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ZnSe scintillating bolometer with ionization readout - a new approach for particle discrimination technique

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The registration of elusive particles requires the use of new high quality detectors with enhanced characteristics. Scintillating bolometers are among the most promising detectors used in rare event physics, what have clearly demonstrated by the excellent background rejection capabilities that arise from the simultaneous, independent, double readout of heat and scintillation light.
The main goal of LUCIFER experiment is to search for neutrinoless double beta decay of ^{82}Se isotope with ZnSe crystals that work as scintillating bolometer. At the same time, the ZnSe is also wide band gap semiconductor material (2.8 eV at room temperature). The present report relate to results on the development and study of semiconductor detector based on ZnSe crystal in order to develop of triple read-out detector - heat, light and ionization channels. Such experimental technique, as we expect, will allow getting more information about interacting particle and helps to reduce the radioactive background to virtually “zero” level. Additionally, these investigations will help to understand energy distribution into scintillating crystals.
The results on the tests of ZnSe crystal as scintillating and semiconductor detectors at room temperature and low temperature down to 10 K are presented. It was found that ionization and light channels are anti-correlated and strongly depend on crystal temperature. The way to increase the average lifetime of the charge carriers under low temperature by applying of external electric field has been shown.

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