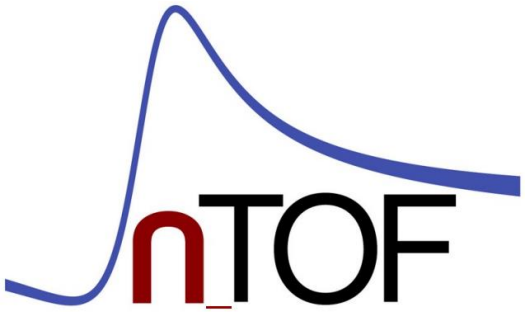


Update on MArEX

CALCI Consortium Session
21 March 2024

Yashwanth Bezawada (Yash)
University of California, Davis

On behalf of the MArEX collaboration

OUTLINE

- Motivation for MArEX
- Experimental Setup
- Preliminary Plots
- Conclusion
- ARTIE-II Update

Motivation for the MArEX Initiative

- Multiple Argon Experiments (MArEX) initiative
  - perform accurate measurements for the transmission and capture reaction channels for neutron interactions in LAr at the n_TOF facility
- To test the feasibility of transmission measurements
  - Transmission experiments haven't been performed previously at n_TOF
  - Measure the cross section of known materials like Bi, Al, and C.
- To test the feasibility of transmission measurements on Ar
  - Carbon fiber SCUBA tank filled with gaseous Argon
  - Measure the argon cross section
  - Proof of concept for a transmission measurement with LAr

Transmission Measurement

Transmission is given by

$$T(E) = \frac{N_{in} - B_{in}}{N_{out} - B_{out}} \frac{Q_{out}}{Q_{in}}$$

- E – Energy of the neutron (converted from the measured time of flight)
- N – Number of neutrons reaching the detector
- B – Number of background events
- $\frac{Q_{out}}{Q_{in}}$ - Beam flux normalization for target in and target out

Cross section is given by

$$\sigma(E) = -\frac{1}{n}\ln[\mathrm{T(E)}]$$

- n – Number density of the target sample (atoms/barn)

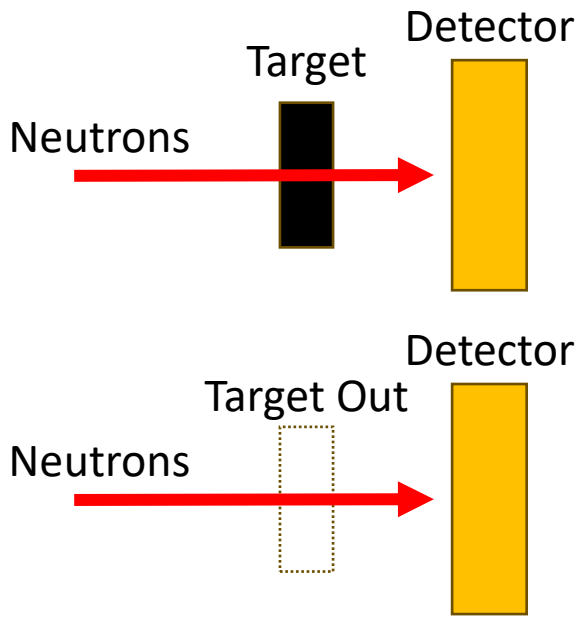
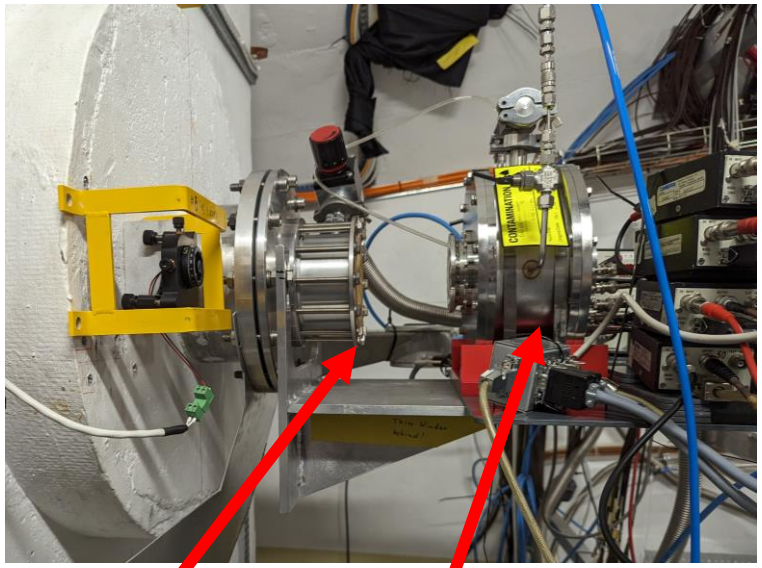


Fig. (Top) Target in measurement; (Bottom) Target out measurement. Ideally should be vacuum in place of target.

