Status of EAR2 neutron flux evaluation for n_TOF-Phase4

n_TOF Collaboration meeting

13.12.2022, Edinburgh

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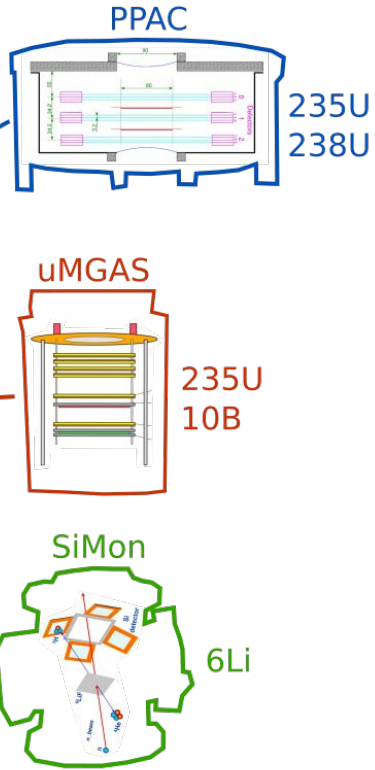
Experimental Setup



The setup to measure the neutron flux consisted of solid state detectors (SiMon) and gas detectors (uMGAS, PPAC), employing (n, charged-particles) and (n,f) reactions on samples considered as standard.

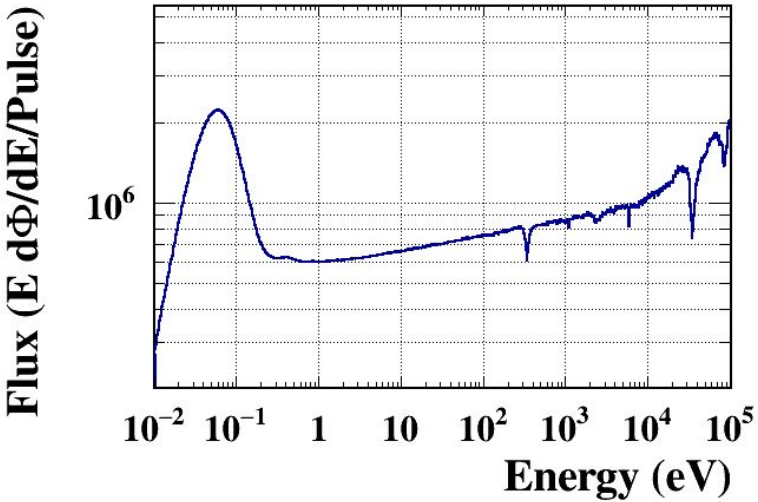
Detector	Sample
SiMon	^{6}Li(n,α)t
uMGAS	^{10}B(n,α)^{7}Li ^{235}U(n,f)
PPAC	^{238}U(n,f) ^{235}U(n,f)

Data Analysis: SiMon ^{6}Li

Analysis status

Corrections	^{6}Li
Flight Path	not calibrated with RF
PSA processing	✓
Gain Shift	✓
Transmission	✓
Efficiency	✓
Pile-up	✓

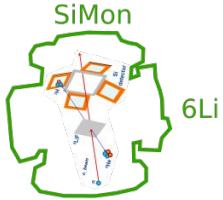
Flux results



Comments

- Implementation of the TC in the data analysis to account for the RF on-going.

S.Amaducci

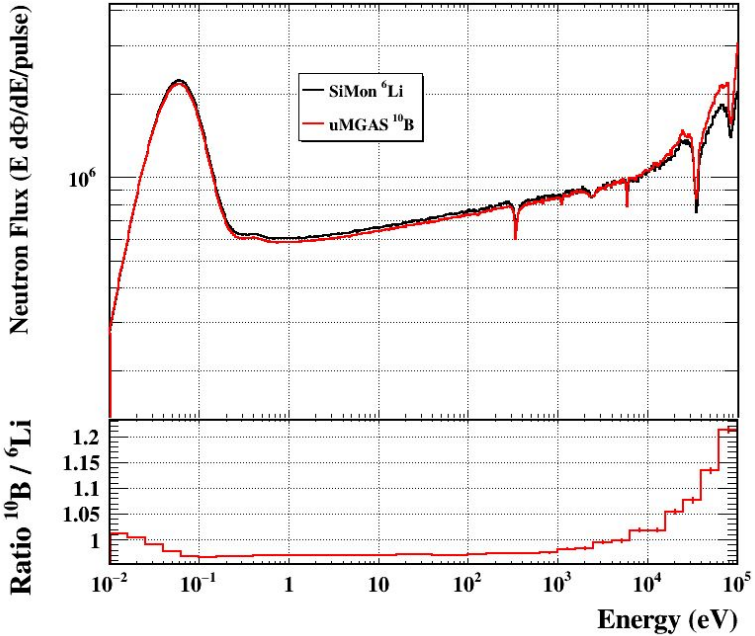


Data Analysis: uMGAS ^{10}B

Analysis status

Corrections	^{10}B
Flight Path	✓
PSA processing	✓
Gain Shift	✓
Transmission	✓
Efficiency	✓
Pile-up	✓

