

# Neutron single-particle states near $^{78}\text{Ni}$

Fourth International Conference on  
Fission and Properties of Neutron-Rich Nuclei

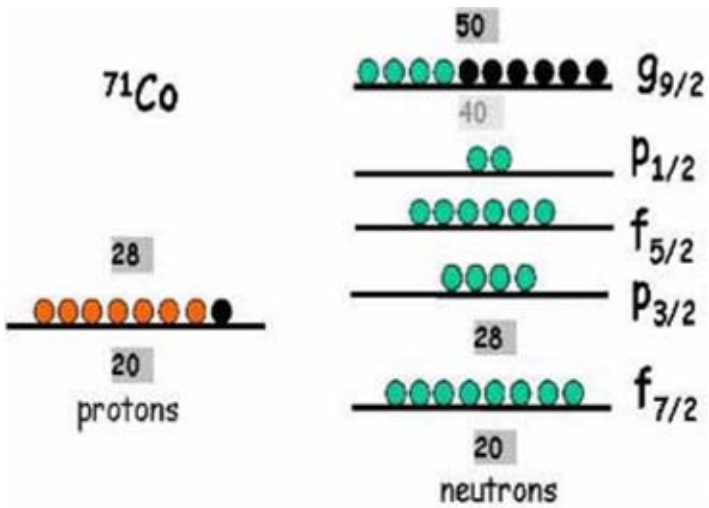
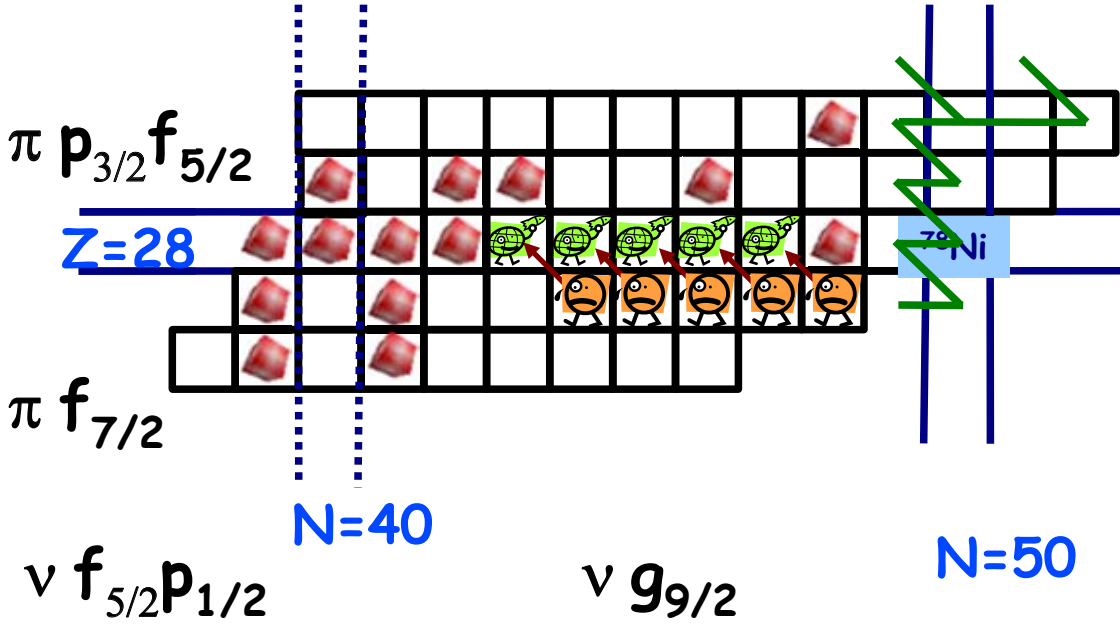
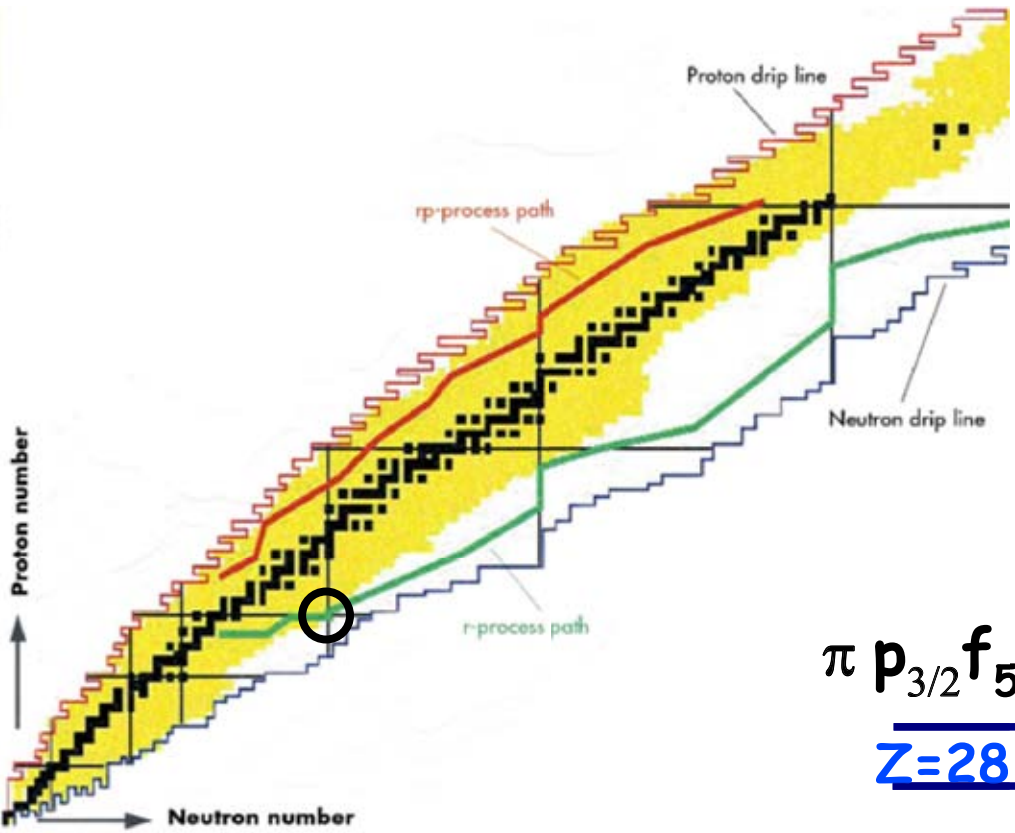
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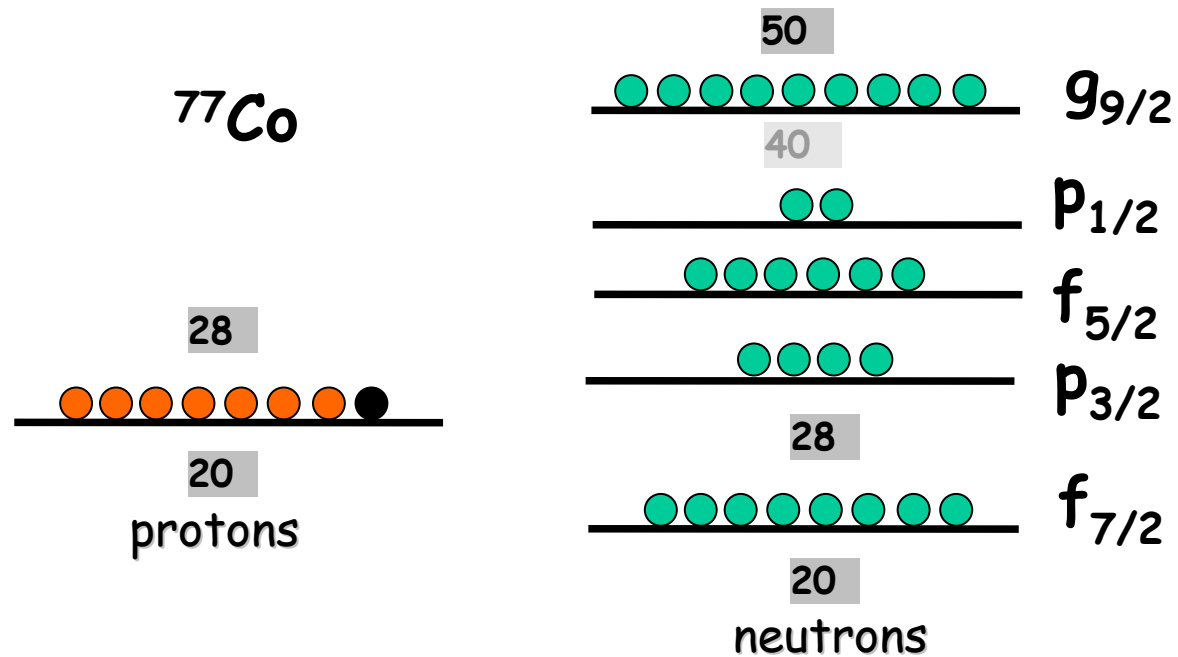
# Nuclear landscape - Region near $^{78}\text{Ni}$