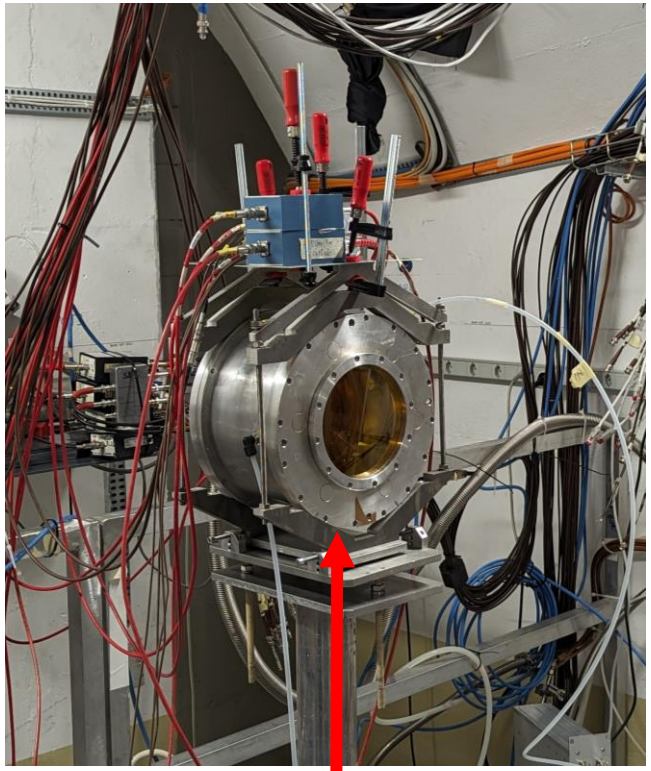
Experimental Setup - Detectors

Beam Direction

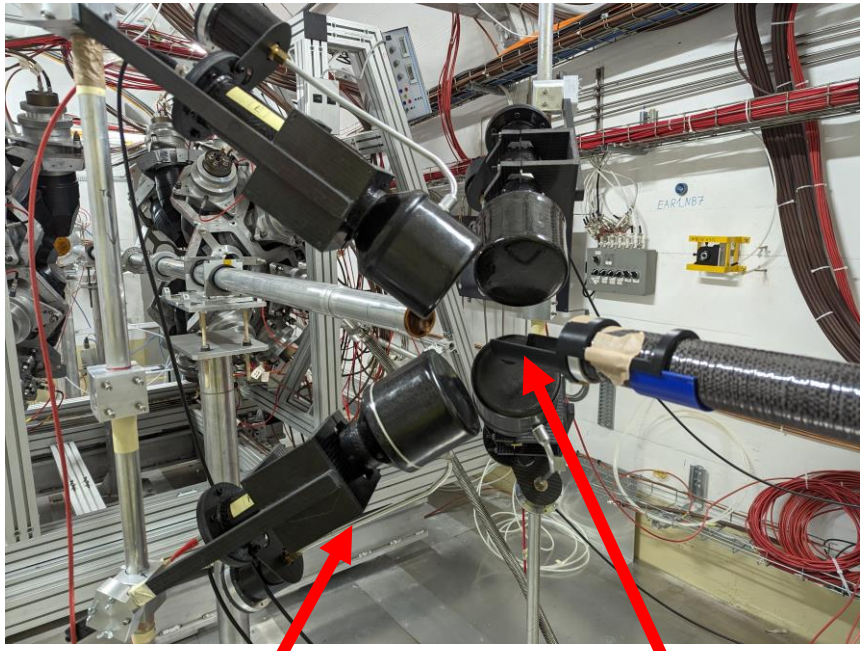


Beam Pipe End

U235 Fission Chamber (PTBC)
- 6 Detectors in the chamber
- 42 mm diameter U235 sample



Micromegas (FIMG)
- 2 detectors with B10 samples



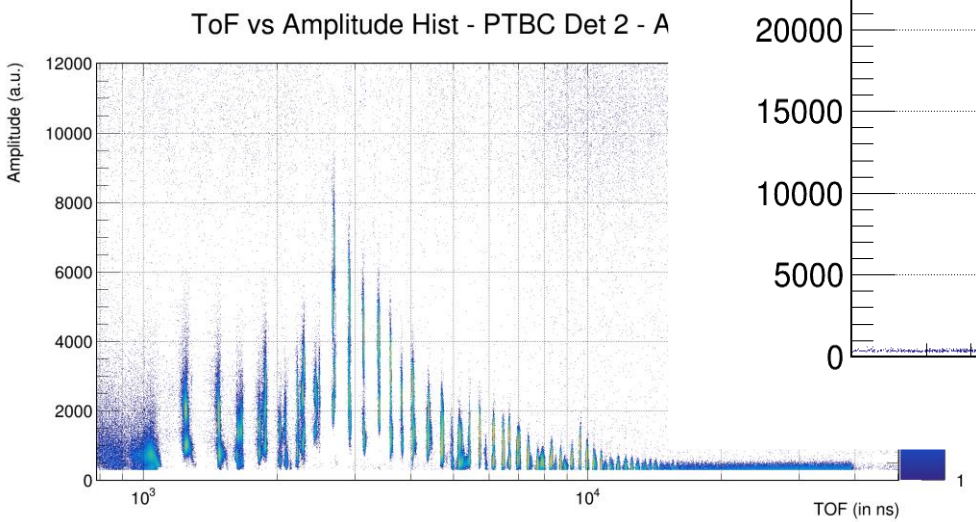
Capture Target Stand

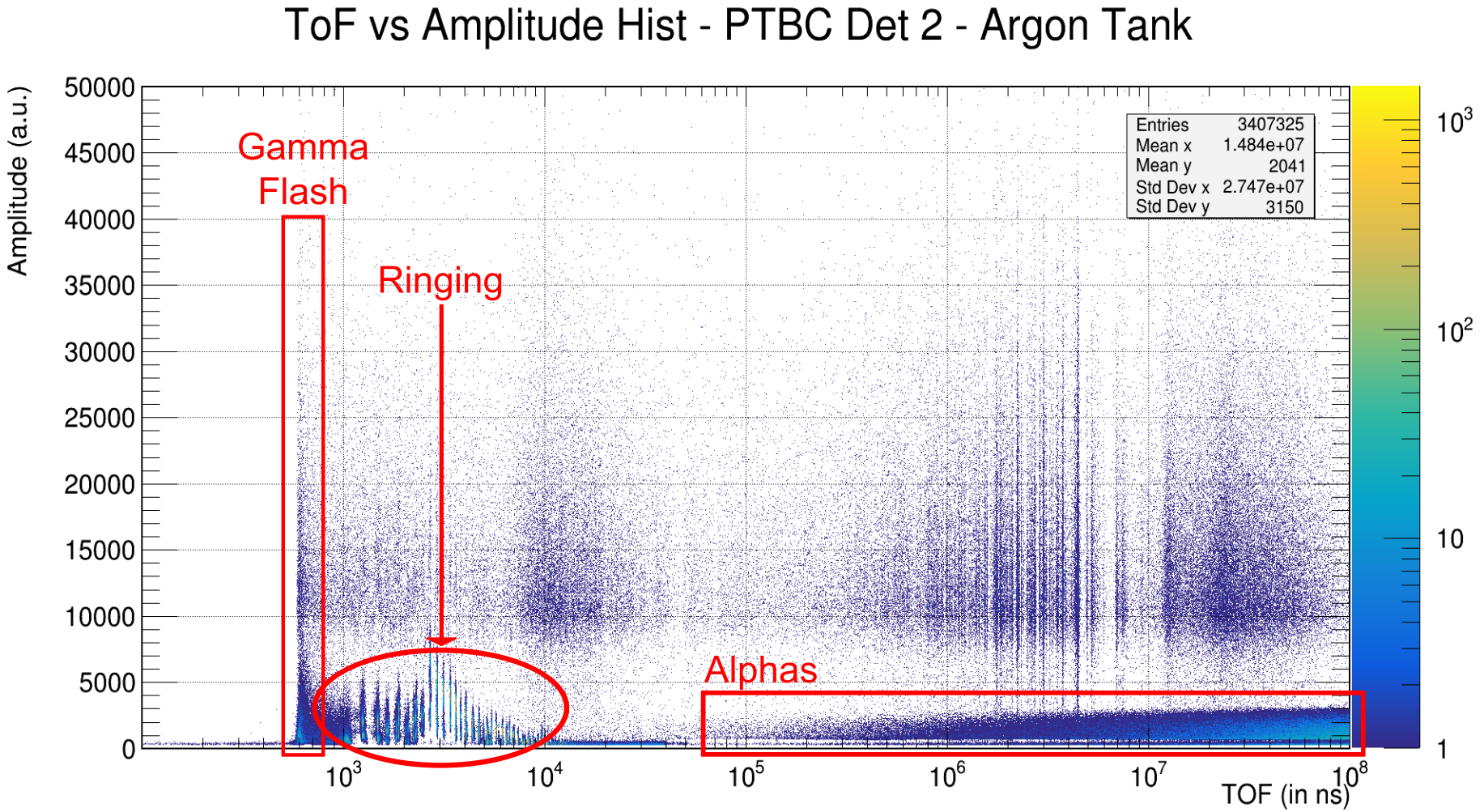
C6D6 Capture Setup
- 4 scintillation detectors
- Placed 125º wrt the beam line

