Virtual depth by active background suppression: The cosmic muon induced background of GERDA Phase II

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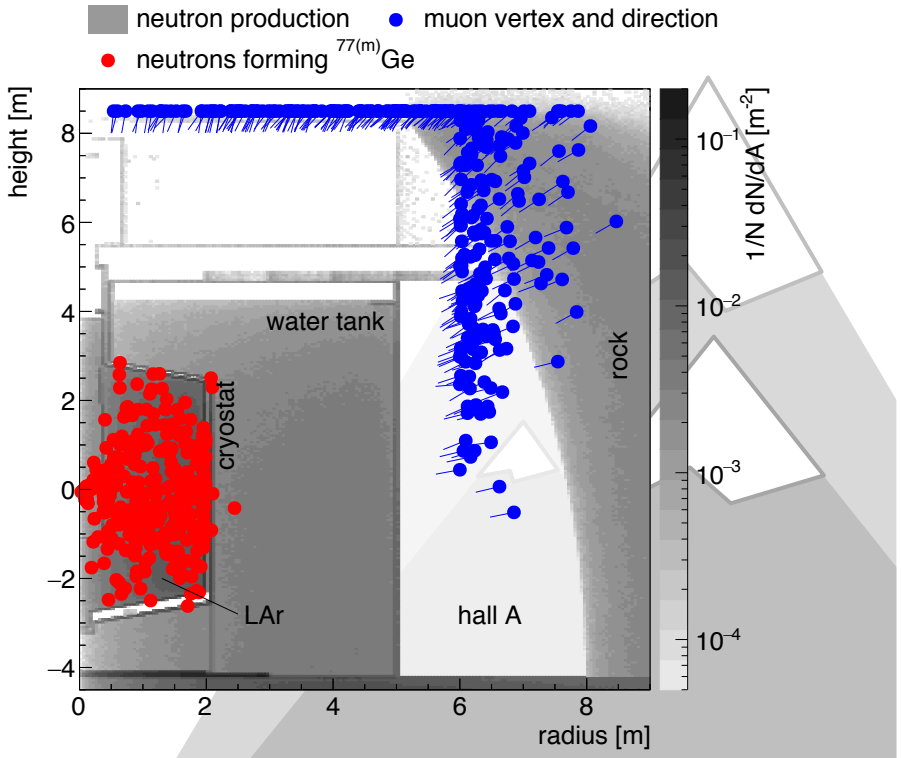
- non-standard background source for next generation **background-free** $0\nu\beta\beta$ searches
- deep underground **in-situ production** of radioactive isotopes by cosmic muons

"How deep is deep enough?"

- $^{76}Ge(n,\gamma)^{77(m)}Ge$ is critical cosmogenic component for $0\nu\beta\beta$ searches with germanium [1]
- simulation of GERDA Phase II [2] as proxy for LEGEND at LNGS [3]

"Capture of neutrons from inner cryostat volume appears prompt and at non-thermal energies"



- $^{77(m)}$Ge production rate: **(0.21 ± 0.01) nuclei/(kg·yr)**

[1] L. Pandola et al., Nucl.Instrum.Meth. A570 (2007) 149-158
[2] GERDA collaboration, Phys.Rev.Lett. 120 (2018) no.13, 132503
[3] LEGEND collaboration, AIP Conf.Proc. 1894 (2017) no.1, 020027

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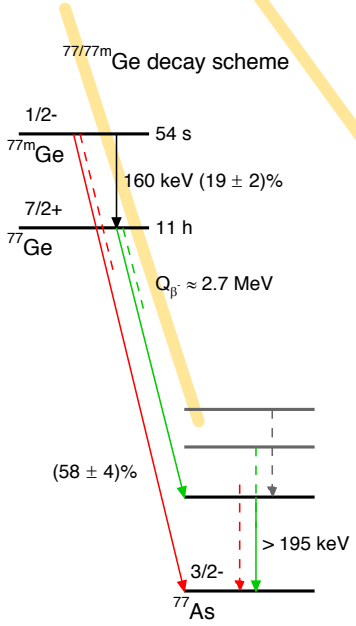

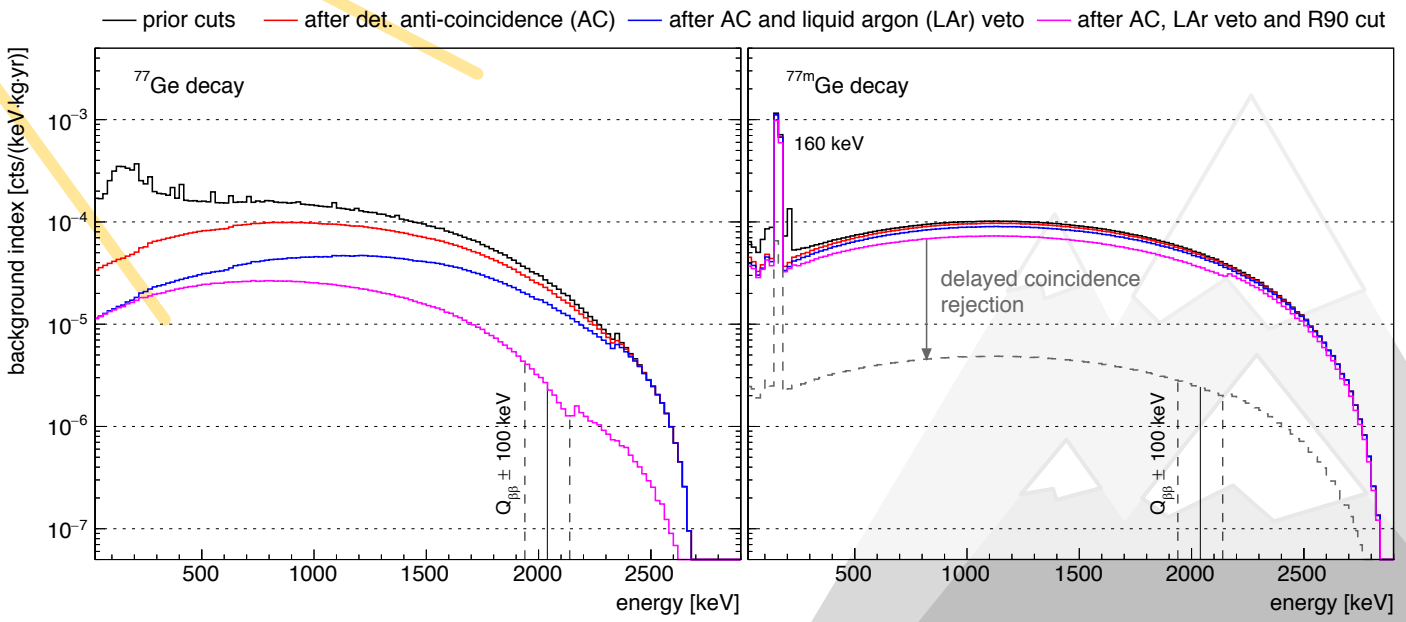

- **distinct features** in $^{77(m)}$Ge production and decay enable active reduction
- large neutron multiplicities allow to tag accompanying **sibling captures** (e.g. ^{41}Ar)

- sequence of coincidence cuts reduces the muon induced $^{77(m)}$Ge background from $(4.0 \pm 0.4) \cdot 10^{-5}$ to $(2.7 \pm 0.3) \cdot 10^{-6}$ cts/(keV·kg·yr)

- suppression can be translated into **effective muon flux reduction**

"The virtual overburden of GERDA Phase II corresponds to about 5000 m.w.e"

see [arxiv:1802.05040]