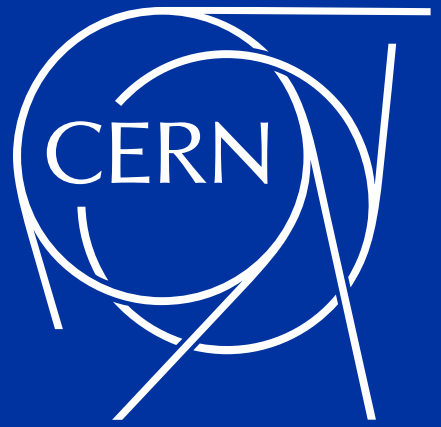


Signal to Background study for capture measurements in EAR2

V. Alcayne, M. Bacak, A. Casanovas, **A. Cintorra**, J. Lerendegui-Marco

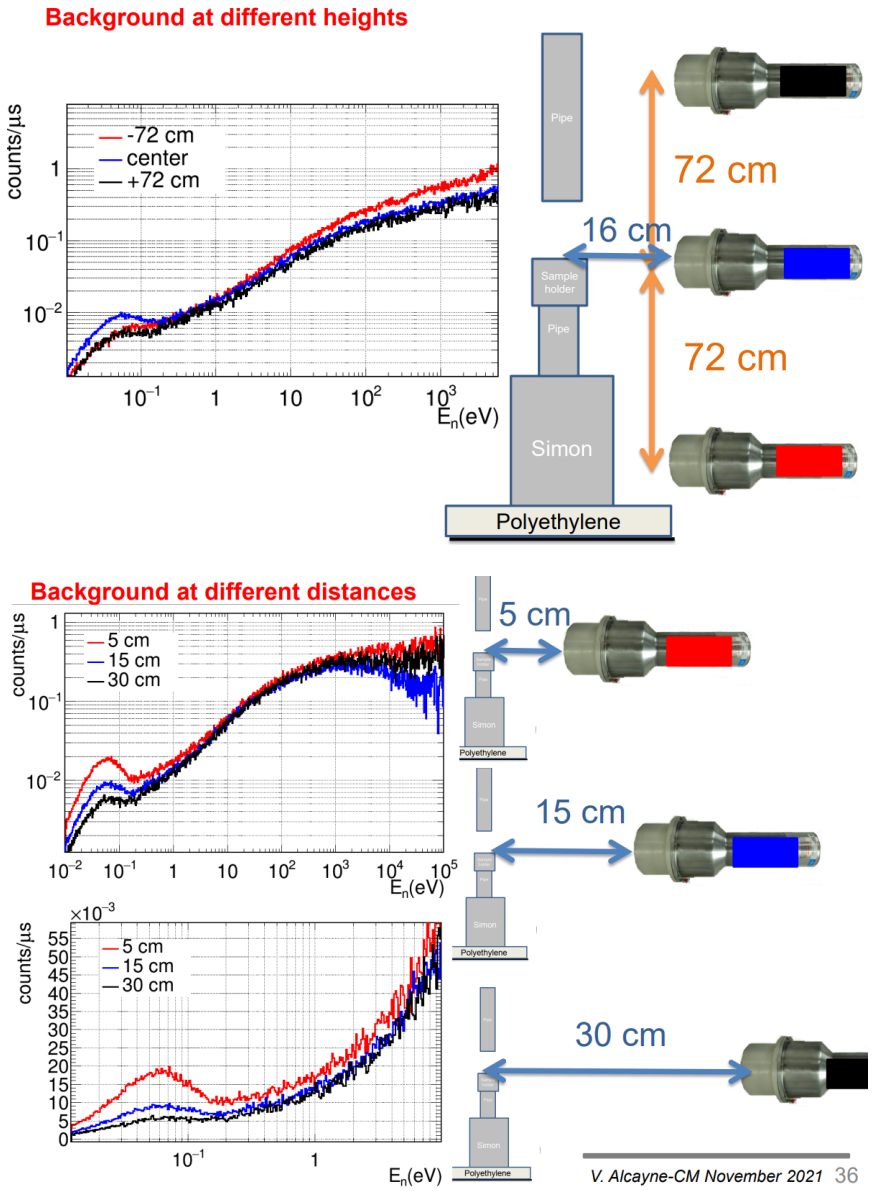
14.12.2022 – n_TOF Collaboration Meeting

Introduction & Motivation

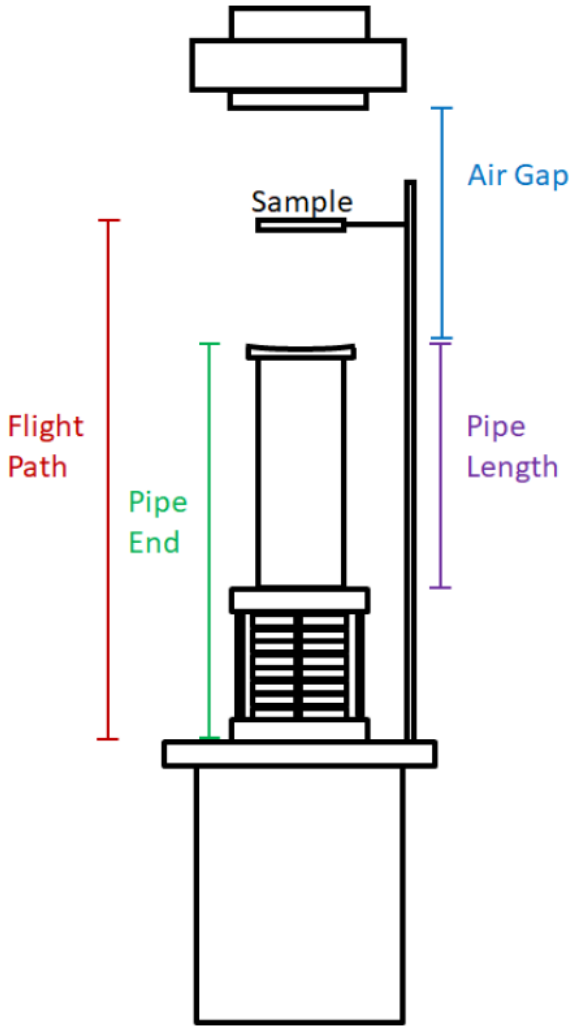
- **Triggered by and continuing investigations from:**
  - Victor (2021) – background study of the effect of different distances with B/L6D6
  - César (2022) – tests with $LaBr_3$ and $LaCl_3$ at different distances and impact on the peak2valley ratio of resonances

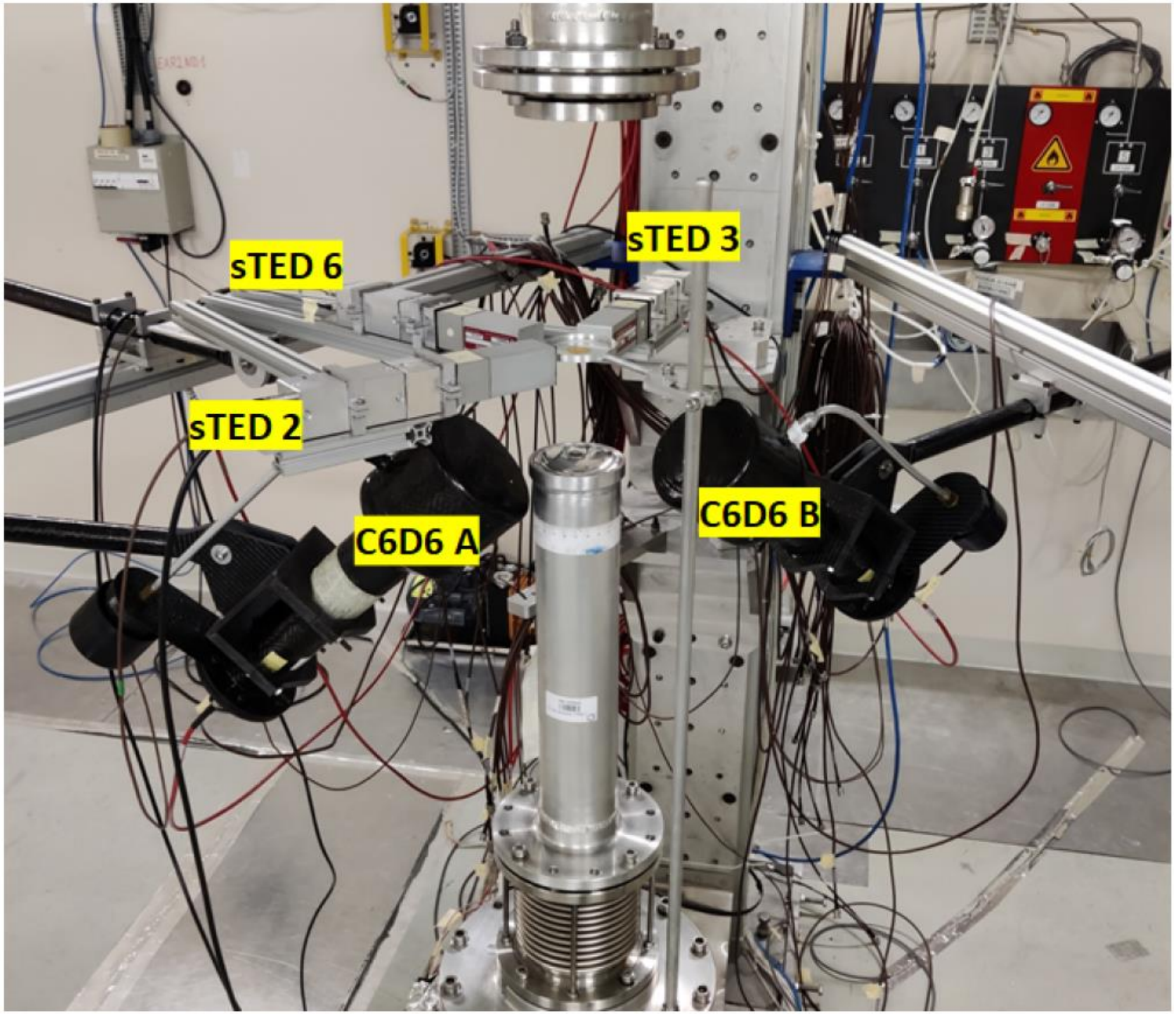
- **“What‘s the ideal capture position in EAR2 wrt SBR?“**
  - Sample positioning (flight path / BIF)
  - Detector positioning (distance to beam center)