Backgrounds: Fission Chamber

Fig. (Right) Time of flight vs amplitude histogram for the detector 2 in the fission chamber, highlighting the different types of backgrounds.

Fig. (Bottom) Zoom in on the ringing caused by the gamma flash.

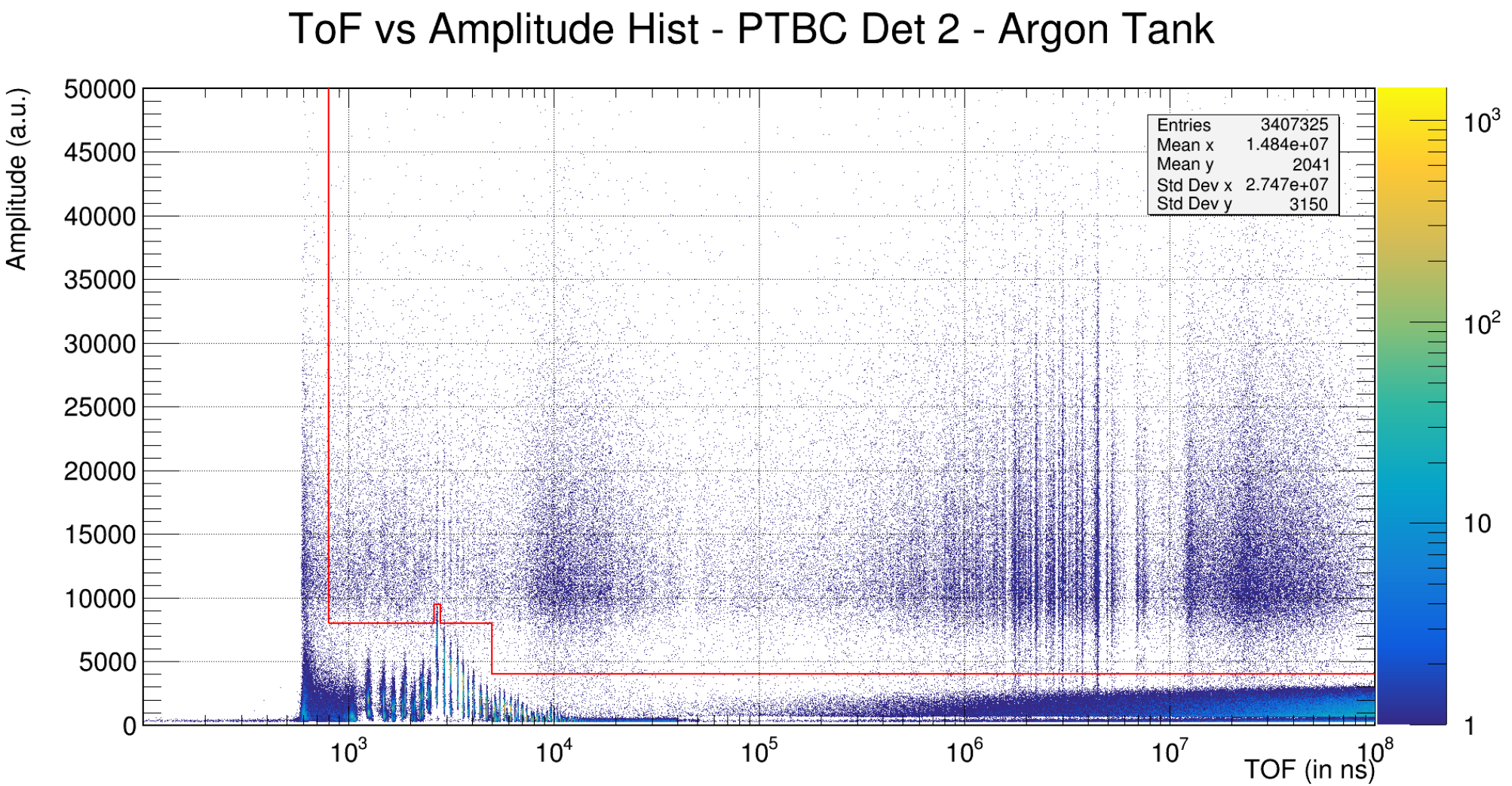




Backgrounds: Fission Chamber

Fig. (Right) Time of flight vs amplitude histogram for the detector 2 in the fission chamber

- Figure shows the cuts used to remove the background for detector 2
- Different cuts were used for dedicated and parasitic pulses
- Similar cuts were used for detectors 3 to 7



