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Development of software for energy calibration of the SuperNEMO Detector

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The discovery of neutrinoless double beta decay ($0\nu\beta\beta$) would be a huge step in the understanding of the nature of the neutrino. SuperNEMO is an experiment designed to search for $0\nu\beta\beta$, whose demonstrator module is located in Modane Underground Laboratory in France (4800 m.w.e). It uses a unique technique combining a tracker and a segmented, scintillator-based calorimeter that allows us to unambiguously identify the two final-state electrons and measure their arrival time and energy.

The calorimeter consists of so-called optical modules (OMs) composed of polystyrene scintillator coupled to photomultiplier tube (PMT). In order to achieve high detector sensitivity, precise energy calibration of individual OMs is necessary. A specialised calibration system consisting of 42 ^{207}Bi calibration sources has been built for this purpose. These sources can be deployed on precise positions in the middle of the detector using 6 stepper motors. OMs are then calibrated using Auger electrons emitted through internal conversion of ^{207}Bi.

There are different effects affecting energy measurement which have to be taken into account. First of all, electrons lose energy while travelling from the calibration source to an OM. Because of that, measured energy is different than the initial one. These losses can be estimated and corrected using model based on Bethe-Bloch formula. Besides these energy losses, the OMs themselves add some imperfections to the energy measurement. Their response is slightly non-linear because of Birks' law and Cherenkov radiation. The collection of scintillation light is also affected by the position of its emission. A correction describing these effects has been developed based on Monte-Carlo simulations.

Including the corrections into the calibration process is not a straightforward task. It leads to a problem of function minimisation which requires numerical solution. The details of this numerical approach will be presented.

Poster prize

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