Searching for WIMPs at the EDELWEISS experiment by optimization of the background reduction

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The EDELWEISS experiment has just started its third phase of direct search for dark matter using cryogenic germanium bolometers.

Since the early 1930s theorists examine different possibilities for dark matter candidates [1]. Some of them found the promising case that dark matter may consist out of weakly interacting, massive particles (WIMPs) [2]. The major challenges in detecting WIMPs are the minimal deposited energy ($\sim 10\,\mathrm{keV}$) and the timescales of the event rates which are small compared to the events resulting of the radioactive background.

Compared to other experiments the EDELWEISS experiment uses both the detection of the thermal phonons, resulting from the nuclear recoil, and of the electron-hole pairs. In the upgraded phase three the fiducial volume has been increased to optimize the signal-to-noise ratio. However, just increasing the fiducial volume is not enough. In order to improve the signal strenght one needs to reduce the background effects as well.

One of the most challenging problems is the achievement of a powerful discrimination between nuclear recoils and the near-surface electron recoils. Therefore, the EDELWEISS scientists developed different methods like special interdigit sensors with series of concentric ring electrodes biased at diffenrent potentials (see Fig.1), different detector geometries and interleaved structures.

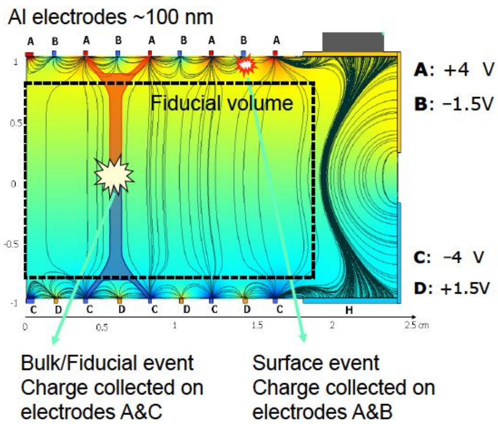

Fig. 1. Fiducial volume and setup to discriminate between nuclear recoils and near-surface electron recoils [3]

Furthermore there are disturbing sources like the cosmic muons and neutrons from radioactive decays in the surrounding rock which contribute to the background events and therefore have to be reduced by special polyethylene shields and a so called muon-veto. Additional background events can be examined with simulations and minimized by further calibrations of the system.

[1] F. Zwicky, Helv. Phys. Acta **6**,110 (1933)
[2] G. Bertone, "Particle Dark Matter: Observations, Models and Searches", 1st ed. (Cambridge University Press, 2010)
[3] G. Drexlin, Lecture "Astroparticle physics" (2014)
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