Backgrounds: Micromegas

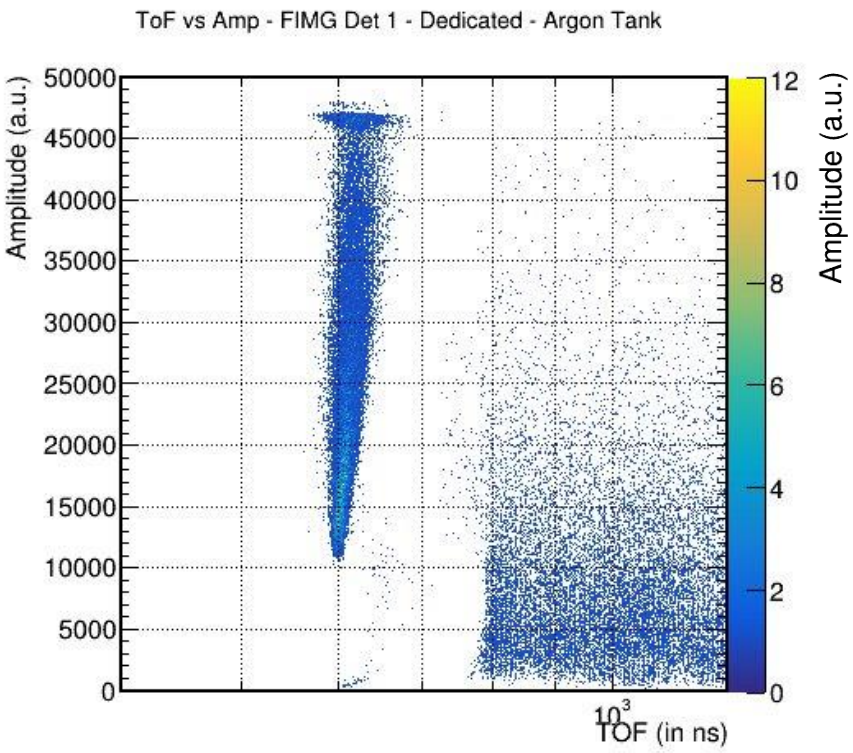


Fig. The above plot shows the gamma flash in the micromegas detector. It has a much higher amplitude than the signal produced by neutrons

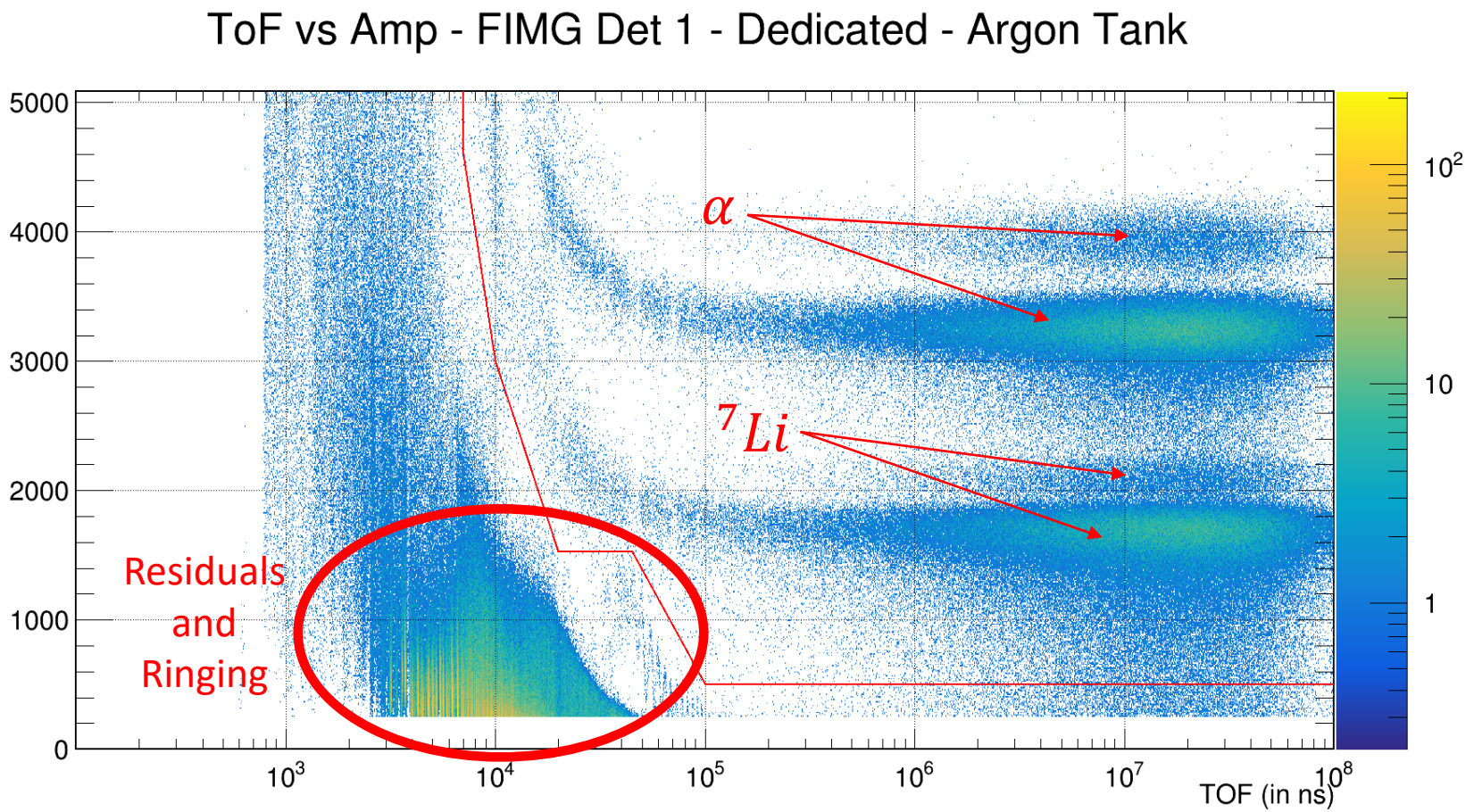


Fig. The above plot shows time of flight vs amplitude histogram for the micromegas detector. Some of the features are highlighted.