$g_{9/2}$  and  $p_{1/2}$  orbitals  
generate isomerism (◻)

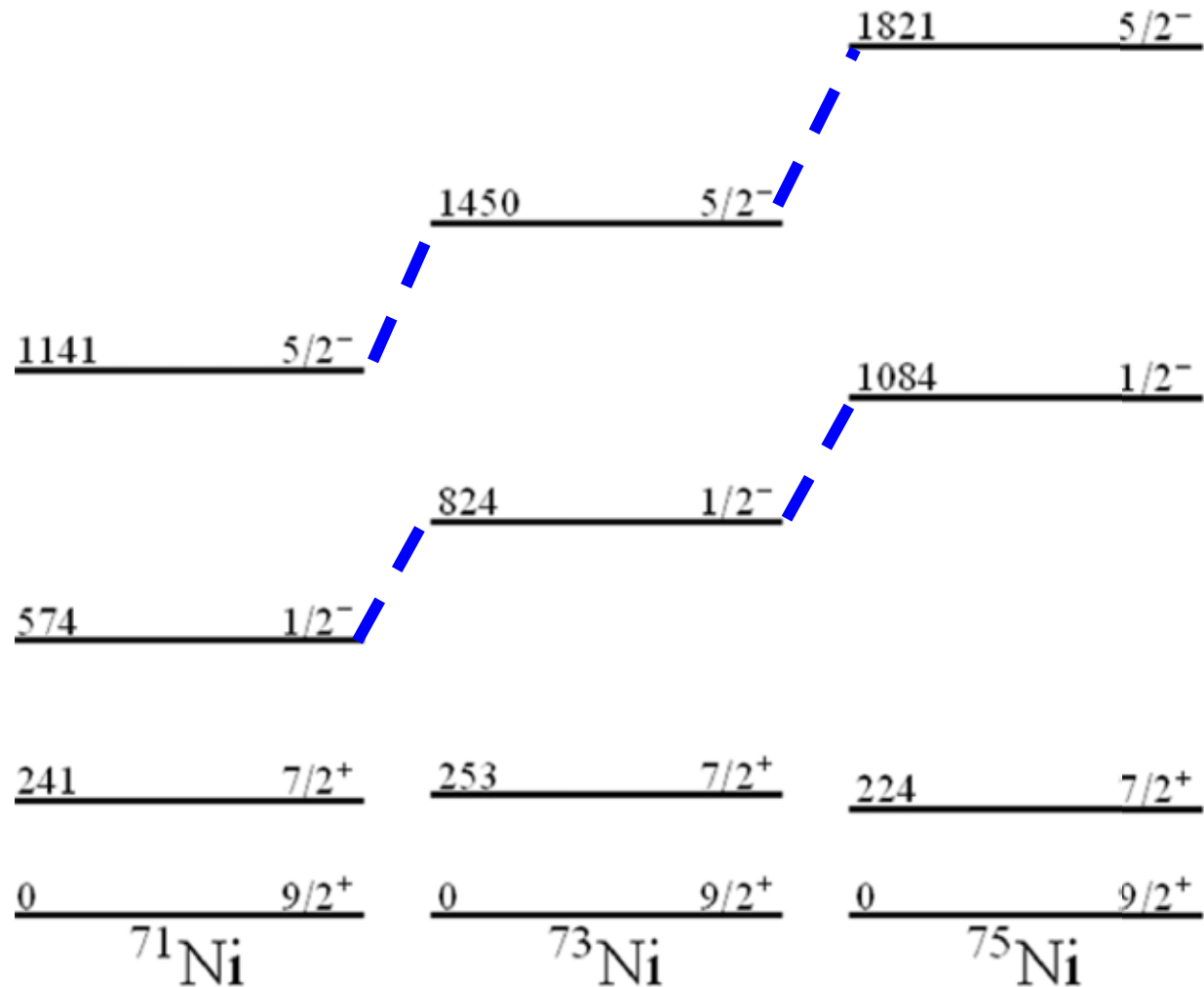




# Trend in 1/2- and 5/2- excited states

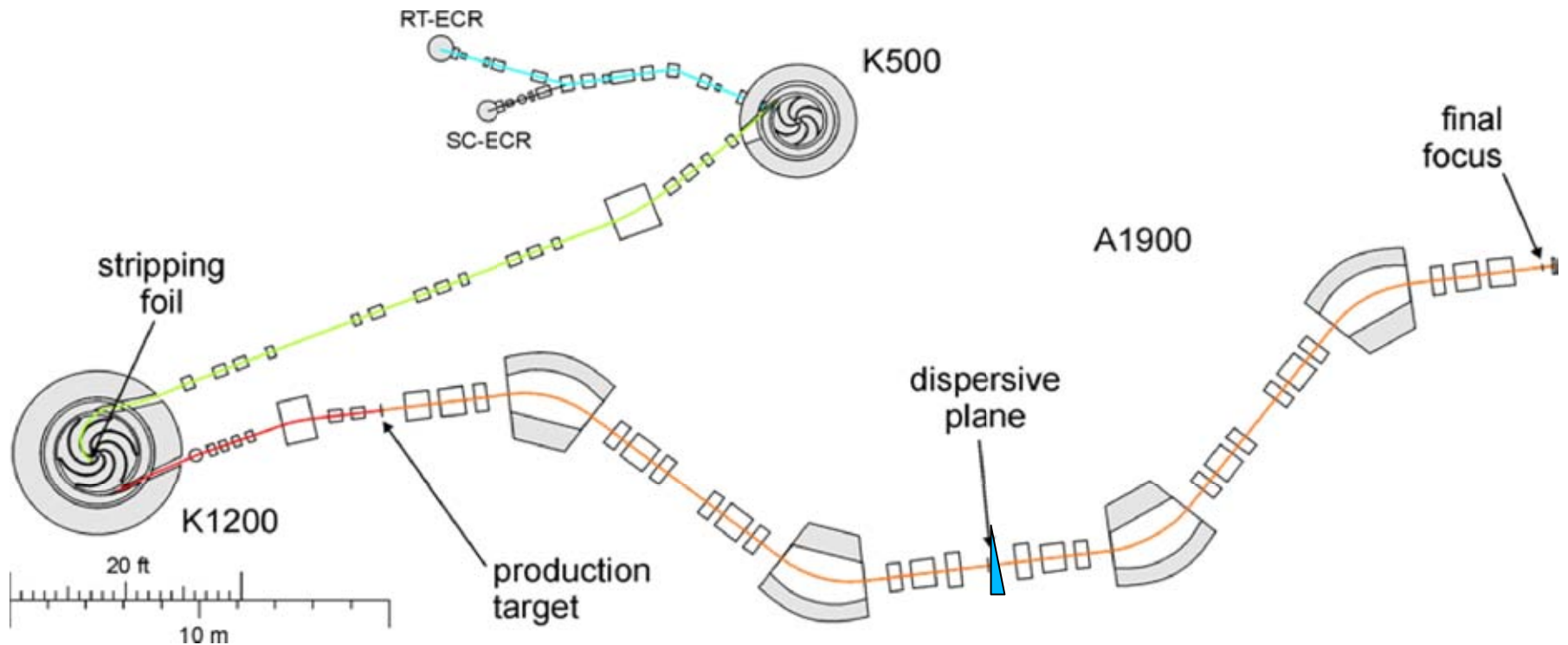


# Trend in 1/2- and 5/2- excited states

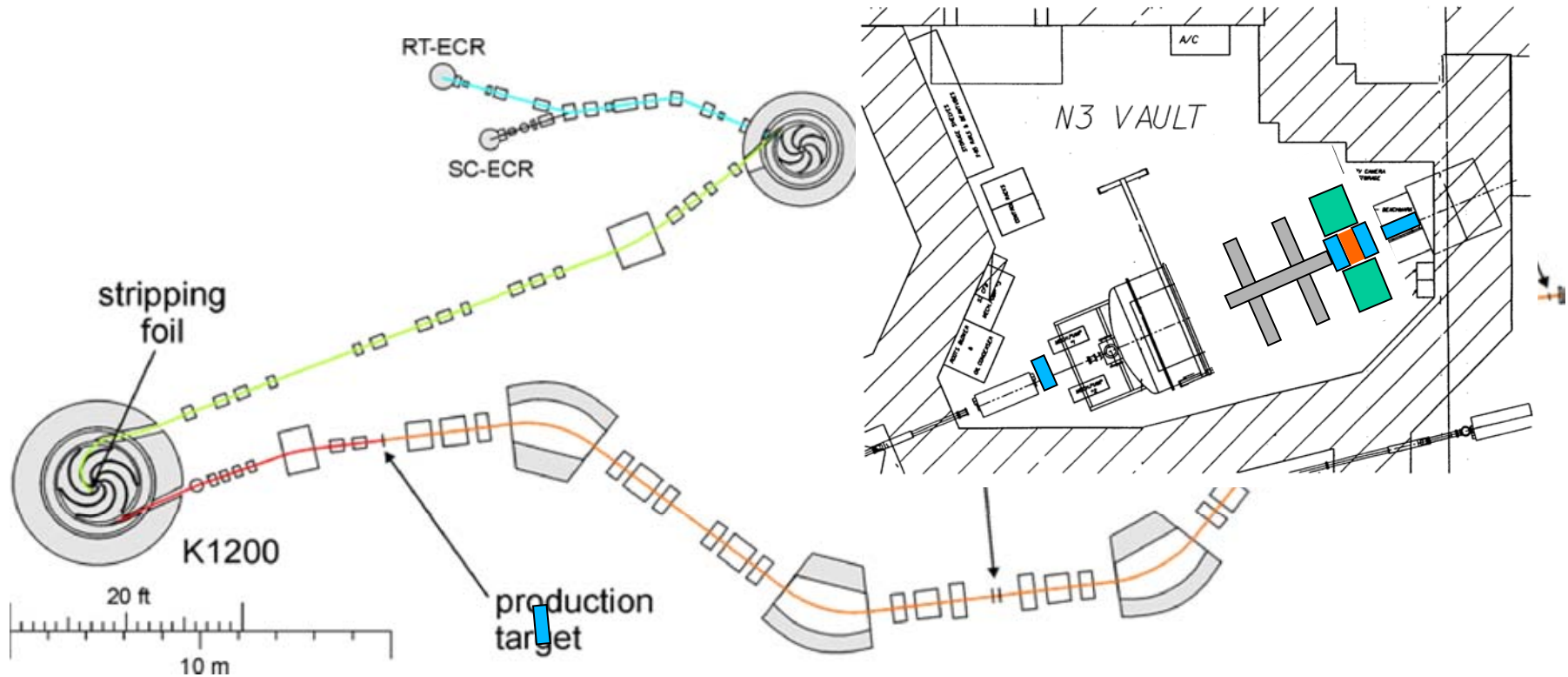


# Experimental details

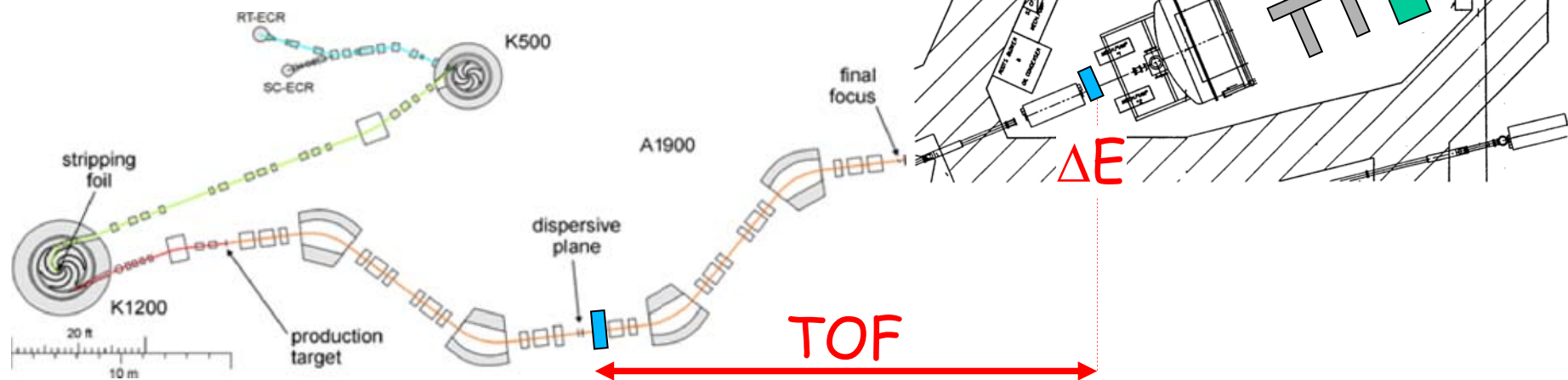
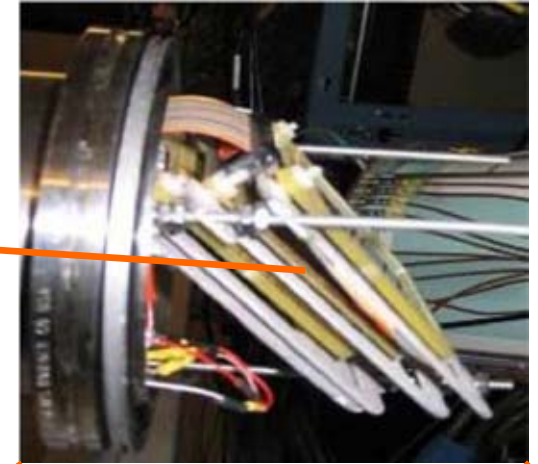
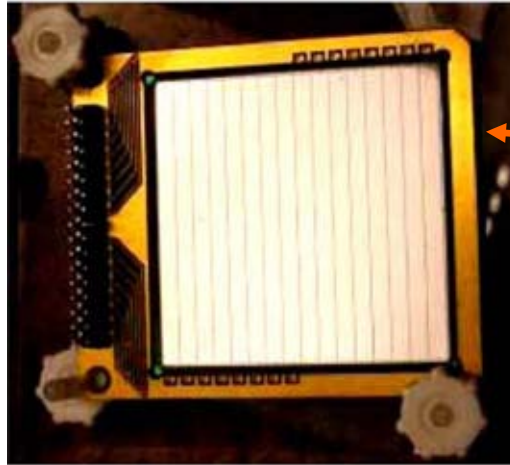
- Experiment conducted at National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University (MSU)
  - Beam time - 10 days
- Primary beam:  $^{86}\text{Kr}^{34+}$  at 140 A MeV  $\rightarrow$  15-20 p nA
- Target  $^{90}\text{Zr}$  412 mg/cm<sup>2</sup> thick on 20 mg/cm<sup>2</sup> thick  $^{90}\text{Zr}$  wedge degrader - Kup



