Gamma-ray Spectroscopy

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Agenda

- Introduction
- Setup
- Target preparation
- Calibration

  -Energy calibration

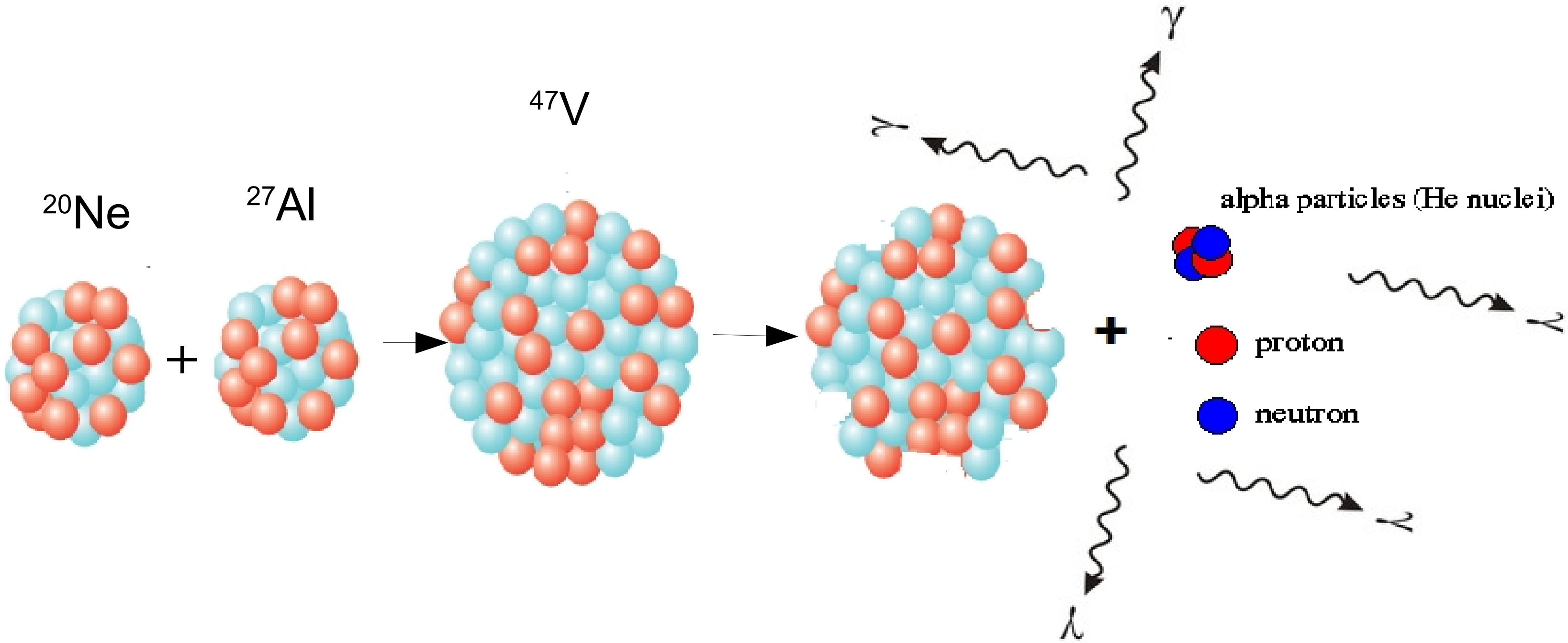
  -Efficiency calibration
- Data Analysis

  -Identifying nuclei

  -Relative population of different reaction channels
- Summary

Introduction

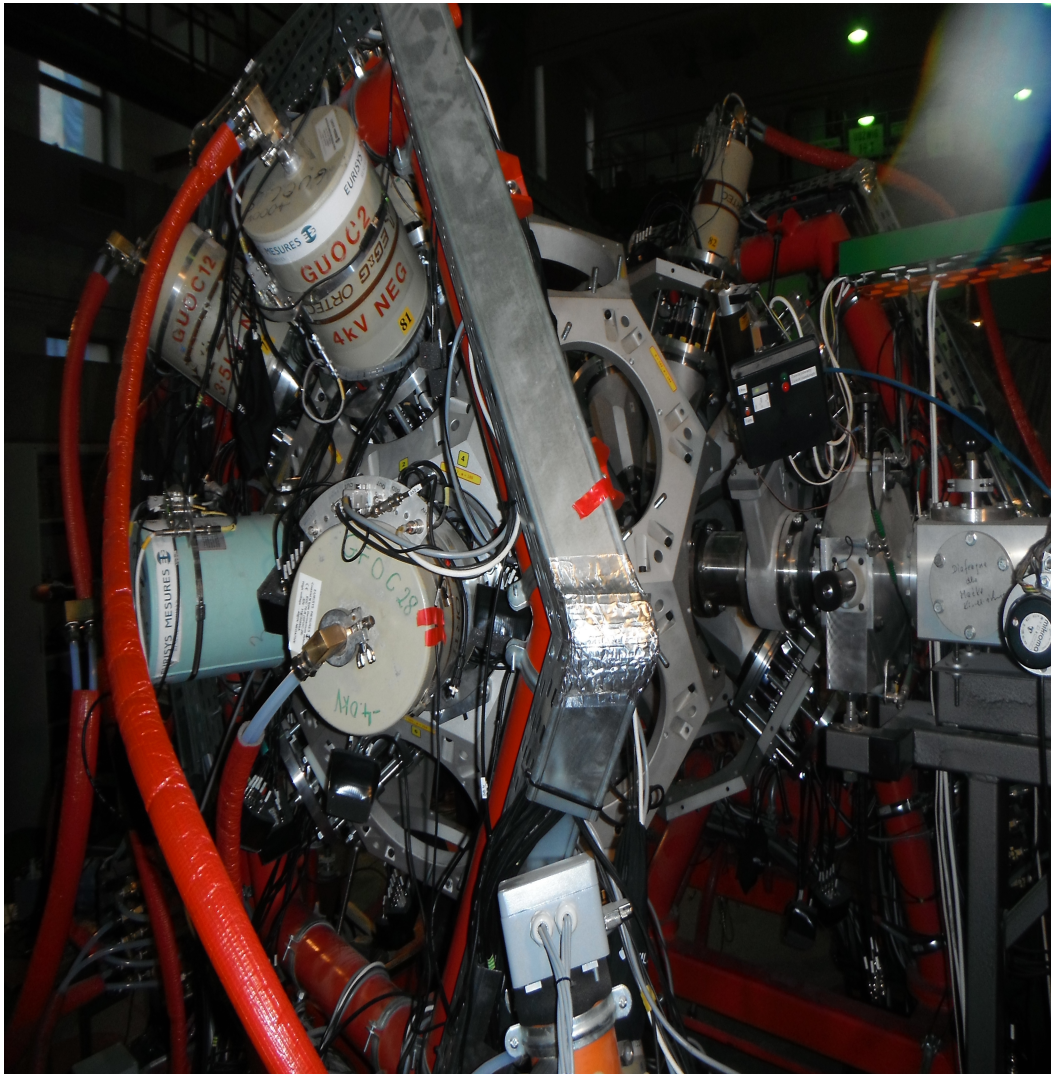
We used a ^{20}Ne beam with an energy of 54MeV at a target of ^{27}Al to obtain a compound nucleus ^{47}V. Various combinations of particles p, n, and α are emmited from CN leading to different residual nuclei.