Argon Transmission Setup

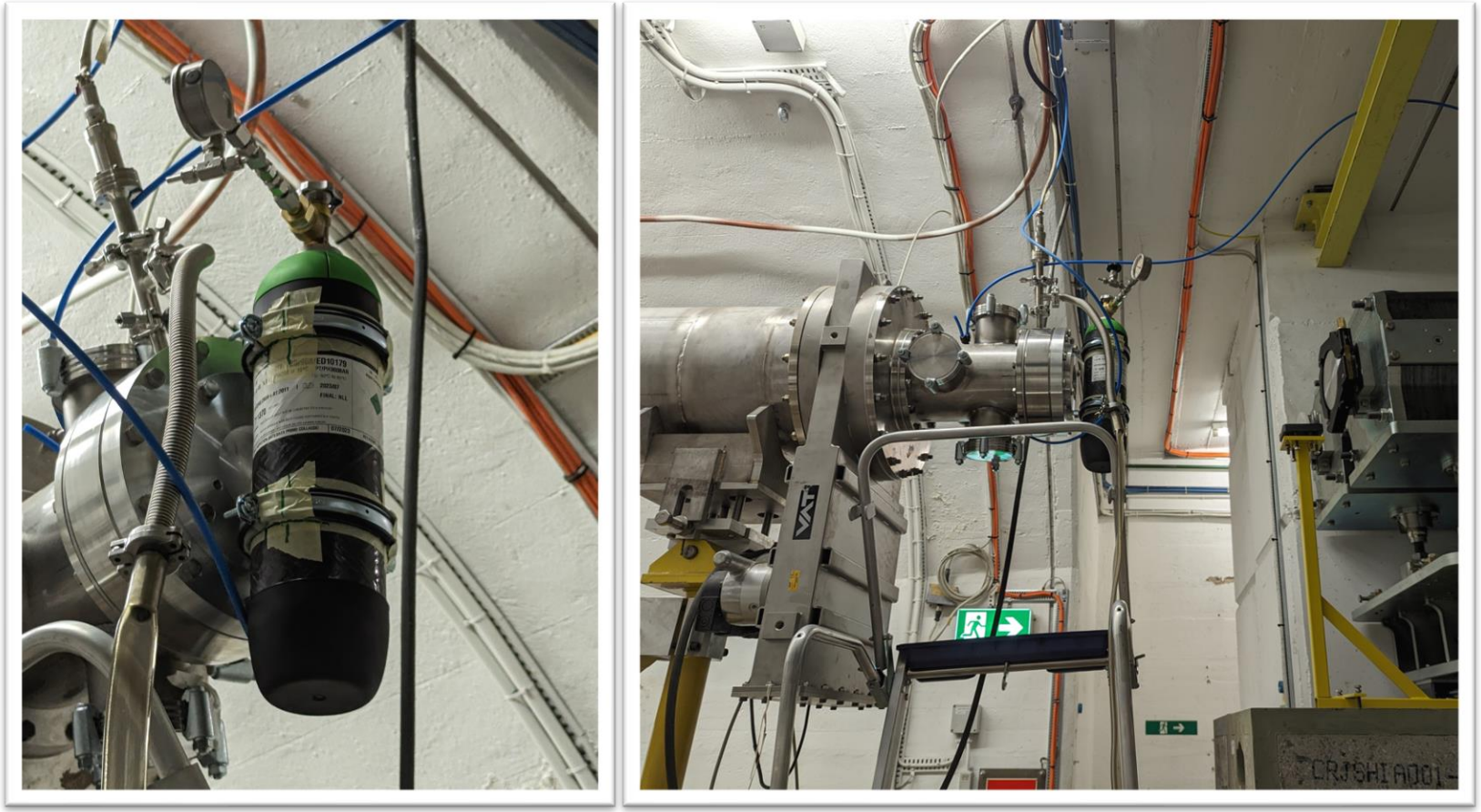
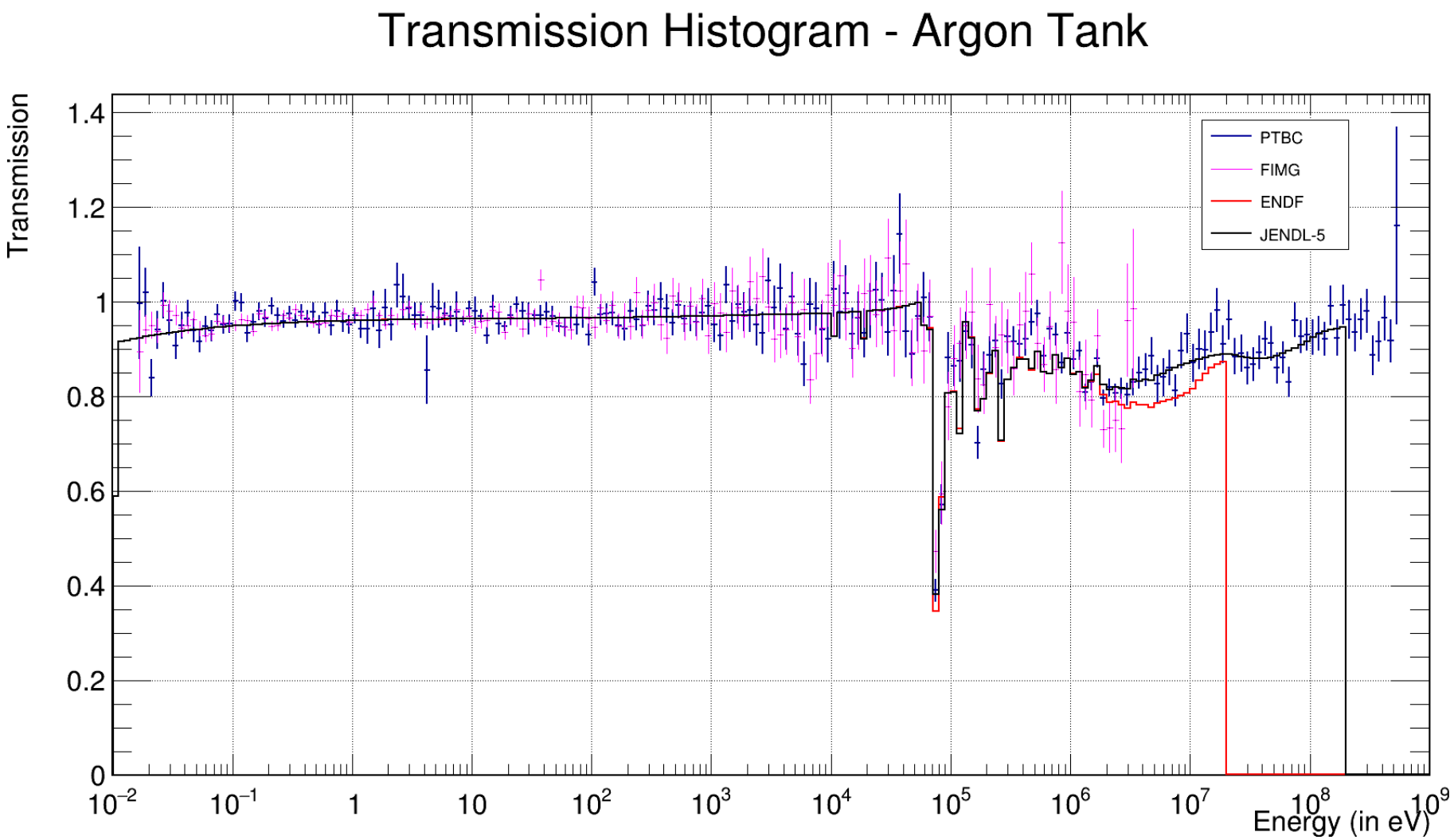


Fig. Argon tank in the transmission station

Argon tank specifics

- Carbon fiber tank
- 3 L volume
- 200 bar pressure
- ~ 10 cm of Ar gas in the neutron path
- ~ 0.05 atoms/barn

Updated Gaseous Argon Transmission



Number of Protons
Argon: 5.42966e+17
Empty tank: 2.81024e+17

Note:
- Empty tank is 1 atm Argon

Fig. A preliminary plot of the measured transmission of the gaseous Agron to the ENDF and JENDL-5 evaluations.

