Status update on the analysis of ^{80}Se(n,γ), ^{56}Fe(n,γ) & ^{93}Nb(n,γ)
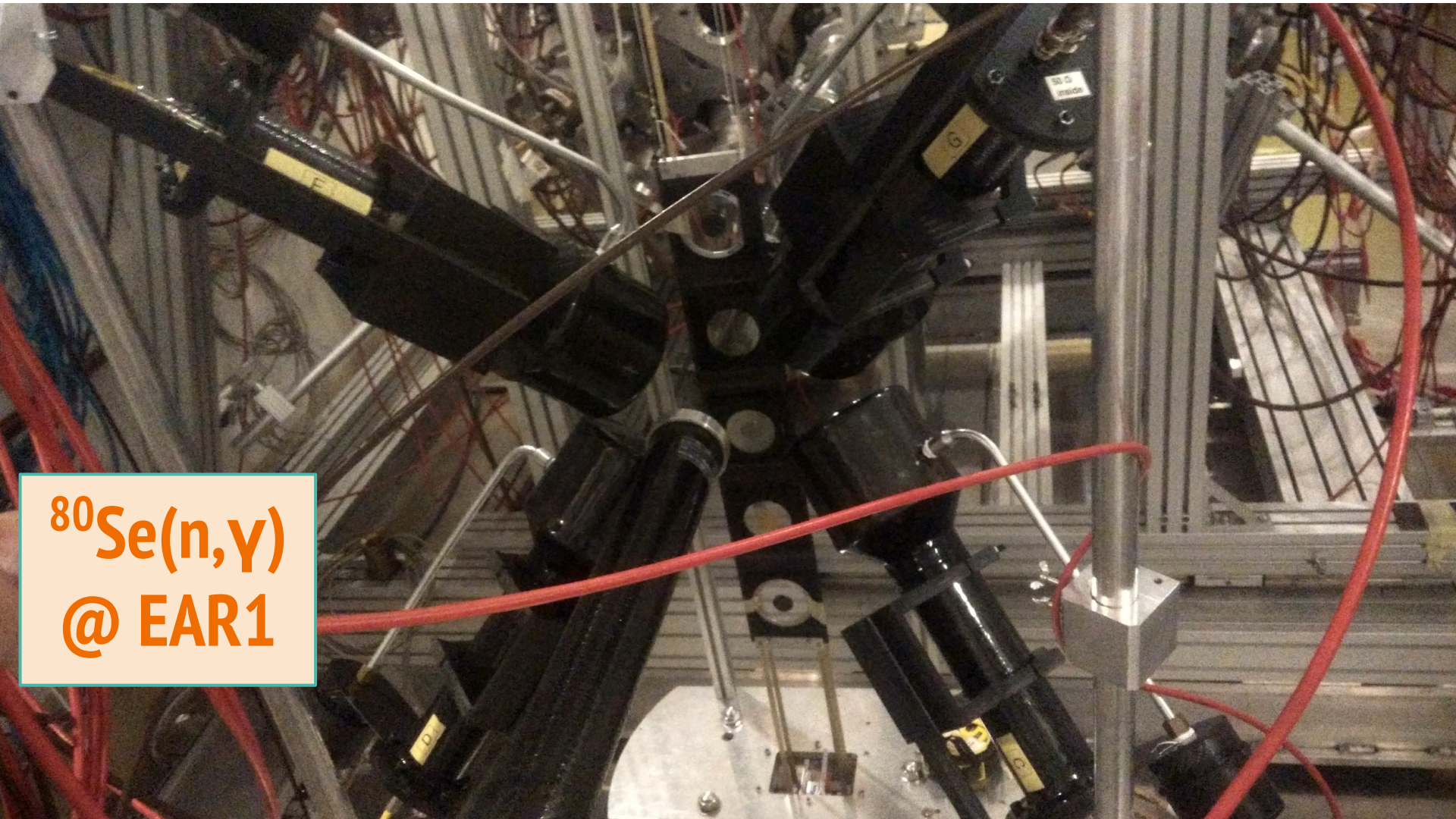
Víctor Babiano Suárez

Javier Balibrea, Luis Caballero, David Calvo, Cesar Domingo, Ion Ladarescu, Jorge Lerendegui, Pablo Olleros, José Luis Taín
IFIC (Universitat de València – CSIC)
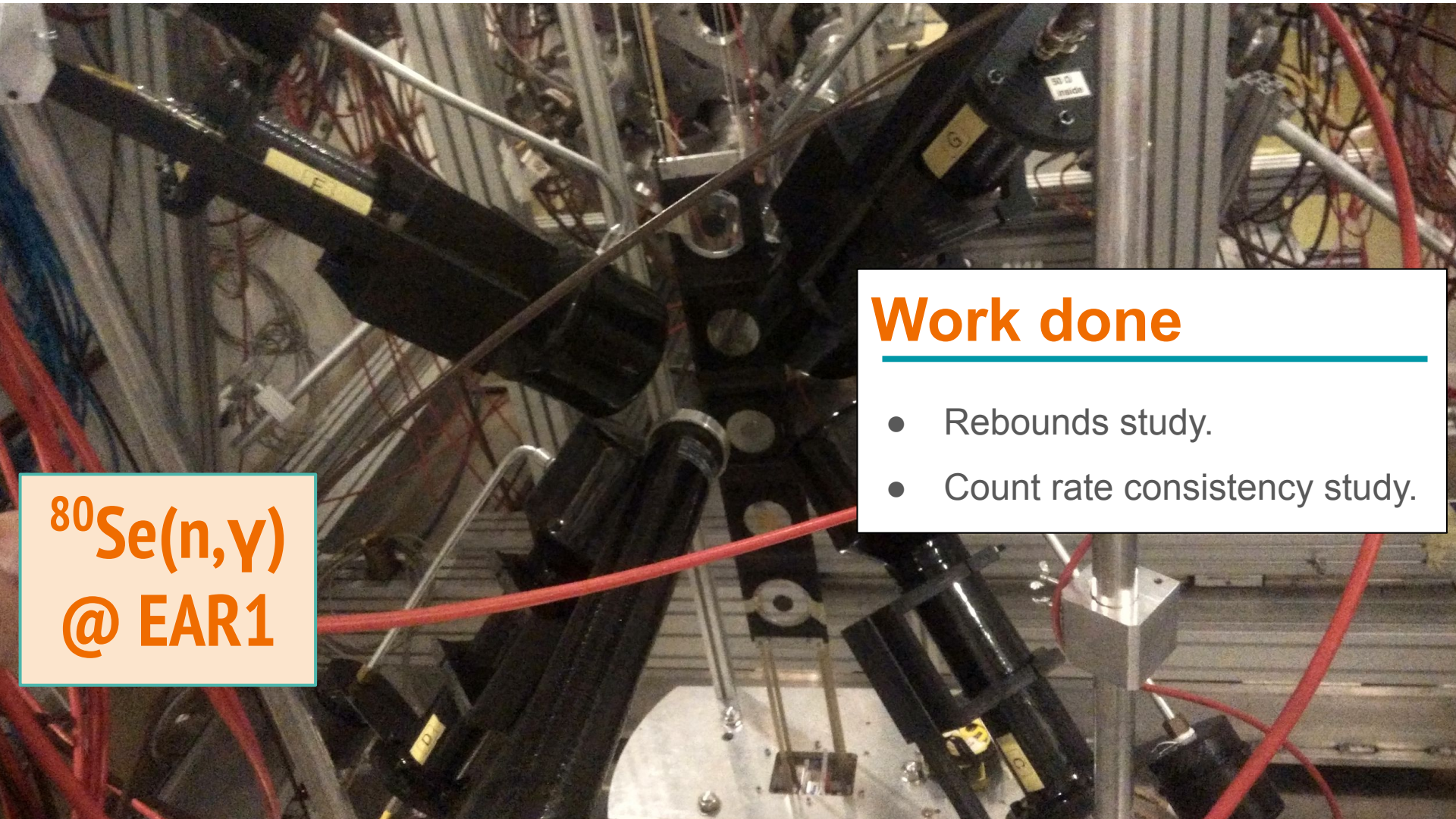
Francisco Calviño, Adria Casanovas, Ariel Tarifeño (UPC)

Victor Alcayne (CIEMAT)

Carlos Guerrero, Mª Ángeles Millán, Mª Teresa Rodríguez (US)

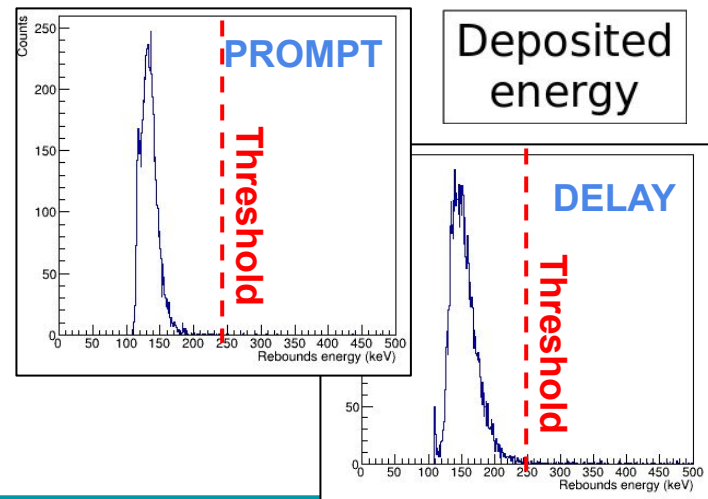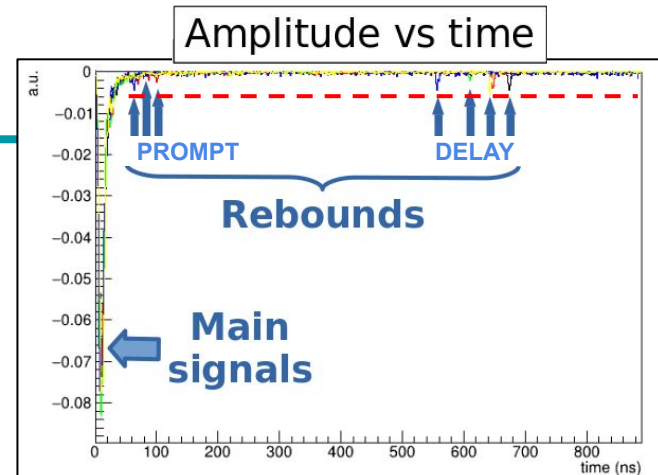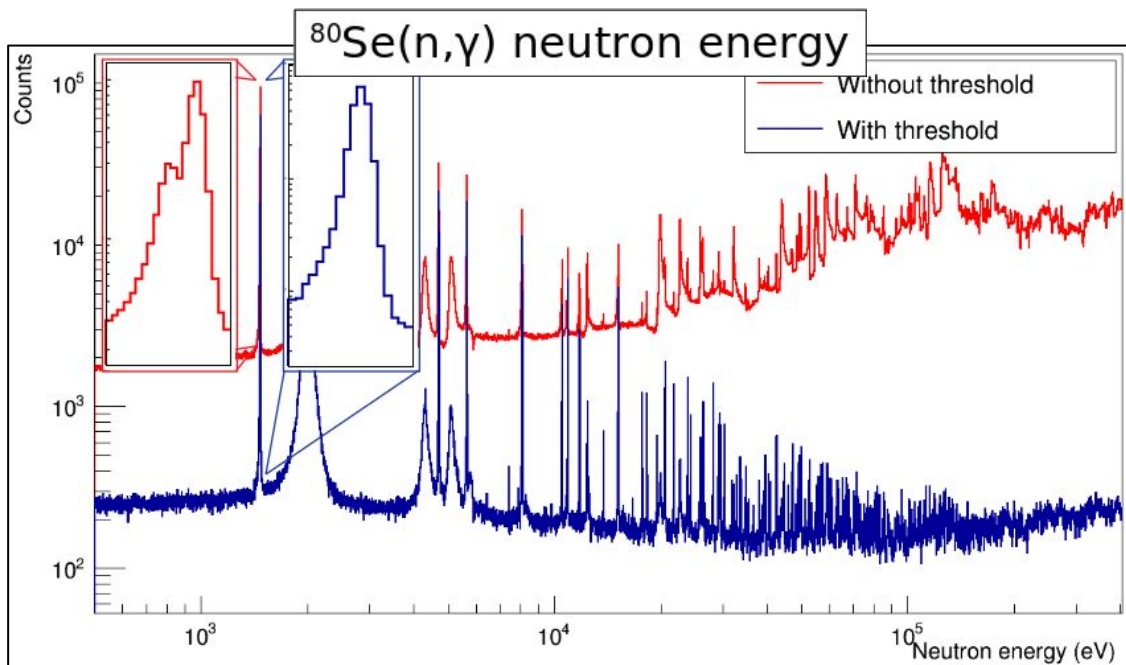n_TOF local team and the n_TOF Collaboration

^{80}Se(n,γ) @ EAR1

^{80}Se(n,γ)
@ EAR1

Work done

- Rebounds study.

