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The BiPo-3 detector

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Content

The BiPo-3 detector, running in Canfranc Underground Laboratory (LSC, Spain) since 2013, is a low radioactive detector dedicated to measure ultra high natural radiopurity in ^{212}Bi (^{228}Th) and ^{214}Bi (^{226}Ra) of thin materials. The ^{208}Tl and ^{214}Bi isotopes, which belong to the natural radioactive chain of U and Th, are the two main background isotopes in the search for the neutrinoless double decay. The BiPo-3 detector has been initialy developped to measure the radiopurity of the selenium double β source foils of the SuperNEMO experiment. In order to measure the ^{208}Tl and ^{214}Bi contaminations, the underlying concept of the BiPo-3 detector is to detect the so-called BiPo process, which corresponds to the detection of an electron followed by a delayed α particle. In this novel experimental technique the foil of interest is installed between two thin ultra-radiopure plastic scintillators. The ^{208}Tl and ^{214}Bi contaminations are then measured by detecting the β decay as an energy deposition in one scintillator without a coincidence from the opposite side and the delayed α as a delayed signal in the second scintillator without a coincidence in the first one. The timing of the delayed α depends on the isotope to be measured. The BiPo-3 detector is composed of two modules. Each module consists of two rows of 20 pairs of optical sub-modules. Each optical sub-module consists of a polystyrene-based scintillator plate coupled with a PMMA optical guide to a 5 inches low radioactive PMT. The optical sub-modules are arranged face-to-face to form a pair. The size of each scintillator is 300x300x2 mm^3. The BiPo-3 detector corresponds to a total number of 80 optical sub-modules and a total surface area of measurement is 3.6 m^2. The experimental design and performances of the detector are presented. Dedicated background measurements have been performed. After an exposure of about 2 years.m^2 , the surface activities of the scintillators of A(^{208}Tl)=0.9 ± 0.2 μBq/m^2 and A(^{214}Bi) = 1.0 ± 0.3 μBq/m^2 are reported. The average rate of random coincidences is 6 . 10^{-4} cts/day/m^2 of surface area of scintillator for the ^{208}Tl measurement, and 0.12 cts/day/m^2 for the ^{214}Bi measurement. The validation of the BiPo-3 measurement with a calibrated aluminium foil is presented. Results of the ^{208}Tl and ^{214}Bi activity measurements of the first enriched ^{82}Se foils of SuperNEMO are reported.

About the Presenter

Pia Loaiza field of expertise is the low radioactivity assay for dark matter and neutrinoless double-beta decay experiments. She was involved in the Edelweiss dark matter experiment and is currently a member of the SuperNemo collaboration. She has previously worked in ultra-low background gamma spectrometry and she has developped two low background HPGe detectors which are installed in the Modane Underground Laboratory. Since 2012 she has joined the SuperNemo double beta experiment and she is in charge of the BiPo detector.

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