- **Setup:**
  - Detectors at different distances and flight paths
  - Samples at different flight paths

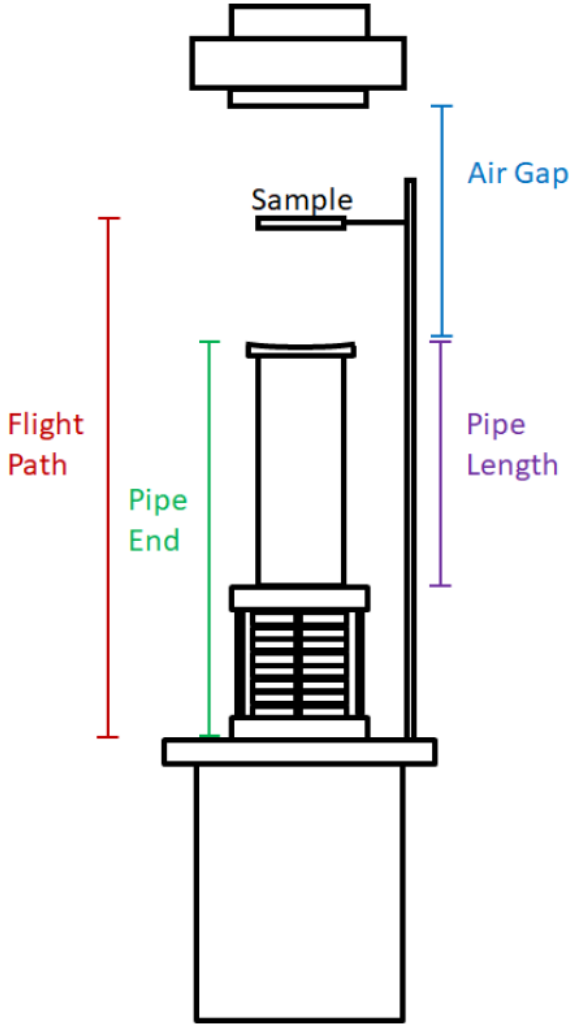


Exp. Setup


Air Gap
Sample
Flight Path
Pipe End
Pipe Length


sTED 6
sTED 3
sTED 2
C6D6 A
C6D6 B

Exp. Setup and campaign



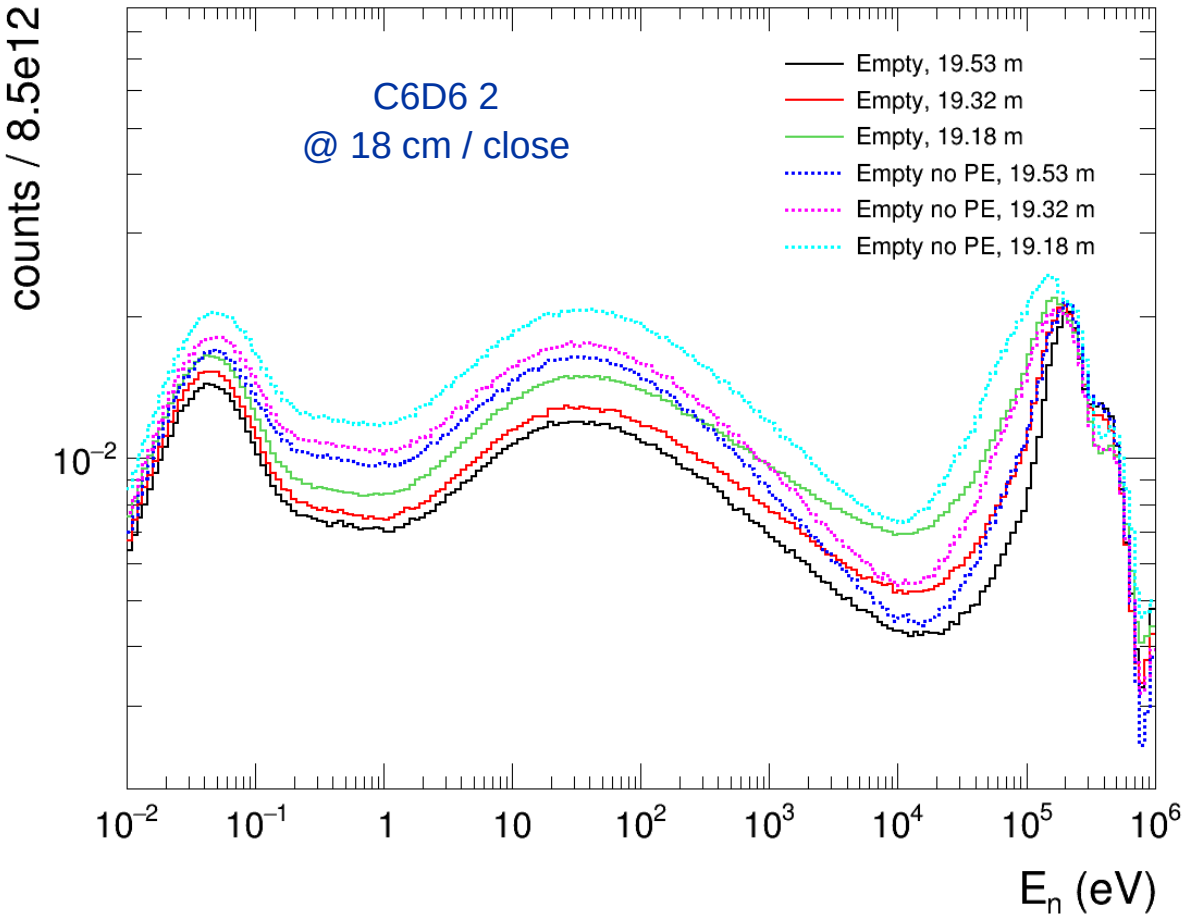
	Flight Path	Pipe End	Pipe Length	Air Gap	L_0
FP1	65.5 cm	56.5 cm	38.0 cm	26.5 cm	19.525 m
FP2	44.5 cm	35.0 cm	17.0 cm	33.0 cm	19.315 m
FP3	30.5 cm	20.5 cm	17.0 cm	48.0 cm	19.175 m