- Count rate consistency study.

Past meeting results

- Rebounds

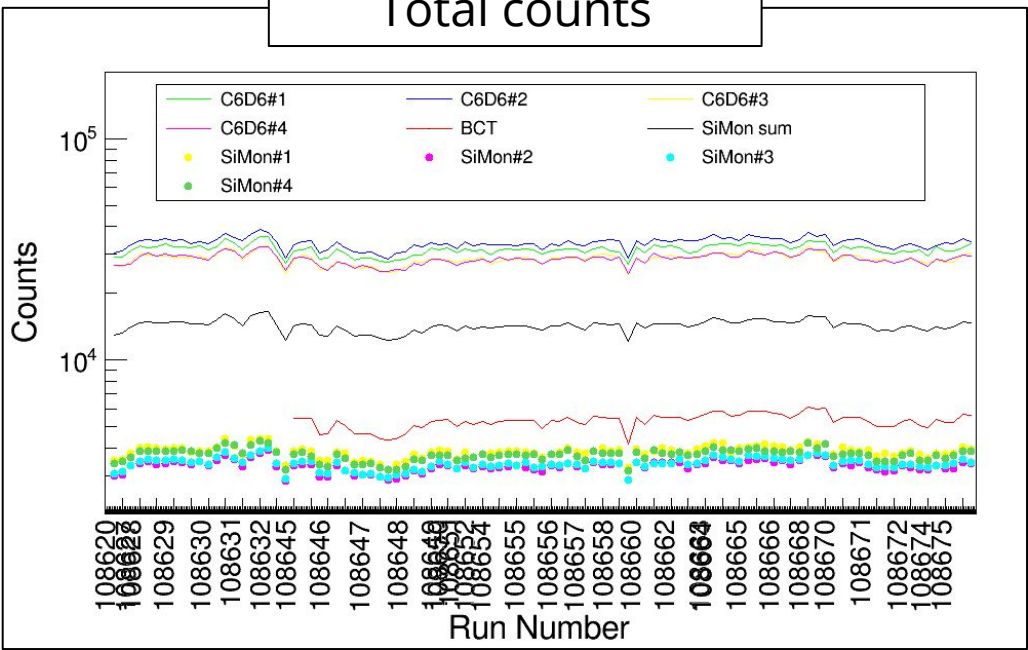Amplitude vs time

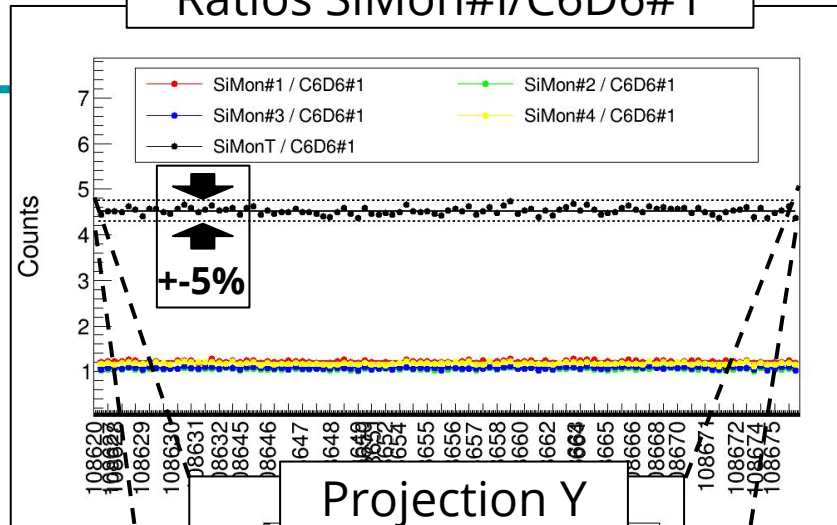^{80}Se(n,γ) neutron energy

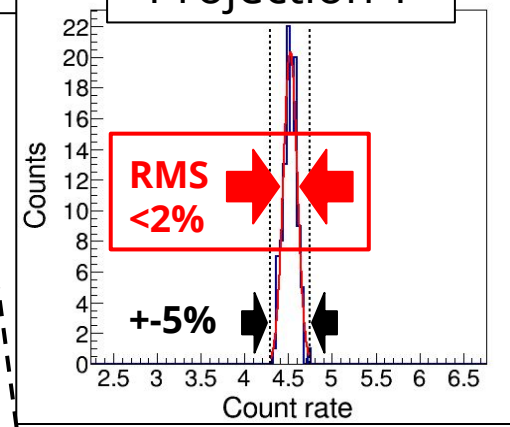Deposited energy

Past meeting results

- Count rate consistency study

Total counts

Ratios SiMon#i/C6D6#1

Projection Y

Past meeting results

- Count rate consistency study
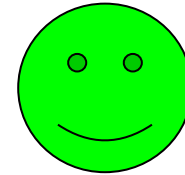
Sample	Total	Good	%
Au	2.136e17	2.136e17	**100**
Empty	1.512e17	1.512e17	**100**
Empty + Filters	3.579e17	3.579e17	**100**
Se Thick	1.732e18	1.732e18	**100**
Se Thick + F	1.109e17	1.109e17	**100**
Se Thin	9.618e16	9.618e16	**100**

Ongoing work

Determination of the PHWT:

- Detectors gain stability study.

- Monte-Carlo simulation of monoenergetic gamma rays.

- C_6D_6 detectors calibration.

- Spectra convolution.

  Measurements + Simulation results

- Calculate a weighting function (WF) for each C_6D_6 detector.

- Check WFs.

- Weight ^{80}Se(n,g) spectrum.

Ongoing work

Determination of the PHWT:

- Detectors gain stability study.

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Measurements + Simulation results

- Calculate a weighting function (WF) for each C_6D_6 detector.

- Check WFs.

- Weight $^{80}Se(n,g)$ spectrum.

DISCLAIMER
- All results are preliminar.
- Systematic study is now ongoing.
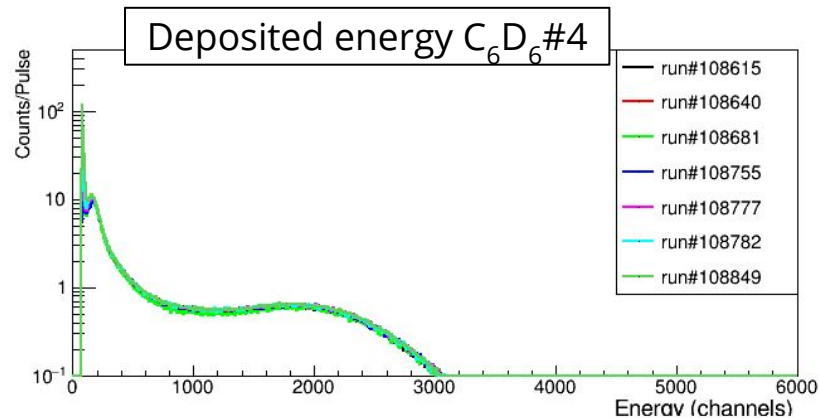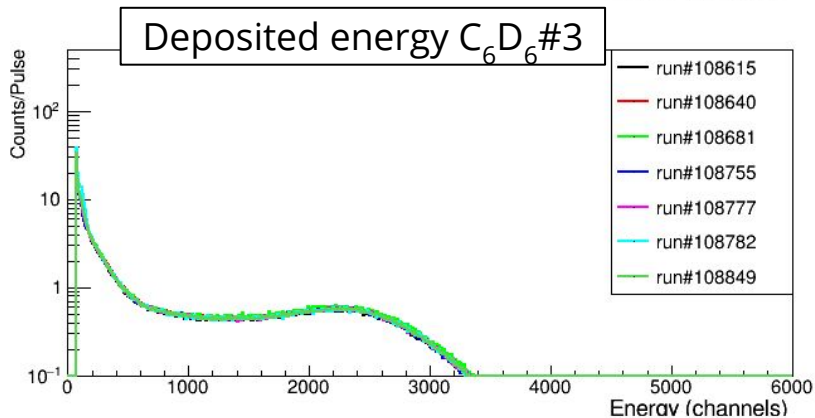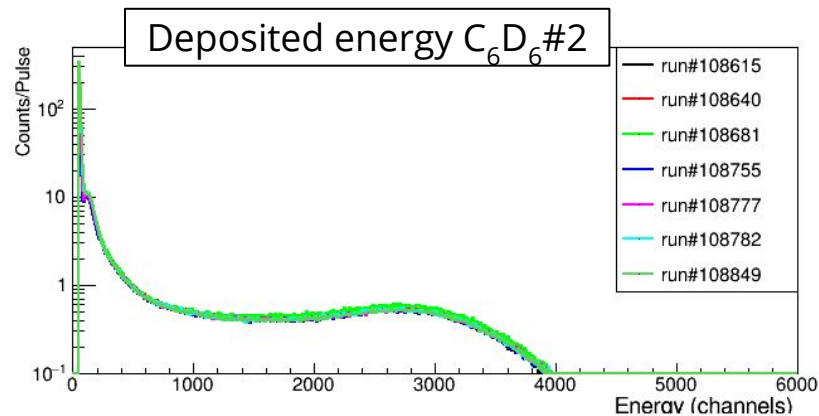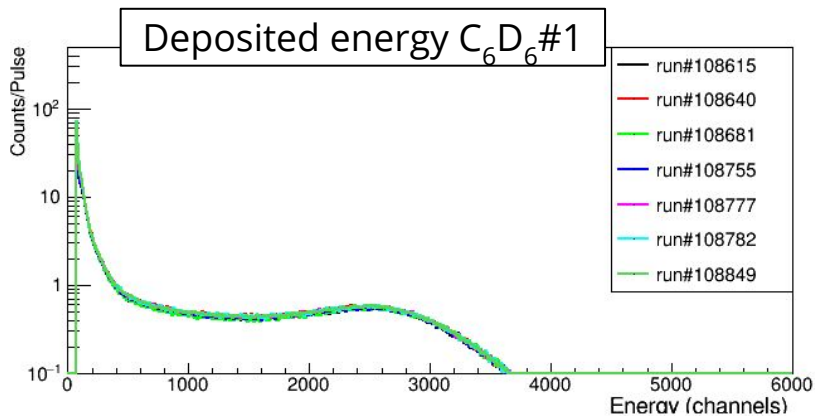- Every comment will be well received!

Ongoing work

Determination of the PHWT:

- Detectors gain stability study.

- Monte-Carlo simulation of monoenergetic gamma rays.

- C_6D_6 detectors calibration.

- Spectra convolution.

  Measurements + Simulation results

- Calculate a weighting function (WF) for each C_6D_6 detector.

- Check WFs.

- Weight $^{80}Se(n,g)$ spectrum.