# Experimental details

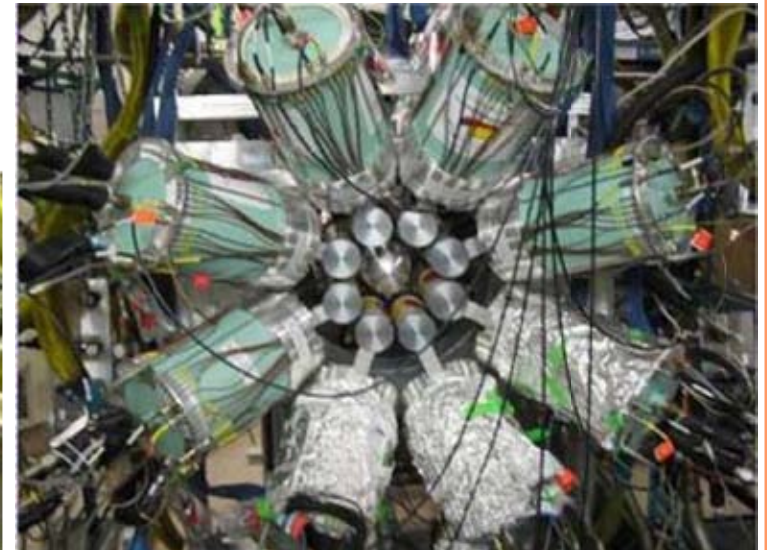
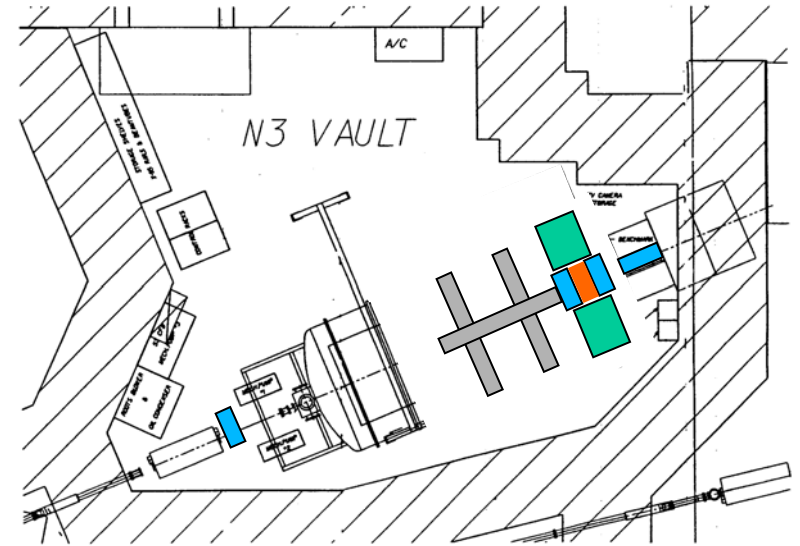
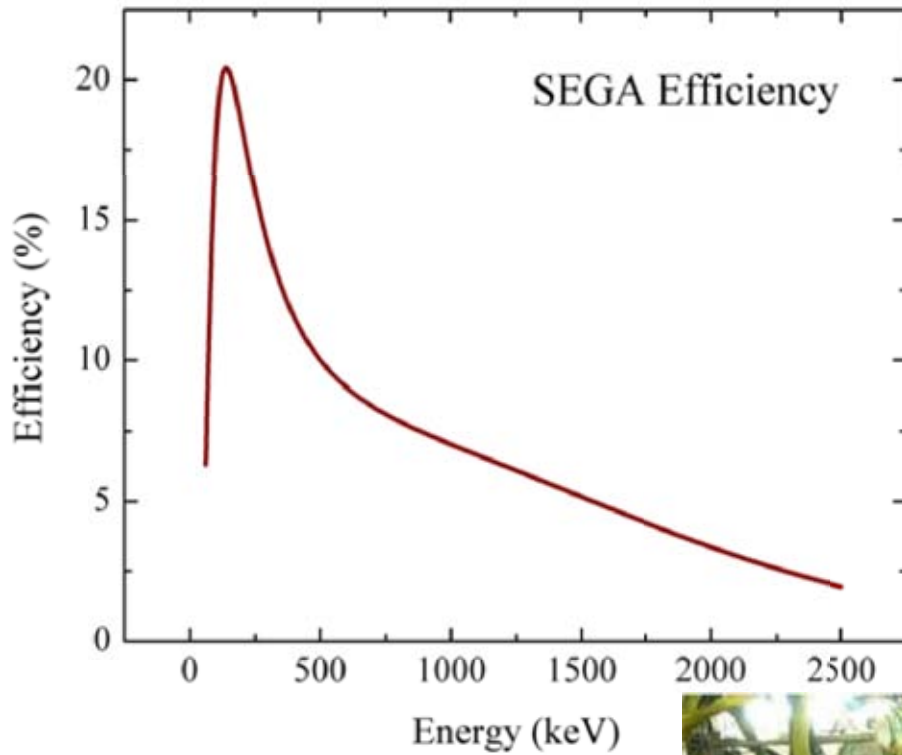


# Experiment $\rightarrow$ $\beta$ -counting



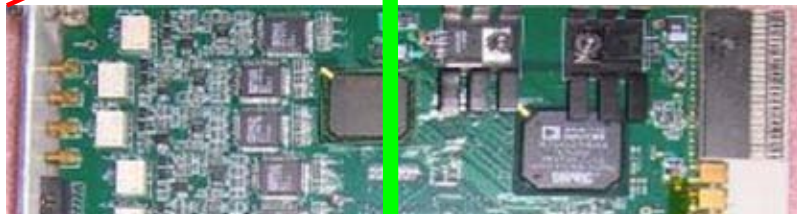
# SEGA- Segmented Germanium Detector (NSCL)

- High efficiency 20% @ 140keV



# Digital Acquisition (XIA-Pixie16)

- Logarithmic preamps (1keV-10MeV linear, 10MeV -2 GeV Log)
- Digitize early low noise
- Low threshold (~60keV)



