

# Testing the CVC Hypothesis in the $\beta$ Decay of $^{14}\text{O}$

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The  $A = 14$  system offers an opportunity to test the Conserved Vector Current hypothesis of the electroweak interaction. CVC relates the width of an M1 transition in a nucleus with the shape factors of the beta decay spectra to the same nucleus from isospin analog states. This implication of CVC has been tested in the  $A=12$  system by examining the shape factors of  $^{12}\text{B} \rightarrow ^{12}\text{C}$  and  $^{12}\text{N} \rightarrow ^{12}\text{C}$ . However, the agreement with CVC is rather poor, and several experiments disagree.<sup>1</sup> The  $A = 14$  system offers another CVC test with larger shape factors. The shape factor is a deviation of the  $\beta_{\pm}$  spectrum from the allowed-order shape by a factor  $S(E) = 1 + a_{\pm}E$ , where  $E$  is the total  $\beta$  energy. The difference ( $a_+ - a_-$ ) depends on the weak magnetism form factor, which is related via CVC to the 2.3 MeV  $\gamma$  decay rate in  $^{14}\text{N}$ .

We intend to measure the shape factor in the  $0^+ \rightarrow 1^+$  branch of the  $\beta^+$  decay of  $^{14}\text{O}$  using a flat-field magnetic spectrometer with a multi-wire proportional chamber detector. Because the half-life of  $^{14}\text{O}$  is only 71 seconds, it must be produced on-line at the 88" Cyclotron. To avoid error in the spectrum from a thick source for the spectrometer, we will produce a beam of radioactive  $^{14}\text{O}$  using an ECR ion source. The  $^{14}\text{O}$  is produced by  $^{12}\text{C} (^3\text{He}, n)^{14}\text{O}$  using a heated carbon target. The C-O gas evolving from the target is transported in a closed gas line to the ion source on the cyclotron vault roof. The ionized  $^{14}\text{O}$  will be implanted into a thin foil source at nearly uniform depth. Positrons from the implanted  $^{14}\text{O}$  then enter the spectrometer. The ECR ion source has been tested and has demonstrated 26.5% ionization efficiency for  $^{16}\text{O}^{6+}$  from CO.

During 1998, we tested our production target and transport hardware and were able to achieve  $2 \times 10^7$  atoms per second of  $^{14}\text{O}$  at the input to the ion source, using a  $^3\text{He}$  beam current on target of 2 p- $\mu\text{A}$ . (Fig. 1) This production rate

is sufficient to perform the shape factor measurement to an uncertainty of 0.005 / (MeV) in 45 hours of operation. This copious production was achieved using a novel physical form of graphite – reticulated vitreous carbon “foam” – as a resistively heated oven element. Our target production as a function of temperature is shown in Fig. 1. During 1999, we expect to integrate  $^{14}\text{O}$  production with the new ECR ion source. We hope to achieve the ionization and implantation steps during 1999.

We also intend to measure the branching ratio of the superallowed  $0^+ \rightarrow 0^+$  transition in  $^{14}\text{O}$ . This branching ratio has been measured only once,<sup>2</sup> and is important for a precise measurement of the  $V_{ud}$  element in the CKM matrix. This requires a precise measurement of the  $\beta$  spectrum at several spectrometer B fields to deconvolve the branches of the beta decay.

## Footnotes and References

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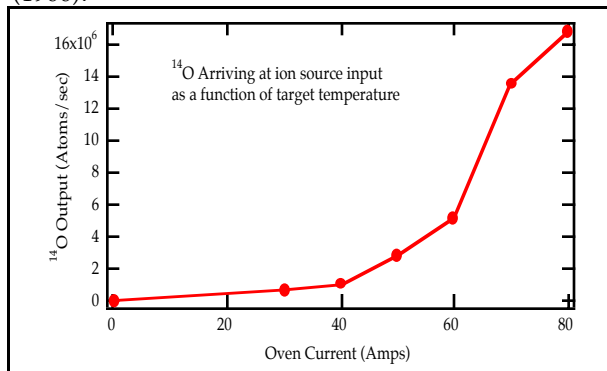


Fig. 1 Production of  $^{14}\text{O}$  as a function of target temperature.