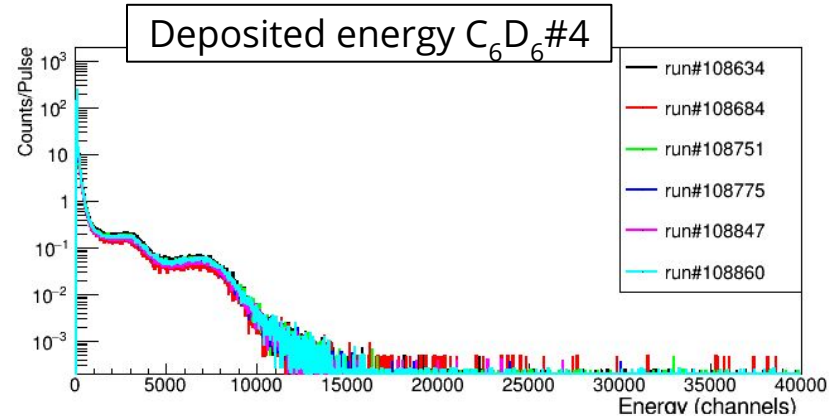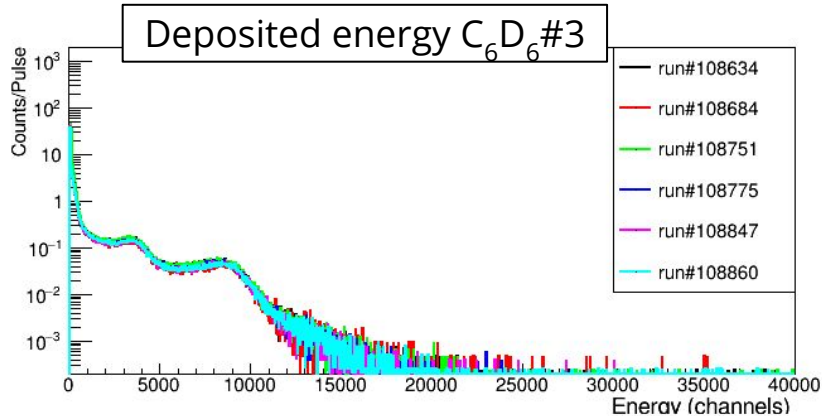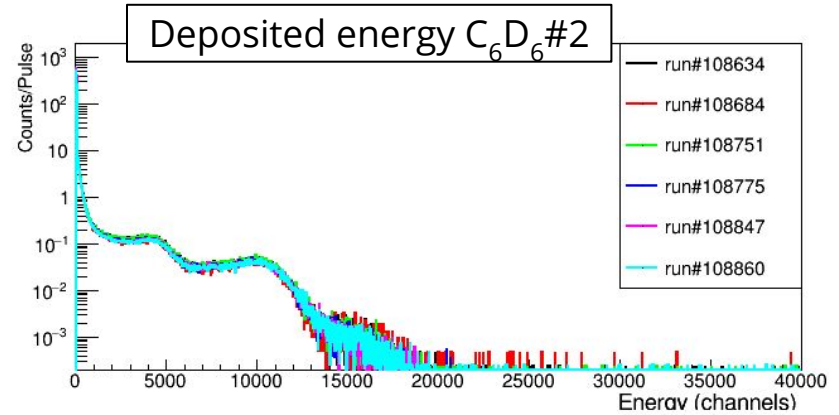# Detectors gain stability study

Deposited energy C_6D_6#1 — run#108615, run#108640, run#108681, run#108755, run#108777, run#108782, run#108849

Deposited energy C_6D_6#2 — run#108615, run#108640, run#108681, run#108755, run#108777, run#108782, run#108849

Deposited energy C_6D_6#3 — run#108615, run#108640, run#108681, run#108755, run#108777, run#108782, run#108849

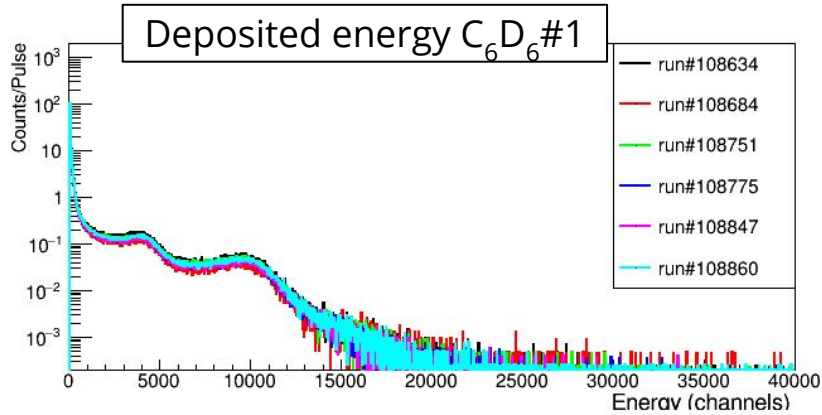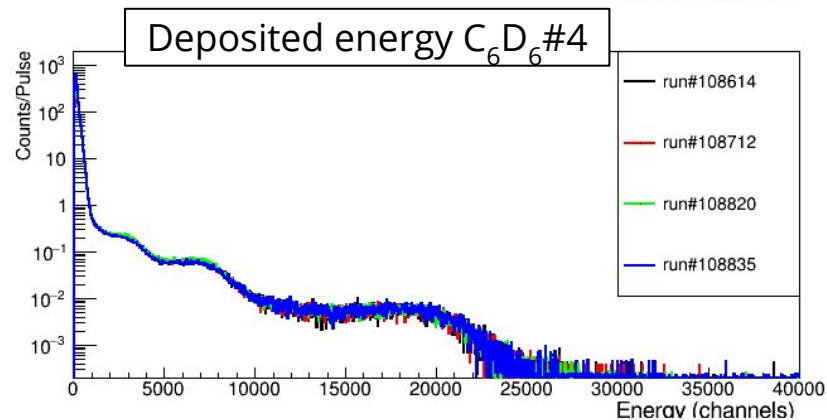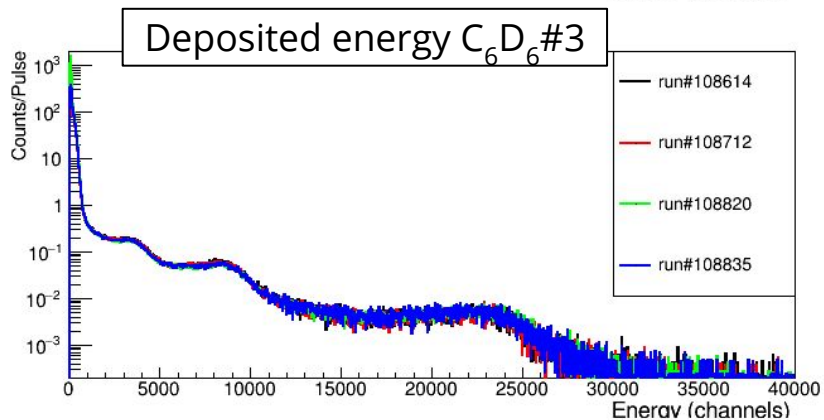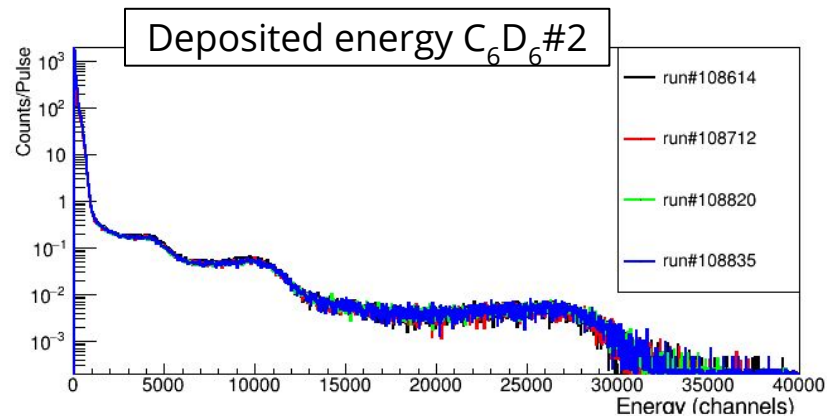Deposited energy C_6D_6#4 — run#108615, run#108640, run#108681, run#108755, run#108777, run#108782, run#108849

Detectors gain stability study

Deposited energy C_6D_6#1

Deposited energy C_6D_6#2

Deposited energy C_6D_6#3
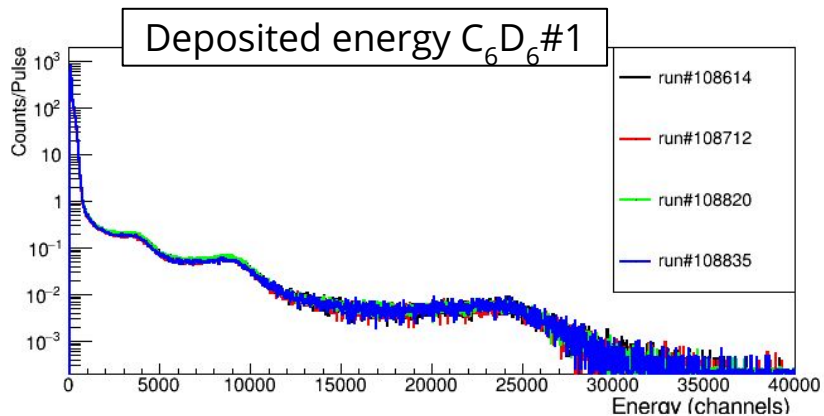
Deposited energy C_6D_6#4

Detectors gain stability study

Deposited energy C_6D_6#1 — run#108614, run#108712, run#108820, run#108835

Deposited energy C_6D_6#2 — run#108614, run#108712, run#108820, run#108835

Deposited energy C_6D_6#3 — run#108614, run#108712, run#108820, run#108835

Deposited energy C_6D_6#4 — run#108614, run#108712, run#108820, run#108835

Detectors gain stability study

Detectors gain stability study

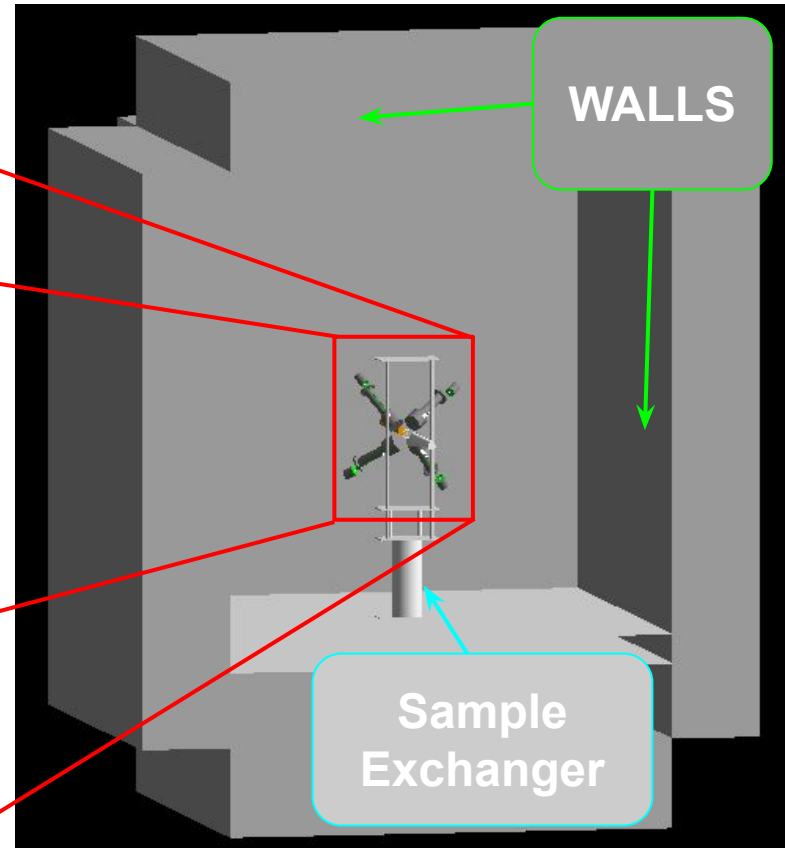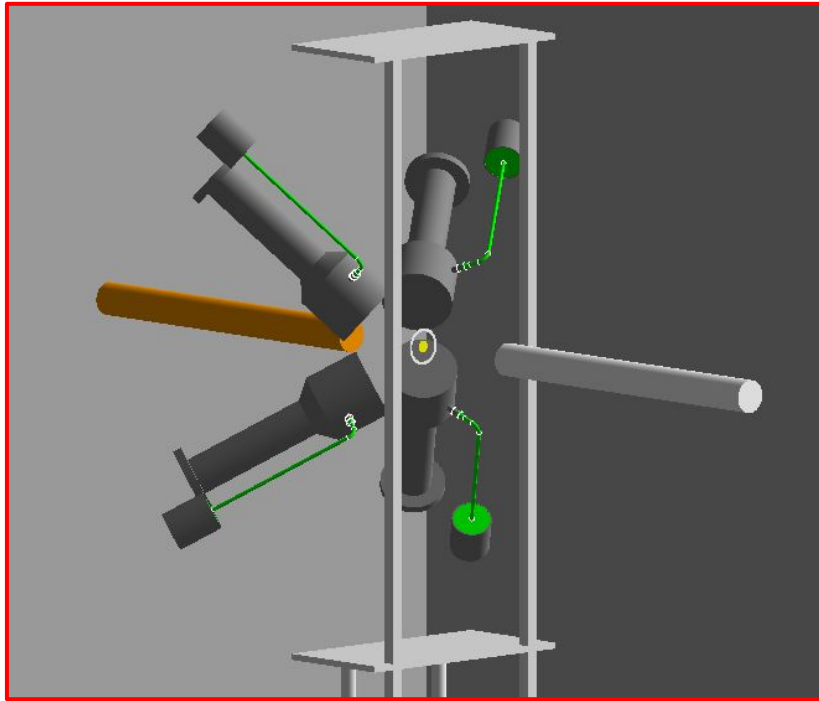Gain stability for all C_6D_6 detectors has been checked successfully

On going work

Determination of the PHWT:

- Detectors gain stability study.