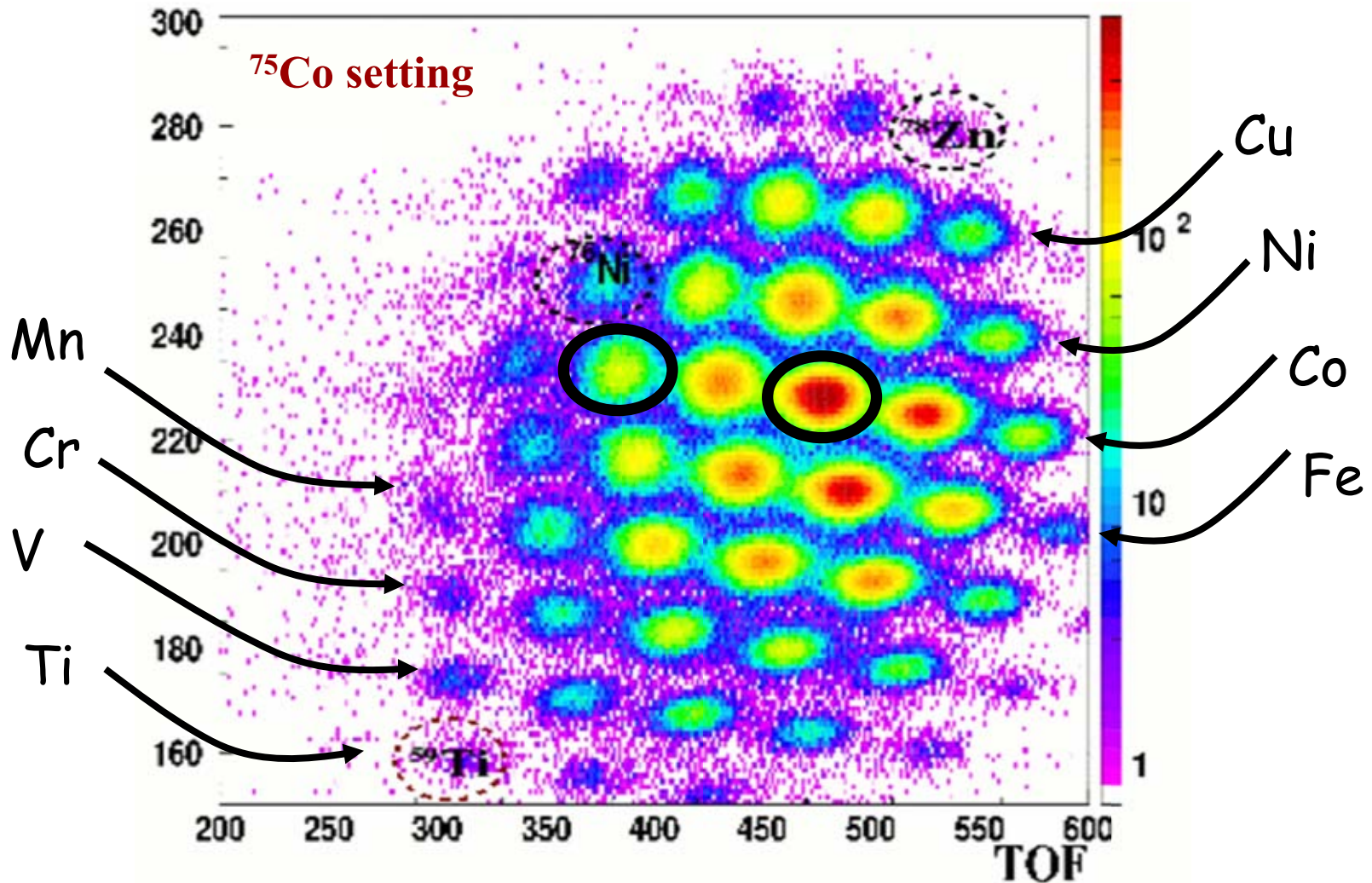
Analog | Digital

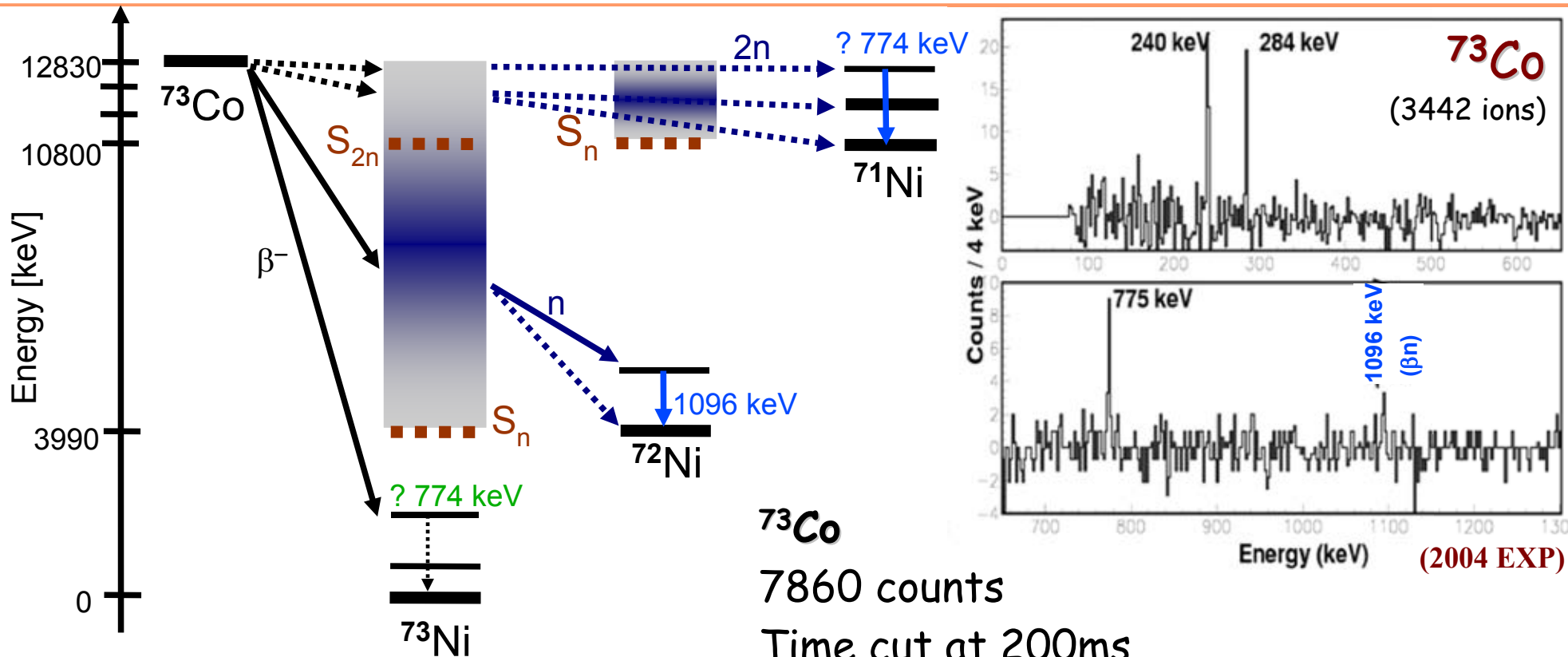
- Time stamping - decay studies
- Higher rate
  - Sampling ADC @100MSPS
  - No master trigger

