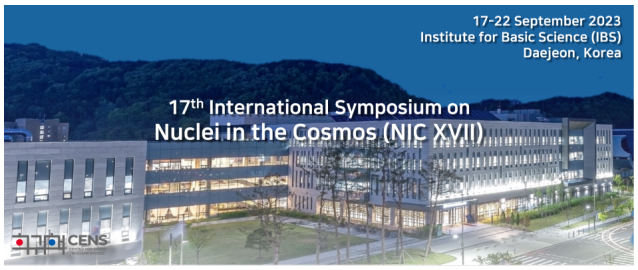

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Constraining the key reaction rates using indirect methods

Friday, 22 September 2023 13:30 (30 minutes)

Indirect methods play an important role in constraining the astrophysical rates of nuclear reactions. This talk will review several recent indirect studies that provided almost model-independent constraints for the key rates.
Neutron-upscattering enhancement of the triple-alpha reaction responsible for the production of carbon, suggested in [1], was investigated by measuring a time-inverse process, 12C(n,n')12C(Hoyle), using the Texas Active Target Time Projection Chamber [2]. The total cross section for inelastic neutron scattering in carbon was measured in a wide range of energies, and the detailed balance and R-matrix analysis was used to establish the 12C(Hoyle)(n,n')12C reactions cross section at astrophysically relevant energies [3].
The radiative width of the Hoyle state has a direct impact on the triple-alpha reaction rate. Recent measurements by Kibedi [4] reported a radiative width significantly above the previously recommended value [5]. I will report the results of the new study performed at the Cyclotron Institute, Texas A&M University, which provides a definitive resolution to the controversy.
The α-cluster properties of the ground state of 16O (the alpha asymptotic normalization coefficient, ANC) influence the low energy extrapolation for the key 12C(α,γ)16O reaction rate [6]. The new measurements at Texas A&M University used 12C(20Ne,16O)16O alpha-transfer reaction at sub-Coulomb energy to provide nearly model-independent constraints to the respective ANC values.

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