Data Stability: Fission Chamber

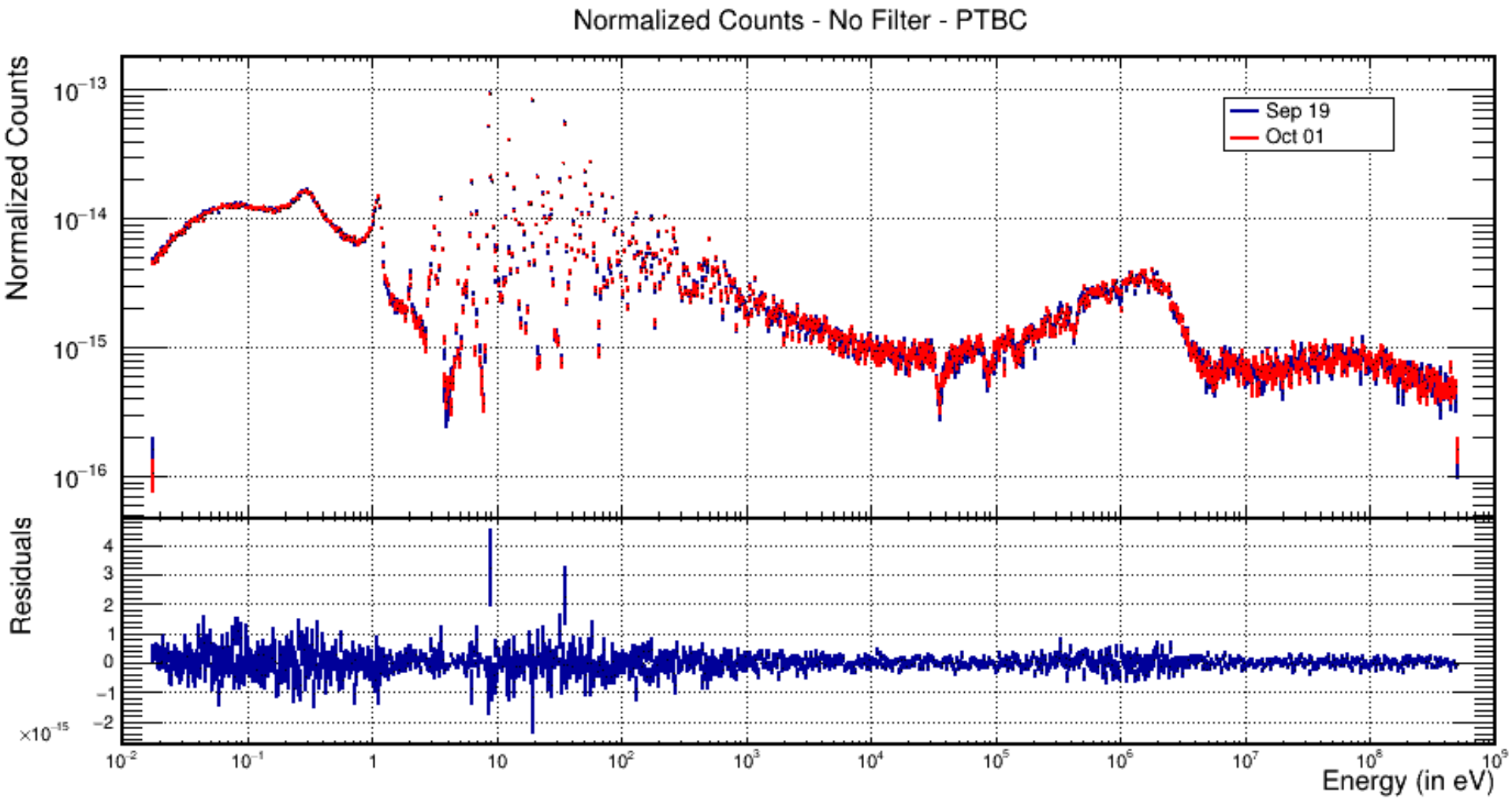


Fig. Plot of normalized counts vs energy for no filter runs on Sep 19 and Oct 1, for the fission chamber. Shown with 100 BPD

- Normalized wrt the total pulse intensity of the run
- The residuals are centered around zero
- This was repeated for 4 different types of measurements

