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Measurement of the gamma background in Modane Underground Laboratory with SuperNEMO, and estimation of SuperNEMO's overall background levels

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Discovering neutrinoless double-beta decay ($0\nu\beta\beta$) would be a huge step in understanding the neutrino's nature. The SuperNEMO experiment is designed to search for $0\nu\beta\beta$, using its Demonstrator Module in LSM, Modane, France, at a depth of 4800 m.w.e. Its tracker and segmented, scintillator-based calorimeter enable unambiguous particle identification, time-of-flight and individual energy measurements. SuperNEMO aims to achieve an ultra-low background level of $< 10^{-4}$ events/(keV.kg.yr) in the $0\nu\beta\beta$ ROI. We must therefore understand both internal (within the $\beta\beta$ foil) and external sources of background.

The main external background to the unshielded detector comes from photons produced by ^{208}Tl, ^{214}Bi and ^{40}K decays in the LSM walls. These occasionally interact in the detector, mimicking $\beta\beta$ events. Iron shielding, which will almost eliminate this background, will be installed by summer. This work takes advantage of data taken before shielding installation to measure this photon background. Using SuperNEMO's particle-identification abilities, we present a new measurement of this γ flux through multiple channels: by direct γ detection; and independently via a measurement of $\beta\beta$-like events generated by γ. Combining these measurements provides an overall estimate of the γ flux at LSM.

Additionally, we have simulated processes anticipated to contribute to the internal background, developing a first version of SuperNEMO's background model. The most significant contribution is expected to be due to contamination of the $\beta\beta$ source foil, where isotopes of ^{208}Tl, ^{214}Bi, ^{234m}Pa and ^{40}K can mimic $\beta\beta$ events.

Fully comprehending SuperNEMO's background, combined with its topological reconstruction capabilities, will allow us to search for the $0\nu\beta\beta$ mechanisms and test the possible deviations of the $2\nu\beta\beta$ spectrum from the Standard Model.

First affiliation

University of Edinburgh

Second affiliation

Collaboration (if any)

SuperNEMO

Poster prize

No

Given name

Cheryl

Surname

Patrick

Institutional email

cpatrick@exseed.ed.ac.uk

Gender

Female

Primary authors: PATRICK, Cheryl (University of Edinburgh); MARQUET, Christine (IN2P3); CHAUVEAU, Emmanuel (IN2P3); PETRO, Maros; AGUERRE, Xalbat (University of Edinburgh)

Presenter: PATRICK, Cheryl (University of Edinburgh)

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