Rejection of alpha surface background in non-scintillating bolometric detectors: the ABSuRD project

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Neutrinoless double beta decay (DBD) is a hypothesized lepton number violating process, forbidden by the Standard Model, in which a double beta decay without emission of neutrinos occurs; this is possible only if neutrinos are massive Majorana particles. An evidence of neutrinoless double beta decay would provide important information about the nature of neutrino particles. In case neutrinoless DBD exists, it is an extremely rare event with an expected half life greater than 1025 years.

At present, bolometric detectors are widely used in experiments searching for neutrinoless double beta decay, due to the excellent values of energy resolution that they can achieve and to the vast choice of possible materials. A limiting aspect of bolometers rises from their inability to discriminate among radiation types or surface from bulk events. Identification, control and reduction of the radioactive background is instead one of the main issues for the experiments searching for rare events. It has been demonstrated that the main limitation to sensitivity for bolometric experiments is represented by surface alpha contaminations, causing a continuous background in the region of interest that cannot be discriminated by a purely bolometric detector.

A new scintillation based technique for alpha surface background rejection in non-scintillating bolometric experiments is proposed in this work. The idea is to surround purely bolometric detectors with a scintillating foil and equip the system with a bolometric light detector. The analysis of coincidence signals of heat and light, in the thermal bolometer and in the light detector respectively, will enable to tag alpha particles releasing only part of their energy in the bolometer and the rest in the scintillating foil, thus allowing the discrimination of the continuous background. The development of this technique will be described and discussed.