Comments and Addenda

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Half-Life of ^{14}O†

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The half-life of ^{14}O is measured as 70.48 ± 0.15 sec, in agreement with a recently reported value. The error assigned to the present result is thought to include a realistic assessment of the systematic errors in the measurement and analysis.

INTRODUCTION

In a recent paper by Clark *et al.*[1] a new value of 70.580 ± 0.035 sec has been reported for the half-life of ^{14}O. This result was obtained from a variety of measurements on the γ rays from ^{14}O using plastic and NaI(Tl) detectors. The authors state that their quoted error does not allow for any systematic errors, and they further claim that the systematic errors are expected to be small compared with the statistical errors. Table I of their paper presents the results of nine separate groups of measurements on the ^{14}O half-life. The average deviation of the nine values from the adopted value is 0.08 sec, the maximum deviation is 0.20 sec, and the over-all spread in values is 0.35 sec. It seems possible that systematic errors could be present.

During the past two years half-life measurements[2-7] have been made at Brookhaven National Laboratory on 14 different short-lived radioactivities. Much of the work was undertaken because of the wide discrepancies in half-life values reported in the literature due, in part, to the failure to allow for systematic effects. A general conclusion that has emerged from this experimental work is that the systematic errors have always been larger than the statistical errors. The actual deviations of individual results from the mean, presumably due largely to systematic effects, have therefore been used as a basis for assigning a final error that is thought to be realistic. These guidelines have been followed in the present work on ^{14}O.

METHODS AND RESULTS

The ^{14}O activity was produced at the 3.5-MeV Van de Graaff by bombarding a thick graphite target with a 1-μA 3.0-MeV ^{3}He beam for 60 sec. The target was then transferred to a well-shielded 5×5-in. NaI(Tl) detector known to have negligible counting-rate gain shift.[2,4] A 3.5-cm-thick Pb plate covered the front face of the detector in order to strongly discriminate against 0.511-MeV annihilation radiation. With a pulse-height window set to encompass the full-energy-loss peak of the

2.31-MeV ^{14}O γ rays the discriminator pulses were multiscaled. All other techniques and methods of analysis were similar to the work reported previously.[2-7]

Based on the various computer analyses of several runs on ^{14}O, including dead-time corrections, the adopted value for the half-life is 70.48 ± 0.15 sec. The assignment of the error is in accord with the customary procedures discussed above.

DISCUSSION

The present result for the ^{14}O half-life is in agreement with that reported by Clark *et al.*,[1] but it is somewhat lower than the older measurements by Hendrie and Gerhart[8] (70.91 ± 0.04 sec), Bardin *et al.*[9] (71.00 ± 0.13 sec), and Frick *et al.*[10] (71.3 ± 0.1 sec). With this lower value there is, indeed, better agreement between the *ft* values of ^{14}O and ^{26}Al^{m}, as pointed out by Clark *et al.* However, in very many of the older half-life measurements the assigned errors have been too small; thus the differences between the older ^{14}O work and the newer results cannot be considered to be especially significant. Also, it should be noted that if a half-life value is assigned an error that is too small, as was almost certainly the case in the three older measurements on ^{14}O, and may possibly be the case in the work by Clark *et al.*, then one might be tempted to draw some theoretical conclusions that are not fully warranted.

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Tensor Force and the Boundary-Condition-Model *T* Matrix

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The relation between the half-off-shell *T* matrix, the on-shell *T* matrix, and the two-particle wave function is generalized to the fully-off-shell *T* matrix and tensor forces. The new relation is used to derive the boundary-condition-model *T* matrix when tensor coupling is present.

Recently Kim and Tubis[1] derived the central, as well as tensor-force, *T* matrix for the boundary-condition model (BCM), by taking the limit of a potential model. For the tensor-force case, carrying out the limiting process is a rather lengthy procedure. Brayshaw[2] developed the tensor-force *T* matrix by simply writing it down by analogy with the central-force case, and then showed that his *T* matrix is the only one which satisfies certain reasonable requirements with respect to analytic structure and asymptotic behavior. In this note the tensor-force BCM *T* matrix is derived by starting with a generalization of the relation between the half-off-shell *T* matrix, the on-shell *T* matrix, and the two-particle wave function.[3]

The two-particle *T* matrix is the solution of the equation

$$T(s)=V+V(s-H_0)^{-1}T(s), \tag{1}$$