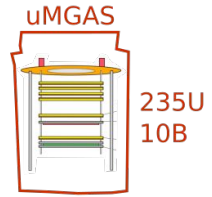
Flux results



Comments

- Saturated γ-flash in ^{10}B limits the energy range up to 1 keV. Bug in the ntoflib found, disabling PSA features for saturated pulses, necessary to reconstruct and an accurate t-flash in this energy region.

JA.Pavon-Rodriguez

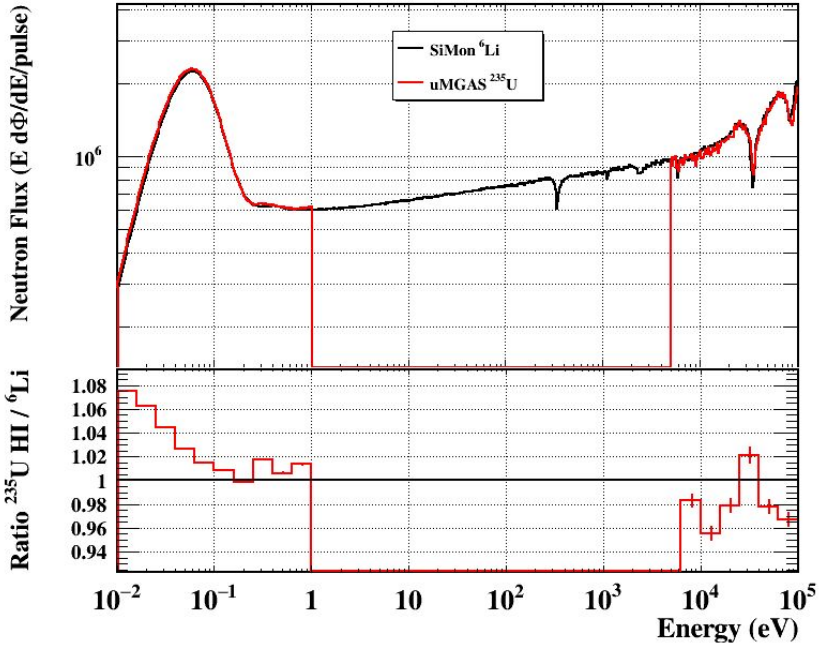


Data Analysis: uMGAS ^{235}U

Analysis status

Corrections	^{235}U
Flight Path	✓
PSA processing	✓
Gain Shift	✓
Transmission	✓
Efficiency	🏃
Pile-up	✓
t_0 correction at E > 1 MeV	🏃

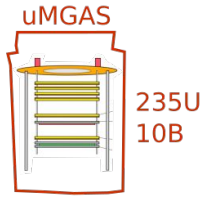
Flux results



Comments

- Improvement needed in MC simulations for efficiency in the amplitude cut.

