code ; Antoine

# C<sub>NS</sub> Summary

- We have studied high-spin states in neutron-rich Ti isotopes by secondary fusion reaction,  $^{46}\text{Ar}(^{9}\text{Be},\text{xn})^{55-\text{x}}\text{Ti}$ .
- By  $\gamma$ - $\gamma$  coincidence analysis and excitation function analysis, we observed cascade gamma decay from **(23/2)**, **(11+)**, and **(17/2)** states in  $^{49-51}\text{Ti}$ , respectively.
- To compare with shell model calculation, we observed the existence of **1plh excitation** in this region, systematically.

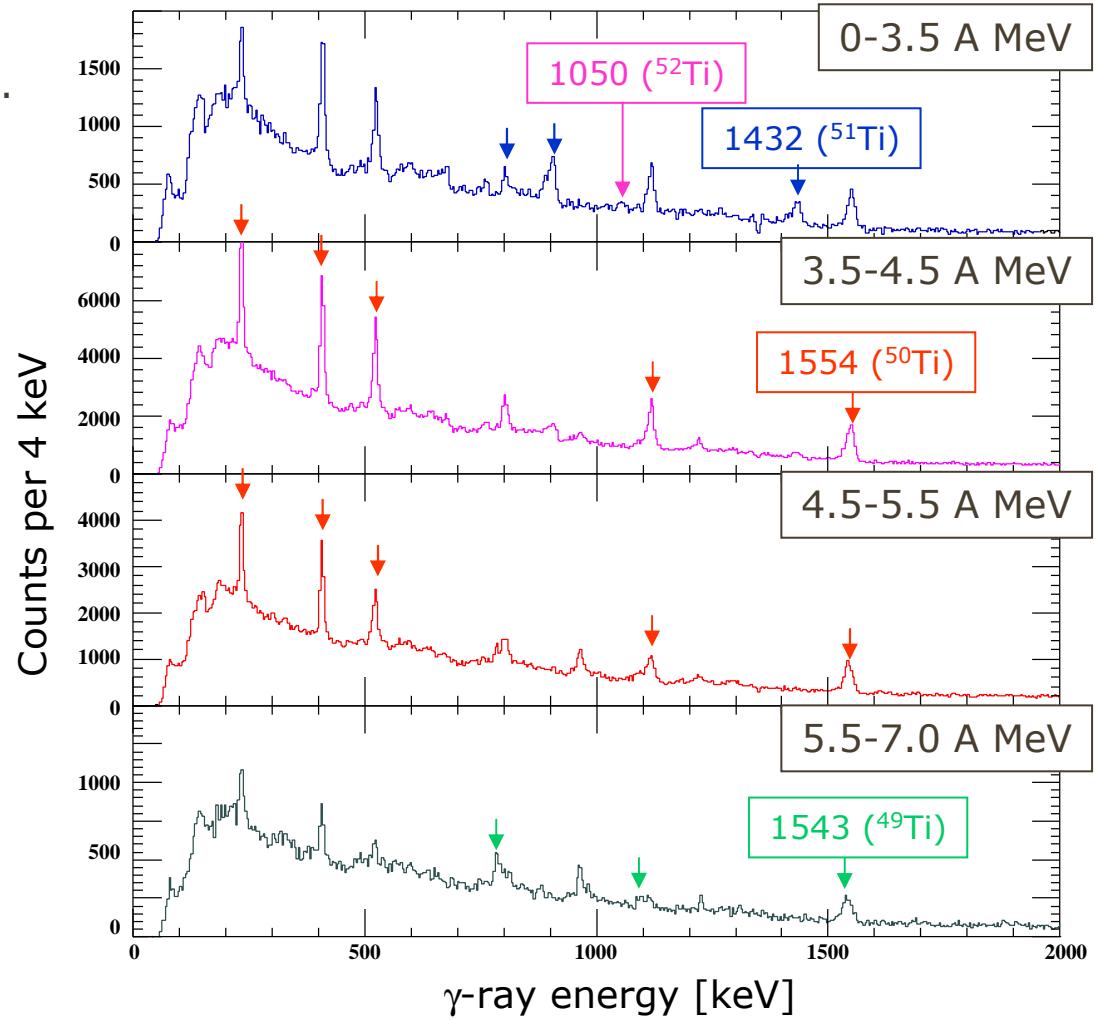
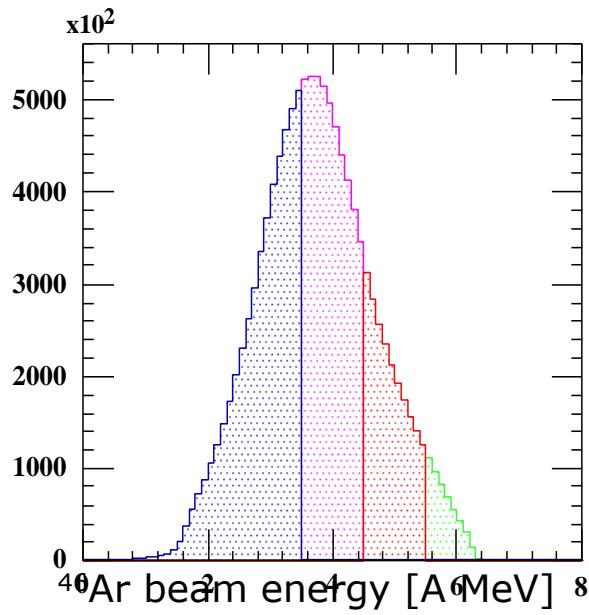