- **Monte-Carlo simulation of monoenergetic gamma rays.**

- C_6D_6 detectors calibration.

- Spectra convolution.

Measurements + Simulation results

- Calculate a weighting function (WF) for each C_6D_6 detector.

- Check WFs.

- Weight $^{80}Se(n,g)$ spectrum.

Detectors calibration

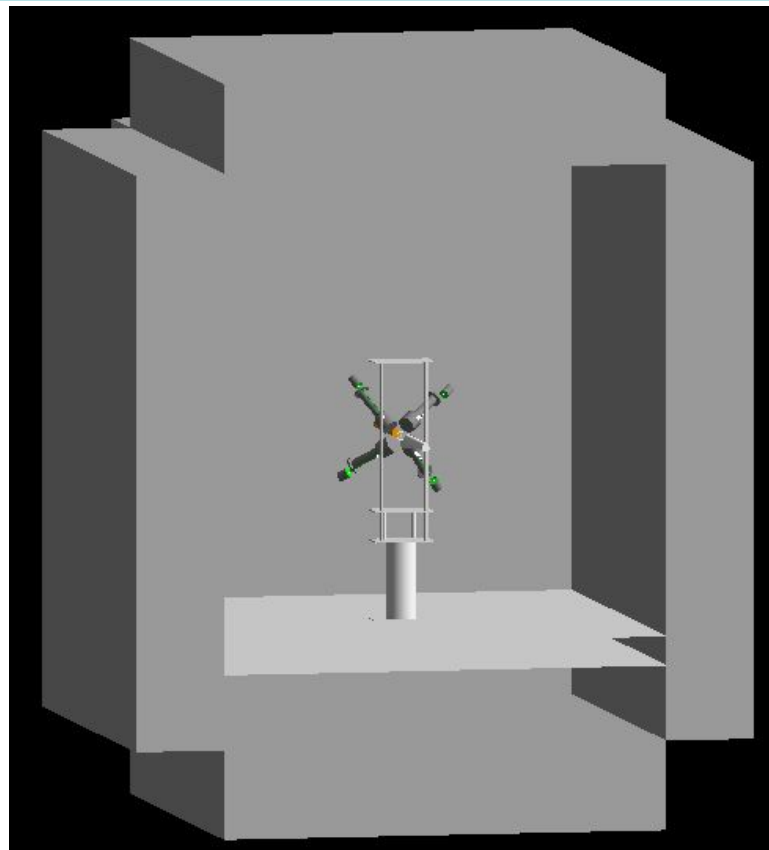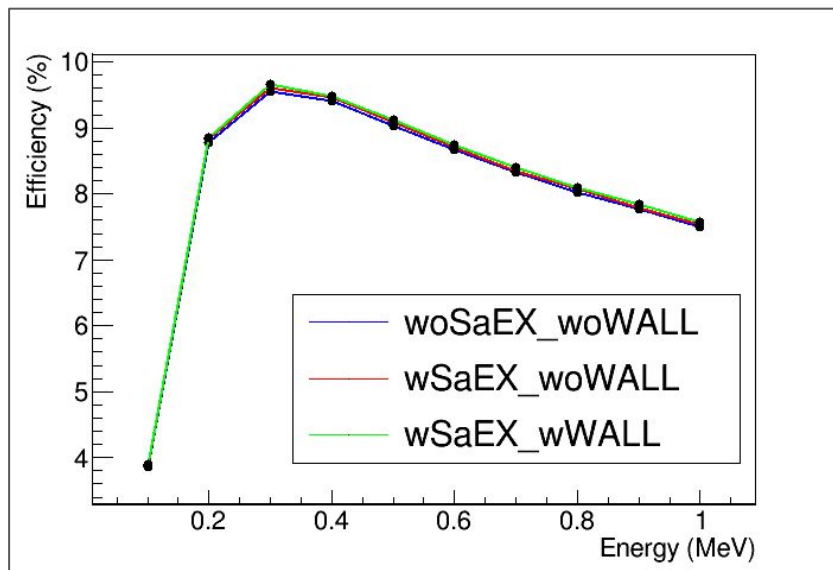- Geant4 simulation

WALLS
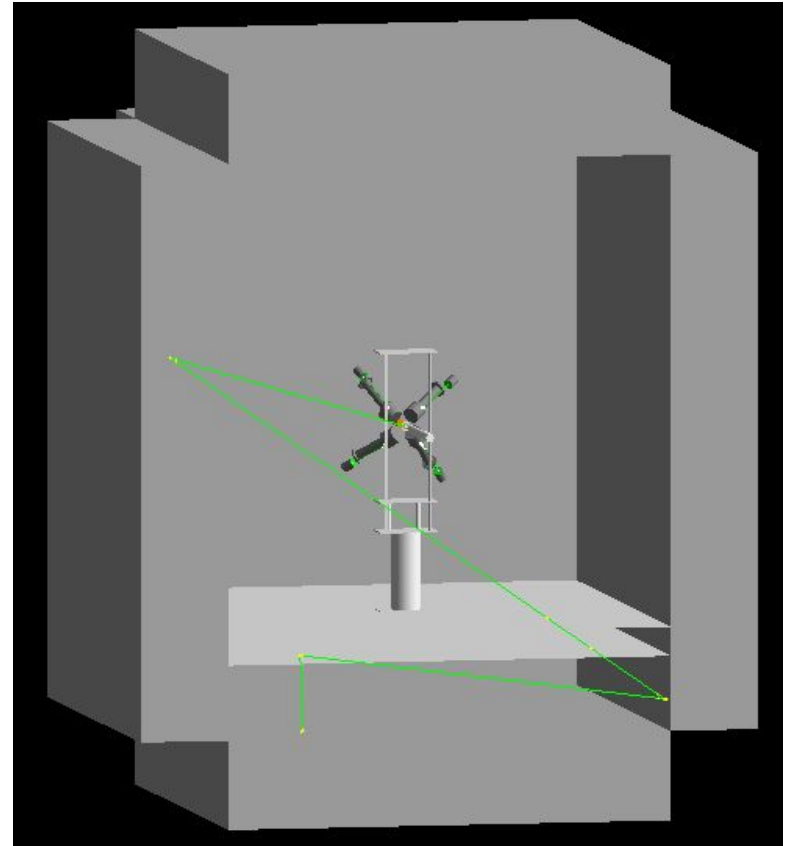
Sample Exchanger

Detectors calibration

- Geant4 simulation

● Slight efficiency differences

Detectors calibration

- Geant4 simulation

- High computational cost

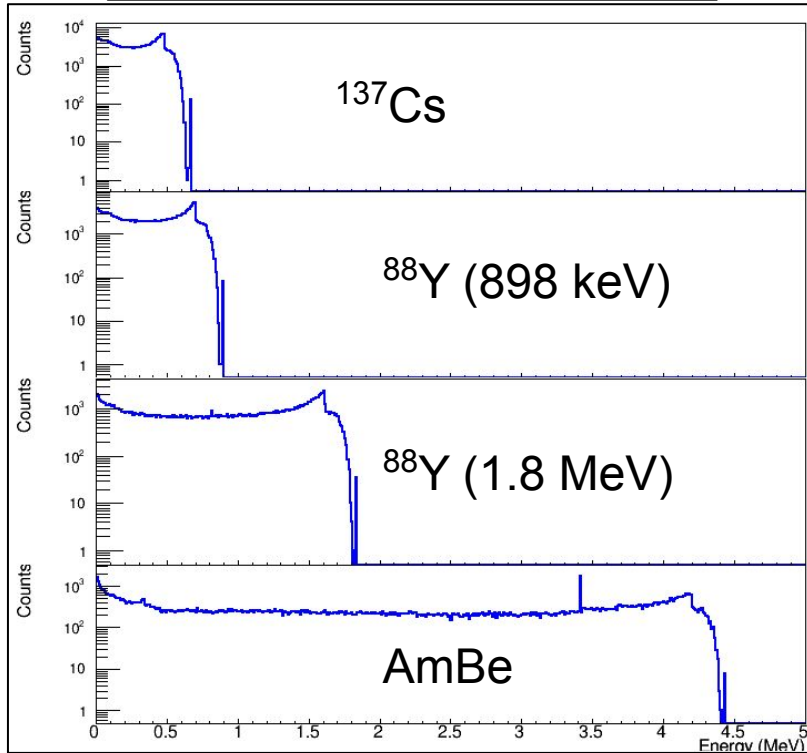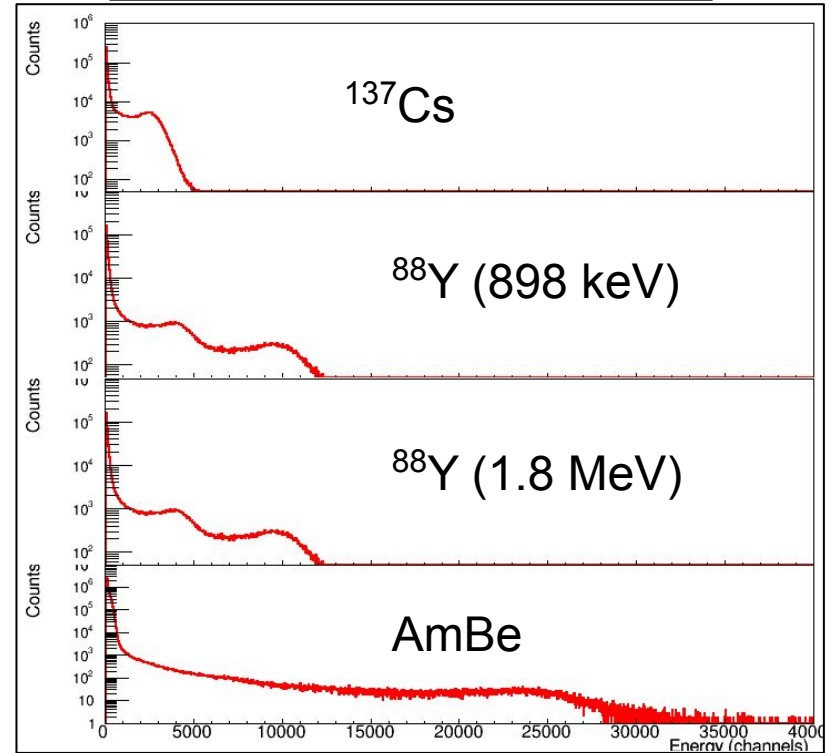| Gamma Energy Simulated (MeV)	Number of events	Time Without (m)	Time With (m)
1.000	1e7	5	7
6.000	1e7	7	15
8.000	1e7	7	19

On going work

Determination of the PHWT:

- Detectors gain stability study.

- Monte-Carlo simulation of monoenergetic gamma rays.

- C_6D_6 detectors calibration.

- Spectra convolution.

