

CYGNO simulations update

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Calibration simulation

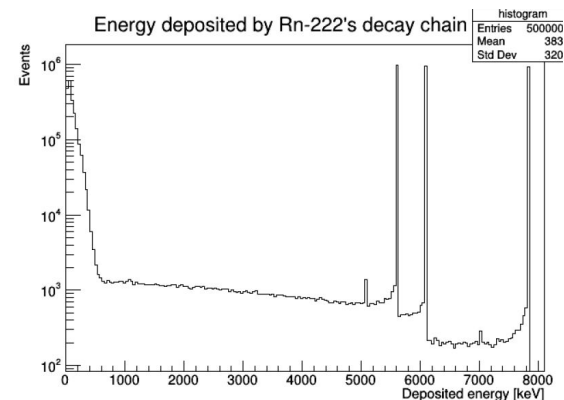
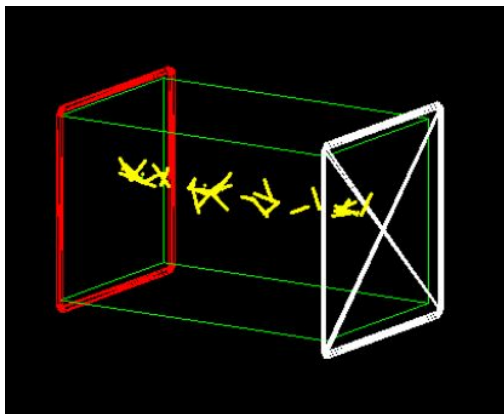
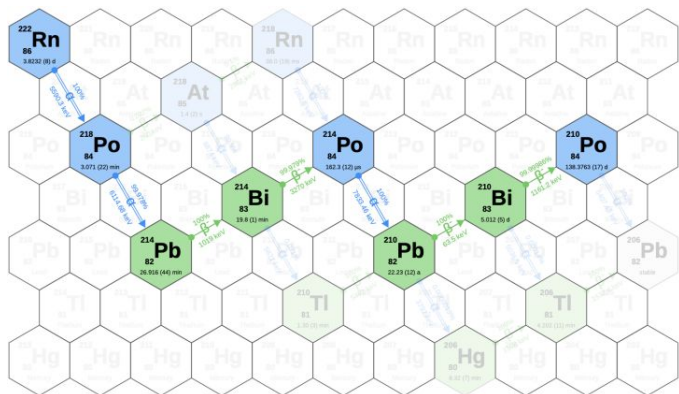
- Estimate of the ^{55}Fe source rate was presented by Zahoor in the last simulation meetings
- Simulated different sizes of holes in the copper shield/PMMA windows

S.No	Copper Hole Size	PMMA Windows Size	PMMA 2 mm layer/cover on windows	Frequency for 1.5 million events (approx.)
5	4.5 mm x 40 mm x 10 mm	430 mm x 20 mm x 14.5 mm	No	230 Hz
6	4.5 mm x 40 mm x 10 mm	430 mm x 20 mm x 14.5 mm	Yes	6 Hz

- Target rate: ~ 20 Hz
- Geometry of calibration windows in Cu/PMMA allows a rate higher than target, but can be easily reduced with a thin layer of material (e.g. ETFE or PMMA)
 - verified that 2 mm of PMMA gives a factor ~ 40 reduction, compatible with NIST tabulated value

Radon simulation

- Presentations at the last simulation meetings by Federico Vavalà (master student Roma1)
- Goals: simulation of Rn-222 chain (Geant4 + digi + reco & analysis) and comparison with LIME data to understand/quantify Rn contamination
- Completed G4 simulation of 10^6 events for each isotope → next digitization



QF simulation

- We plan to produce samples of NR for different purposes (AmBe, training of ML analysis, ...)
- QF at the moment is not included in the “official” Geant4 simulation
 - work in progress in my fork (lime branch):
<https://github.com/gdimperi/CYGNO-MC/tree/lime>
 - added variables energyDep_NRQF and energyDep_hits_NR_QF
 - Parameterized with a function obtained fitting SRIM simulations (from Flaminia Di Giambattista PhD thesis)

$$QF(E) = \frac{k(E_{ion} + aE_{ion}^b)}{1 + k(E_{ion} + aE_{ion}^b)}$$

$$F(E) = \frac{d(E \times QF(E))}{dE}$$

→ used to calculate hit-by-hit dE_{ion} (corrected with QF)

Ion	k	a	b	χ^2/ndf
H	0.65 ± 0.02	1.82 ± 0.08	0.48 ± 0.04	40.35/20
He	0.117 ± 0.005	3.9 ± 0.2	0.44 ± 0.03	20.94/20
C	0.0195 ± 0.0007	14.7 ± 0.4	0.33 ± 0.1	36.53/20
F	0.0083 ± 0.0002	27.4 ± 0.7	0.303 ± 0.008	16.74/20

Geant4 code upgrade

- To work on CYGNO Cloud, Geant4 + CADMesh (application to import CAD geometry) should be updated
 - Geant4.10.5 → Geant 4.11
 - CADMesh1.1 → CADMesh2
- Melba is working on this, a preliminary version of the code is in her github page: <https://github.com/dastolme/CYGNO-MC/tree/lime>
- added a few new features (e.g. multithread,..) see presentation at sim meeting
- We should decide a benchmark simulation to run with old/new Geant4 and compare results
- After crosschecks → merge everything on CYGNO official github page