JA.Pavon-Rodriguez

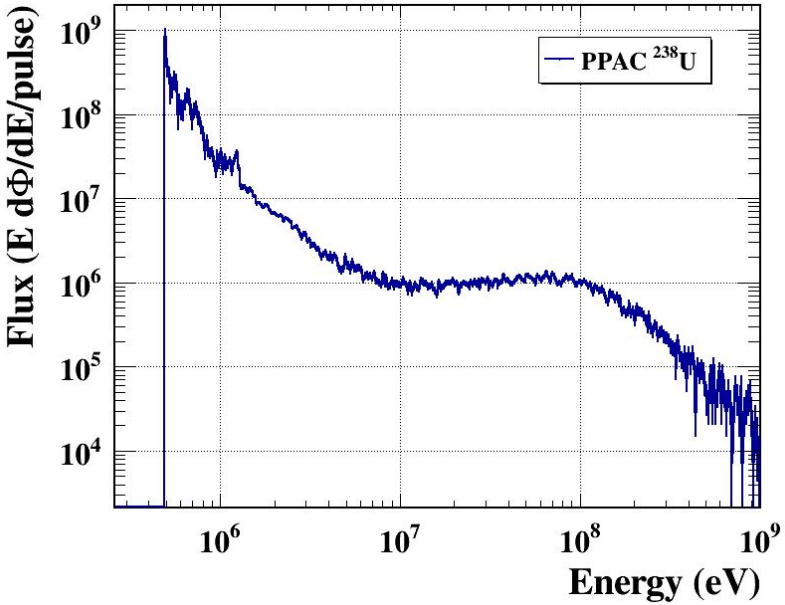


Data Analysis: PPAC ^{238}U

Analysis status

Corrections	^{238}U
Flight Path	✓
PSA processing	✓
Gain Shift	N/A
Transmission	🏃
Efficiency	🏃
Pile-up	N/A

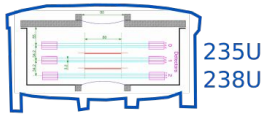
Flux results



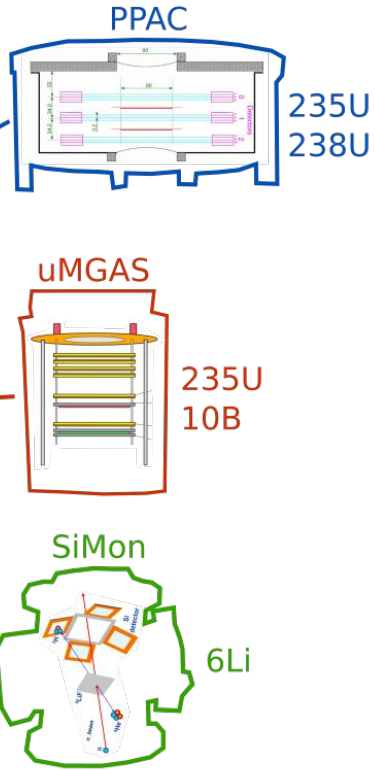
Comments

- First results for PPAC ^{238}U. Flight path calibrated with TC and t_0 calibrated with ^{238}U xs in TOF.

A.Manna



Experimental Setup



Samples used for each energy range of the evaluation presented in this meeting:

Energy range [eV]	SiMon	μMGAS		PPAC	
	^{6}Li	^{10}B	^{235}U	^{235}U	^{238}U
2 x 10^{-3} - 2 x 10^{-2}	✗	✓	✓	✗	✗
2 x 10^{-2} - 1 x 10^{3}	✓	✓	✗	✗	✗
1 x 10^{3} - 1 x 10^{5}	✓	✗	✓	✗	✗
1 x 10^{5} - 2 x 10^{6}	✗	✗	✓	✗	✗
2 x 10^{6} - 2.7 x 10^{6}	✗	✗	✓	✗	✓
2.7 x 10^{6} - 1 x 10^{9}	✗	✗	✗	✗	✓

EAR2 evaluation

Weighted sum

The different data sets have been combined in energy, as weighted sum of them, where the weight is the statistical uncertainty of the data, having a bigger relevance those data with better statistics.

$$y = \frac{\sum_i \left(\frac{y_i(E)}{\Delta y_i(E)^2} \right)}{\sum_i \left(\frac{1}{\Delta y_i(E)^2} \right)} \qquad \sigma_y = \left(\sqrt{\sum_i \left(\frac{1}{\Delta y_i(E)^2} \right)} \right)^{-1}$$