We register the γ rays and in this way we determine properties of the excited states of the residual nuclei.

Setup

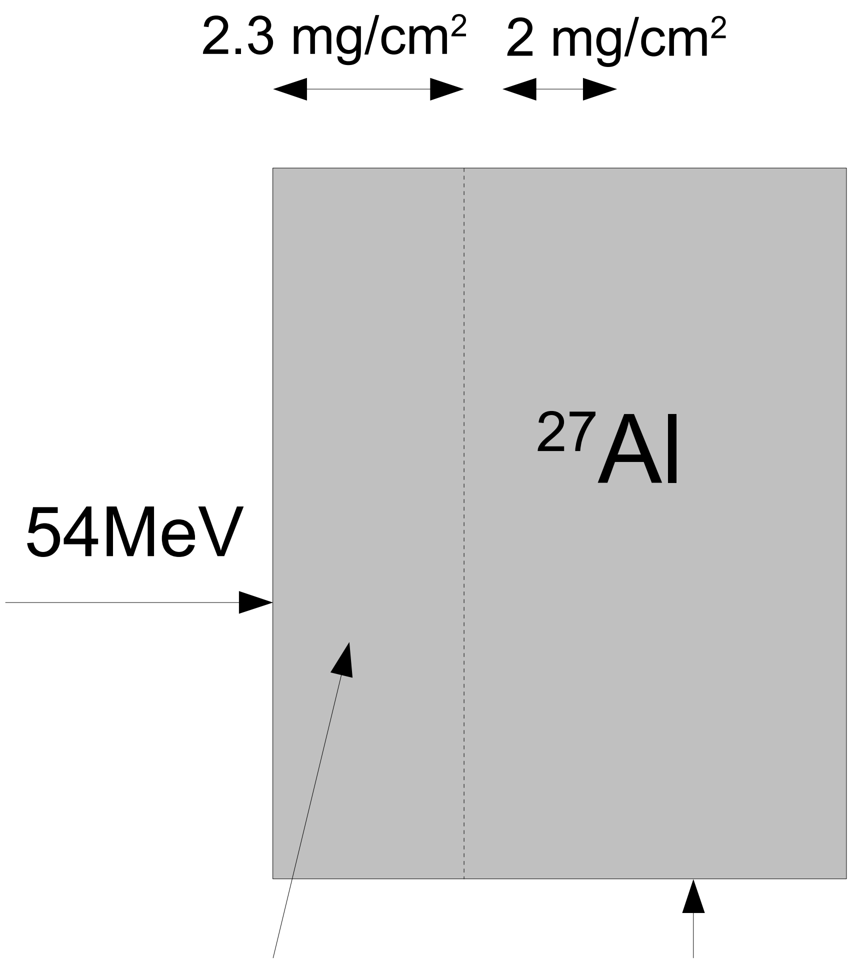
EAGLE



We used 13 compton suppressed Ge detectors

Target

E_c=37.2 MeV (Coulomb barrier)



Slowing down to Ec

Stopping the residual nuclei

Target thickness including safety margin : 5.4 mg/cm²

Target preparation using rolling method

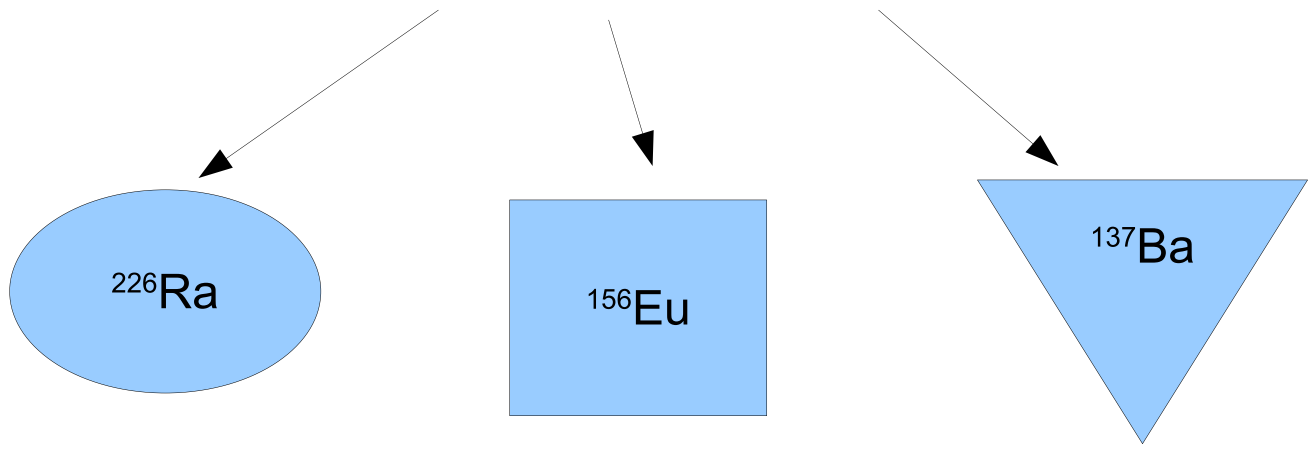
20 μm

Thanks to Anna Stolarz

Energy Calibration

Energy calibration: translating channel numbers (from ADC) to true energy of gamma rays
E= f(x) x-channel number