Measurements + Simulation results

- Calculate a weighting function (WF) for each C_6D_6 detector.

- Check WFs.

- Weight $^{80}Se(n,g)$ spectrum.

Detectors calibration

Detectors calibration

SIMULATION + MEASUREMENT
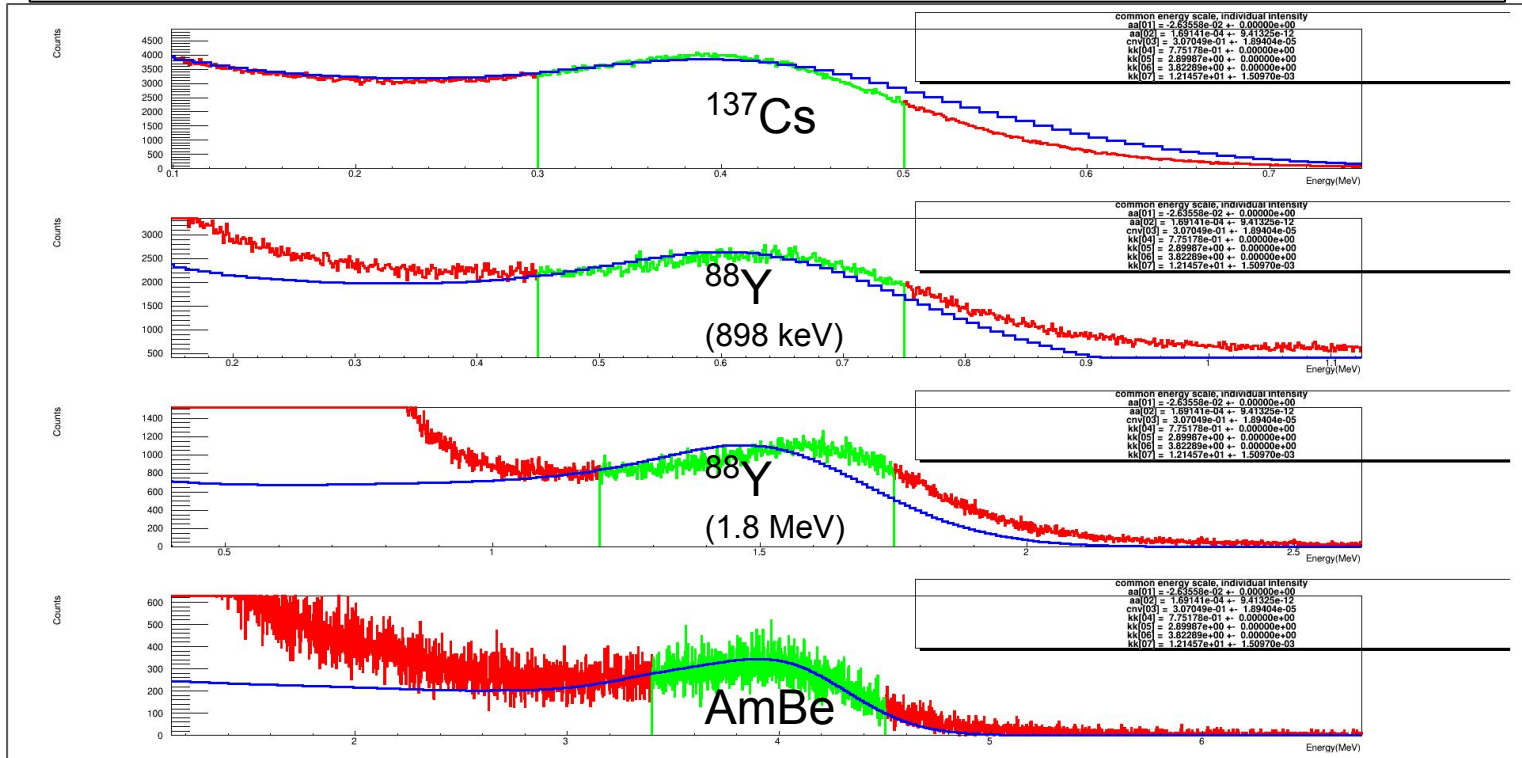
^{137}Cs

^{88}Y

(898 keV)

^{88}Y

(1.8 MeV)

AmBe

Detectors calibration
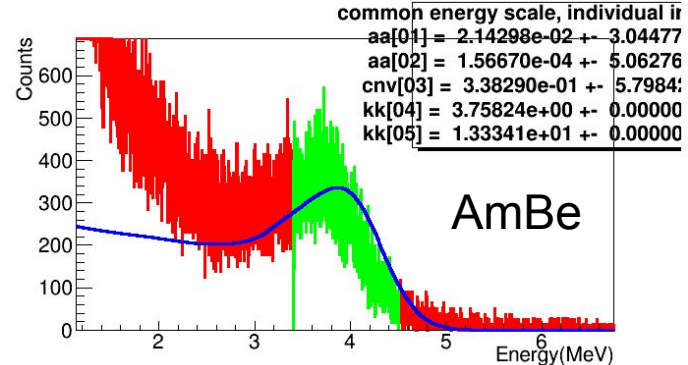
Detectors calibration

SIMULATION + MEASUREMENT

^{137}Cs

^{88}Y
(898 keV)

^{88}Y
(1.8 MeV)

AmBe

AmBe

Detectors calibration

- Geant4 simulation

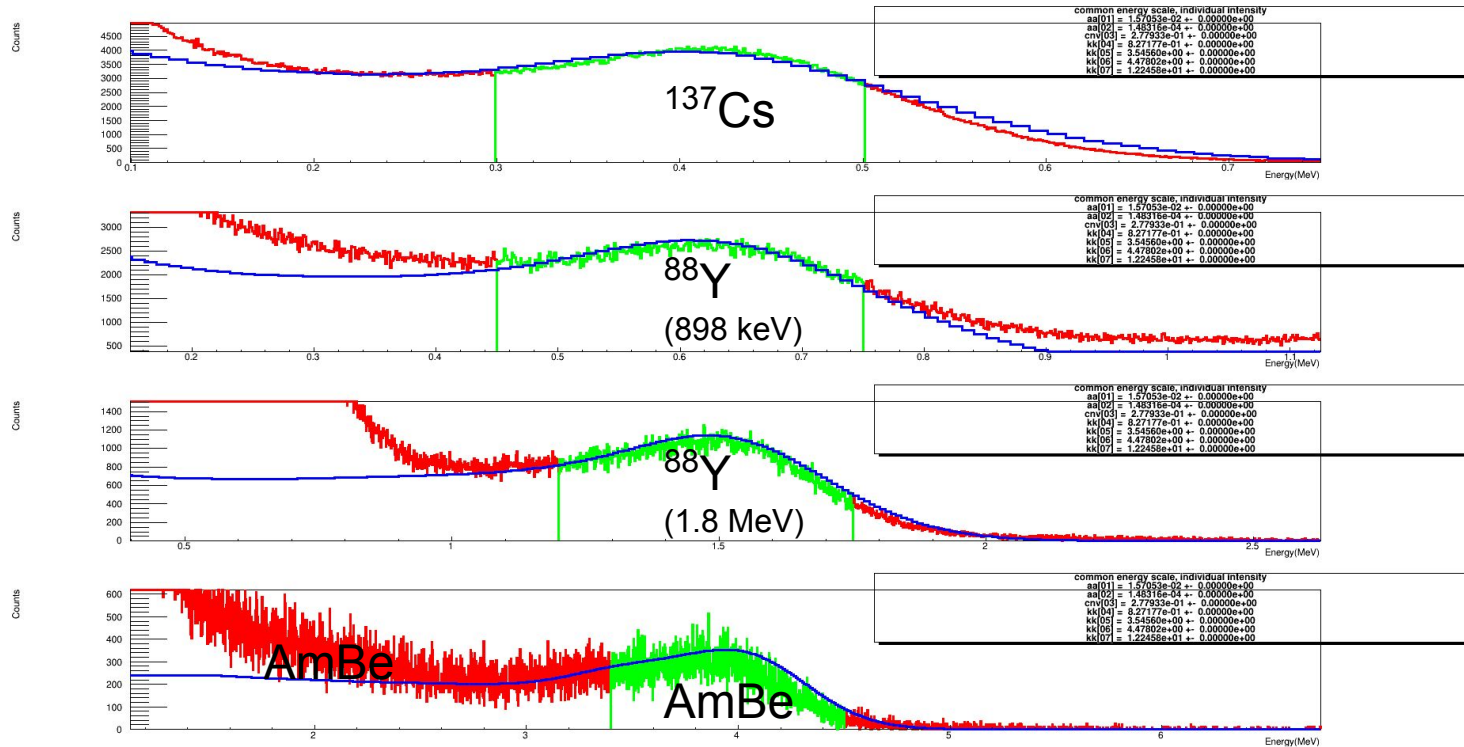| C6D6#	Resolution (%) (@ 1MeV)
1	30
2	28
3	30
4	32

On going work

Determination of the PHWT:

- Detectors gain stability study.

- Monte-Carlo simulation of monoenergetic gamma rays.

- C_6D_6 detectors calibration. ⎤
                                    ⎥ Measurements + Simulation results
- Spectra convolution. ⎦

- Calculate a weighting function (WF) for each C_6D_6 detector.

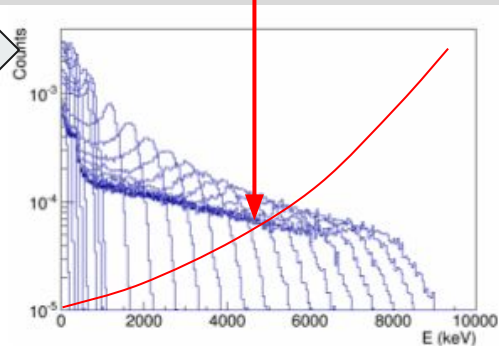- Check WFs.

- Weight $^{80}Se(n,g)$ spectrum.