# C<sub>NS</sub> Collaborators

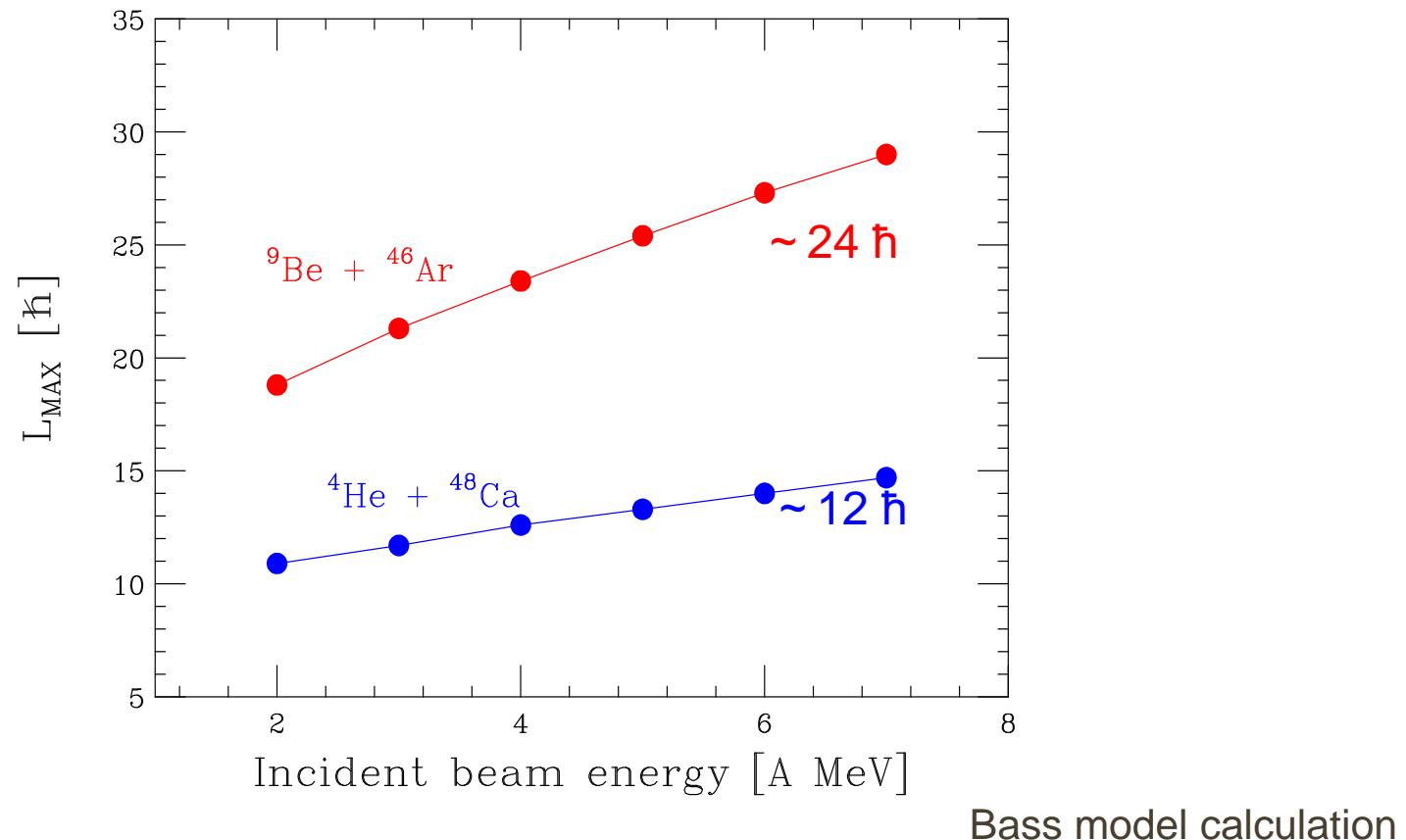
- **CNS, University of Tokyo**  
**E.Ideguchi, S.Shimoura, S.Ota, Y.Wakabayashi, S.Michimasa**
- **Dep. Phys., University of Tokyo**  
**T.Onishi, Y.Ichikawa, H.Suzuki, D.Suzuki, H.Iwasaki**
- **Nishina Center, RIKEN**  
**T.Kubo, K.Yoshida, N.Aoi, T.Ohnishi, H.Baba**
- **Dep. Phys., Osaka University**  
**T.Fukuchi**
- **IMPCAS, China**  
**M.Liu, Y.Zheng**

# Excitation function analysis

$\gamma$ -ray spectra by gating different region of the beam energy spectrum.  
Different isotopes are populated in different beam energy region.