Used sources

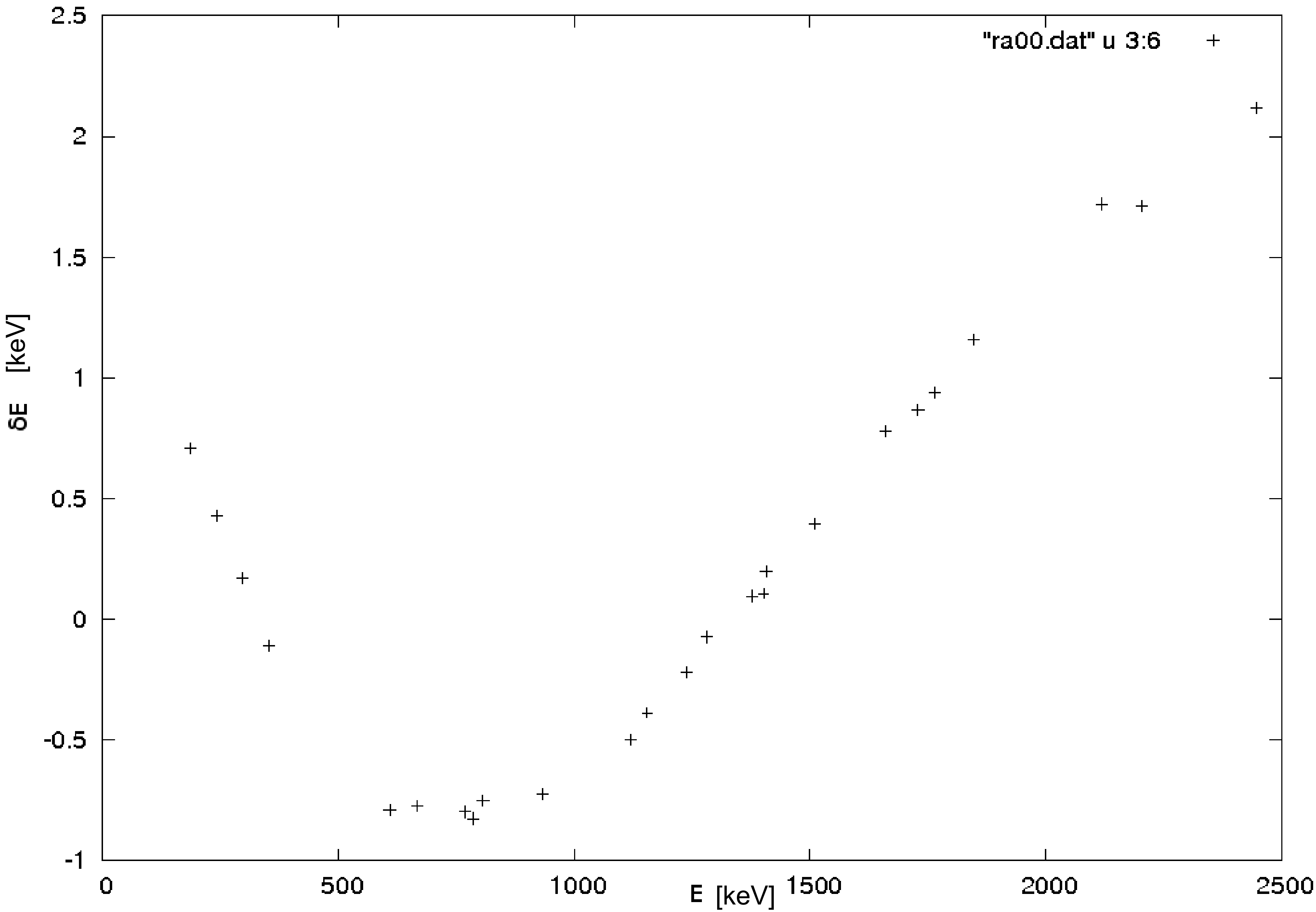


- Positions X_i of peaks corresponding to known γ-ray energies E_i are determined
- A function E = f(x) is fitted to (E_i,X_i) points

