An Ar-gas ionization chamber for alpha particle detection at the Yangyang underground laboratory

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A high-sensitivity ionization detector for measuring alpha particles in a laminar sample has been operating in the Yangyang underground laboratory. The alpha counter is used to assay detector materials, especially their surface contamination, for the COSINE dark matter experiment and the AMoRE double beta decay experiment. Using distinct rise time, this instrument describes characteristic signals from ionization electrons produced from the sample tray and veto those from other sources. The detector can reach a sensitivity as low as 0.0001 count/cm²/hr. In this presentation, in addition to the low-background measurements, surface alpha measurements with various treatments such as cleaning and artificial contamination are reported.

Calibration

Source position 15cm

Sample tray

Understanding of Surface Pb-210

Surface Events

Nuclear Recoil

Sample material

Po-210 surface

Po-210 bulk

Po-210(Pb-210)

Rate does not increase

Sample cleaned

Pinpoint contamination & Effect of cleaning with Rn-222

Po-210 exposure 4/22/16 for 10 days

Po-210 alpha range PDFs

CUP Preliminary

Summary

• An Ar ionization chamber alpha counter at Yangyang has been used to study surface contamination in the detector materials for rare event search detector experiments.
• Low activity samples including Cu plate and NaI powders are measured in the chamber.
• With a Rn-exposed Cu plate and a NaI(Tl) crystal, we have been studying effect of surface contamination from a Rn-222 source.
• A maximum likelihood fit has been developed to extract surface contamination parameters from the ionization chamber alpha data.
• Sample treatment methods are also developed for removal of the surface contamination.