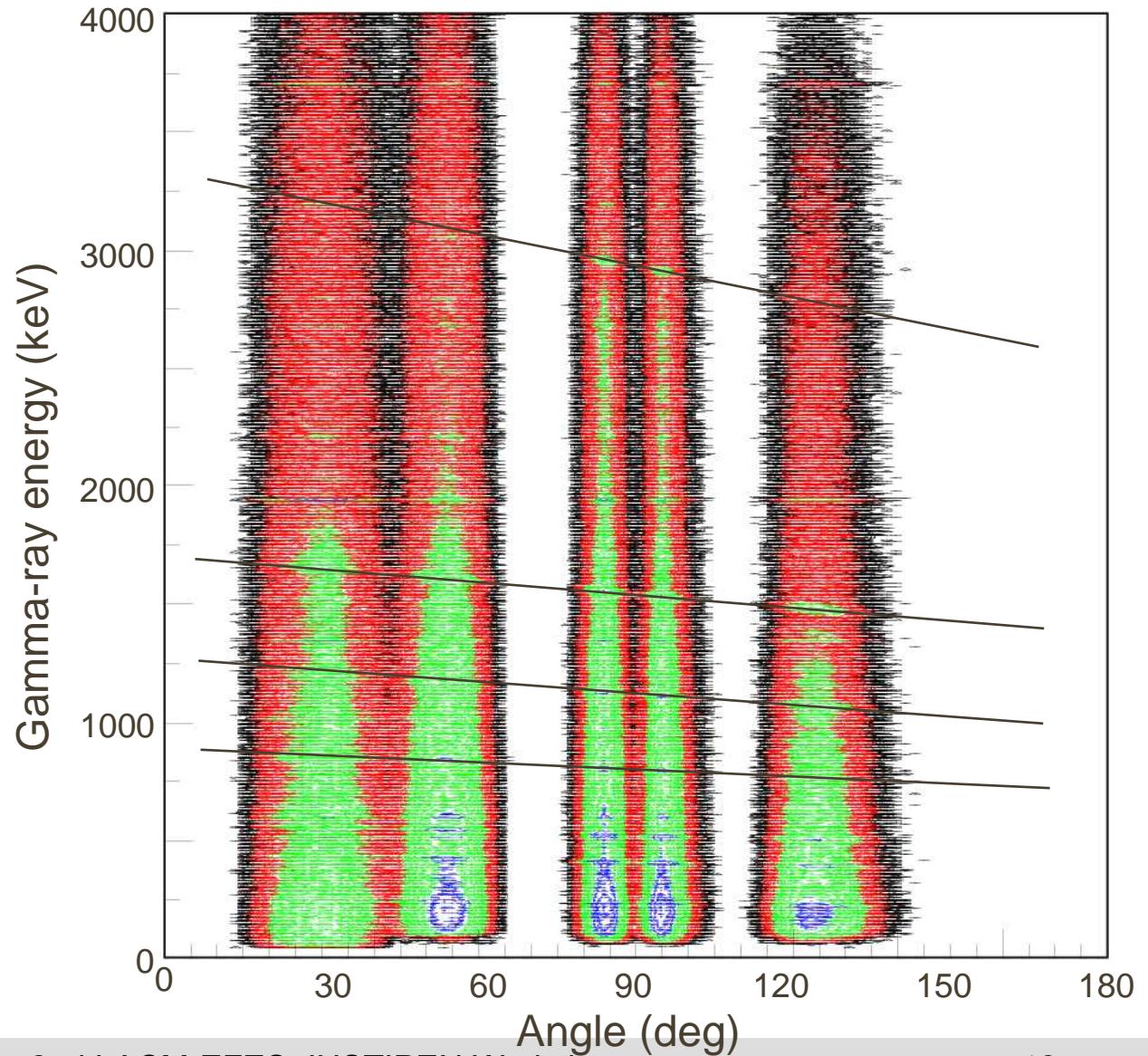
Maximum angular momentum brought in to the reaction products by the fusion reaction.