Energy Calibration

-Deviation from linearity

^{226}Ra source

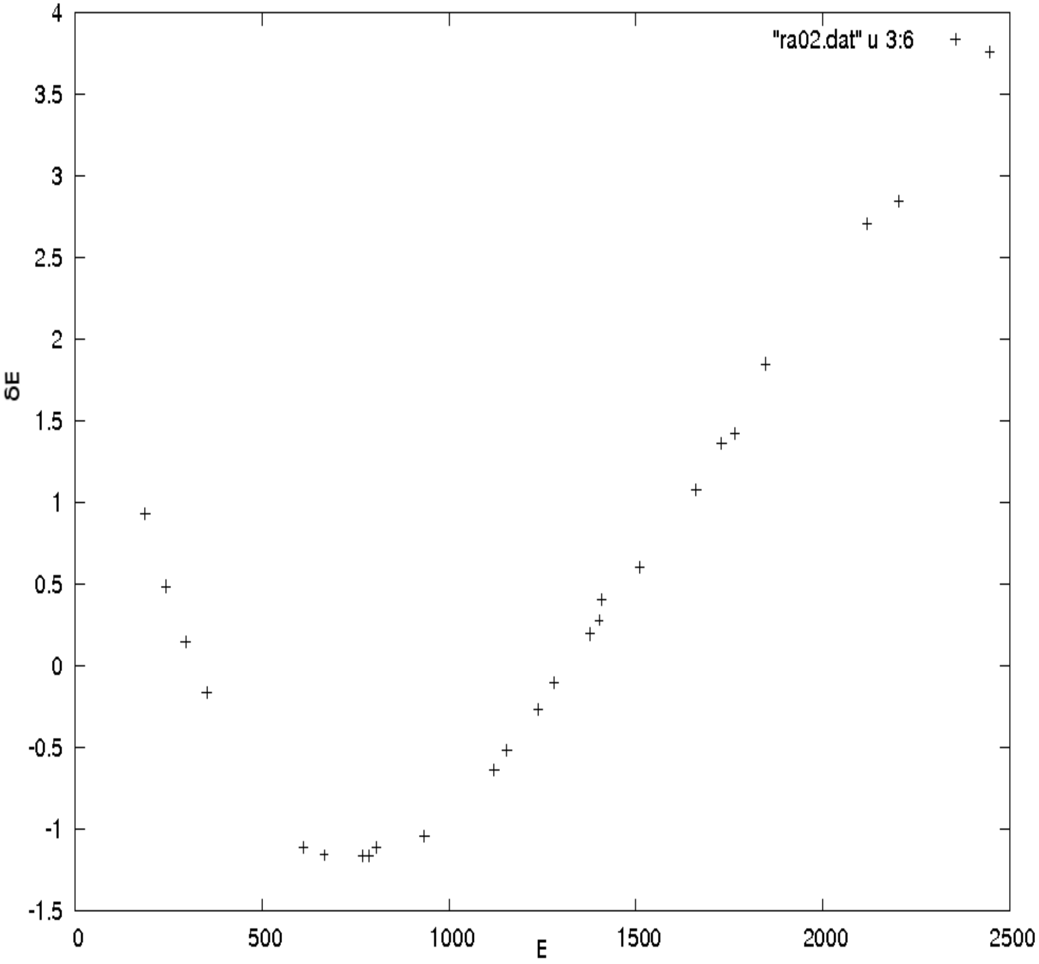


Energy calibration-deviation from linear

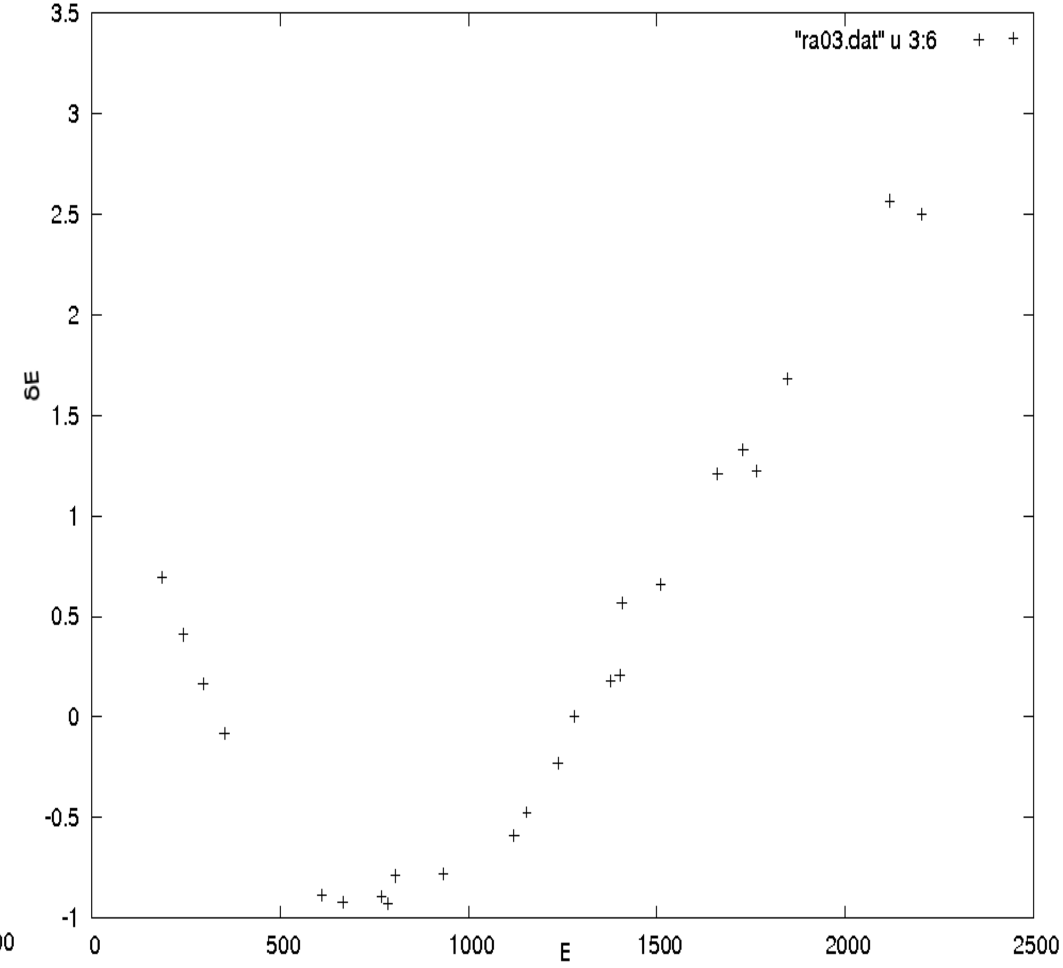
-All detectors have similar nonlinearity