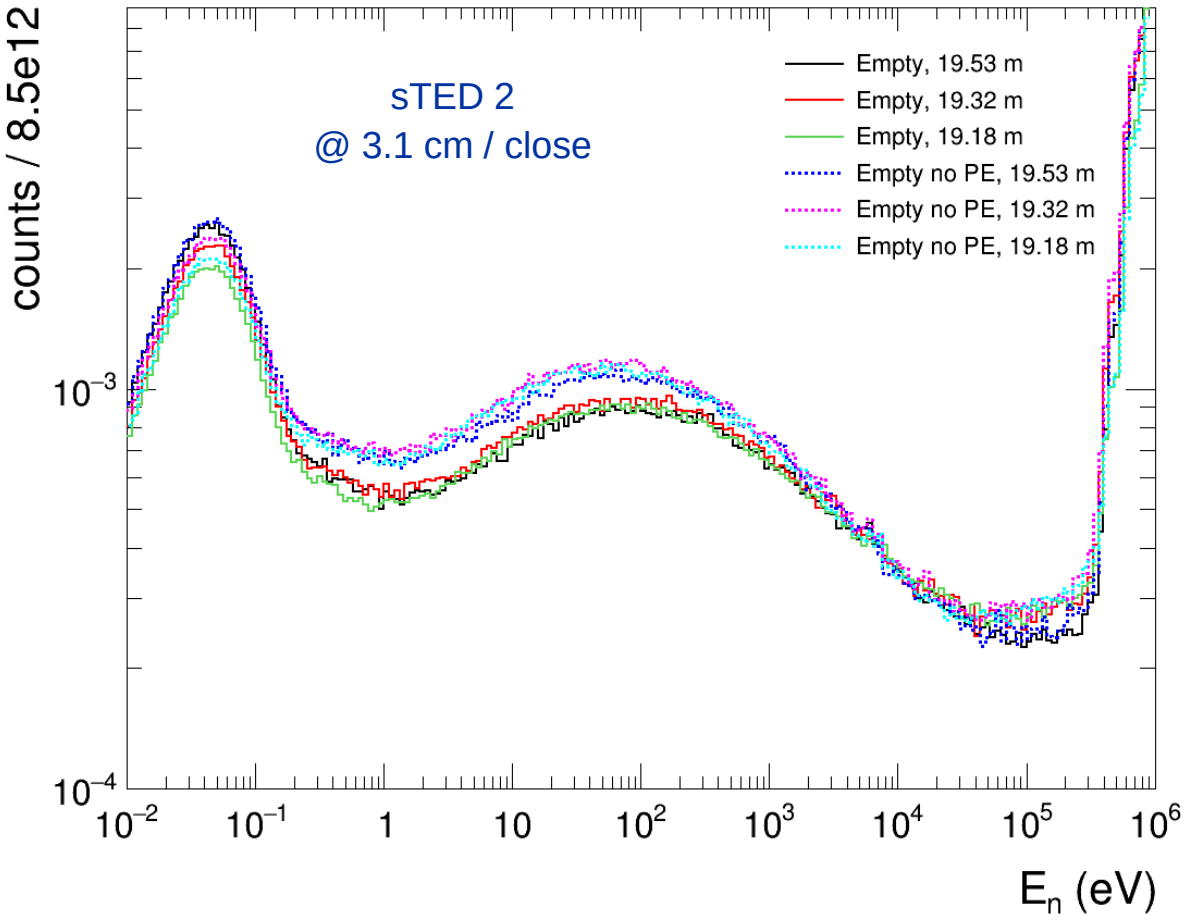
Detector	Distance
C6D6 A	24.0 cm
C6D6 B	18.0 cm
sTED 2	3.1 cm
sTED 3	4.0 cm
sTED 6	5.0 cm

ID	Source	Mass	Thickness
689	^{197}Au (20 mm)	645 mg	100 µm
1189	^{197}Au (10 mm)	-	102 µm
106	C (nat) (20 mm)	2.646 g	5 mm
1209	Fe (20 mm)	5.143 mg	2.1 mm
184	Pb (nat) (20 mm)	7.281 mg	2.1 mm

+ empty (with and without PE floor)

Empties PE-noPE (no normalization required)

