CYGNO WP3

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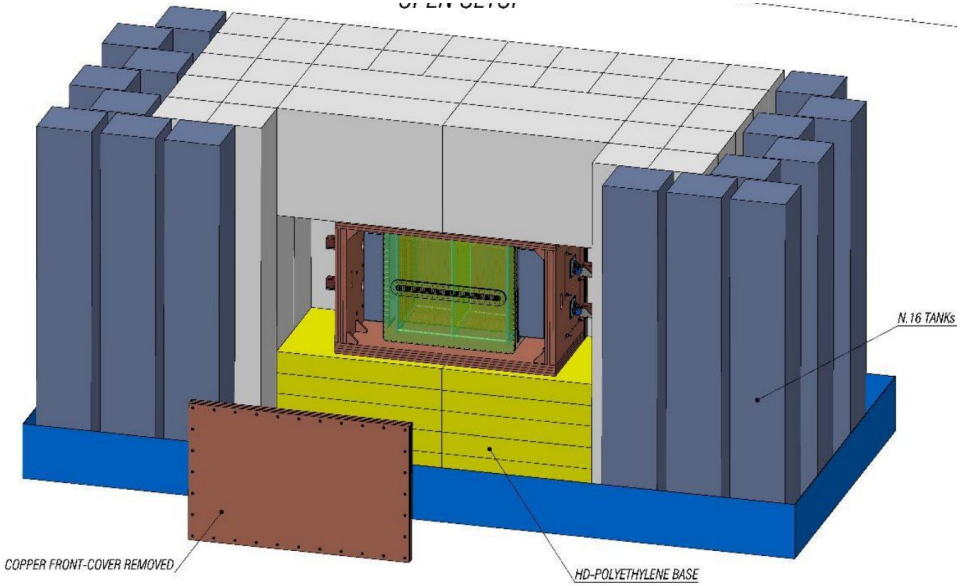
WP1-WP2-WP3 joint meeting
17-18/06/25

Simulation activities

- CYGNO-04 full background simulation (Melba/Giulia)
- Radon simulation (Federico) ➜ see presentation
- Calibration simulation (Zahoor) ➜ see presentation
- AmBe full simulation and comparison with LIME data (Pietro)
- Low energy ER and NR simulations for ML (Giulia)
- Geant4 code development (Melba/Giulia)
  - import SRIM tables to simulate low energy NR
  - upgrade v10.5.1 ➜ v11.3
- Digitization code development (Pietro/Giorgio/Stefano)
  - reproduce data saturation
  - include PMT simulation

CYGNO-04 background simulation



Radioactivity measurements in the DB

Setup components to simulate:

- Water shielding
- PE basement
- Cu shielding
  - outer layer: 6 cm OPERA
  - inner layer: 4 cm Schreiber
- 6 Cameras (body + lens)
- 8 PMTs
- Acrylic box
- Field Cage
- GEMs
- GEM frame
- Cathode
- Cathode frame

CYGNO-04 background simulation

Summary Table	NR/yr 1-20 keV	ER/yr 1-20 keV	Reference
GEM		8.94E+04	T-REX GEM
AcrylicBox		4.55E+04	DS acrylic
CameraBody	0.00E+00	5.19E+04	Laubenstein@LNGS
CameraLens	0.00E+00	9.35E+04	Laubenstein@LNGS
Cathode (Cu)	5.00E+00	1.98E+03	Schrieber Laubenstein+ICP-MS
Field Cage (PET+Cu	1.20E+03	1.56E+05	PET+Cu (Laubenstein/Donatella)
GEM frame		2.45E+03	LNGS acrylic
Cathode frame		1.78E+03	LNGS acrylic
Cu Shielding	0.00E+00	3.45E+04	Laubenstein@LNGS
PMTs			
PE basement			
Water Shielding			
Total (internal)	**1.21E+03**	**4.77E+05**	
External Gamma	0.00E+00	1.00E+04	SABRE gamma flux @LNGS
External Neutrons	7.50E+00	3.41E+00	CUORE n flux @LNGS
Total (external)	**7.50E+00**	**1.00E+04**	
Tot	**1.21E+03**	**4.87E+05**	

Missing simulations:

- PMTs
- PE basement
- Water shielding

Old/ scaled from old sim:

- Cameras
- External gammas and neutrons

To redo:

- field cage kapton+Cu (material implementation not correct)

NB: field cage measurements are mostly HPGe upper limits, ICP-MS measurements scheduled

Final goal: process all with digitization + reconstruction ➔ spectrum

Status and to-do-list (1)

- CYGNO-04 background simulation:
  - update with ICP-MS radioactivity measurements when available (FC, GEM, Acrylic?)
  - complete Geant4 sim + digitization + reconstruction
  - impact on WP1 ➔ background spectrum input for limits calculations
- Radon simulation:
  - done: Geant4 simulation for 22-Rn progeny in LIME
  - apply digitization + reconstruction and compare with data
- Calibration simulation:
  - done: demonstrated that our 55-Fe source gives a sufficient rate to perform CYGNO-04 calibration and covers all the detector area
- Low energy ER and NR simulation:
  - done: QF from SRIM applied in geant for He, C, F ➔ reliable for low energy
  - in progress: ER of 1-3-5-10-15-20-25-30-35-40-45-50 keV
  - track length not reliable for few keV NR ➔ ranges should be imported from SRIM as well
  - important input for WP2

Status and to-do-list (2)

- AmBe simulation:
  - done: preliminary data/MC comparison with low stat
  - goal: full analysis of Run5 AmBe campaign and comparison with MC
  - very important to validate NR simulation ➜ trust MC for analysis training (WP2)
- Geant4 code development:
  - done: first working version using v11.3 on cloud (does not include last updates on QF)
  - cross check v10.5.1 vs 11.3 on some "benchmark" dataset
- Digitization code development:
  - done: saturation parameters defined, PMT simulation close to be integrated
- From yesterday's discussion: full simulation of Run4 background
  - geant4 from Flaminia + digi + reco