^{226}Ra source

Detector 3



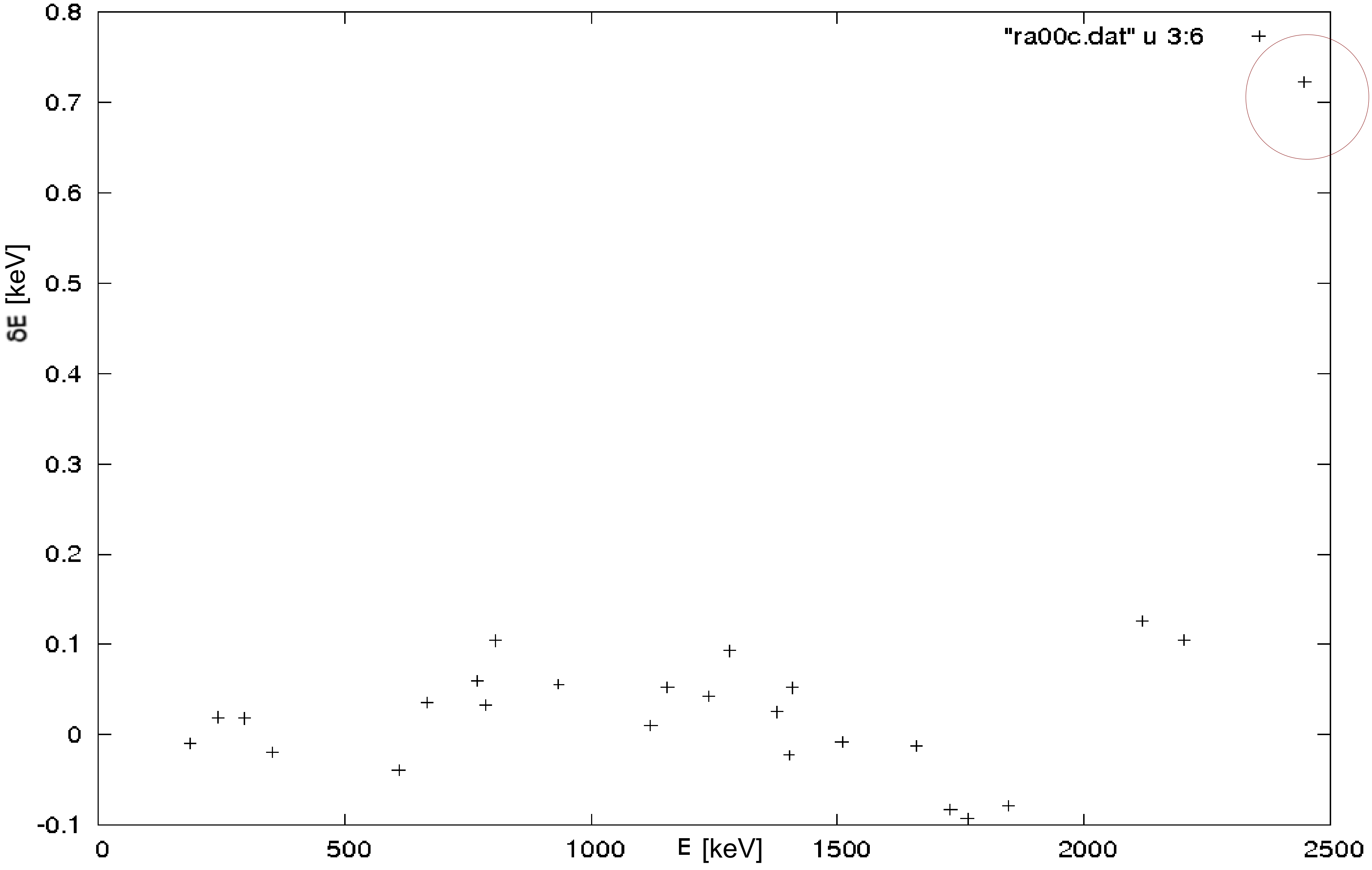
Detector 4



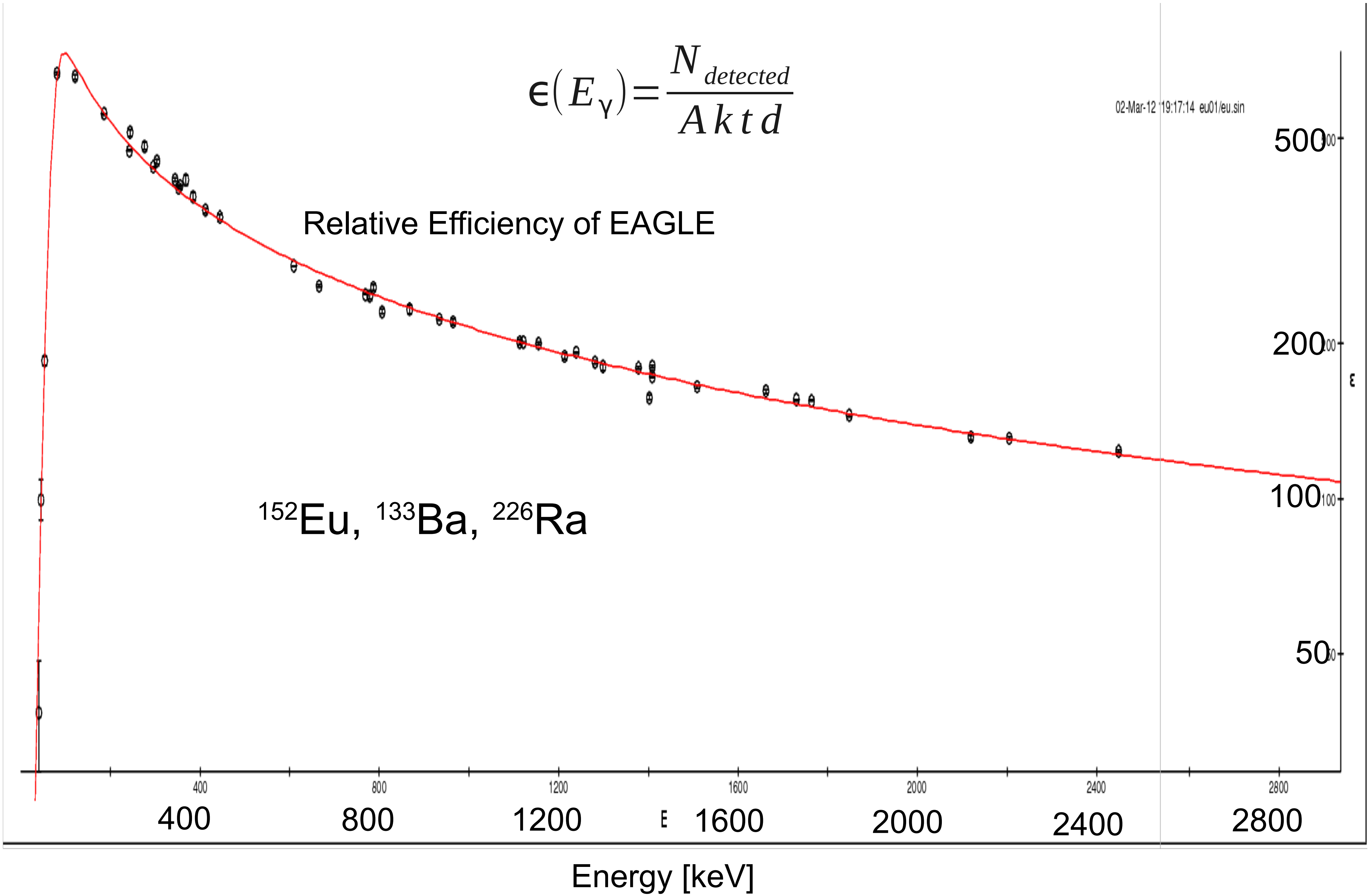
Energy Calibration

-Deviation from third order polynomial fit

^{226}Ra source

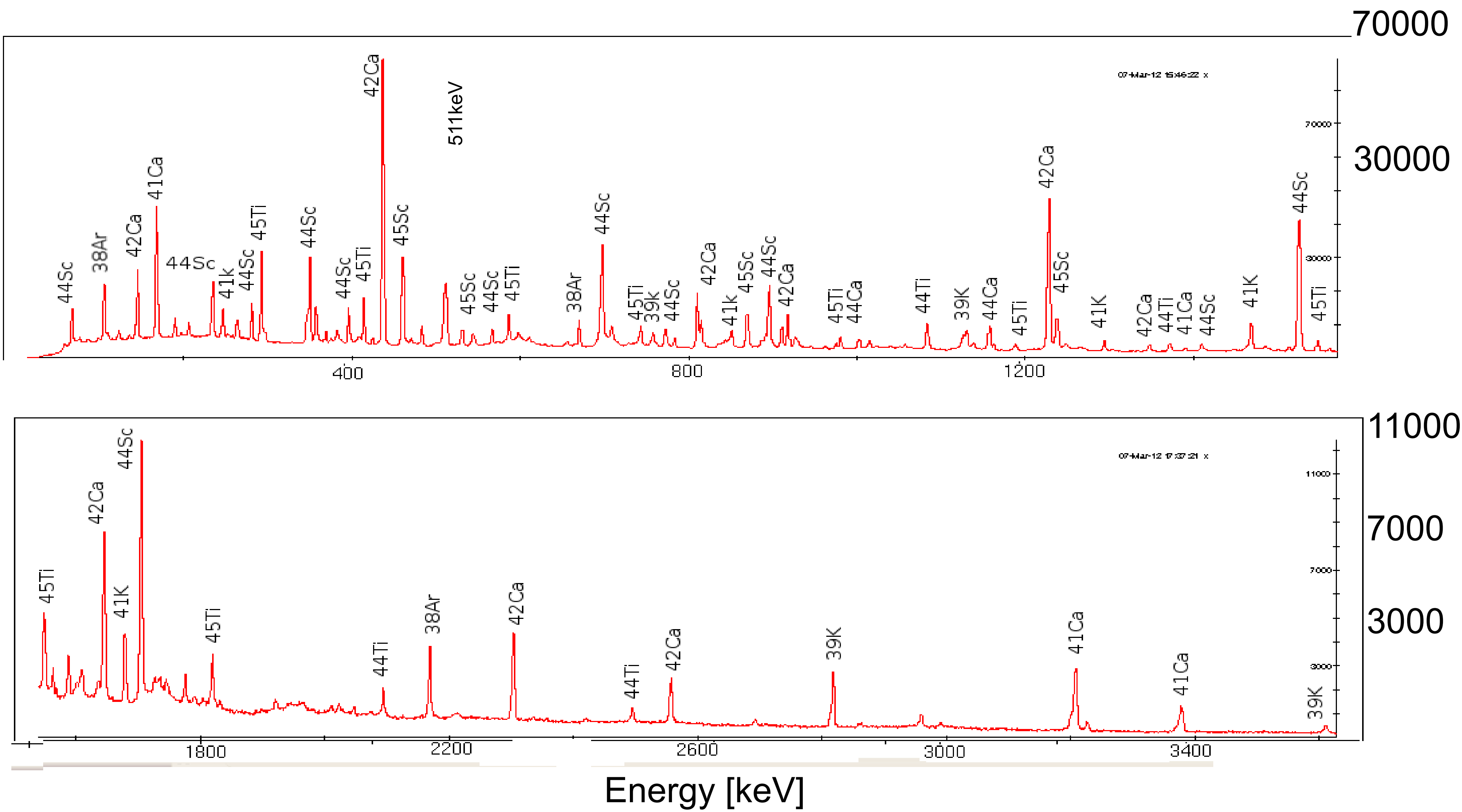


Efficiency calibration

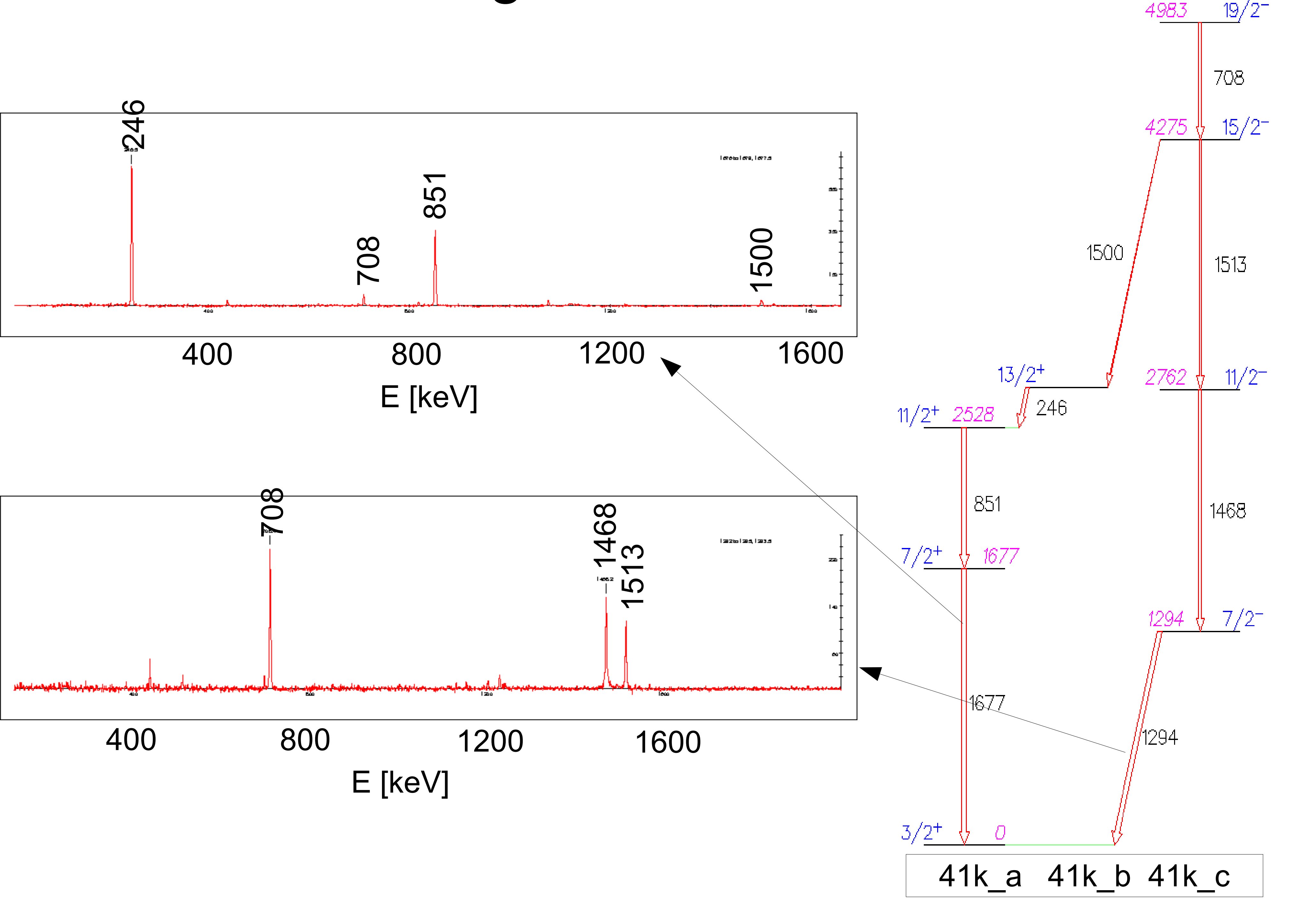