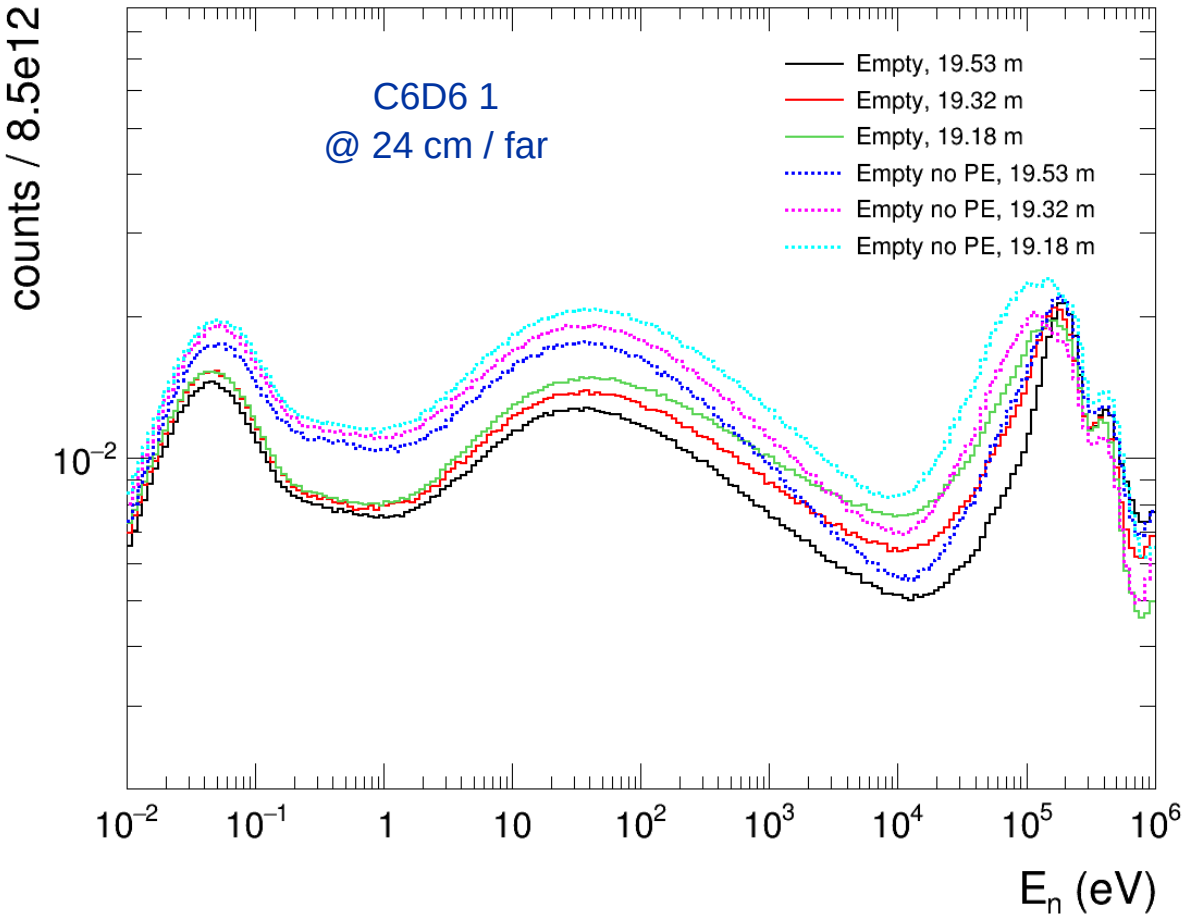


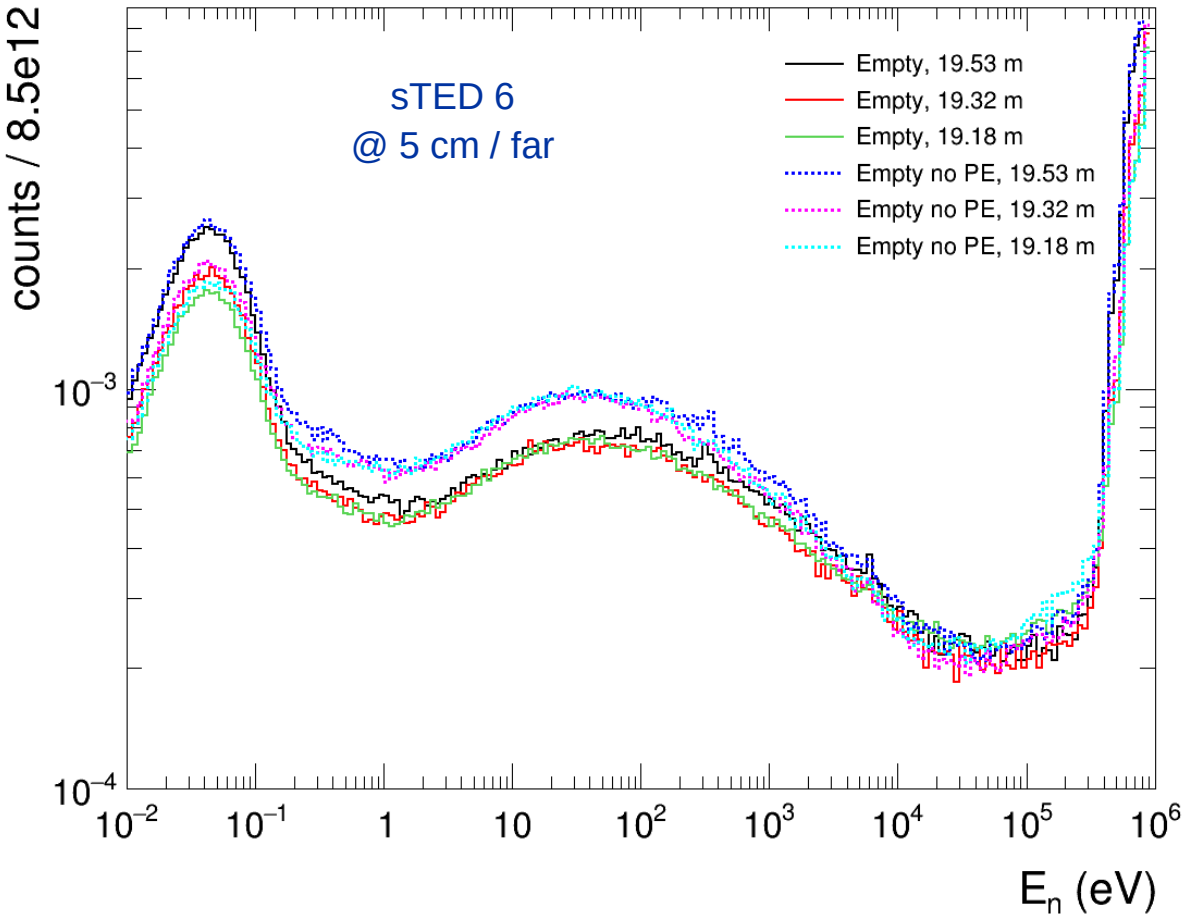


noPE → more background irrespective of detector size/position

Background dependence on flight path for C6D6 (seems stable in STED position range)

Empties PE-noPE (no normalization required) II





noPE → more background irrespective of detector size/position

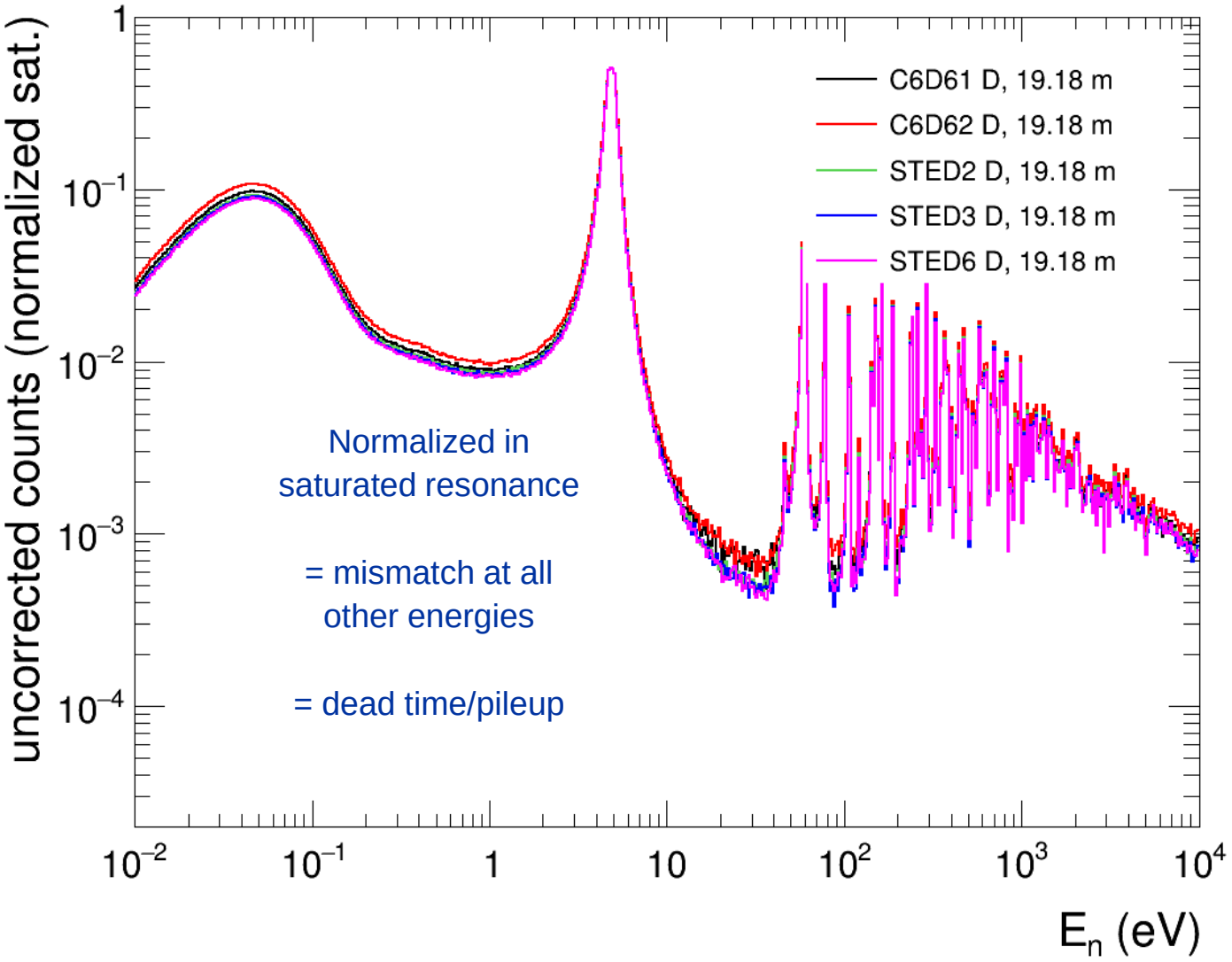
Background dependence on flight path for C6D6 (seems stable in STED position range)

Important: normalization with Au to correct for BIF

- **Problem: Count rates of up to 10 counts / us:**
  - Important corrections for the normalization otherwise direct comparison is invalid

