

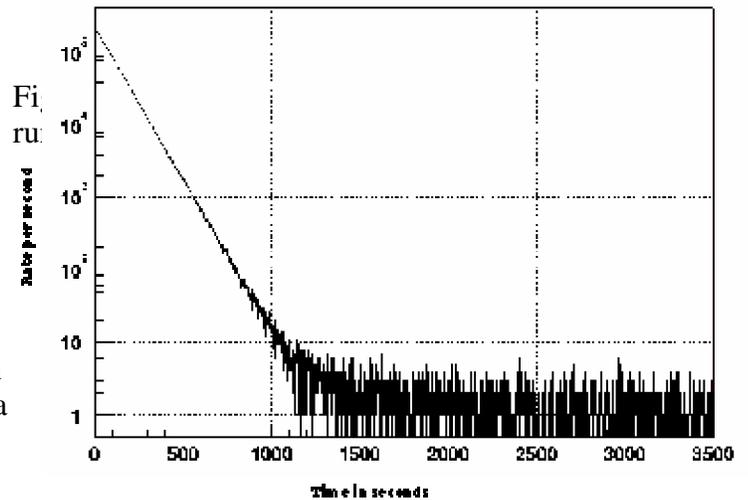
^{14}O Lifetime Measurement as a Test of the Unitarity of the CKM Matrix

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The best experimental values of the effective weak vector coupling constant G_V come from measurements of the $0^+ \rightarrow 0^+$ superallowed Fermi beta decay. We are currently measuring the lifetime of ^{14}O to determine the V_{ud} element of the Cabibbo–Kobayashi–Maskawa (CKM) matrix relating the mass and weak eigenstates for quarks. Previous determinations of V_{ud} along with other measurements of V_{us} and V_{ub} have suggested that the CKM matrix is not unitary. This in turn has implications that contradict the standard model.

We measure the lifetime of ^{14}O which due to its 70.6 second lifetime has to be produced online at the 88" cyclotron with the $^{12}\text{C}(^3\text{He},n)^{14}\text{O}$ reaction. A radioactive beam of ^{14}O , produced by IRIS (Ion Source for Radioactive Isotopes) is implanted into a thin Be foil. After loading the foil for 100 seconds a beam stop is inserted to ensure that no ^{14}O is implanted on the transfer mechanism. The foil is then transferred under vacuum to a detector system using a magnetically coupled pneumatic transfer arm. The positrons from the $^{14}\text{O} \rightarrow ^{14}\text{N} + e^+ + \nu_e$ decay are then detected using four independent detectors. Each detector consists of a 0.4 mm plastic scintillator connected to a fast timing photomultiplier tube. The detector that detects the minimum ionizing pulse from a beta particle passing through it..

The lifetime experiment was run on October 20/21, 2001. Over one billion events were recorded during the 48 hour run. Currently analysis is underway to fit the data from 20 one hour counting periods. Below is a typical data set from one of the detectors during the experiment. A new KBr imaging system was used to center the beam on the Be foil. This enabled accurate beam steering which resulted in a 50 % deposition of the radioactivity. Initial rates on the order 250 000 counts per second per detector were observed.



Footnotes

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