Weighting functions calculation
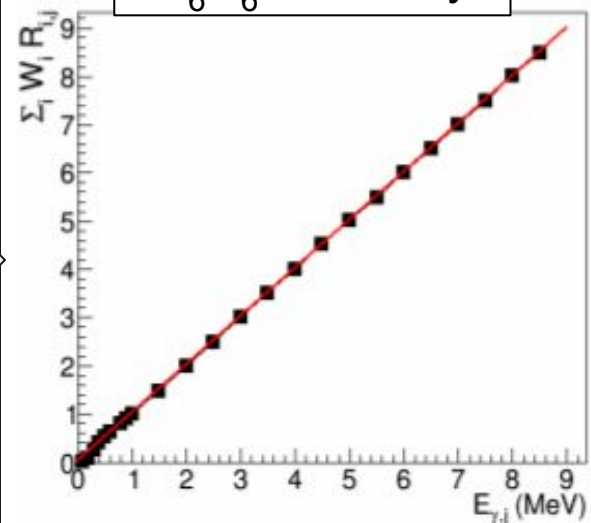

Experimental C_6D_6 efficiency
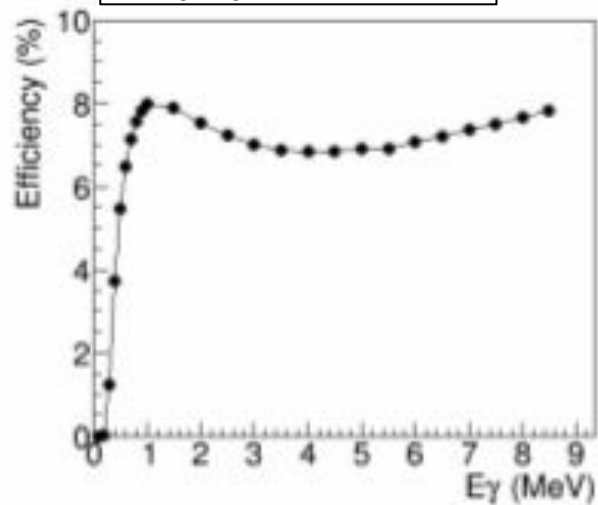
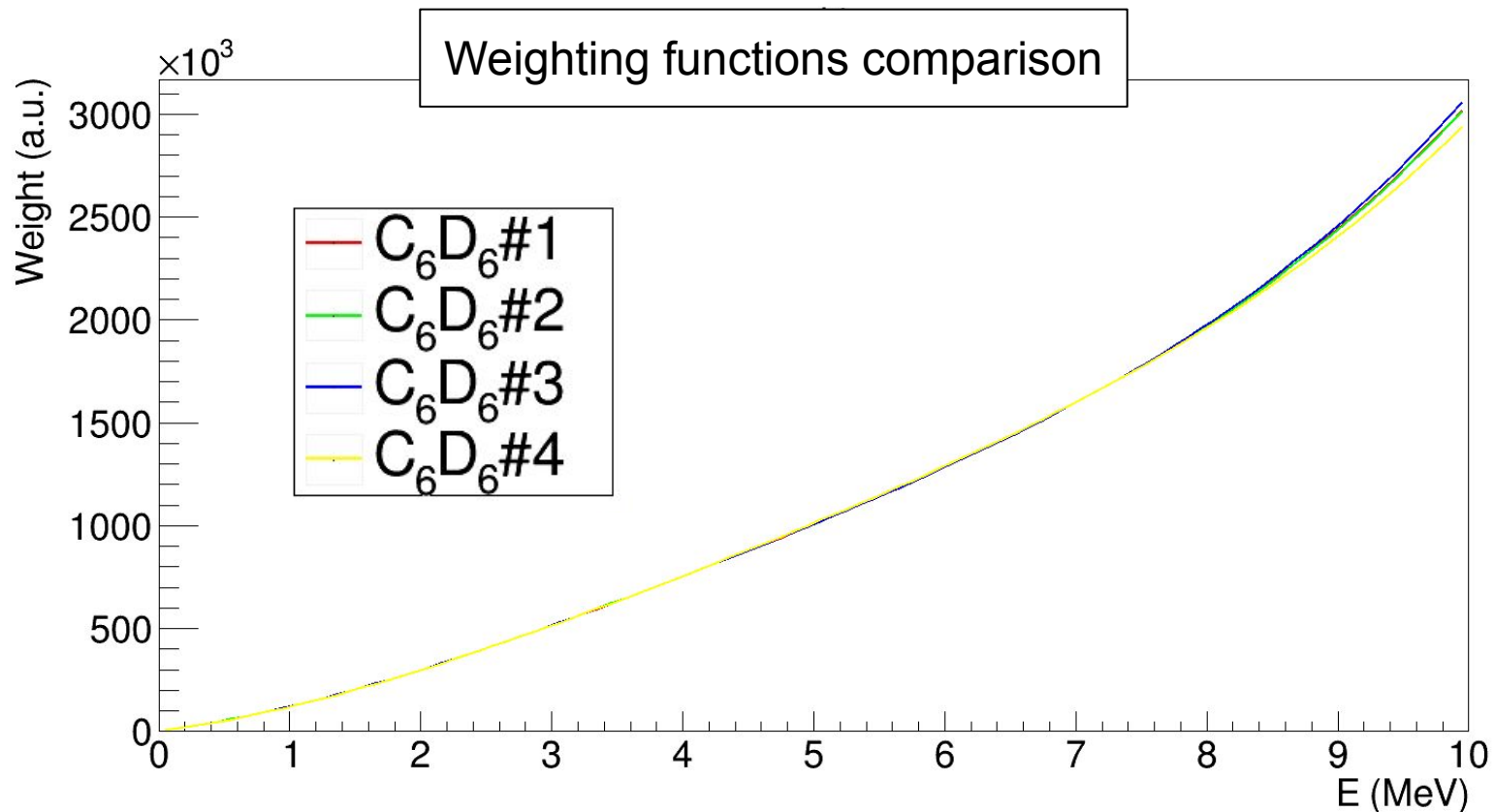$$\min\sum\left(\sum W_i R_i^j - \alpha E_j^\gamma\right)^2$$

$$W_i = \sum_{k=0}^{n} a_k E^k$$

Manipulated C_6D_6 efficiency

Weighting functions calculation

Weighting functions comparison
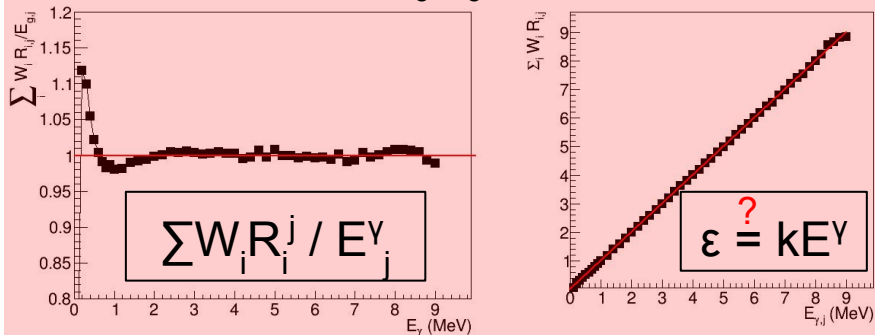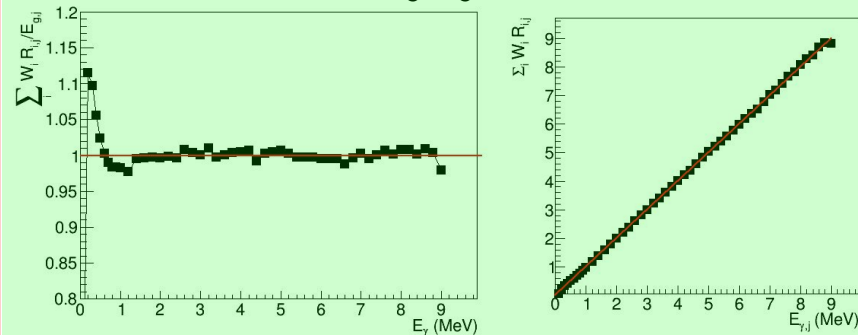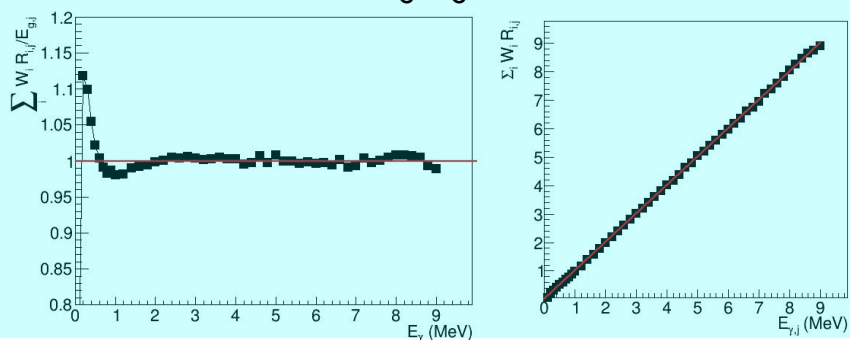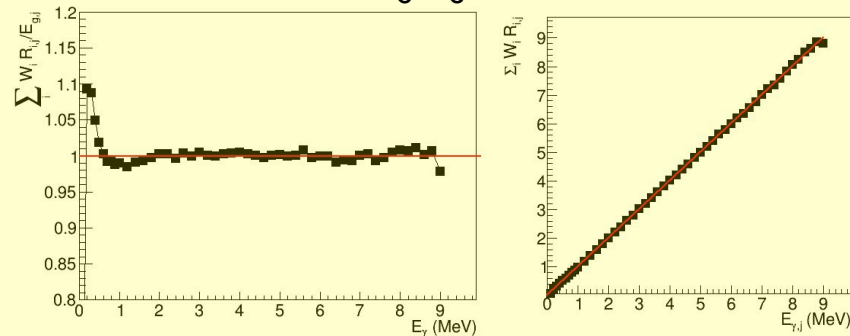
Weighting functions calculation

Weighted ^{80}Se(n,γ) spectrum

Weighted ^{80}Se(n,γ) spectrum

Resonance energy (keV)	Signal to noise ratio Unweight.	Signal to noise ratio Weight.
1	140	200
10	13	20
100	2.5	3

Neutron energy

Weighted spectrum

Weighted ⁸⁰Se(n,γ) spectrum

Resonance energy (keV)	Signal to noise ratio Unweight.	Signal to noise ratio Weight.
1	140	200
10	13	20
100	2.5	3