TOF to E conversion

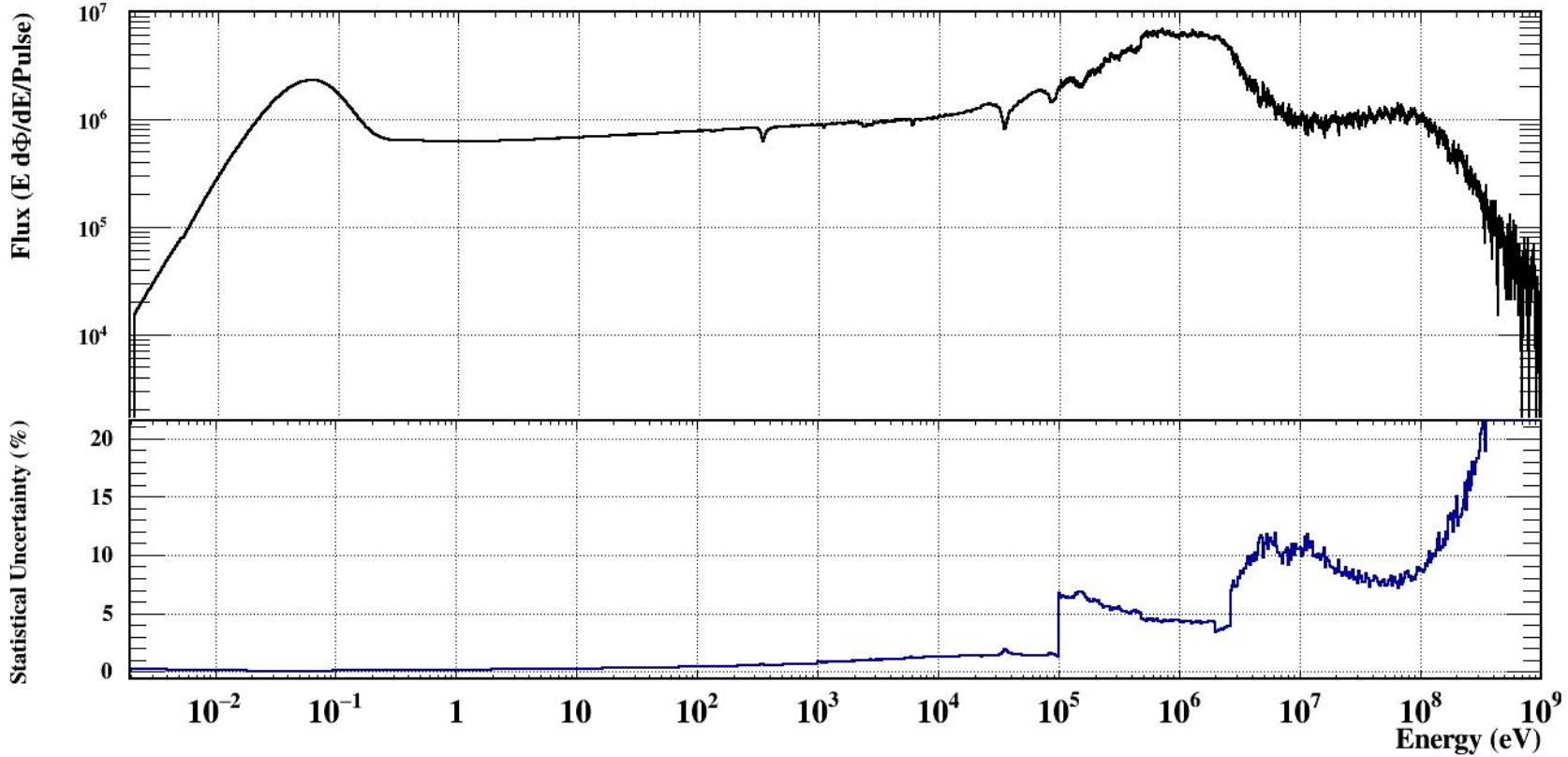
The criterion applied for the TOF to E conversion in the different data sets is the use of an effective flight path, including an average effect of the resolution function. Therefore:

$$L(TOF) = L_0 + \lambda^{eff}(TOF) = L_0 + \lambda^{eff}_{const} = L_{const}$$

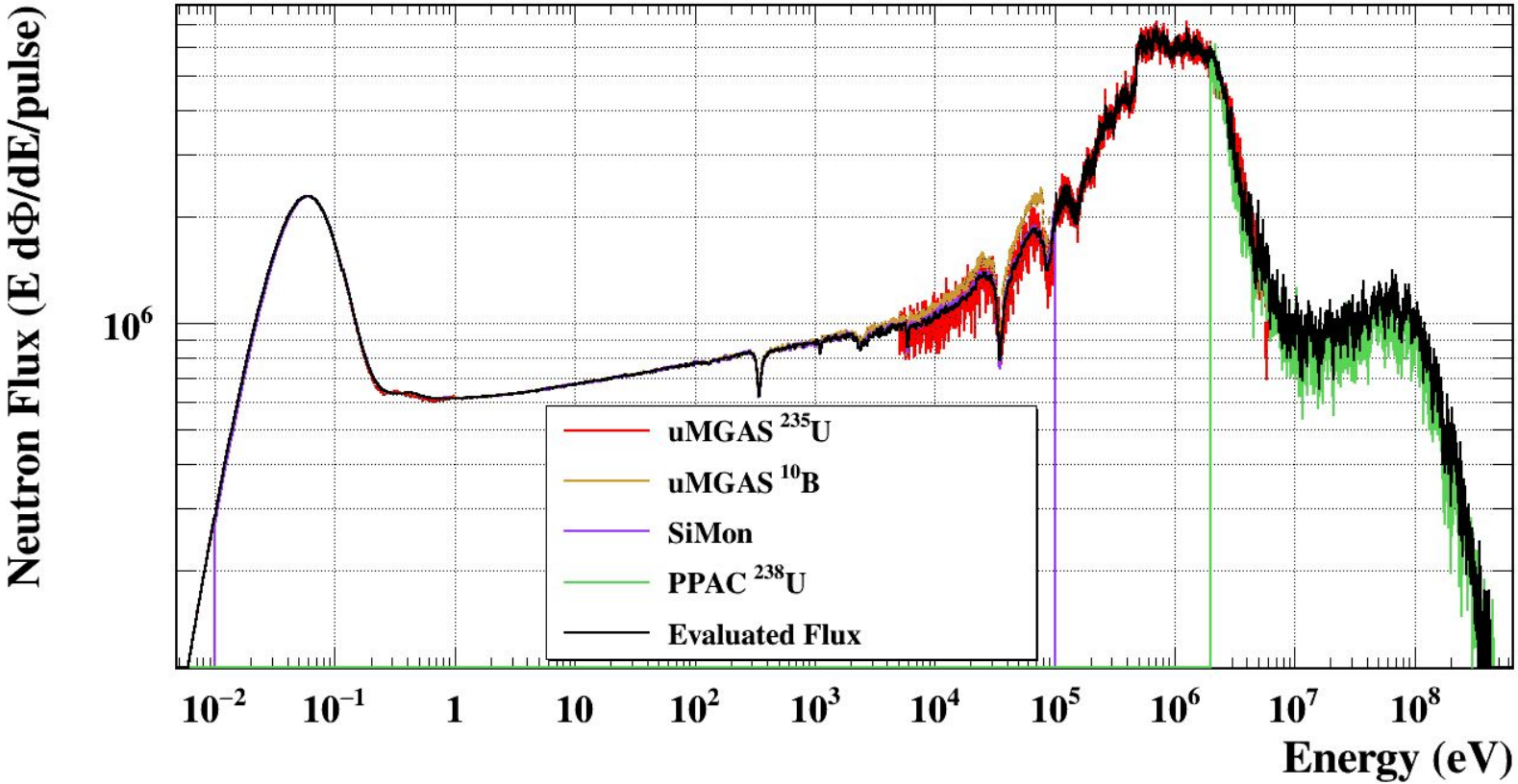
Normalisation of data sets

All data sets have been normalised when possible to the integral of 235U data set between 7.8 eV and 11 eV.