# First Results

# Particle identification

- Large range of isotopes



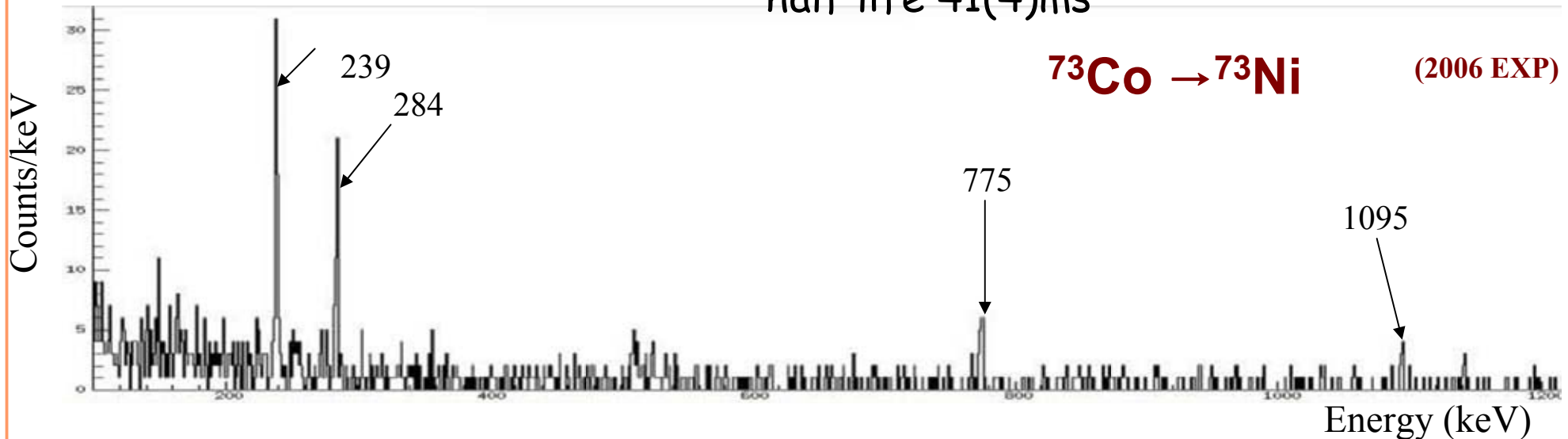


$^{73}\text{Co}$

7860 counts

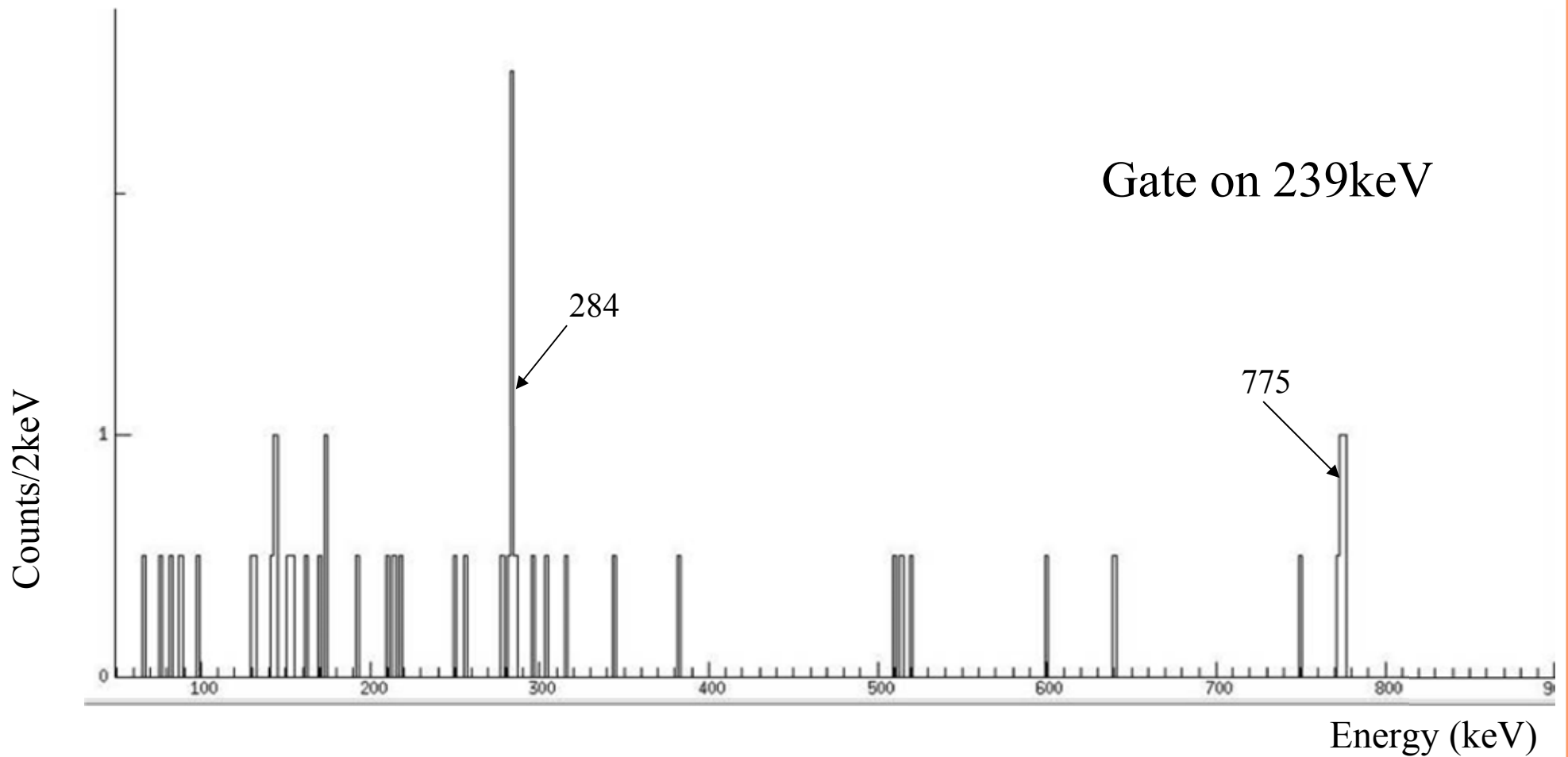
Time cut at 200ms,

half life 41(4)ms

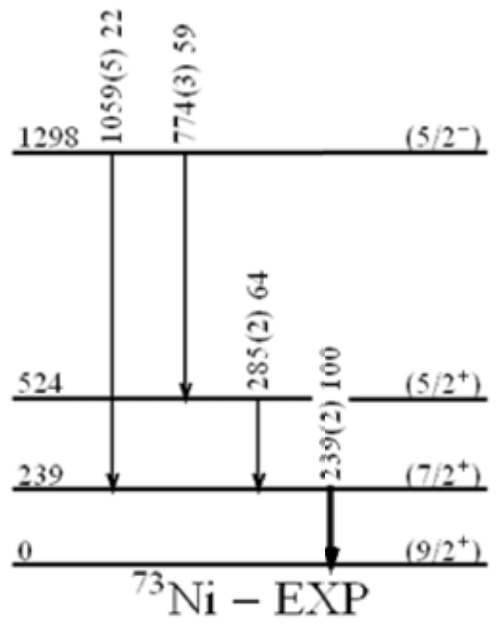




# $\beta$ - $\gamma$ - $\gamma$ coincidence



41(4) ms (7/2<sup>-</sup>)  
<sup>73</sup>Co



2103 9/2<sup>-</sup>  
 2043 7/2<sup>-</sup>

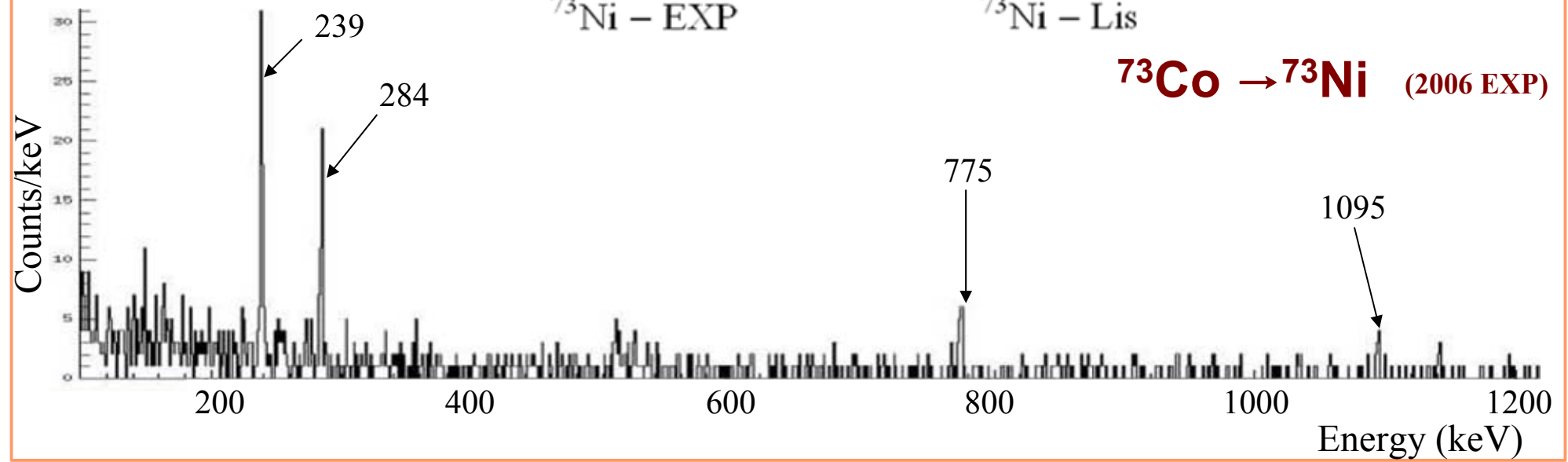
1700 3/2<sup>+</sup>  
 1645 3/2<sup>-</sup>  
 1553 5/2<sup>-</sup>  
 1450 5/2<sup>-</sup>

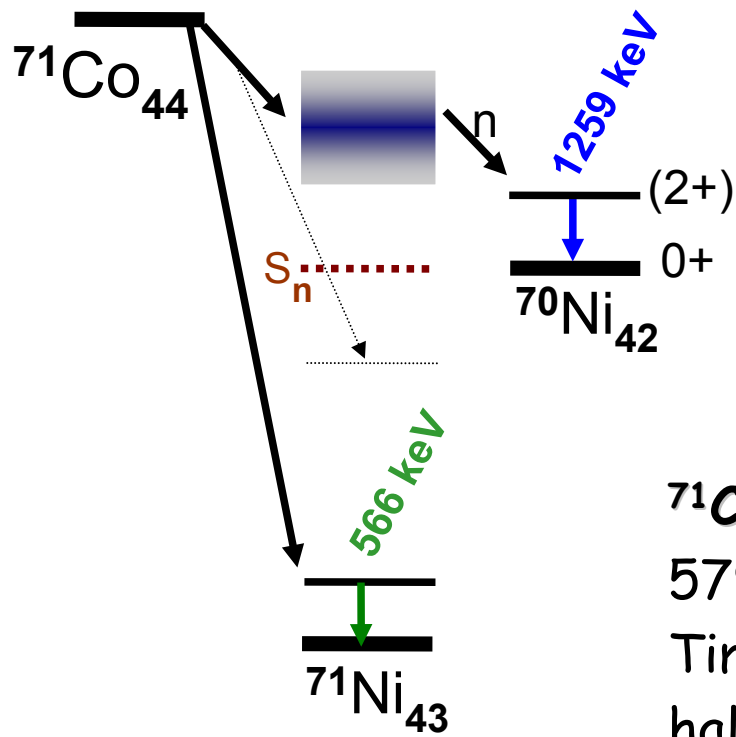
824 1/2<sup>-</sup>  
 788 5/2<sup>+</sup>  
 602 5/2<sup>+</sup>

