Test of the conserved vector current hypothesis in the beta-decay of ^{14}O

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In 1957, Feynman and Gell-Mann proposed the conserved vector current (CVC) hypothesis.[1] In the classic case of the mass-12 isospin triplet (B-C-N), CVC relates the width of the electromagnetic transition ($^{12}C^* \rightarrow {}^{12}C$) to the shape factors of the beta decay spectra ($^{12}B \rightarrow {}^{12}C$) and ($^{12}N \rightarrow {}^{12}C$). The shape factor represents a deviation of the beta spectrum from the simple allowed shape by the additional factor $S(E) = 1 + aE$, where E is the total electron energy Several experiments have measured a in the mass-12 system, but the agreement with CVC is weak at best.[2]

The mass-14 isospin triplet (C-N-O) represents another viable system for testing CVC (Fig. 1).

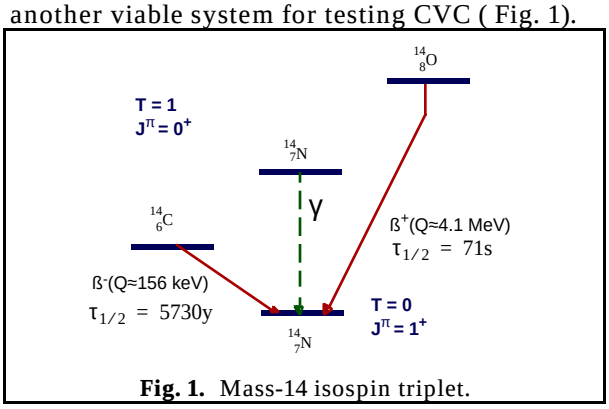

Fig. 1. Mass-14 isospin triplet.

We are preparing to measure the ground state to ground state decay of ^{14}O. Since the half-life of this decay is only slightly more than a minute, the activity must be produced on-line at the 88" cyclotron. In order to avoid spectral distortion associated with thick sources, we have decided to pursue a new approach. Using a cusp source devloped by the AFRD at Lawrence Berkeley National Laboratory, we will produce a radioactive beam of ^{14}O. A cross-sectional view of the cups source is shown in Fig. 2. The ^{14}O will be produced by the reeaction $^{12}C(^3He,n)\,^{14}O$ in a heated graphite target. The evolving C-^{14}O will be transported to the cusp source where a it will be ionized to produce a beam of ^{14}O to impant in a thin carbon foil.

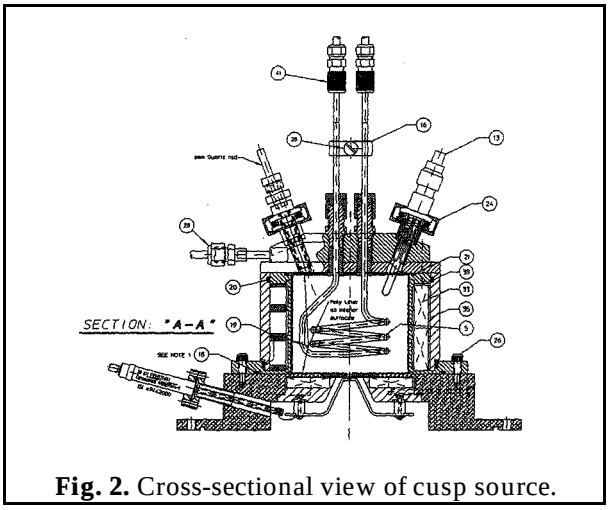

Fig. 2. Cross-sectional view of cusp source.

To measure the beta-spectrum we have a 180° spectrometer with an approximately 50% momentum bite. We will detect the positrons with a multi-wire proportional chamber. We expect prelimanry tests of the entire system by late 1997. In addition to measuring the ground state to ground state decay, we also plan to measure the superallowed 0+ to 0+ decay. This branching ratio has been measured only once[3] and is directly related to the value of V_{ud} in the CKM matrix.

Footnotes and References

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