Total gamma-ray spectrum

- about 3 hours of data taking



Gamma-gamma coincidences

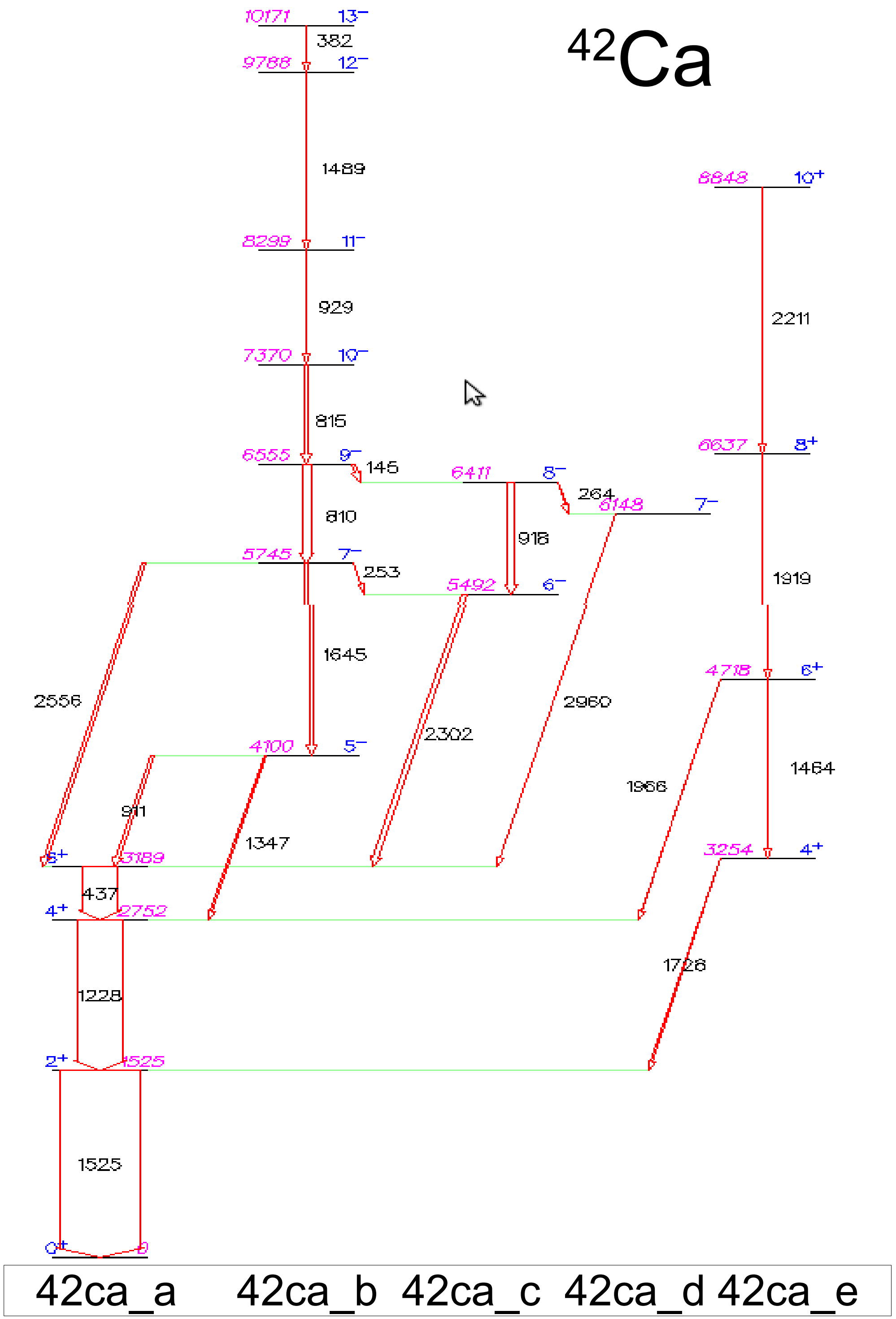


Reaction products - relative yields

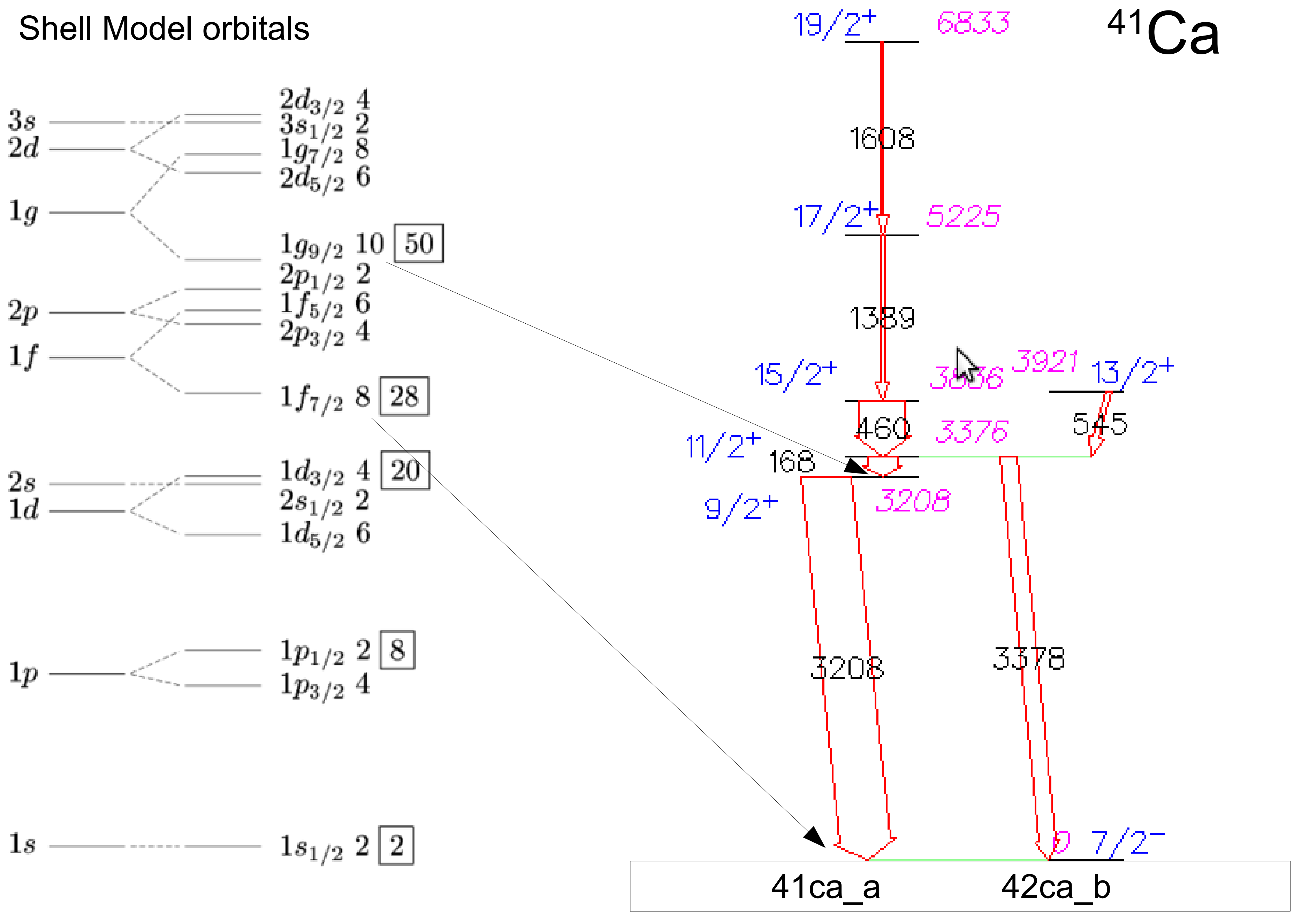
^{20}Ne (54 MeV) + ^{27}Al ----> ^{47}V (CN)

19	20	21	22	23	24	N/Z
^{42}V	^{43}V	^{44}V	^{45}V	^{46}V	^{47}V CN	23
^{41}Ti	^{42}Ti	^{43}Ti	^{44}Ti 4.3% p2n	^{45}Ti 11.6% pn	^{46}Ti	22
^{40}Sc	^{41}Sc	^{42}Sc 1.2% αn/3n2p	^{43}Sc	^{44}Sc 23.3% 2pn	^{45}Sc 10.2% 2p	21
^{39}Ca	^{40}Ca	^{41}Ca 7.8% αpn/3p3n	^{42}Ca 29.1% αp/3p2n	^{43}Ca	^{44}Ca 0.7% 3p	20
^{38}K	^{39}K 4.6% 2α/4p4n	^{40}K	^{41}K 4.0% α2p/4p2n	^{42}K	^{43}K	19
^{37}Ar	^{38}Ar 3.2% 2αp/5p4n	^{39}Ar	^{40}Ar	^{41}Ar	^{42}Ar	18

Level Scheme



Level Scheme



Summary

- We used EAGLE setup to study $^{20}Ne + ^{27}Al \rightarrow ^{47}V$ (CN)
- Target preparation
- Energy and efficiency calibration
- Identified 11 different reaction products
- Relative yields determined

Thank You for your attention!