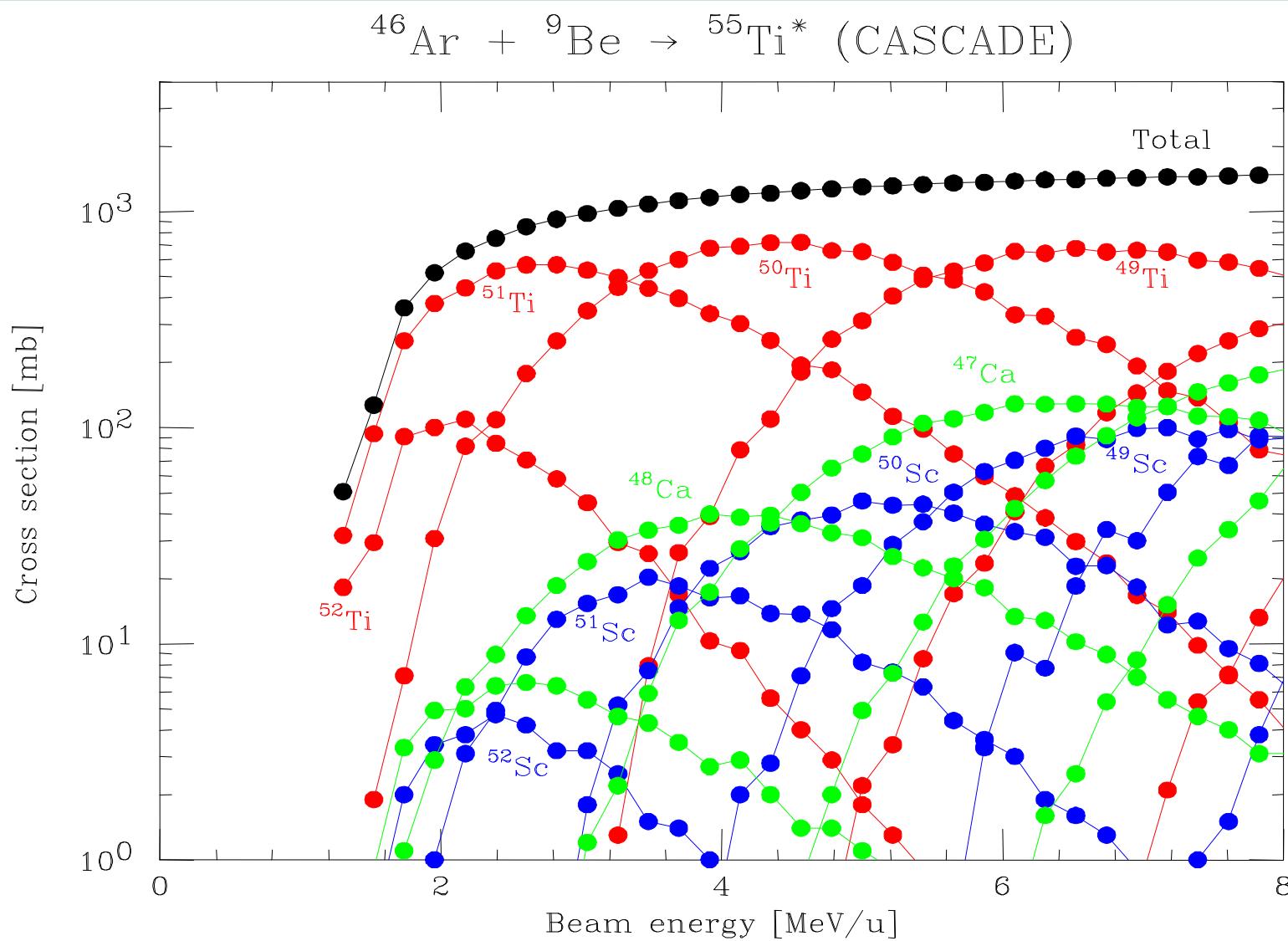


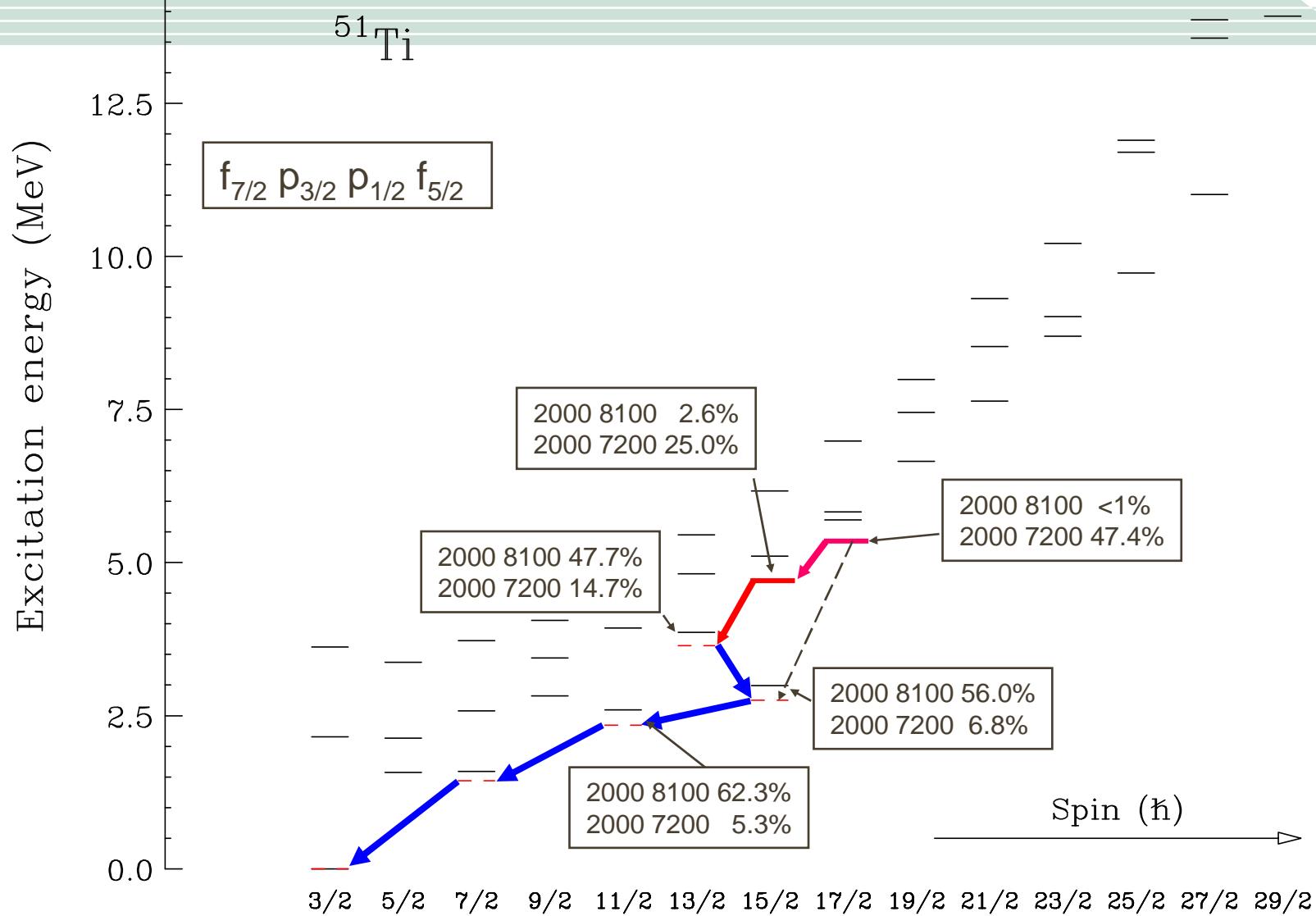
# C<sub>NS</sub> **γ-ray spectrum**

ドップラー補正

$$E_\gamma = E_{\text{lab}} \frac{1 - \beta \cos \theta_{\text{lab}}}{\sqrt{1 - \beta^2}}$$

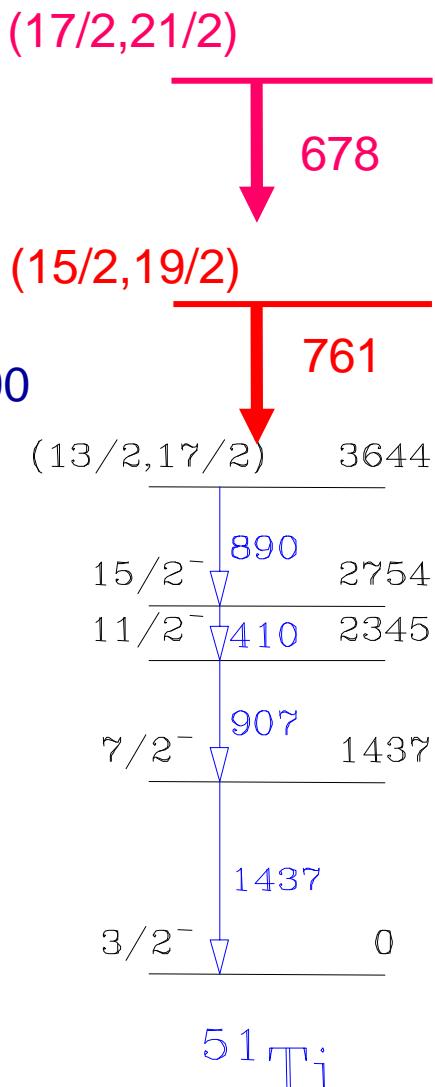
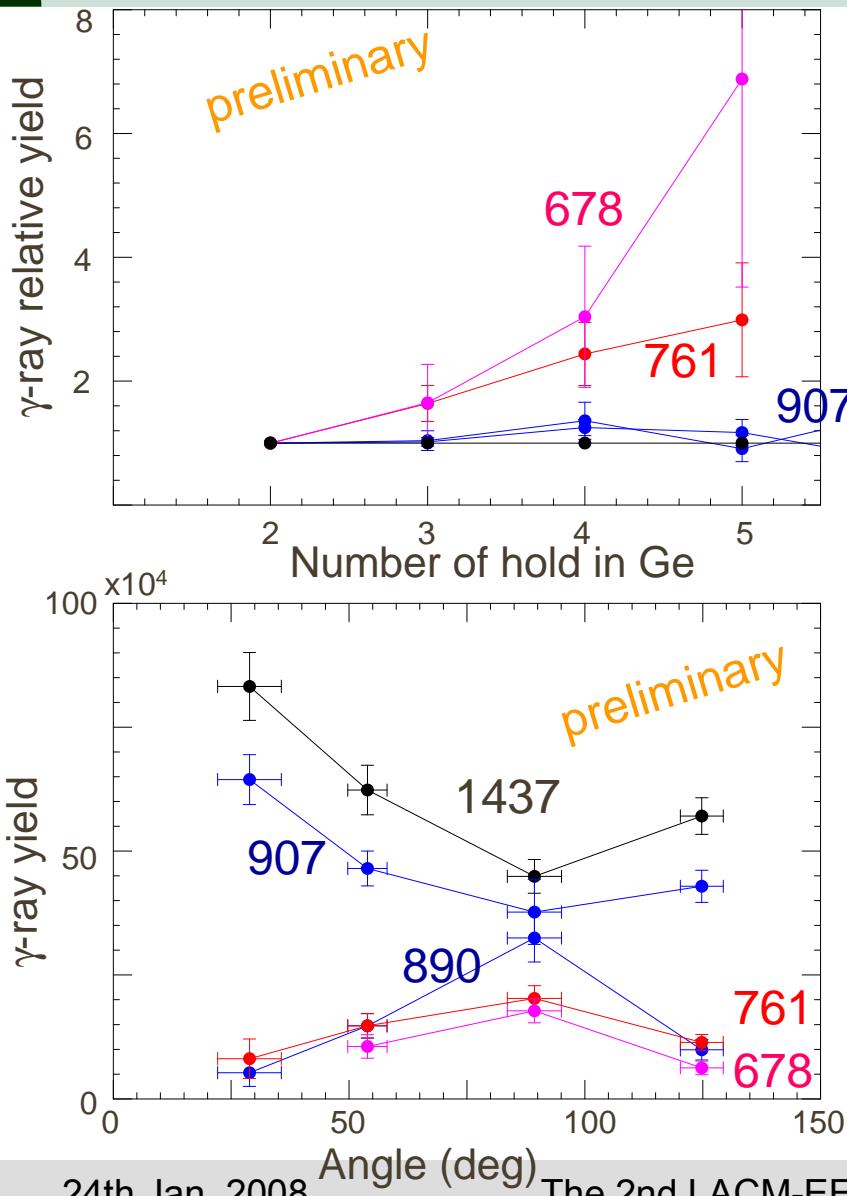