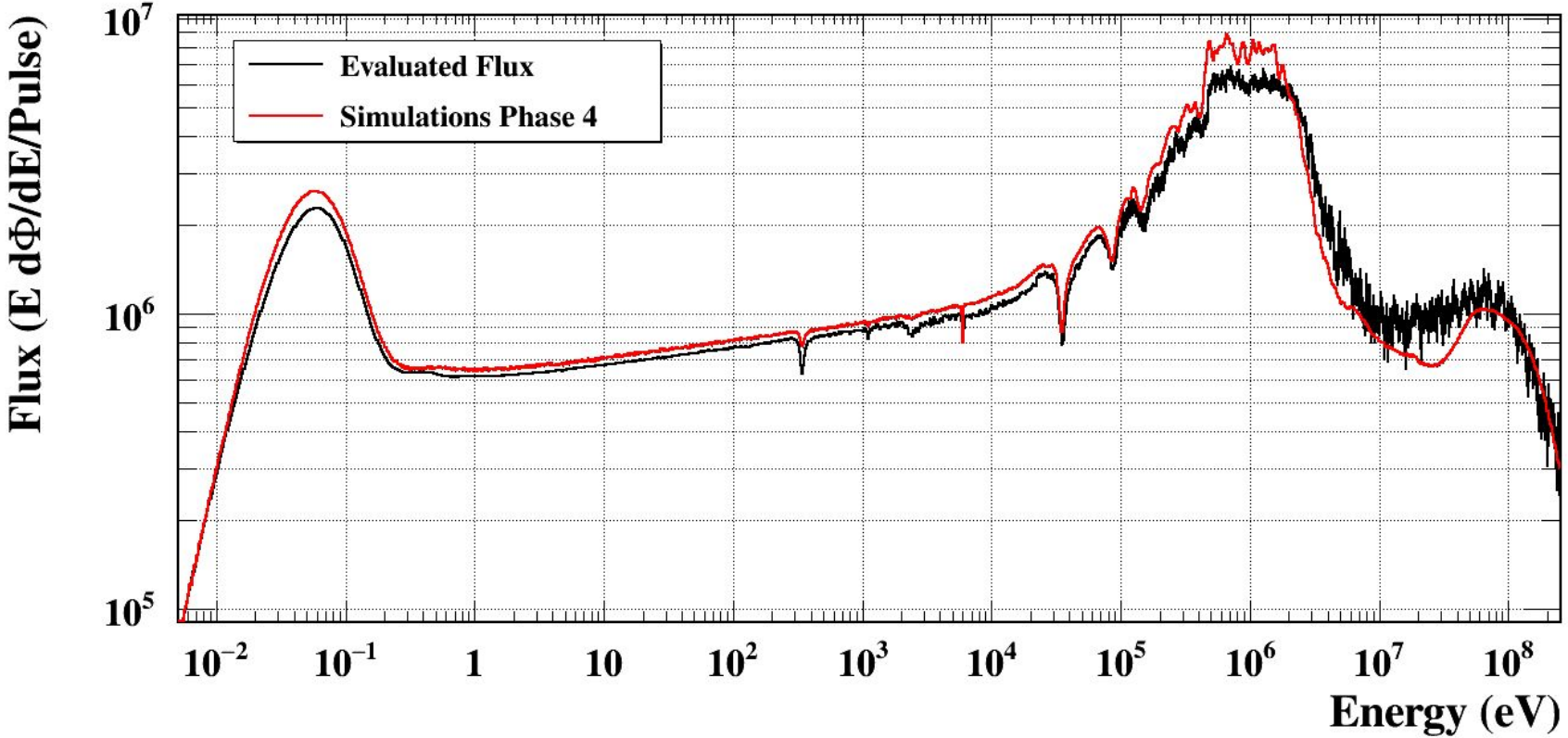
EAR2 evaluated flux



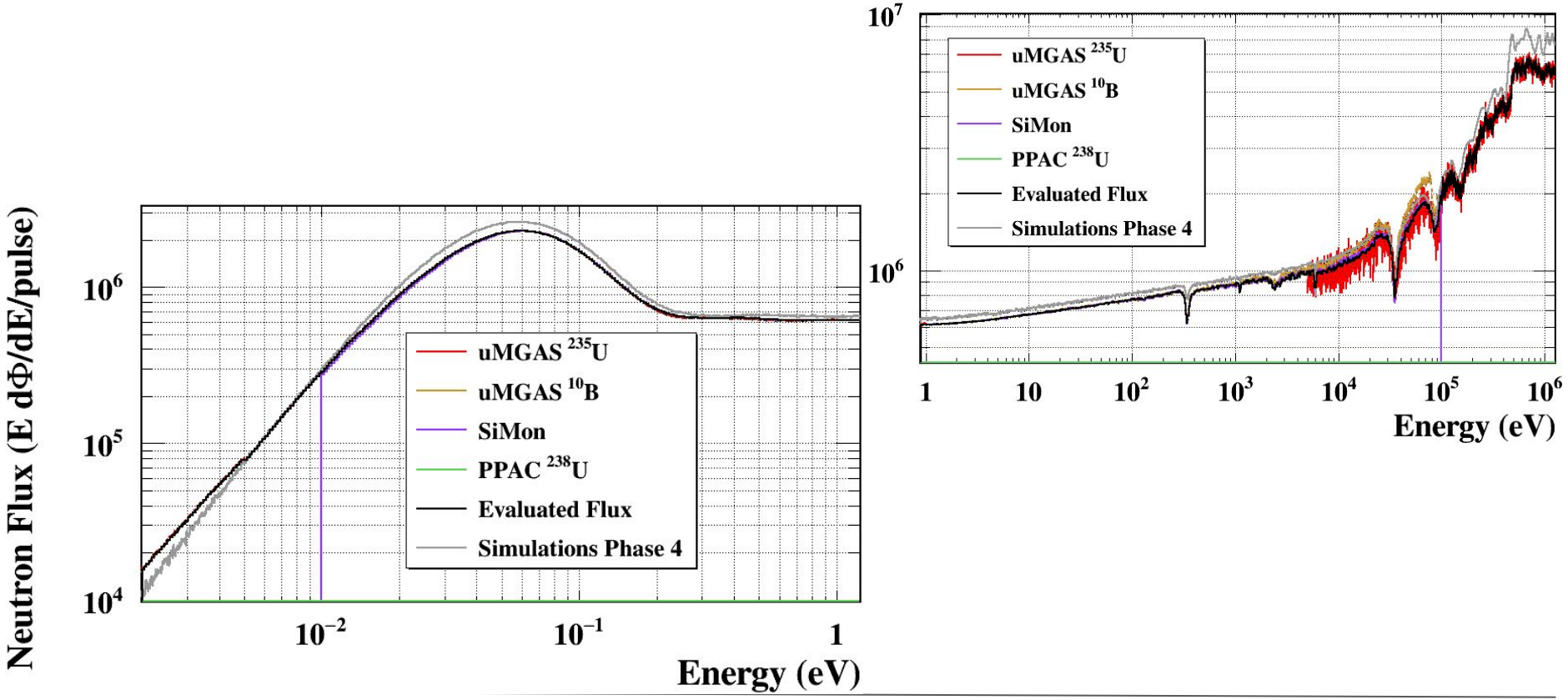
EAR2 evaluated flux and data sets



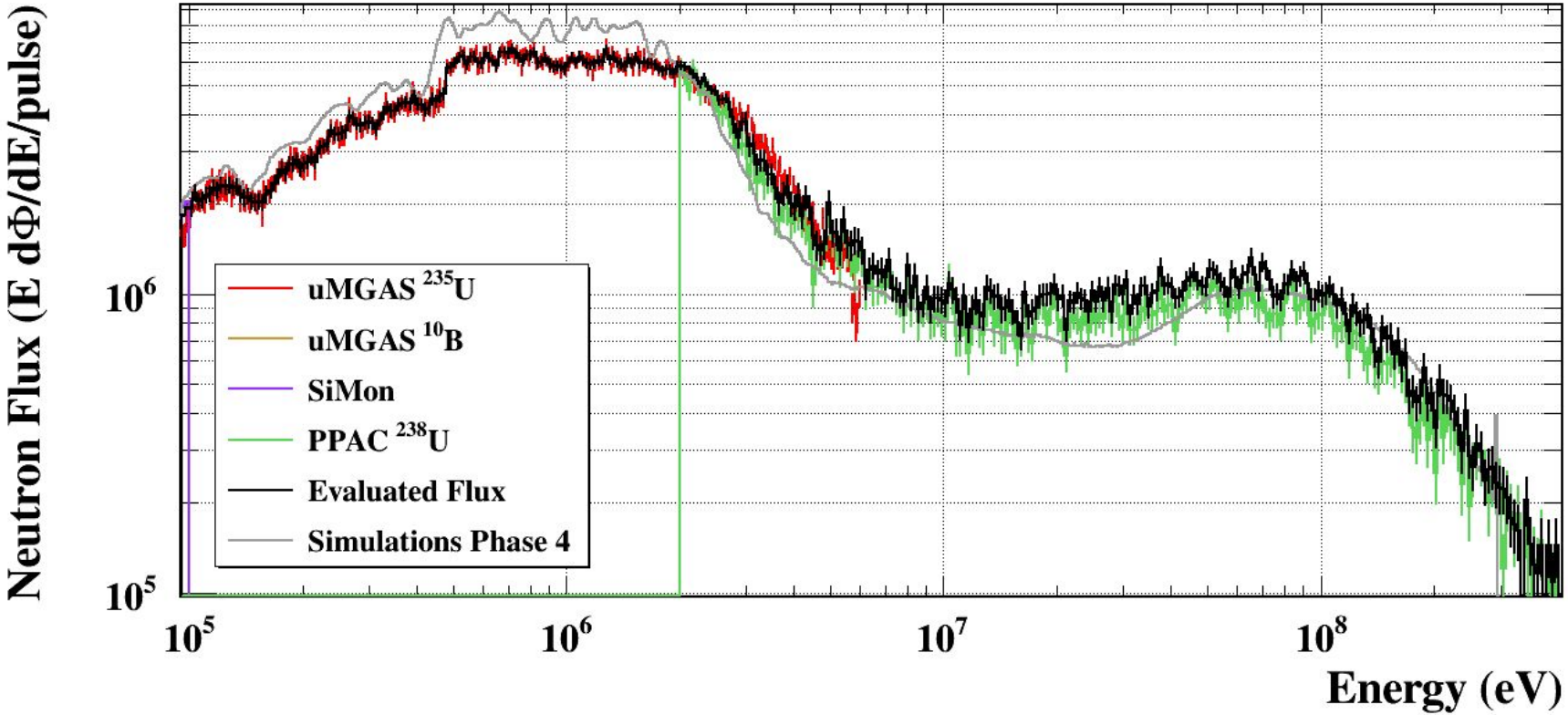
EAR2 evaluated flux and simulations



EAR2 evaluated flux and data sets



EAR2 evaluated flux and data sets



EAR2 evaluated flux and simulations

Summary

- The experimental neutron flux measured with the three detector systems used during the commissioning campaign in EAR2 was presented.
- A first evaluation of the flux has been carried out. Up to 100 keV, all energy ranges rely on two