253 7/2<sup>+</sup>

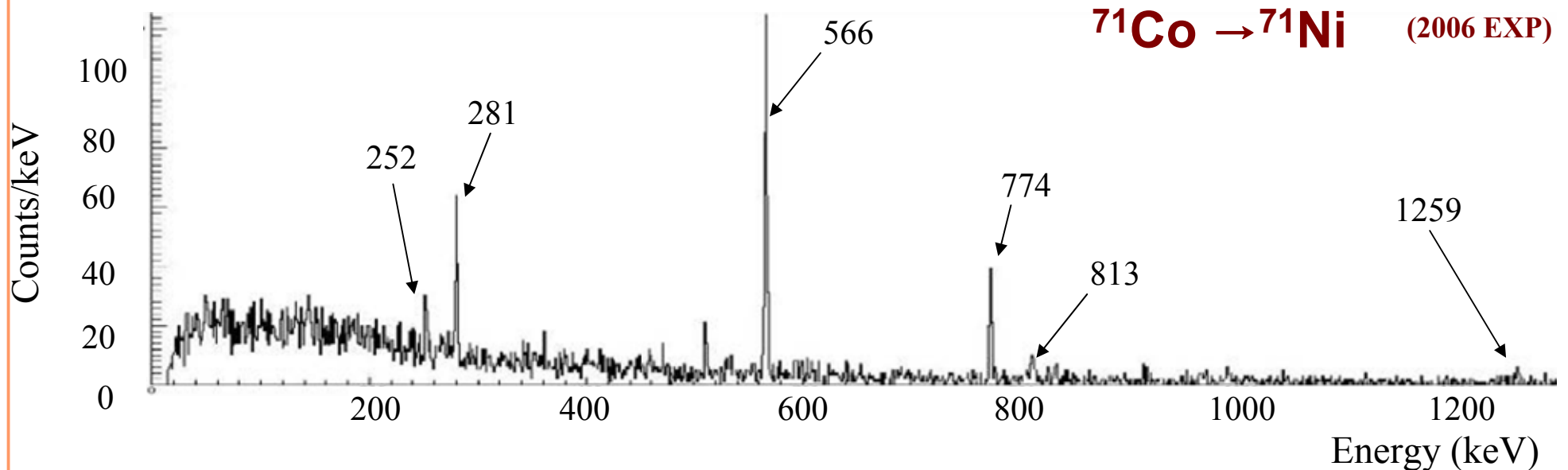
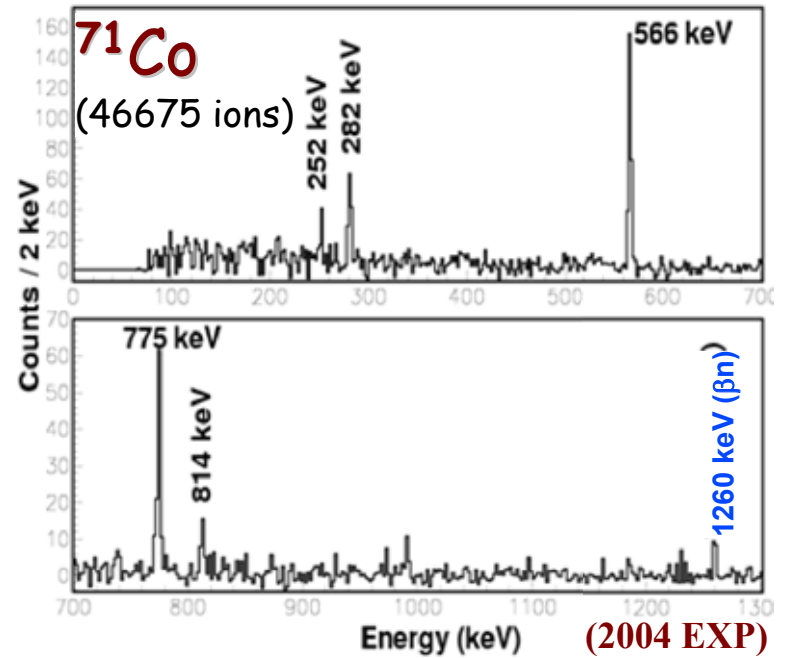
0 9/2<sup>+</sup>

**<sup>73</sup>Co → <sup>73</sup>Ni (2006 EXP)**

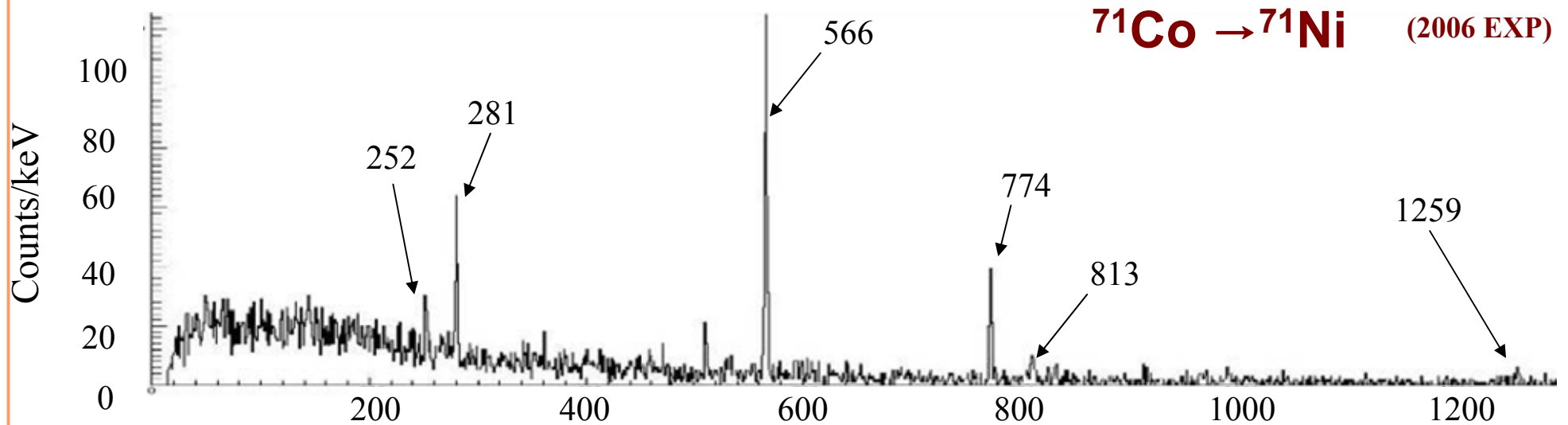
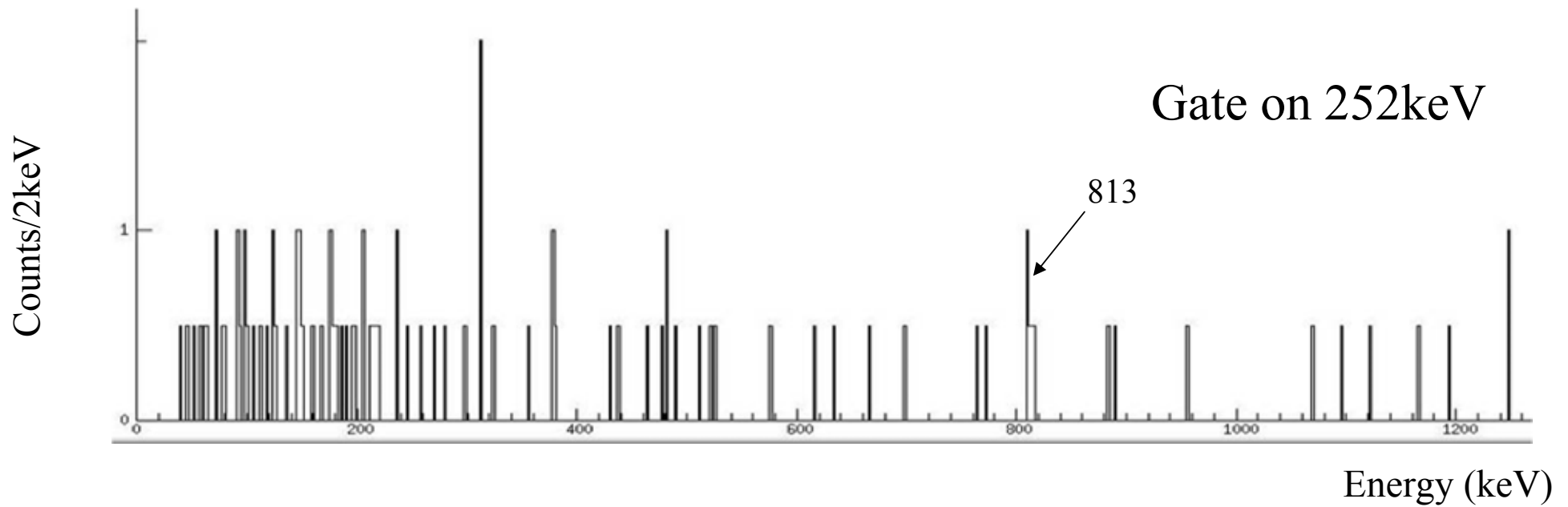