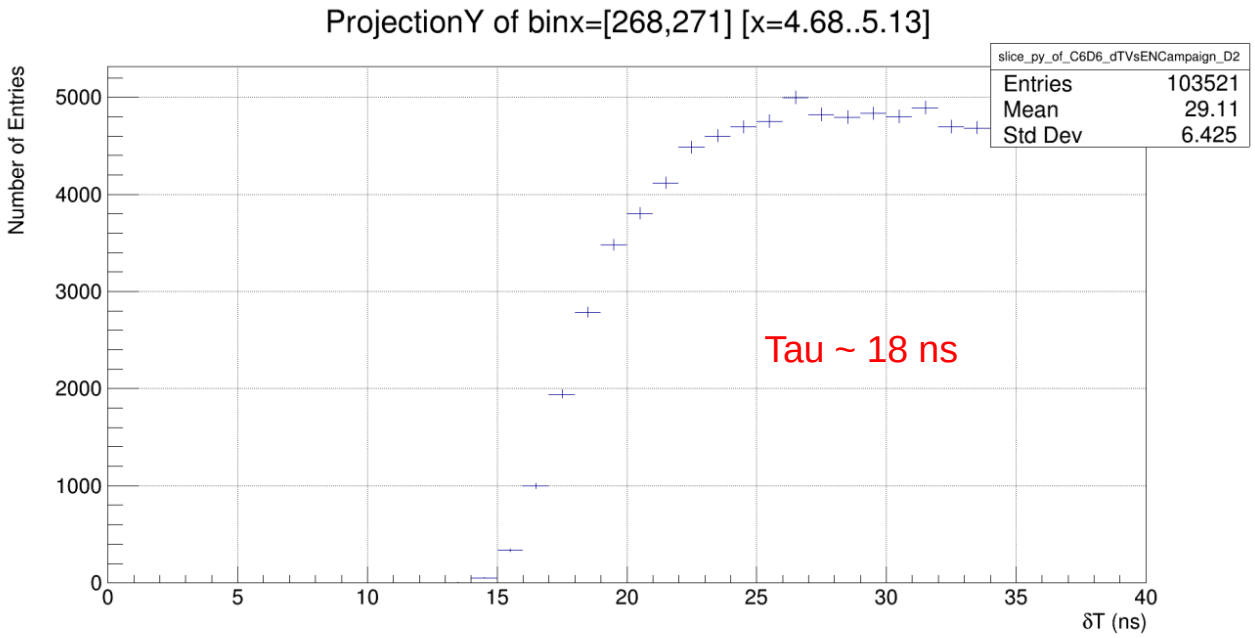
- **Dead time model:**

$$CF(E_n) = \frac{1}{1 - \tau \cdot CR(TOF)}$$

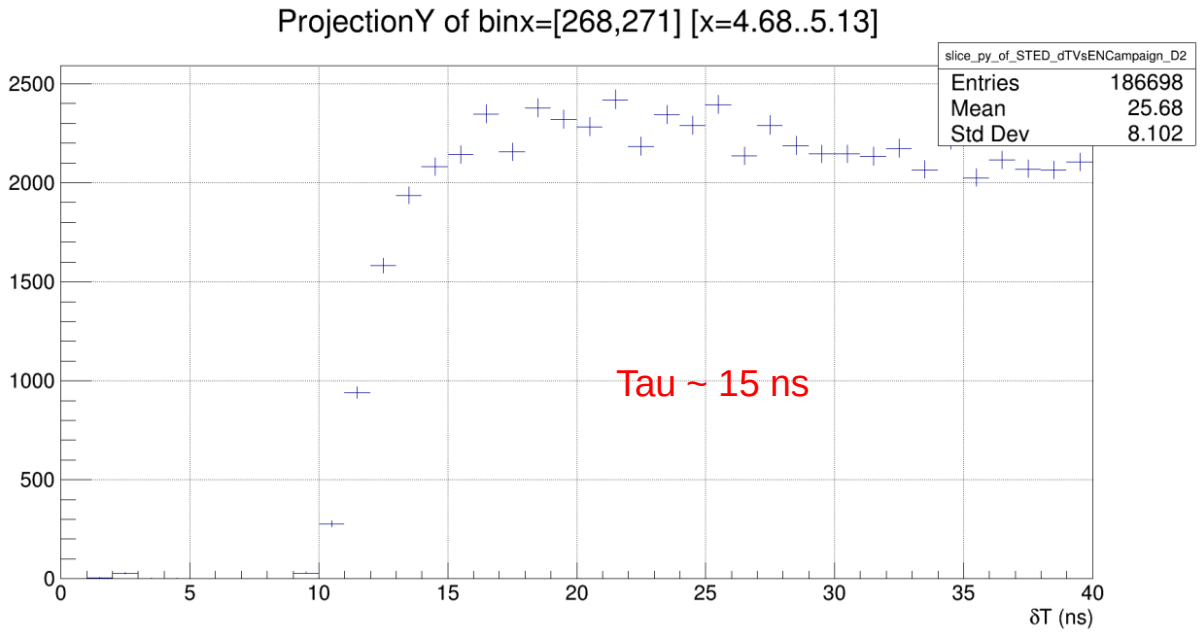


Pile-Up/Deadtime

$$CF(E_n) = \frac{1}{1 - \tau \cdot CR(TOF)}$$



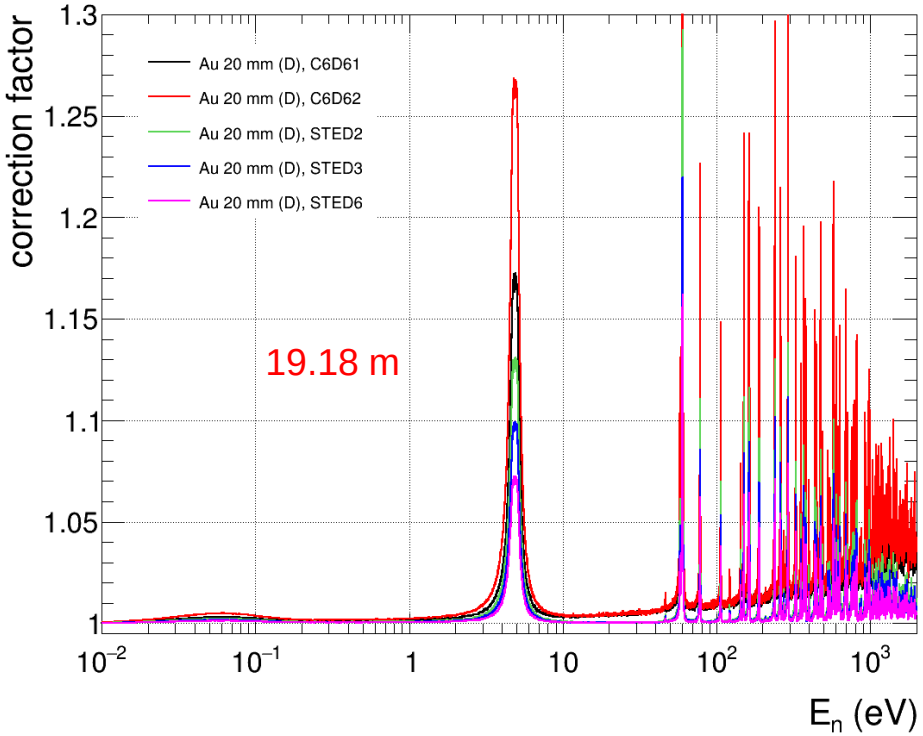
((b)) C6D6B

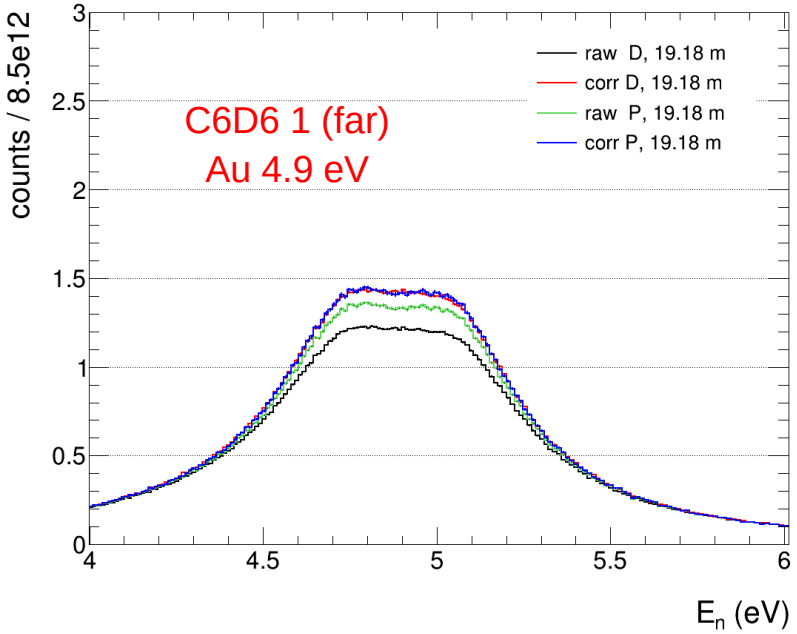


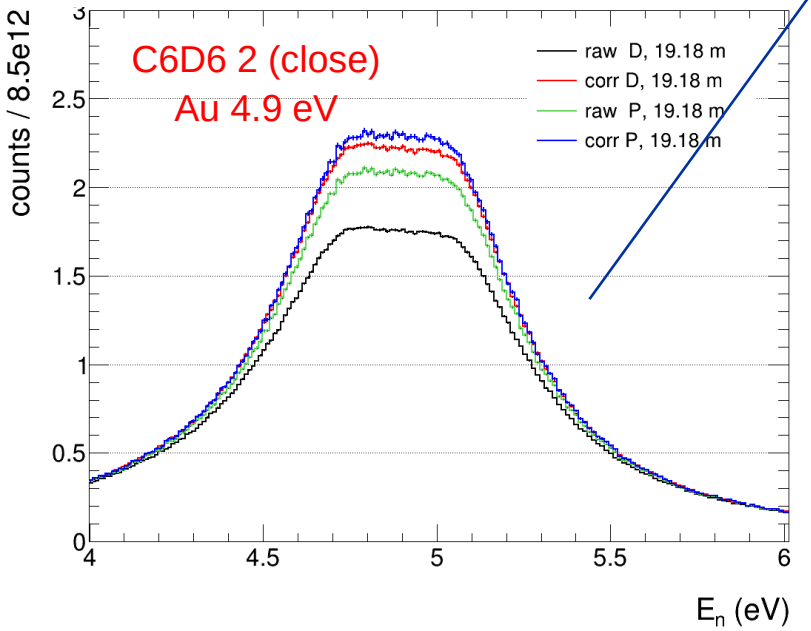
((c)) sTED2

This is an easy-to-implement technique but an approximation potentially not sufficieny for a physics measurement but it works well enough for a first comparison