**$^{51}\text{Ti}$  shell-model calculation**

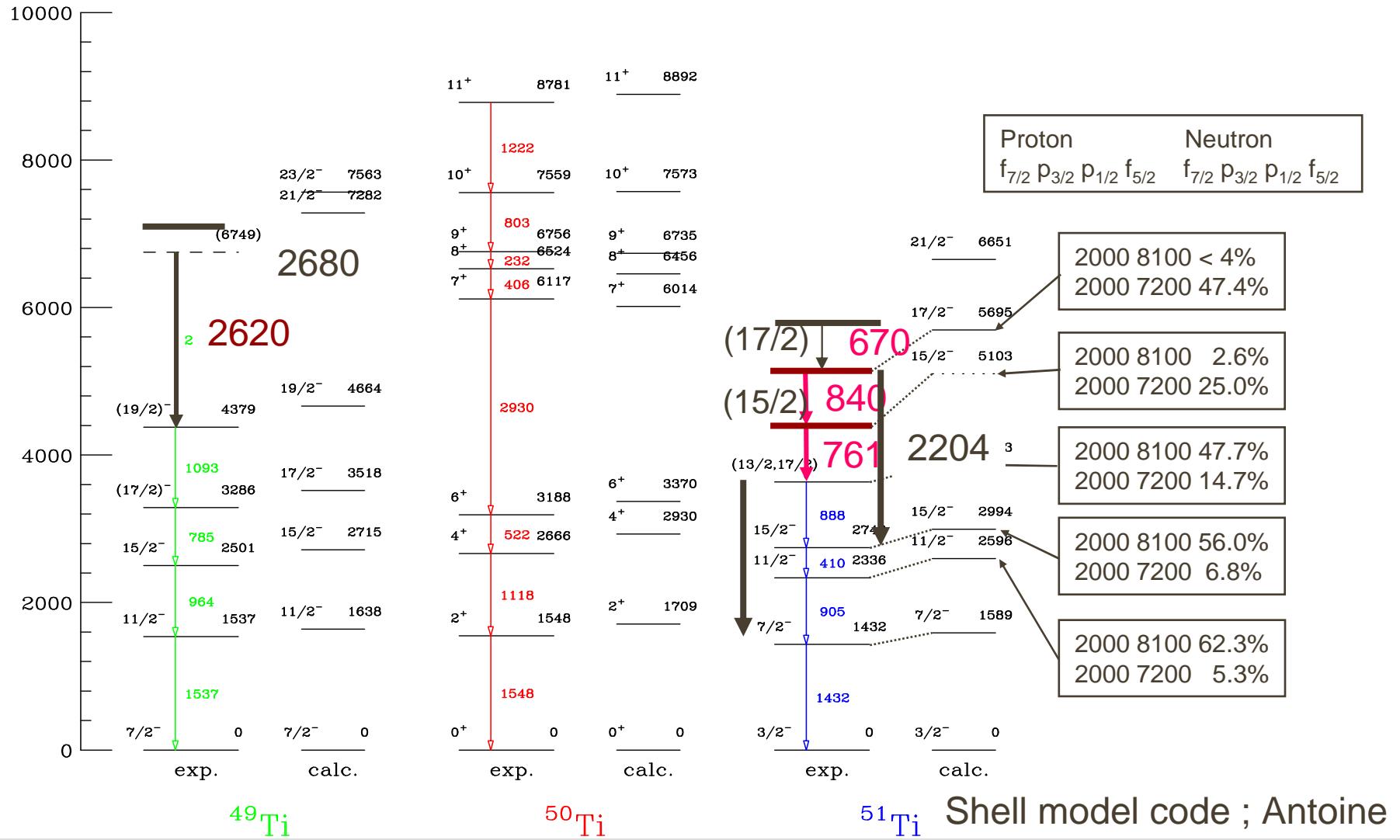
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# Multiplicity measurements