Data Stability: Micromegas

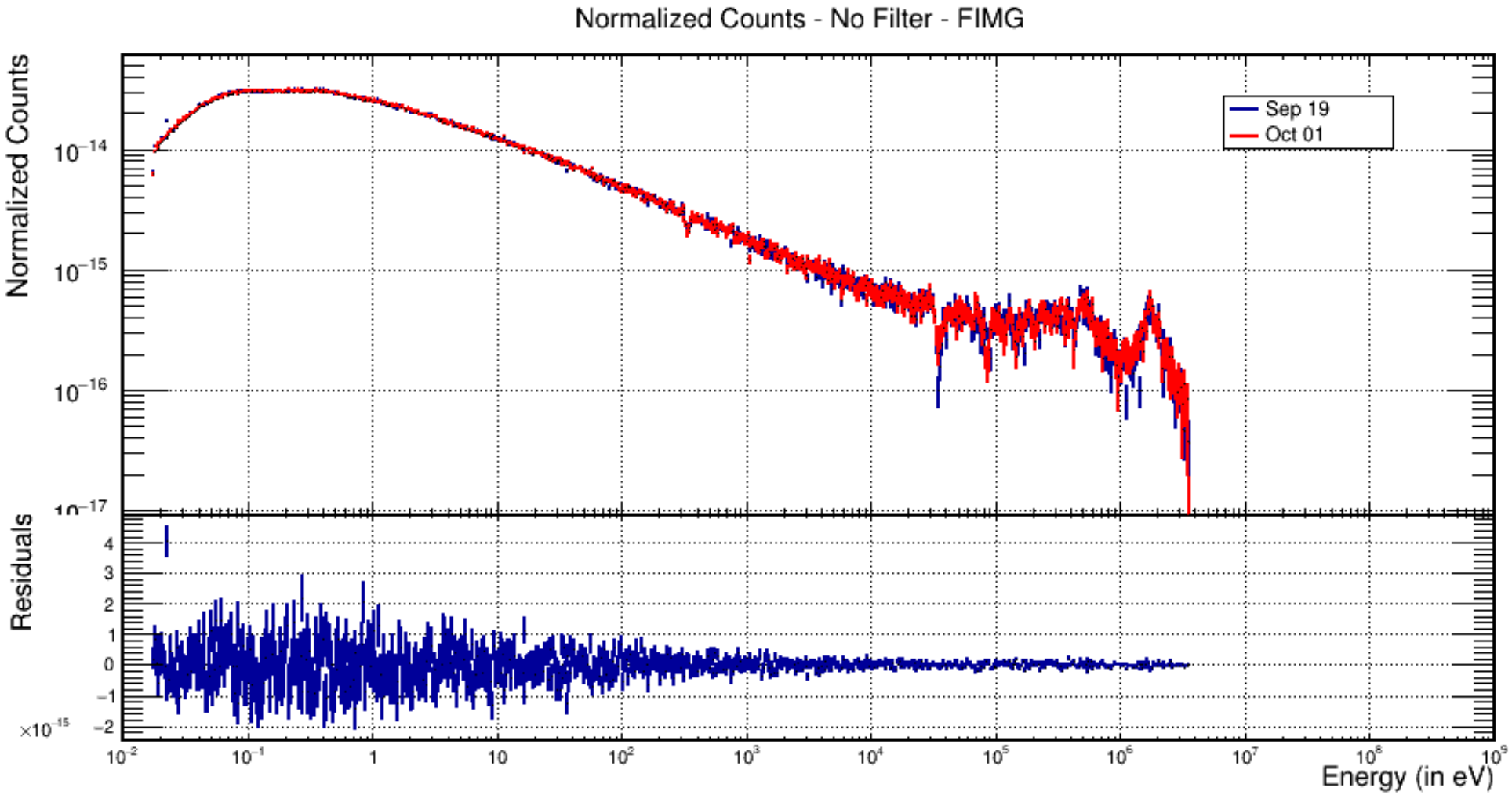


Fig. Plot of normalized counts vs energy for no filter runs on Sep 19 and Oct 1, for the fission micromegas. Shown with 100 BPD

- Normalized wrt the total pulse intensity of the run
- The residuals are centered around zero
- This was repeated for 4 different types of measurements

Day-Night Stability: Fission Chamber

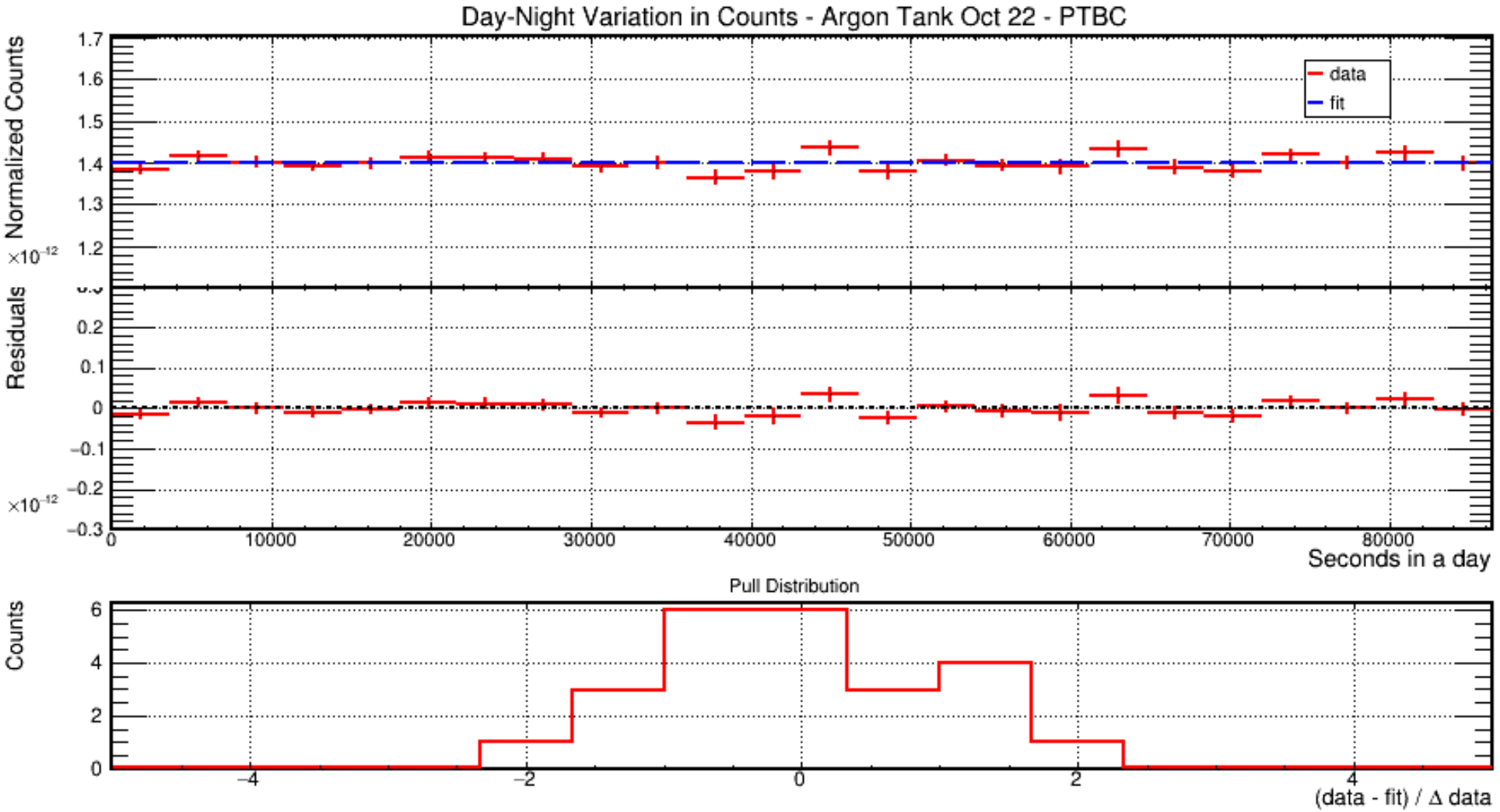


Fig. Figure shows the day-night variation in the fission chamber on Oct 22 during the Gaseous Argon run.

