Determination of the asymptotic normalization coefficients for the ^{14}C + n $\leftrightarrow$ ^{15}C, ^{14}C(n,γ)^{15}C reaction rate and evaluation of a new method to determine spectroscopic factors

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The ^{14}C + n $\leftrightarrow$ ^{15}C system has been used as a test case in the evaluation of a new method to determine spectroscopic factors that uses the asymptotic normalization coefficient (ANC). The method proved to be unsuccessful for this case. As part of this experimental program, the ANCs for the ^{15}C ground state and first excited state were determined using a heavy-ion neutron transfer reaction as well as the inverse kinematics (d,p) reaction, measured at the Texas A&M Cyclotron Institute. Thevalues $C^2_{2s1/2} = 1.88 \pm 0.18 \, \text{fm}^{-1}$ for the ground state and $C^2_{1d5/2} = (4.25 \pm 0.38) \times 10^{-3} \, \text{fm}^{-1}$ for the first excited state (E_{exc} = 740 keV) were obtained. The ANCs were used to evaluate the astrophysical direct neutron capture rate on ^{14}C , which was then compared with the most recent direct measurement and found to be in good agreement. A study of the ^{15}C spectroscopic factor via its mirror nucleus ^{15}F and a new insight into deuteron stripping theory are also presented.