different detector systems/samples, which are in agreement within a 5 %. In this range, the statistical uncertainty remains below a 2 %.
- Support from ntoflib group is needed to extend ^{10}B energy range.
- From 1 keV to 2 MeV, the flux relies only on uMGAS ^{235}U.
- First results for PPAC ^{238}U above 2 MeV were presented.
- Data analysis for SiMon and uMGAS is close to be finished.
- A comparison with FLUKA simulations shows a similar shape in the epithermal region, while thermal and higher energy ranges require a better understanding.

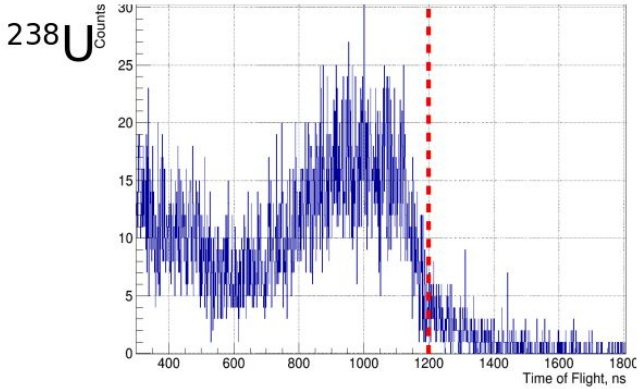