Pile-Up/Deadtime

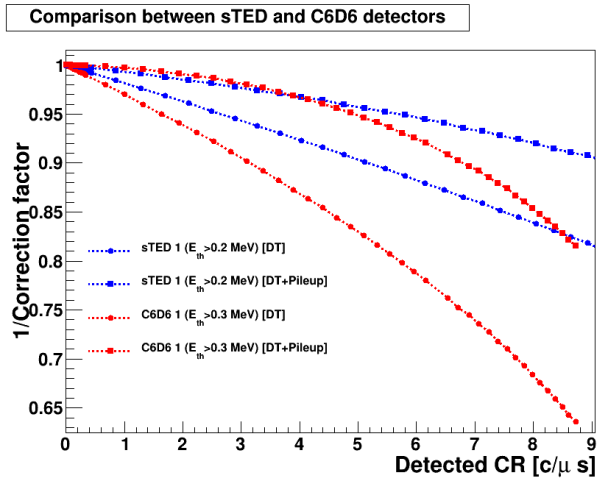






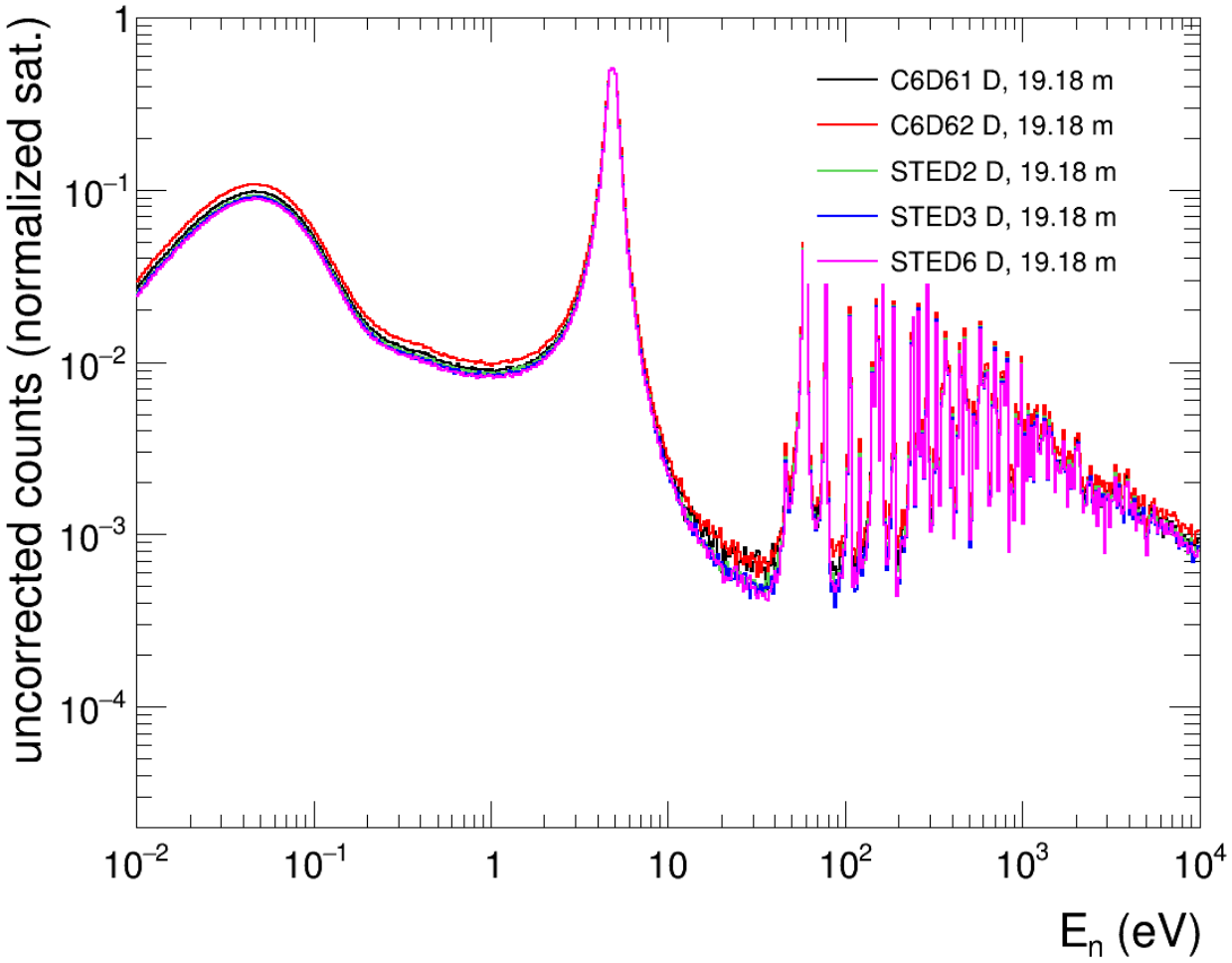
not perfect because not only dead time but also pile-up

