International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

β-decay measurements of ^{12}B using Gammasphere

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The precise branching ratio to the Hoyle state is important for understanding the R-Matrix fits of excitation energies in ^{12}C between 9-13 MeV from studies of β-delayed triple-alpha decay. Accurate fits to the data are crucial to fully disentangle the different states of natural spin and parity in the region. Recent measurements of the β-branch of ^{12}B to the Hoyle state give 0.58(2)% [1], in contradiction with the value found in the literature of 1.2(3)% [2]. In order to obtain an independent measurement of the β-branch, we measured the γ-branch of the Hoyle state (a cascade going through the 4.44-MeV 2^+ state) using the Gammasphere array at ATLAS. The branching ratio to the Hoyle state was obtained from the following relation:

$$\mathrm{BR}(7.65) = \mathrm{BR}(4.44) \cdot \frac{N_{\gamma\gamma}}{N_{4.44} \cdot \epsilon_{3.21}} \frac{1}{C_\theta \cdot \Gamma_\gamma/\Gamma} \tag{1}$$

where BR(4.44) is the well-known branching ratio of 1.28(4)% [2] to the 4.44-MeV state in ^{12}C which will be used for normalization. The efficiency of the 3.21-MeV transition was determined to be 2.95(9)%, and C_θ, a correction factor allowing for the angular correlation in the 0-2-0 cascade, is 1 given the 4π coverage of Gammasphere. For this experiment, we used the literature value of $\Gamma_\gamma/\Gamma = 4.12(11)\times10^{-4}$ [3] and obtained a result of BR(7.65)= 0.68(9)%.

This result served a dual purpose: it confirmed the recent measurements of the β-branch of ^{12}B of half the literature value, and indicates that the method works well. Given the success of this method, we have turned this idea around and are currently carrying out an experiment with higher statistics using the same technique and the now confirmed BR(7.65) of ^{12}B of 0.58(2)% [1] to determine Γ_γ/Γ with an uncertainty on the same level as that in the literature. The current value for the radiative partial width is determined from a weighted average of various measurements, mostly comprised of inelastic scattering data. With this measurement, we will determine a value of Γ_γ/Γ with different systematics.

In this contribution, results on the measured value of the β-branch and implications of these results will be presented. In addition, we will present the results from the new higher statistics experiment to measure the partial gamma width that is currently underway. This work is supported by the U.S. Department of Energy Office of Nuclear Physics under Contracts No. DE-AC02-06CH11357 and No. DE-FG02-04ER41320.

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