Contribution ID: **81** Type: **Poster**

The 12C(a,g) Reaction: Most Important, Least Known: Current Status and Prospects for Future Progress

Tuesday, 26 June 2018 19:00 (1h 30m)

Over the last four decades conflicting data plagued our attempts to deduce the cross section of the 12C(a,g) reaction at low energies and did not allow an accurate extrapo-lation of the astrophysical s-factor to stellar energies. In particular conflicting data did not allow us to chose between the high value (~80 keVb) and the low value (~10 keVb) solutions of the E1 s-factor at stellar energies. The so called "cascade"s-factors were deduced with large uncertainty, as large as a factor of 25. Recent modern measurement of SE1 and SE2 at Stuttgart, were demonstrated [1] to have error bars which are considerably larger than quoted by the authors [2, 3, 4]. In spite of the little progress in measurements of the cross section of the 12C(a,g) reaction, several recent R-Matrix global analyses claim to achieve accuracies of the total s-factor (E1 + E2 + cascade) be-tween 4.5% and 12%.
We apply the strict criteria established in the two Seattle workshops [5, 6] to examine current conflicting measurements of the 12C(a,g) reaction. The Seattle workshops addressed similar confusion in measurements of the 7Be(p,g) reaction and the criteria that were established at the Seattle workshops to judge conflicting data can be used as a model for progress in the field. Applying the Seattle workshops criteria we conclude yet a new ambiguity previously not noticed in the value of SE2(300); namely either ~60 keVb or ~155 keVb values are consistent with current data [1].
We establish strict requirements on future measurements to allow progress in the field and we point out that such data are within reach using gamma-ray beams of the HIγS facility in the USA or ELI-NP facility in the European Union.

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Session Classification: Poster session