Neutron energy

Weighted spectrum

Around 80 resonances found from 1 keV up to 100 keV
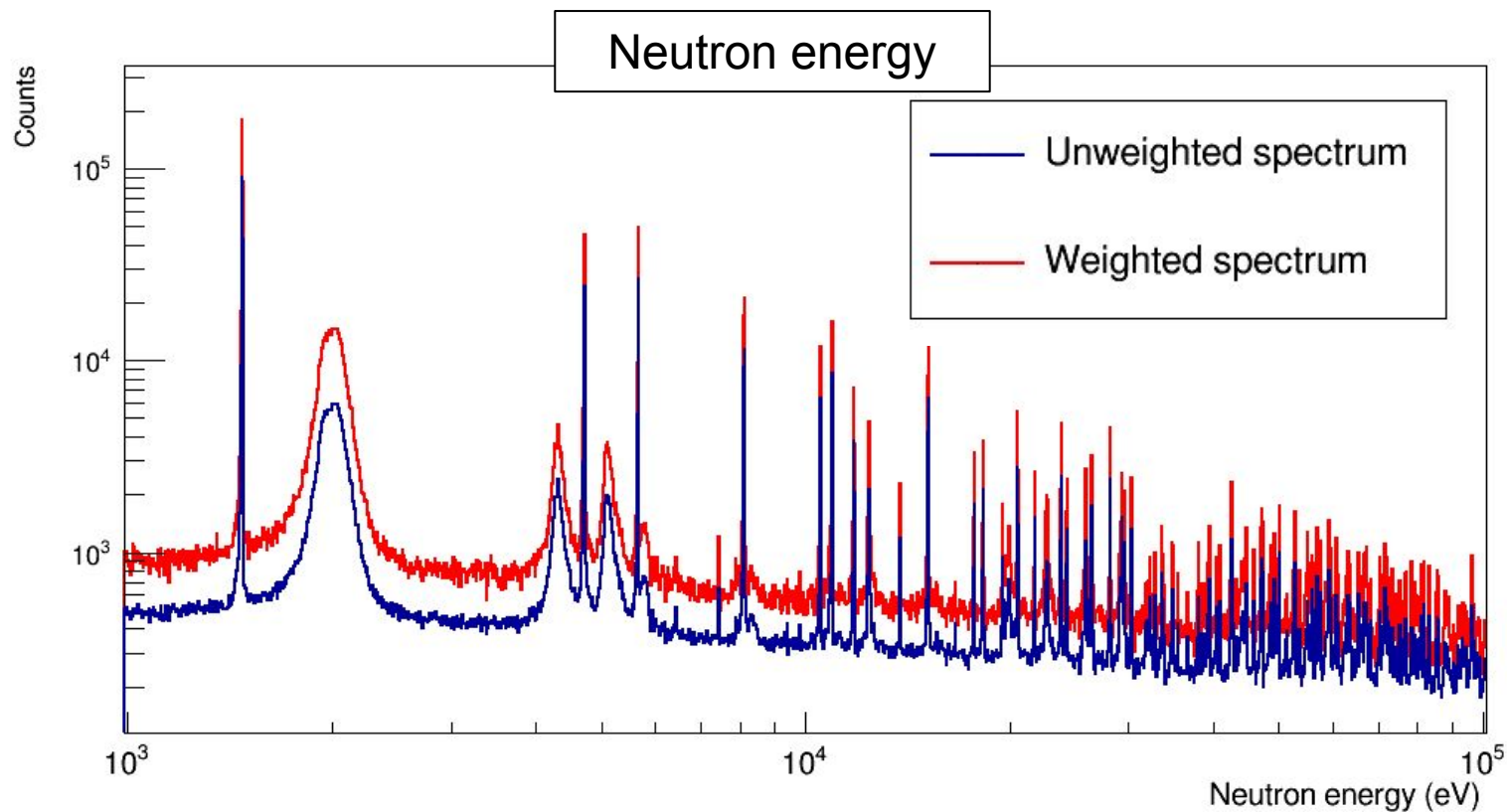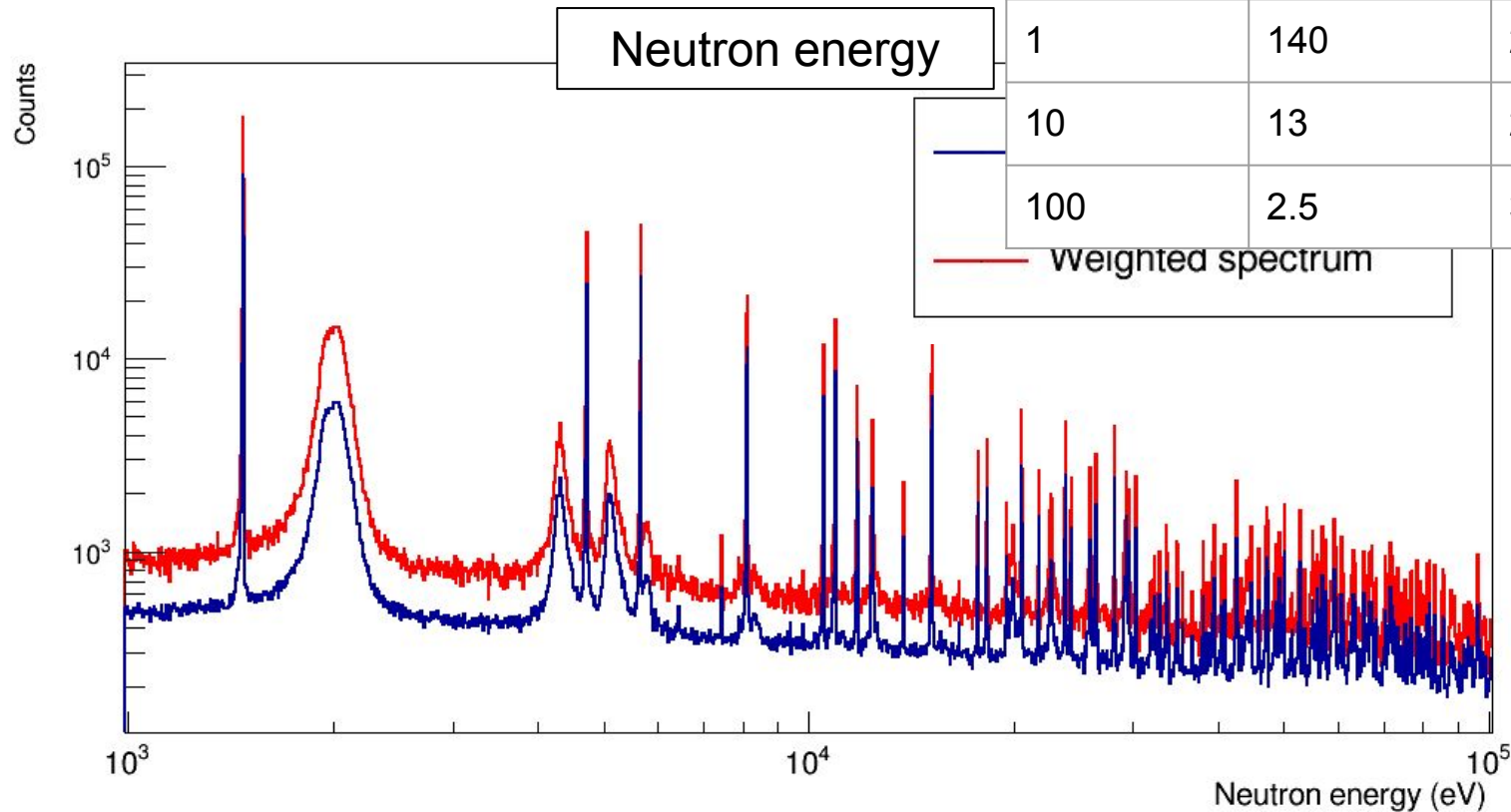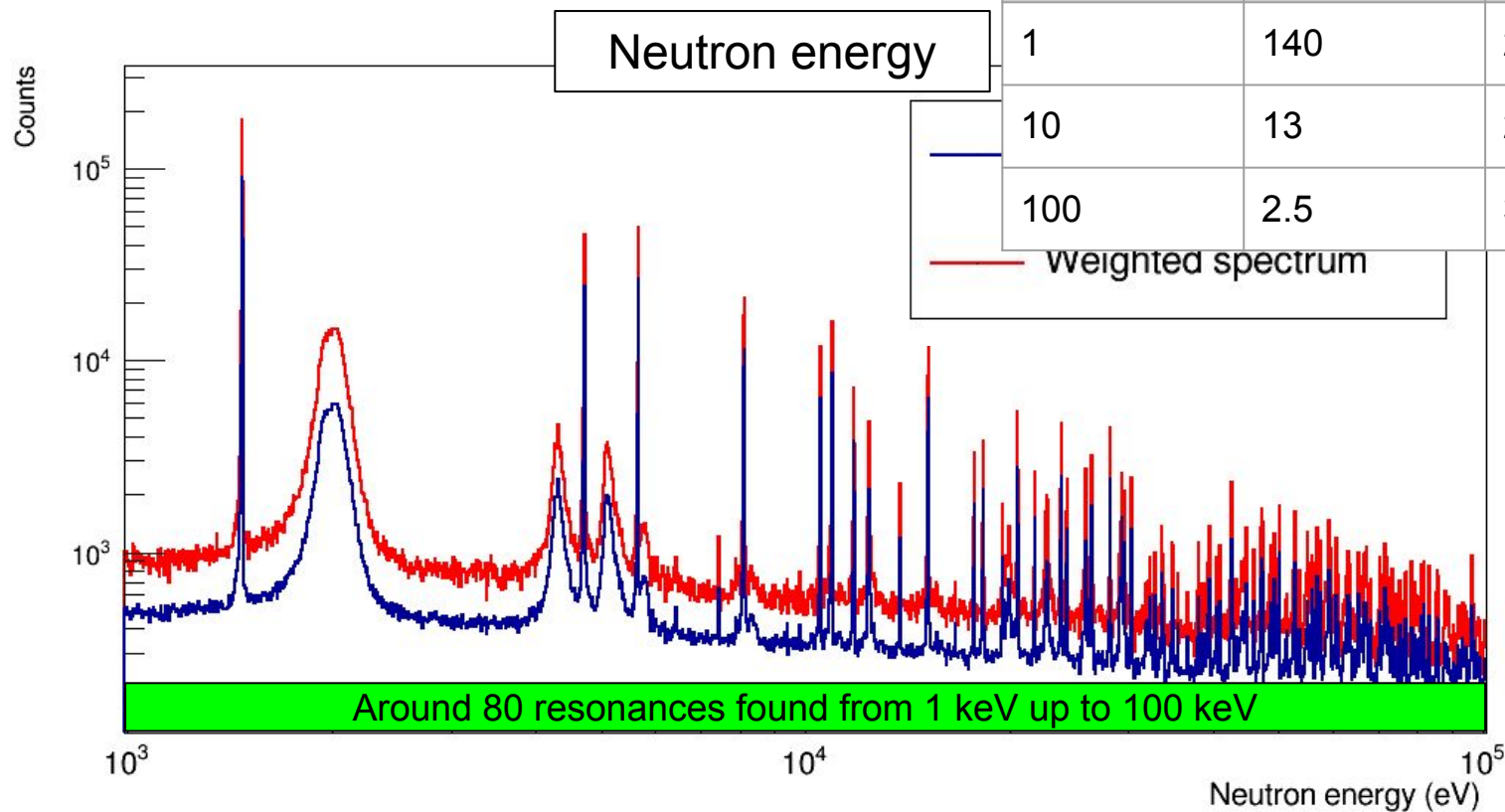
Comparison with previous measurement
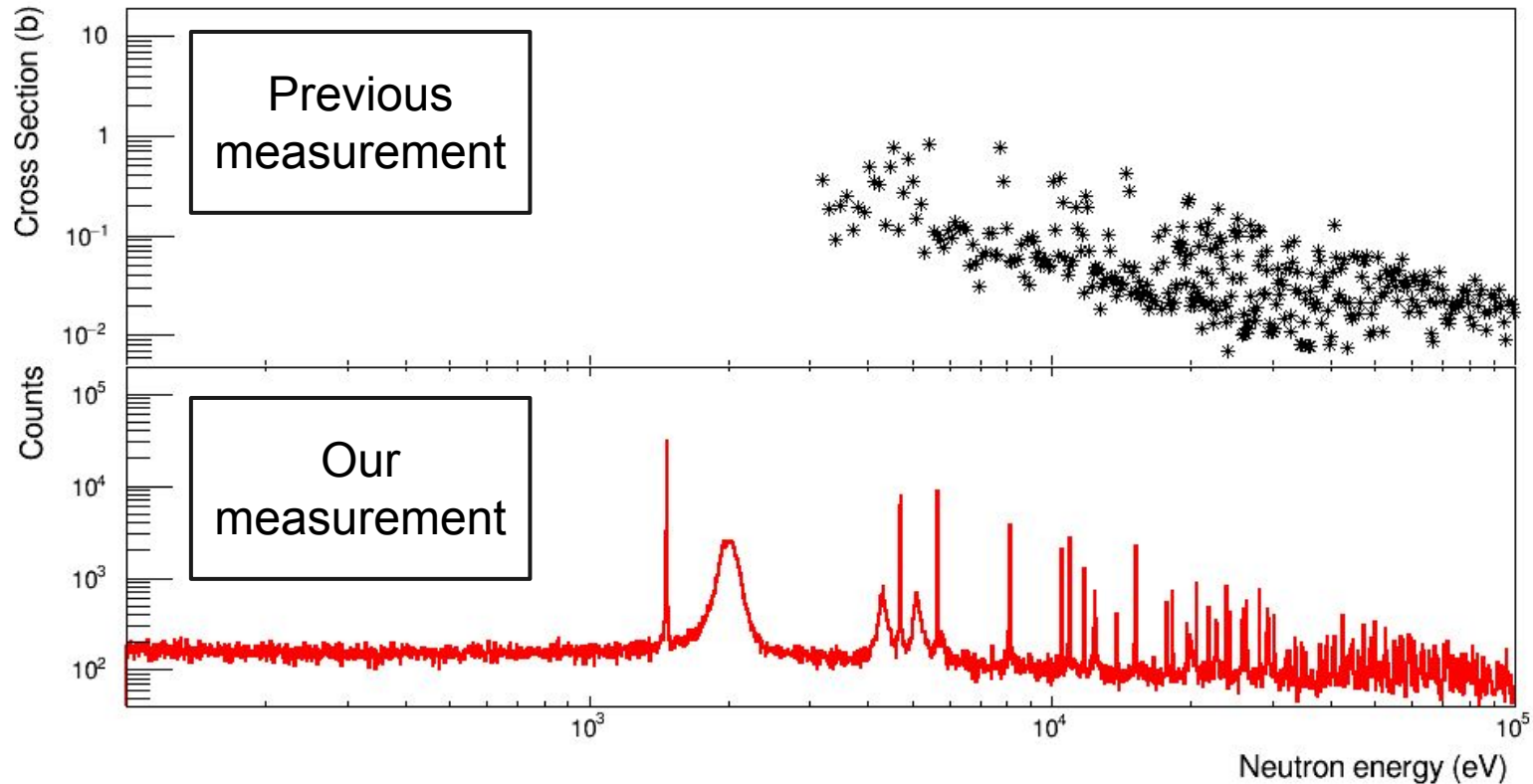
80Se(n,γ) experiment summary

Analysis of the experiment is now ongoing.

Until now:

- Effects of rebounds have been studied.
- A count rate stability study for C6D6 detectors has been done.

Currently ongoing:

- Weighting function search.