- Plots shows 24 bins, 1 bin for 1 hour of data taking
- 0s is 00:00:00 and 86400s is 23:59:59
- Normalized wrt the pulse intensity of the bin
- The residuals are centered around zero
- This was repeated for 4 other days with different targets

Day-Night Stability: Micromegas

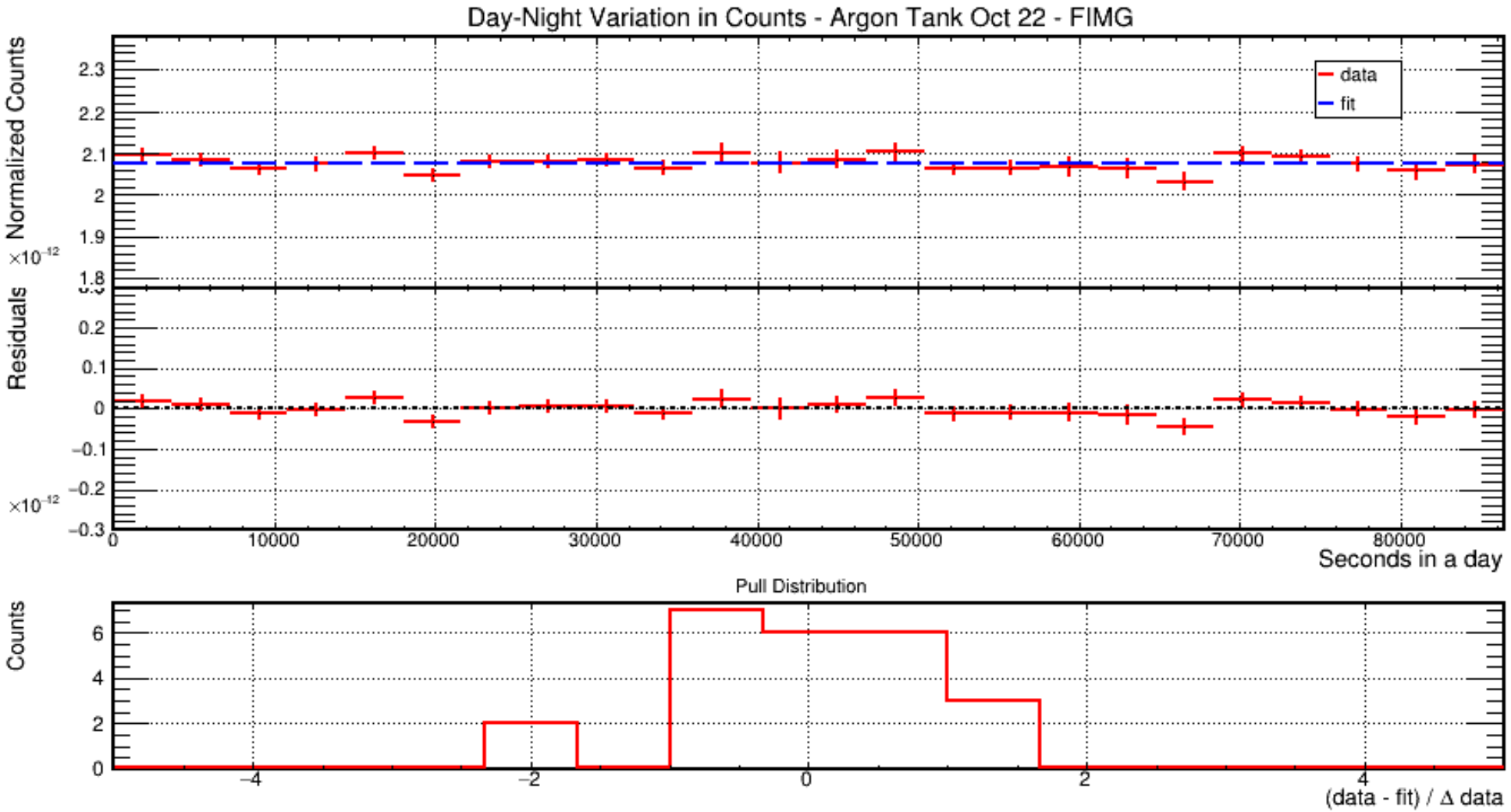


Fig. Figure shows the day-night variation in the micromegas on Oct 22 during the Gaseous Argon run.

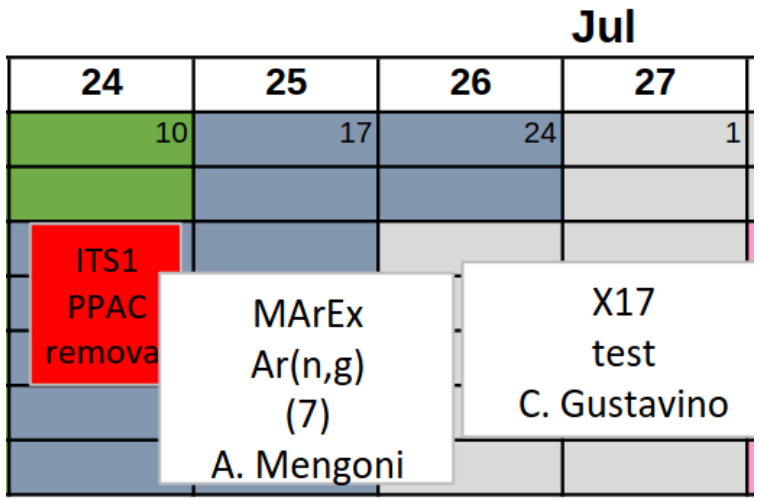
- Plots shows 24 bins, 1 bin for 1 hour of data taking
- 0s is 00:00:00 and 86400s is 23:59:59
- Normalized wrt the pulse intensity of the bin
- The residuals are centered around zero
- This was repeated for 4 other days with different targets

Conclusion

- Finalized the cuts for both, fission chamber and micromegas
- Fixed a bug in the code calculating transmission
  - Calculating the correct values now; matches with n_TOF
- Currently looking at the systematics
  - Looked at the data stability and the day-night variation

This year:

- Argon Capture measurement at the end of June



Thank You!

MArEX Collaboration:

S. Andringa, M. Bacak, Y. Bezawada,

J. Boissevain, D. Cano-Ott, N. Carrara,

A. Casanovas, S. Gollapinni, J. Huang,

W. Johnson, A. Junghans, A. Losko, V. Lozza,

A. Manna, P. Mastinu, E. Mendoza,

A. Mengoni, M. Mulhearn, E. Pantic,

N. Patronis, E. Renner, D. Rivera,

T. Stomatopolous, R. Svoboda, A. S. Tremsin,

J. Ullmann, J. Wang, T. Zhu,

and The n_TOF Collaboration