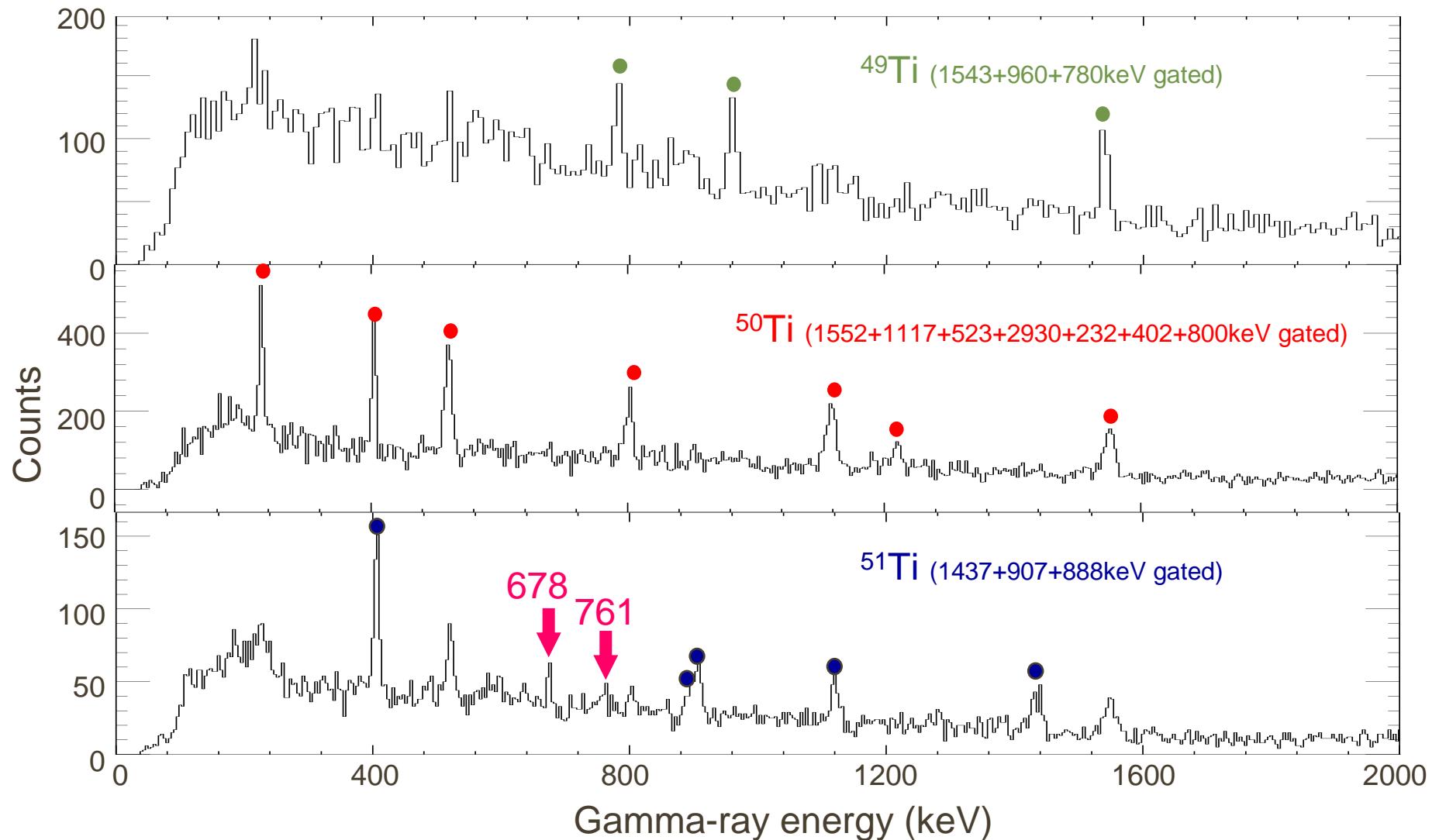


# Level Scheme and Shell Model Calculation

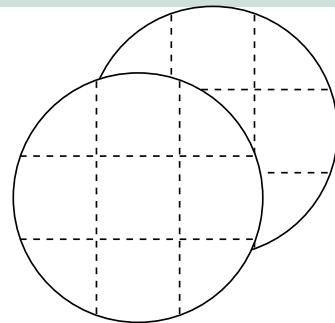


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## $\gamma$ - $\gamma$ coincidence analysis