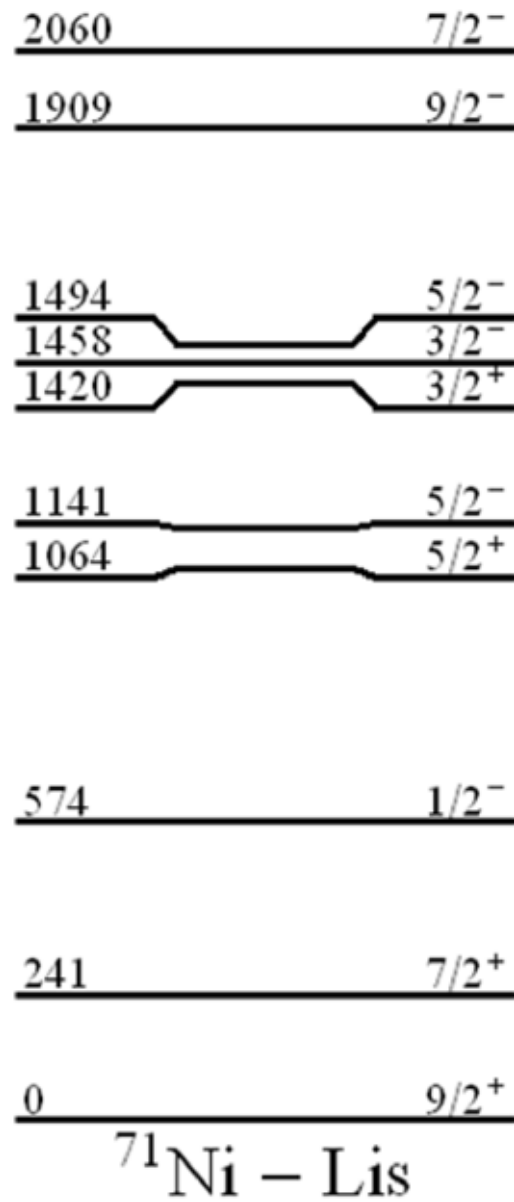
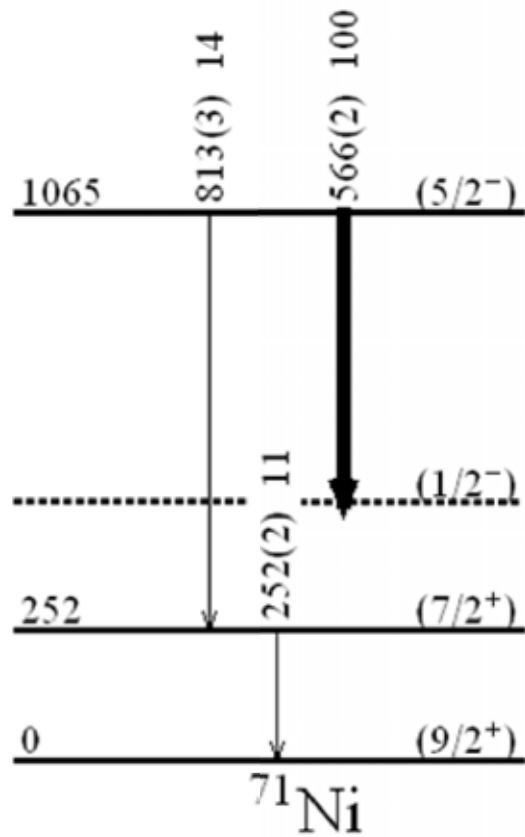
$^{71}\text{Co}$   
 57926 counts  
 Time cut at 400ms,  
 half life 79(5)ms



# $\beta$ - $\gamma$ - $\gamma$ coincidence



$^{71}\text{Co}$  ↘

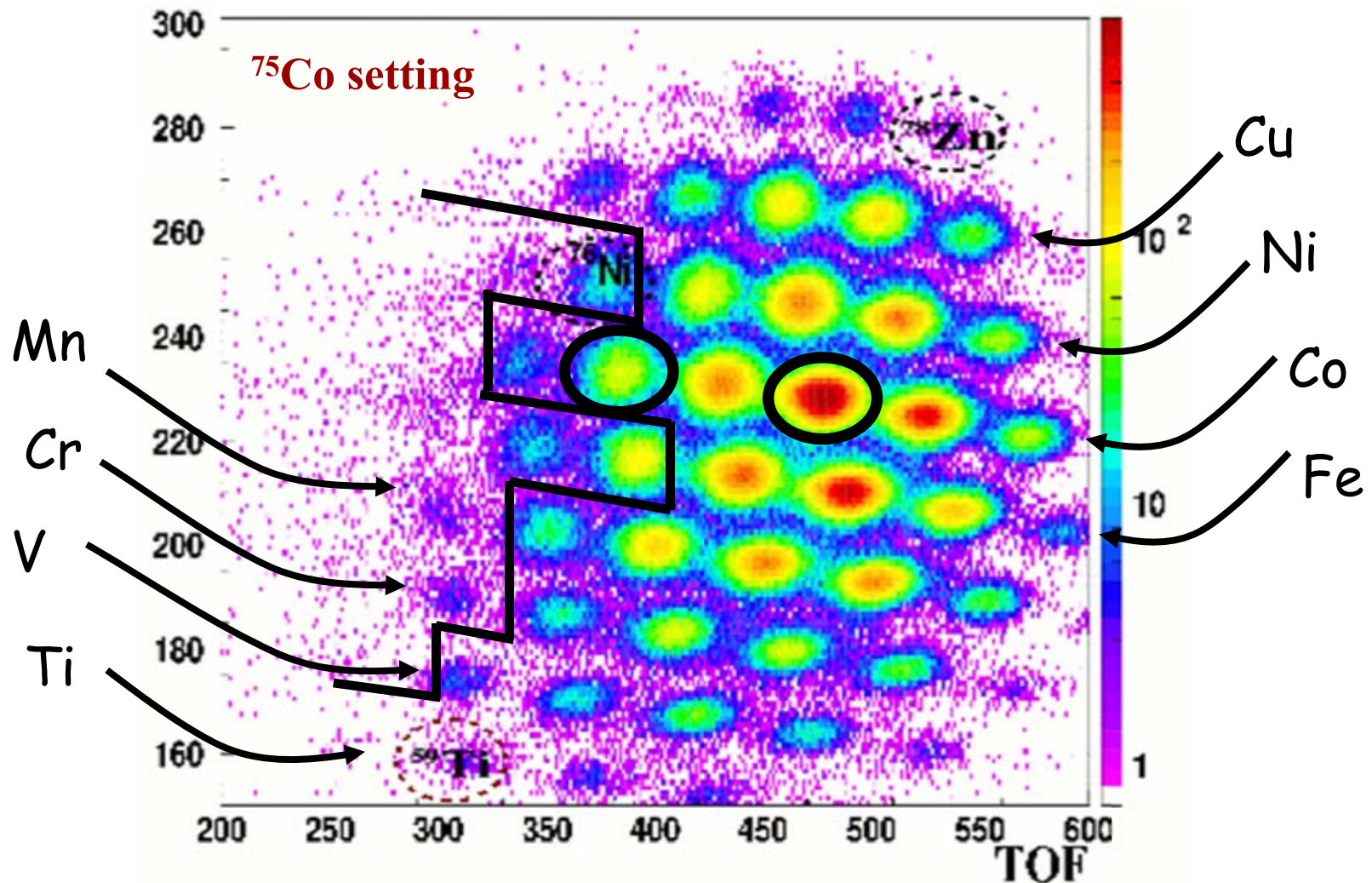


# Summary

- Successful experiment using digital electronics
- Code developed for data acquisition and analysis
- $^{73}\text{Co}$  partial level scheme - determined position of  $5/2^-$
- $^{71}\text{Co}$  odd ball , isomer?
- $\beta$  - decay and  $\beta_n$  emission to be analyzed
- More ions to be analyzed

# What's coming?

- Significant beta decay data for many neutron nuclei



# Collaboration

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END