Outlook

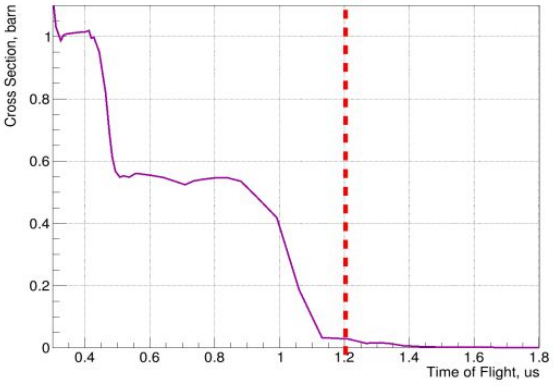
- Finalsing detector analysis:
  - **Deadline**: for final data reduction for all detectors is **mid February**.
- First final evaluation expected by end of **February 2023**.
- Final flux evaluation by **end of March 2023**.

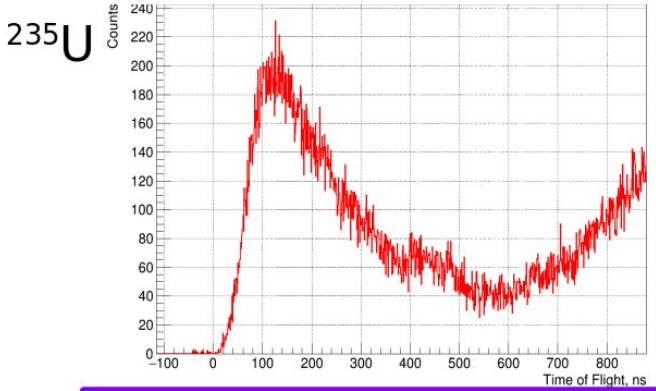
Thank you!

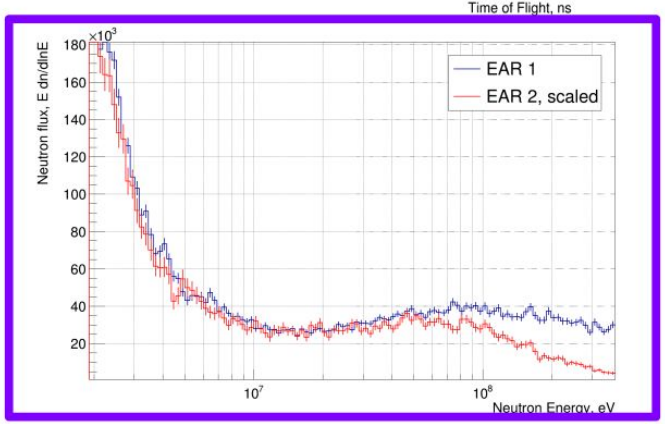
Backup slides

PPAC ^{238}U t_0


238U
Counts
Time of Flight, ns


Cross Section, barn
Time of Flight, us


235U
Counts
Time of Flight, ns


Neutron flux, E dn/dlnE
EAR 1
EAR 2, scaled
Neutron Energy, eV