Astrophysical S-factor for the ^{3}He(α, γ)^{7}Be reaction via the asymptotic normalization coefficient (ANC) method

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The detection of the neutrinos produced in the p−p chain and in the CNO cycle can be used to test the Standard Solar Model. The ^{3}He(α,γ)^{7}Be reaction is the first reaction of the 2nd and 3rd branch of the p−p chain, therefore, the uncertainty of its cross section sensitively influences the prediction of the ^{7}Be and ^{8}B neutrino fluxes. Despite its importance and the large number of experimental and theoretical works devoted to this reaction, the knowledge on the reaction cross section at energies characterizing the core of the Sun (15 keV - 30 keV) is limited and further experimental efforts are needed to reach the desired (≈ 3%) accuracy. The precise knowledge on the external capture contribution to the ^{3}He(α,γ)^{7}Be reaction cross section is crucial for the theoretical description of the reaction mechanism. In the present work the indirect measurement of this external capture contribution using the Asymptotic Normalization Coefficient (ANC) technique is reported. To extract the ANC, the angular distributions of deuterons emitted in the ^{6}Li(^{3}He,d)^{7}Be α-transfer reaction were measured with high precision at the projectile energies of 3.0 MeV and 5.0 MeV. The ANCs were then extracted from comparison of DWBA calculations to the measured data and the zero energy astrophysical S-factor for ^{3}He(α,γ)^{7}Be reaction was found to be 0.534 ± 0.025 keVb.

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