See J. Balibrea's ^{94}Nb talk for a more precise correction

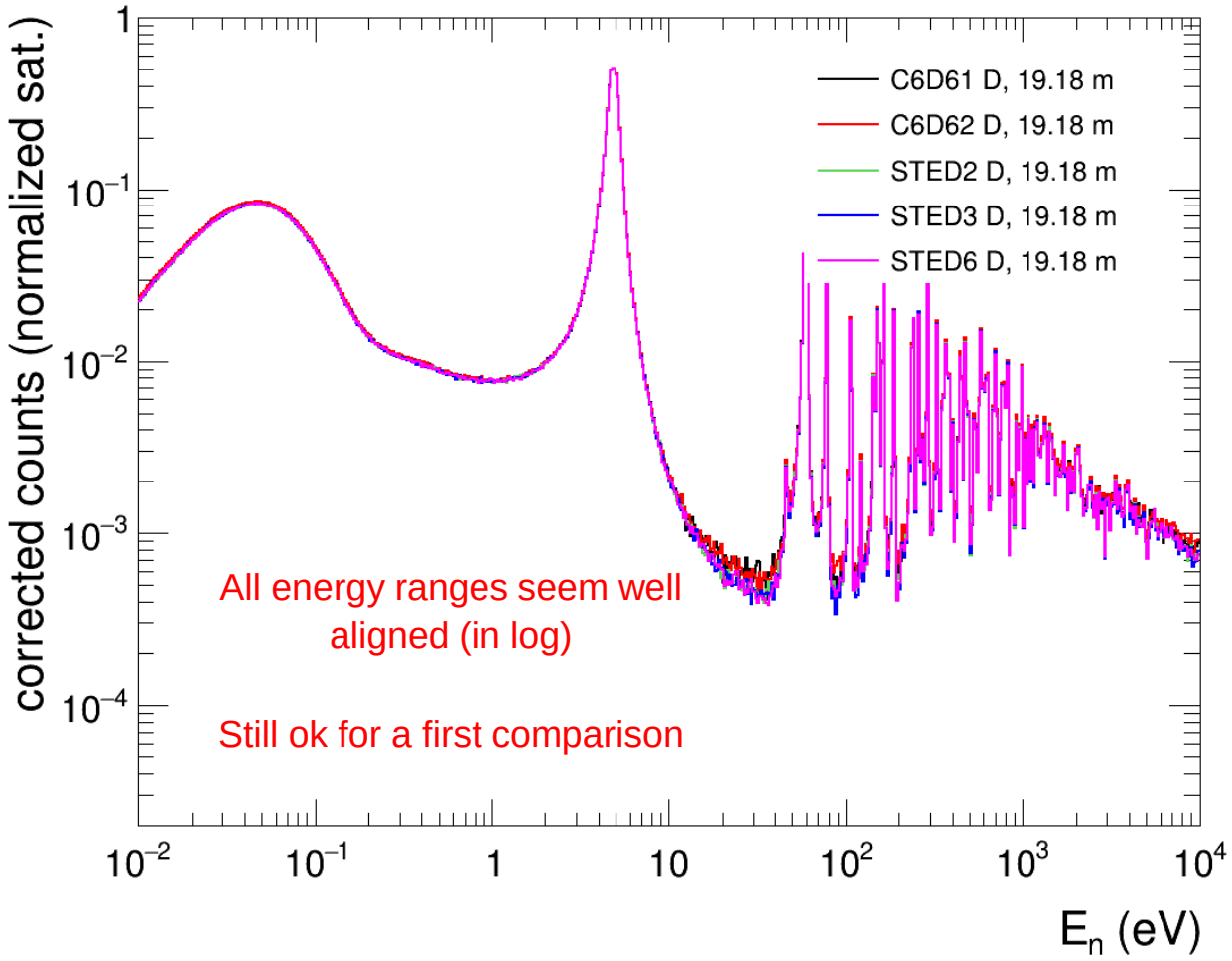


Au before/after DT correctiong & empty subtraction

Before DT correction



After DT correction

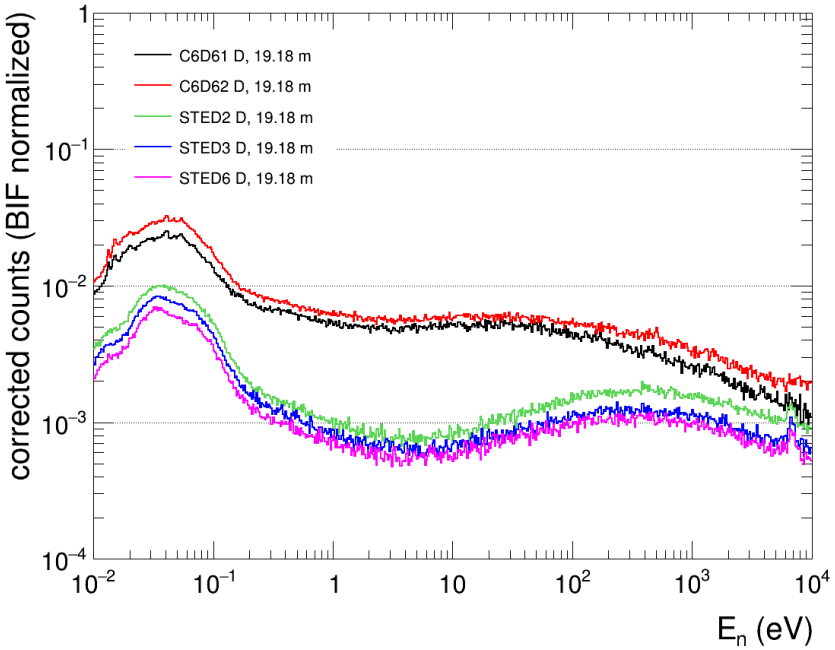


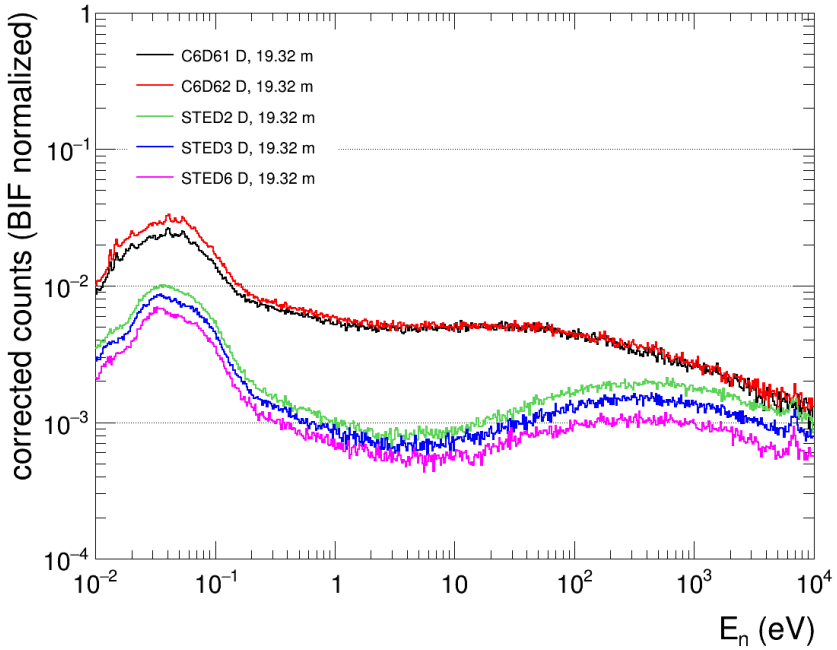
Extracted normalizations / relative BIFs

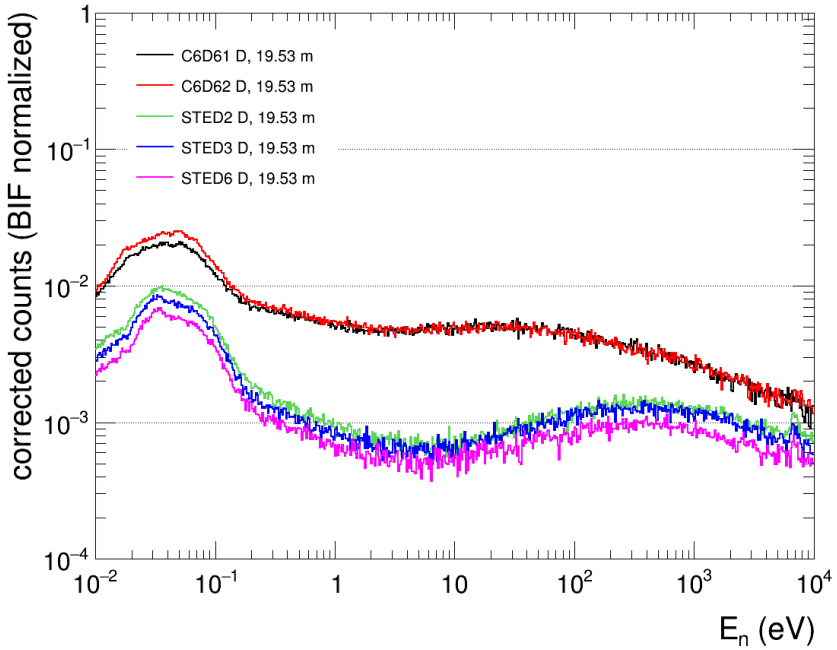
	Au integral (per 8.5e12) @ flight path		
	19.53	19.32	19.18
C6D6 1 (A)	2.27	2.63	2.84
C6D6 2 (B)	3.30	3.87	4.44
STED 2	2.09	2.64	2.79
STED 3	1.66	2.01	2.11
STED 6	1.18	1.41	1.53
	Ratio to max flight path (relative BIF)		
		1.16	1.25
		1.17	1.35
		1.26	1.33
		1.22	1.27
		1.19	1.30
Mean		**1.20**	**1.30**