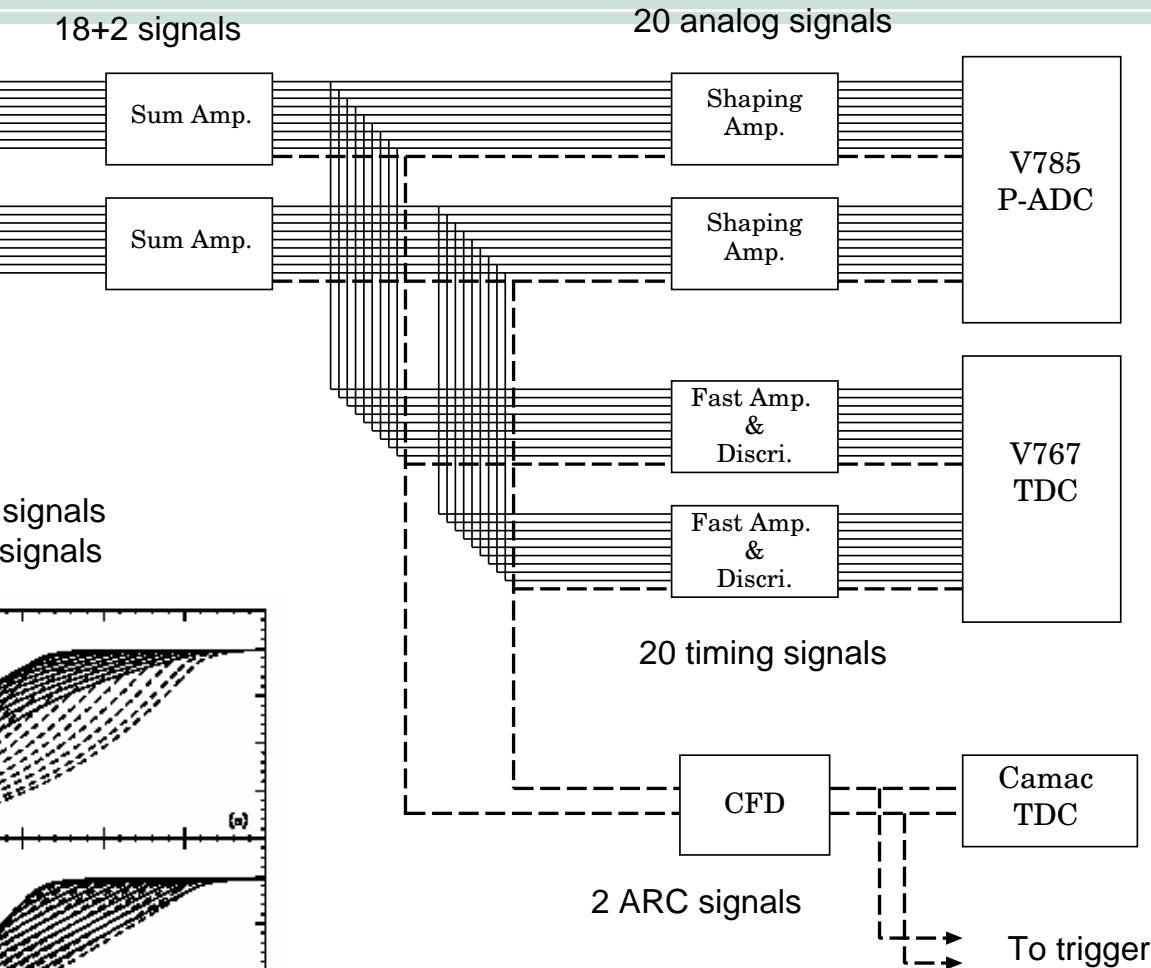
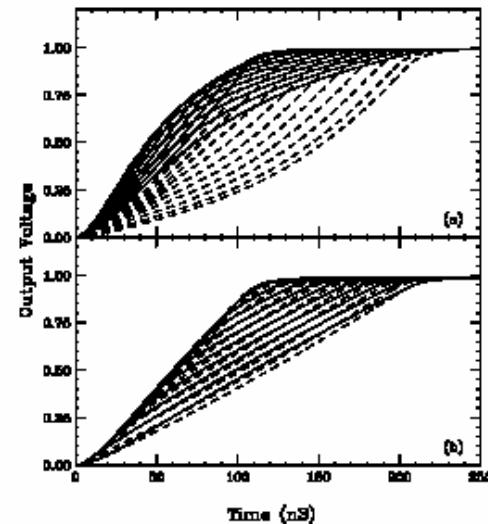


# GRAPEの測定回路



One Ge detector  
2 crystals, 9 segment

Total 340 timing signals  
and 340 analog signals



C<sub>NS</sub>

# ガンマ線の検出位置

