Update on Background Simulation Techniques

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Outline

Simulation Results

- Simulation results

		Cosmogenic	Reactogenic	Total (MC)	**Total (goal)**
Electronic recoils	No Shielding	260 ± 5	4365 ± 301	4625 ± 301	–
[50 eV, 1 keV]	Passive Shielding	166 ± 2	34 ± 4	200 ± 5	–
(evts/day/kg)	Passive Shielding + muon-veto	1.1 ± 0.1		35 ± 4	**100**
Neutron recoils	No Shielding	1554 ± 12	53853 ± 544	55407 ± 545	–
[50 eV, 1 keV]	Passive Shielding	39 ± 1	5.4 ± 0.2	45 ± 1	–
(evts/day/kg)	Passive Shielding + muon-veto	17 ± 1		23 ± 1	**5**

- Veto results

Nuclear recoils background in [50 eV, 1 keV]:

	No shielding	Proposal shielding	Proposal shielding + top μ-veto	Proposal shielding + perfect-coverage μ-veto
Absolute rate	40 DRU	17 DRU	9 DRU	6 DRU
Relative to no shielding case	1	0.43	0.23	0.15
Relative to perfect μ-veto case	6.7	2.8	1.5	1

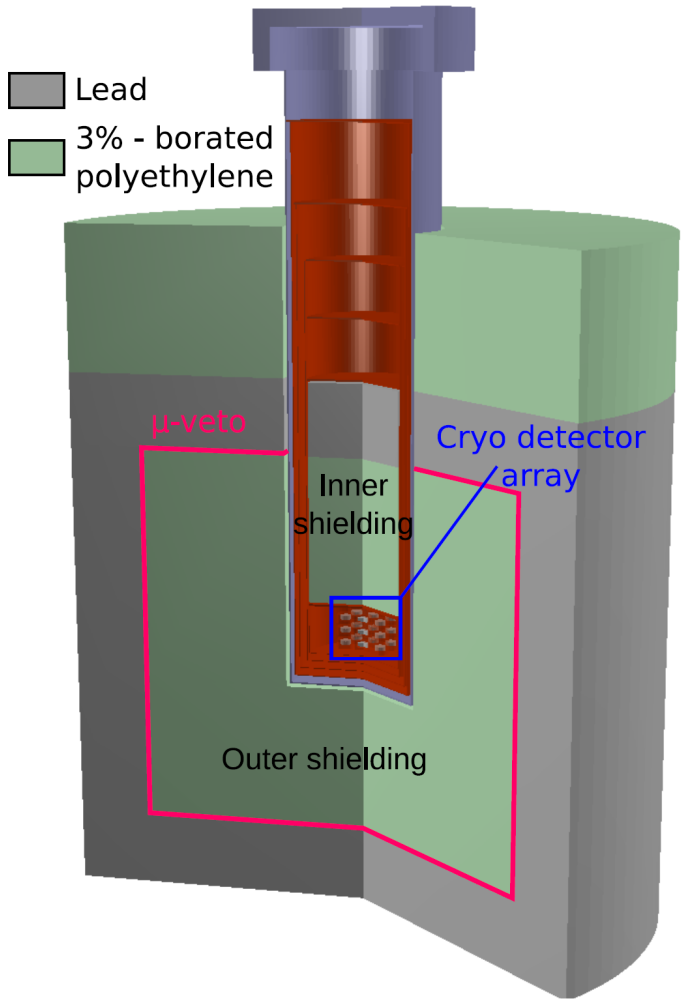
Reactogenic Neutron Simulation

The reactogenic neutron simulation is though to be unrealistic and pessimistic.
Uses the energy spectrum of the neutrons leaking from the ILL H13 beamline, however:

- H7 site not taken into account, so the neutron energy spectrum should be softer
- Neutrons generated close to the shielded detector without any wall $\rightarrow$ higher neutron flux than expected
- Note: neutrons leaving end of H7 line have a max energy of 6 MeV.

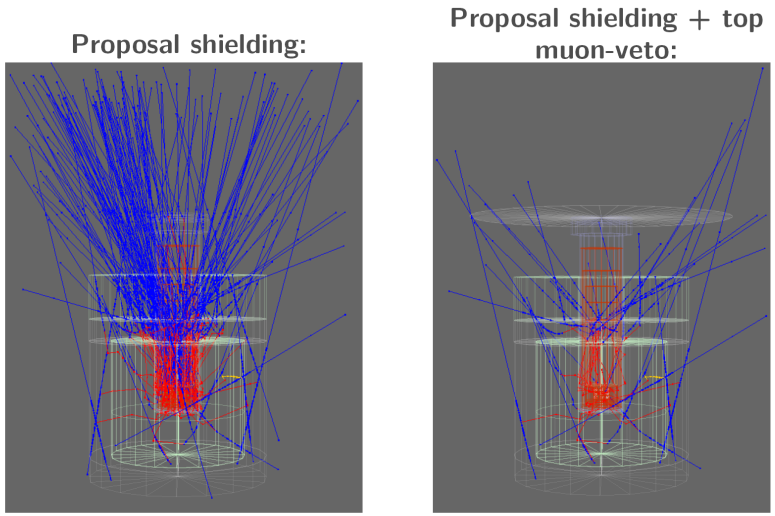
Shielding Improvements

- Split the lead shielding into 2 layers to interpose veto
- Decrease thickness
- Use polyethylene rings in between cryostat screen panels to fill in gaps



Full coverage muon veto

- Hole at the top of the cryostat outer shielding - guiding primary neutrons (red).
- Large contribution of muon "dying", causing neutron spallation in shielding. So decrease thickness of lead shielding.
- Remain 6 DRU rate with perfect veto is mainly due to primary neutrons.
- With top veto, muon induced background represents only 1/3 of the cosmogenic nuclear background.



Background Improvement Techniques

- Implement more realistic reactogenic simulation
- Design a muon-veto with full coverage
- Separate lead shielding into two layers
- Decrease lead shielding thickness
- Use polyethylene rings between cryostat screens to fill gaps