Next steps:

- Determine the experimental capture yield
- Make a R-Matrix analysis with SAMMY.
- Astrophysical interpretations of the results.
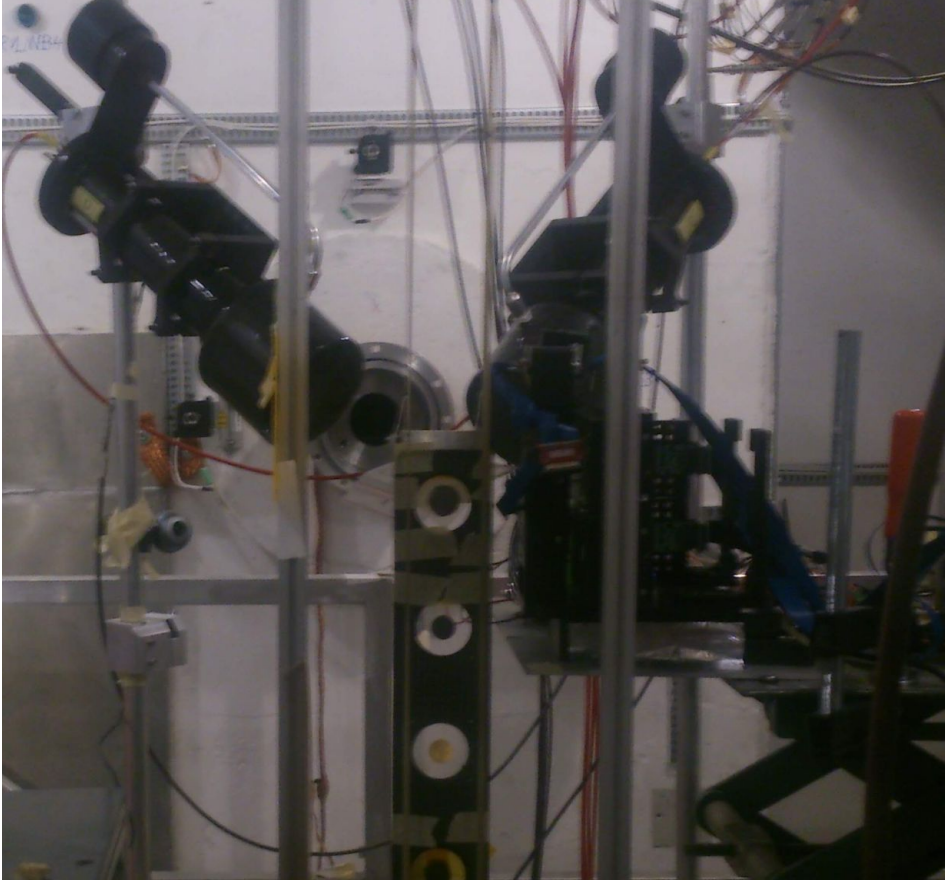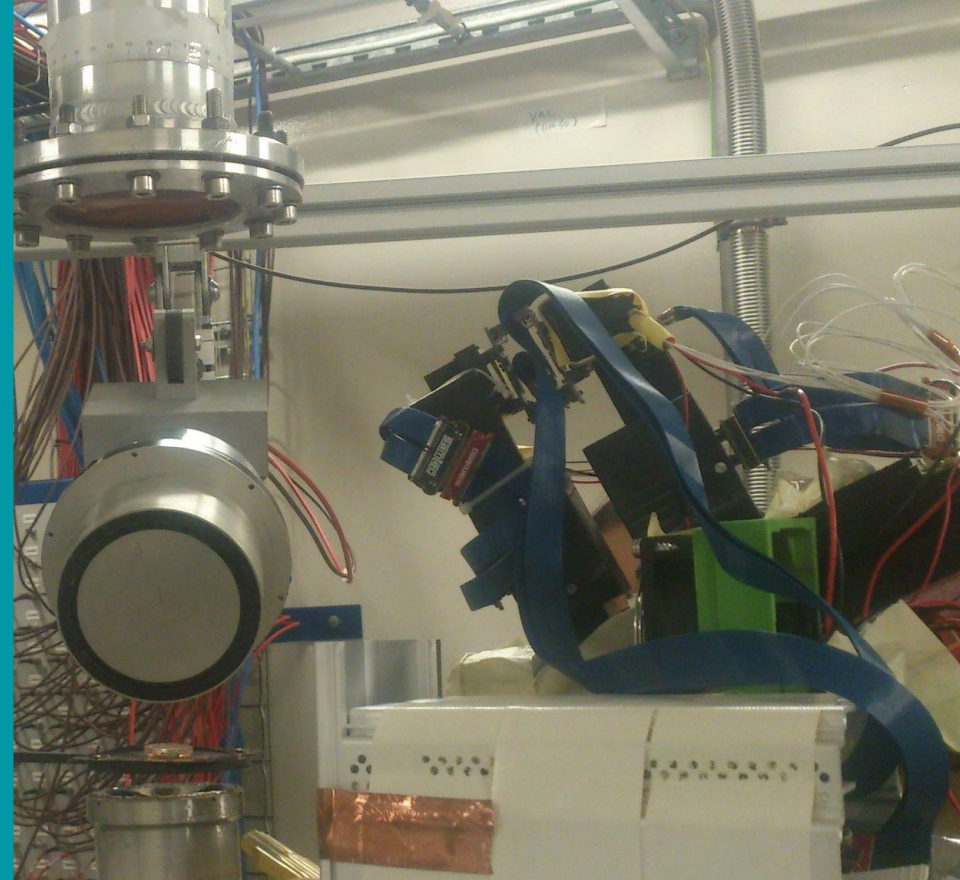
^{56}Fe(n,γ) @ EAR1

^{93}Nb(n,γ) @ EAR2

Past meeting results

- Rebound study done with similar results than ^{80}Se(n,g) (Threshold).
- Count rate consistency study

Sample	%
Au	96
Fe	100
Pb	90
Empty	100

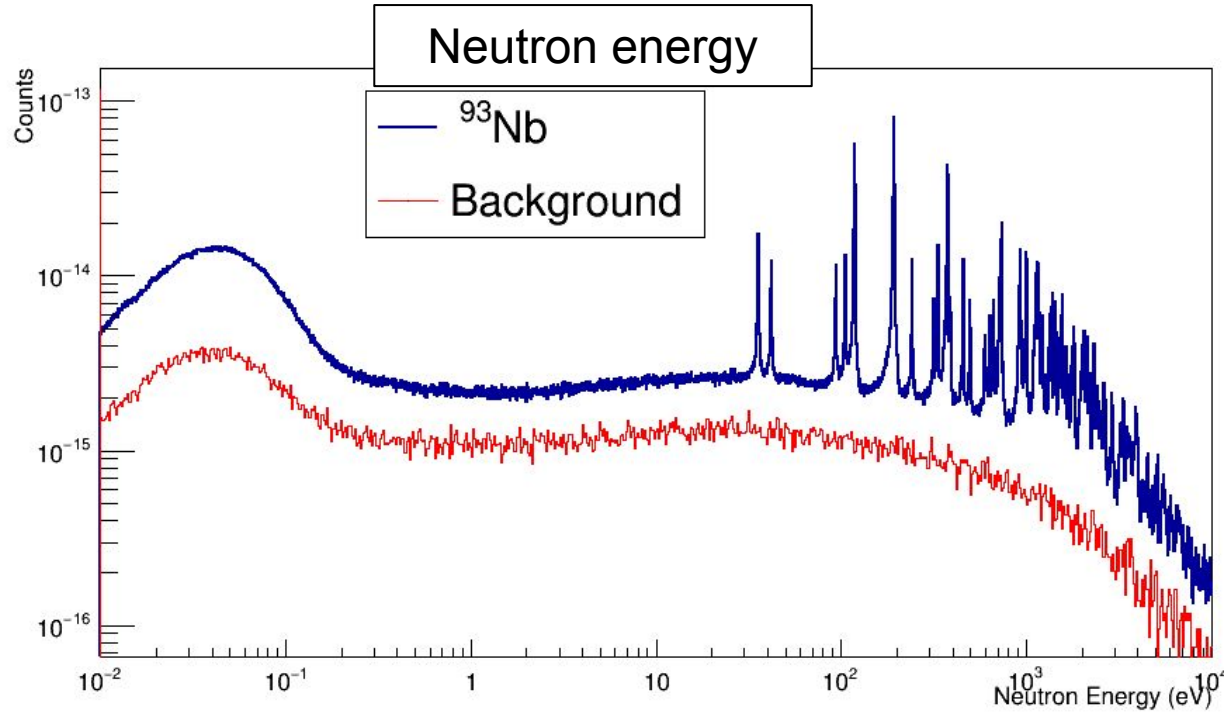| Sample	%
Au	100
Fe	100
Nb	92
Pb	100
Empty	100

^{56}Fe(n,γ) @ EAR1

PRELIMINARY RESULT
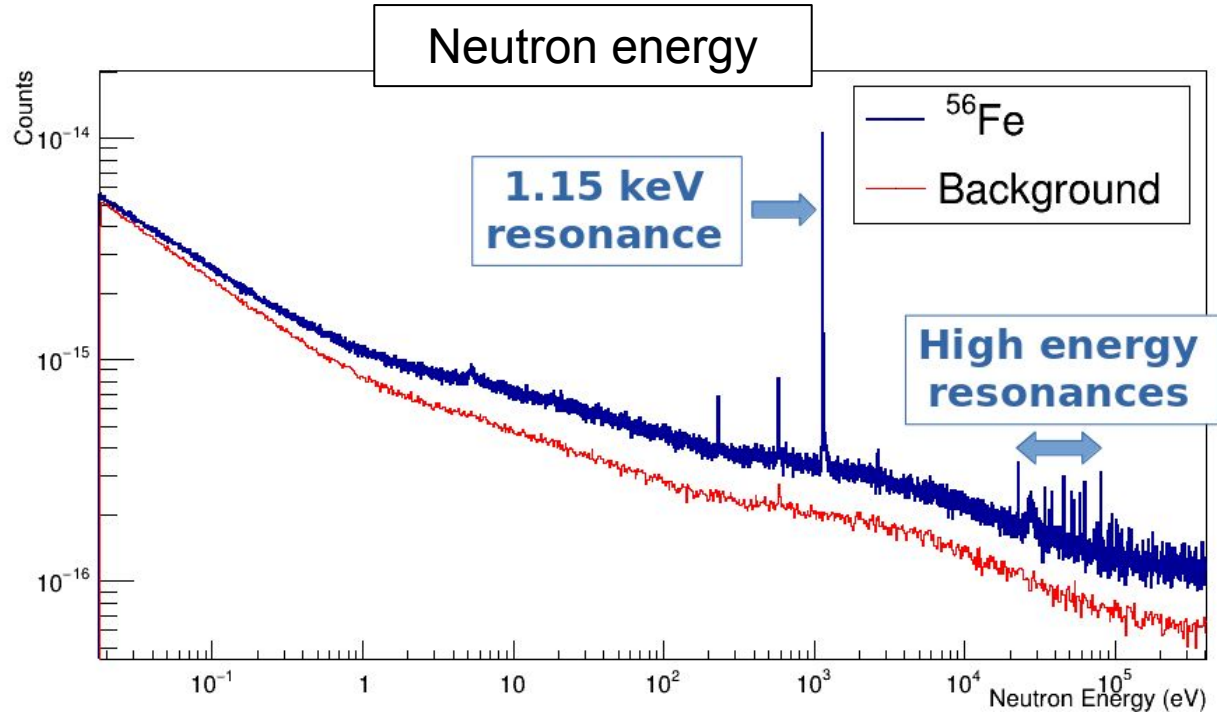
^{93}Nb(n,γ) @ EAR2

PRELIMINARY RESULT

SUMMARY

- A systematic study has been carried out to characterize rebounds and avoid their effects.
- A count rate consistency study has been performed to check the validity of the total statistic.
- PHWT work is now ongoing.

- ^{80}Se(n,g) experiment:
  - Up to 80 resonances can be distinguished in the energy region of astrophysical interest.
  - Next steps: R-Matrix analysis (SAMMY) and astrophysical interpretations.

- ^{56}Fe(n,g) and ^{93}Nb(n,g) experiment:

  - Next steps: WF calculation, R-Matrix analysis and Astrophysical and technical interpretations.

SUMMARY

^{56}Fe(n,g) and ^{93}Nb(n,g) experiment:

- A systematic study has been carried out to characterize rebounds and avoid their effects.

- A count rate consistency study has been performed to check the validity of the total statistic.

- Next steps:

    - WF calculation

    - R-Matrix analysis.

    - Astrophysical and technical interpretations.