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Spectrum-shape method for studying the forbidden beta decay of ^{210}Bi using PbMoO_4 cryogenic detectors

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The spectrum-shape method has been proposed to determine the effective value of the axial-vector coupling constant (g_A) with the vector coupling constant ($g_v=1$) in forbidden nonunique beta decays. ^{210}Bi is an isotope undergoing a first-forbidden nonunique beta decay, and its shape function exhibits strong sensitivity to g_A . Given the short half-life of ^{210}Bi , the decay chain ^{210}Pb (β , $T_{1/2}=22.3$ y) $\rightarrow$ ^{210}Bi (β , $T_{1/2}=5.0$ d) $\rightarrow$ ^{210}Po (α , $T_{1/2}=138$ d) was utilized. PbMoO_4 cryogenic detectors were employed for their high detection efficiency (source = detector configuration) and excellent energy resolution. Two detectors of identical geometric design and crystal size (1 cm^3) were prepared. One PbMoO_4 crystal was grown using modern lead, yielding a ^{210}Pb radioactivity of about 30 Bq/kg. The second PbMoO_4 crystal was made with archaeological lead, characterized by significantly reduced ^{210}Pb radioactivity (about 0.2 Bq/kg), enabling background rejection with minimal systematic error. Both detectors were installed adjacently in a cryogen-free dilution refrigerator. This presentation will outline the detection system's design and performance and present preliminary beta decay spectrum analysis results.

Consent

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