Normalize the 19.32 m and 19.18 m flight paths to the higher BIF

Cnat BIF normalized – neutron scattering



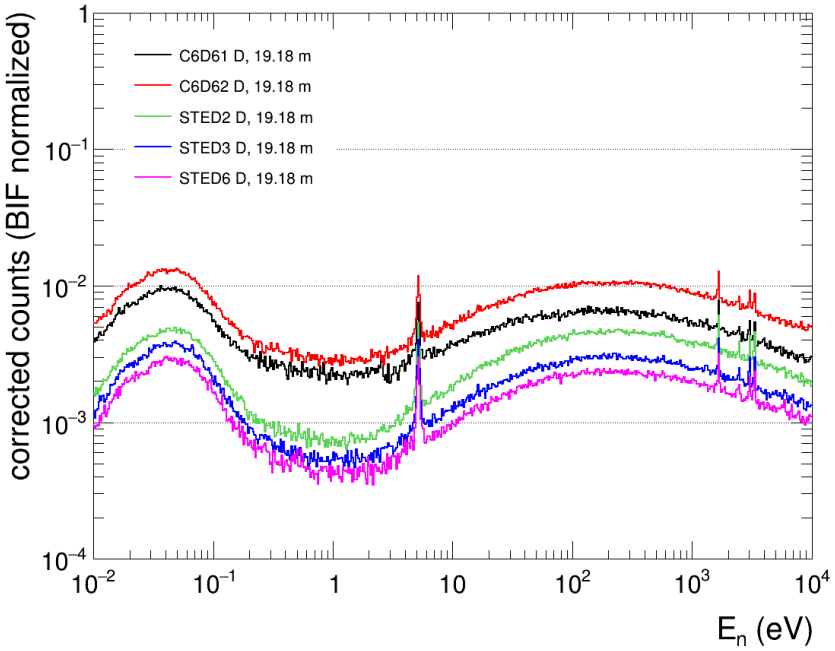


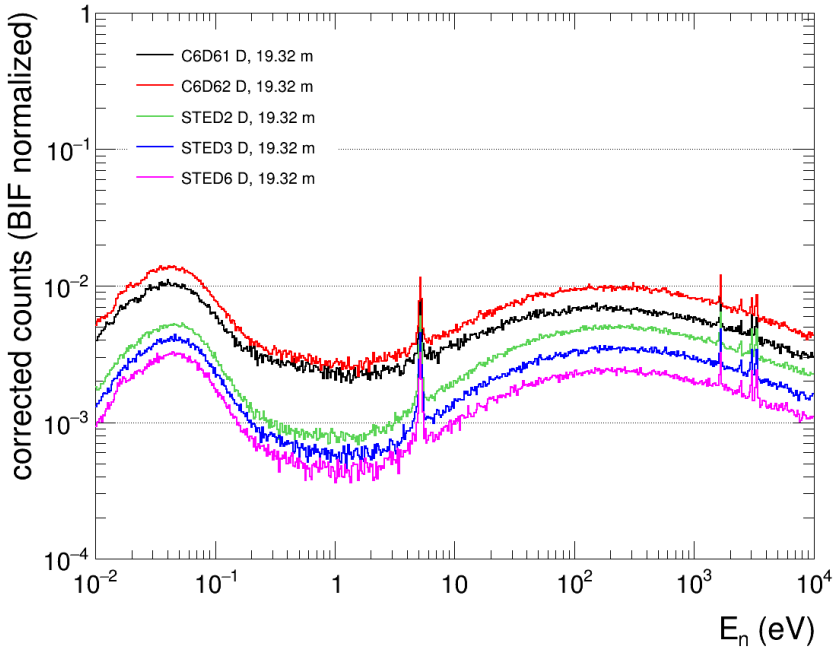


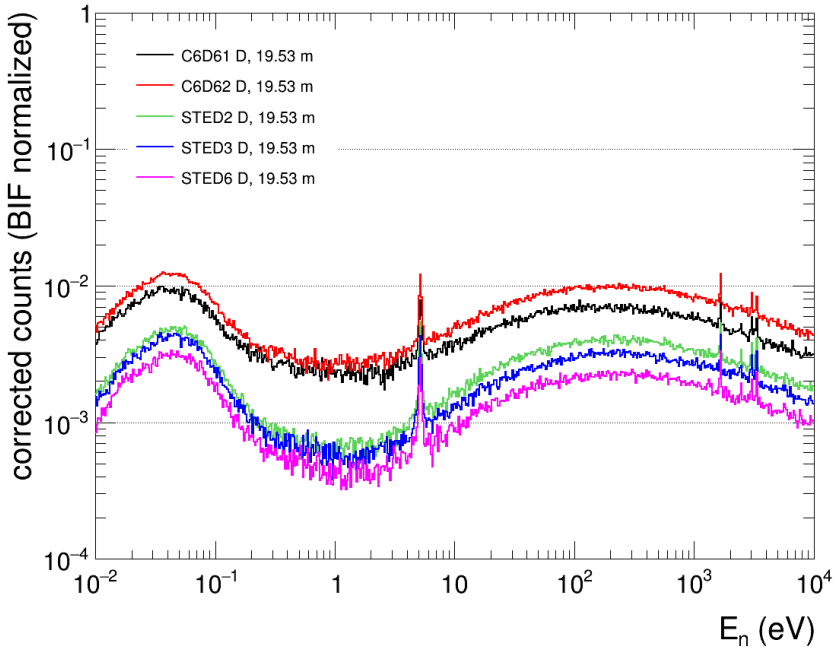
Detectors relative to each other change but overall trend seems stable.

Shape at thermal looks weird – no idea (bragg edges of the carbon crystal?

Pb BIF normalized – gamma scattering



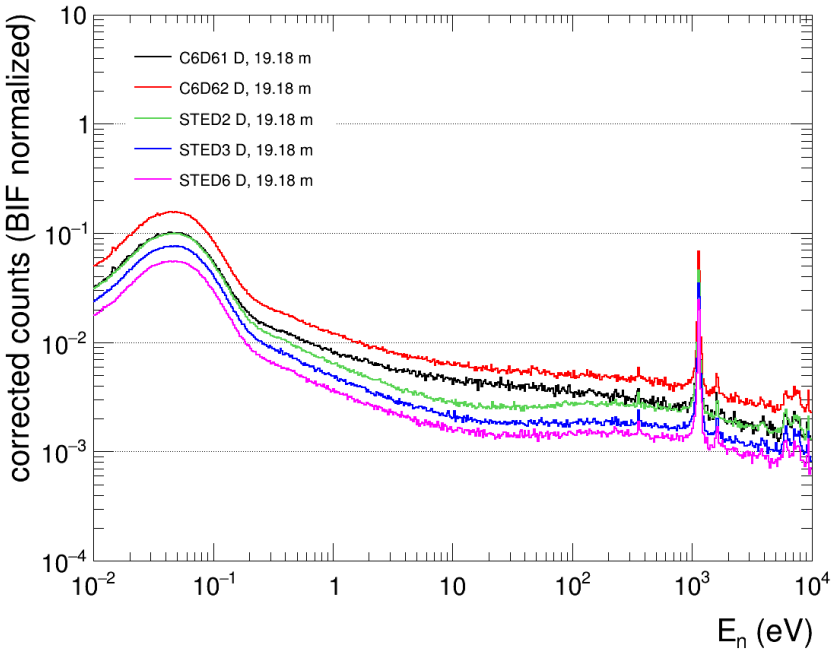


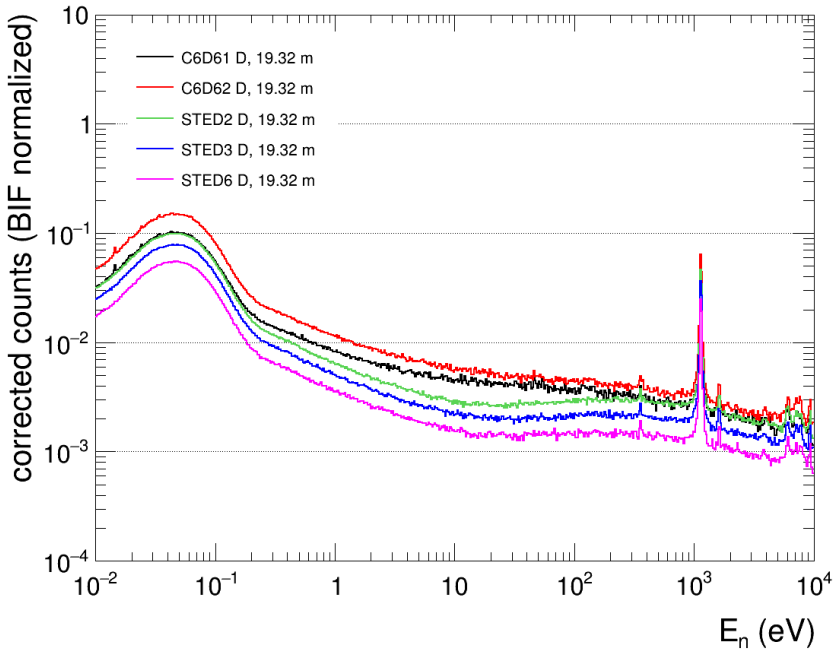


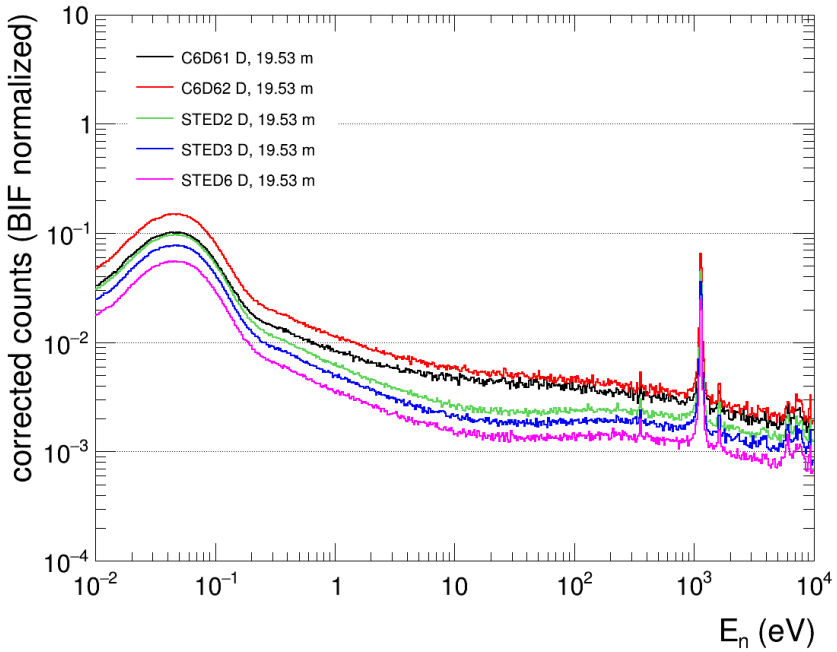
Slightly less counts at longer flight paths

(usual Ag contaminant)

Fe BIF normalized – neutron and gamma scattering







Slightly less counts at longer flight paths

Summary & outlook

- **Three weeks of data taking:**
  - 2 setup swaps to different flight paths → thanks to everybody who helped making this as efficient and reproducible as possible
  - Thanks to Oscar for the needed modifications of the sample holder to make it flexible
  - Thanks to our summer student Alan Cintorra (via Carlos) for his interest, help to set up the experiments and a nice portion of data analysis
- **In depth analysis is pending**
  - Master student anyone?
- **First results might indicate:**
  - Potential to increase BIF (30%?) by reducing the flight path without paying a price in additional background (see Fe, Pb (Cnat))
- **The investigation can still be complimented with a finer and wider grid of detectors**

Thanks!

Michael Bacak
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