The Sandwich Spectrometer for Ultra Low-level Gamma-ray Spectrometry

Abstract:
A new type of ultra low-background gamma-ray spectrometer has been installed in the underground laboratory HADES in Belgium located at a depth of 500 m water equivalent. The spectrometer is composed of two coaxial HPGe-detectors of about 1.9 kg each. The lower detector has the typical U-shaped arm while the top detector's arm is inverted to make the two detectors' windows face each other. The solid angle is effectively doubled for small samples and close to 3.2π. The muon fluence rate in HADES is 0.09 s^-1 m^-2, which is about 5000 times lower than at the surface (40 m above sea level). The detailed muon spectrum is measured with an active muon shield comprising two plastic scintillators stacked on top of the lead shield. The plastic scintillators are 2.5 cm thick and with an area of 0.8×0.8 m². The scintillators are connected in coincidence to exclude environmental gamma- and X-rays. All data is stored in list mode, which is suitable for offline analysis of time-interval distributions, coincidences and subsequent background reduction. A completely new type of lead shield is used around the HPGe-detectors. The outer part of the shield is made of 145 mm low-background lead (20 Bq/kg) while the inner 40 mm is made of ultra low-background lead (2.5 Bq/kg), which in turn is lined on the inside with 35 mm of electrolytic copper. The complete detector shield can be opened in two halves by using a motor. This shield design ensures easy and fast access to change samples, clean the detectors and remove/replace HPGe-detectors. This paper describes the technical details of the sandwich detector system, its performance, the most suitable applications and the achieved background reduction. By using data from the active muon shield the background is reduced and it will also be possible identify certain decay chains by studying coincidences and/or time intervals between pulses of different detectors and identify individual events.

URI:
Authors:
WIESLANDER Elisabeth
HULT Mikael
GASPARRO Joel
MARISSENS Gerd
MISIASZEK M.
PREUSSE Werner
Publication Year:
2009
Type:
Contributions to Conferences