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Exploring the αp-Process with High Precision (p,t) Reactions

Type 1 X-ray Bursts are identified as thermonuclear explosions on the surface of accreting neutron stars. These bursts can be observed and characterized through their bolometric luminosity curves. In a small number of type 1 X-ray bursts, a double peak structure in the light curve has been observed. This double peak structure lead Fisker et al to propose a nuclear waiting point impedance in the thermonuclear reaction flow of the αp-process, and conclude that uncertainties in (α,p) reactions rates on these potential waiting points can be directly observed in the structure of X-ray burst light curves [1]. (α,p) reaction rates on two possible waiting point nuclei, ²⁶Si and ³⁴Ar, were examined by investigating the level structure in the respective compound nucleus, ³⁰S and ³⁸Ca. This was done through high-precision measurements of ³²S(p,t)³⁰S and ⁴⁰Ca(p,t)³⁸Ca reactions utilizing the high energy-resolution zero-degree techniques with the K600 spectrometer at iThemba LABS [2]. States above the α-threshold have been identified and precise excitation energies were determined. These excitation energies, along with calculated level parameters were then used to determine the reaction rates for the ²⁶Si(α,p) and ³⁴Ar(α,p) reaction over stellar temperature ranges. Experimental excitation energies along with calculated reactions rates will be presented.

Ref.
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Primary author: Mr LONG, Alexander (Universty of Notre Dame)

Co-authors: SIDERAS-HADDAD, E. (Technische Universität Darmstadt); BUTHELEZI, E.Z. (iThemba LABS); SMIT, F.D. (iThemba LABS); BERG, G.P.A. (University of Notre Dame); USMAN, I. (iThemba LABS); CARTER, J. (University of Witwatersrand); GÖRRES, J. (University of Notre Dame); MIRA, J. (iThemba LABS); SWARTZ, J.A. (iThemba LABS); VAN ZYL, J.J. (University of Witwatersrand); COUDER, M. (University of Notre Dame); WEISCHER, M. (University of Notre Dame); FEARICK, R. (University of Cape Town); NEVELING, R. (iThemba LABS); TALWAR, R. (University of Notre Dame); MURRAY, S. (iThemba LABS); O'BRIEN, S. (University of Notre Dame); FÖRTCH, S.V. (iThemba LABS); ADACHI, T. (Tohoku University); KHESWA, Y. (iThemba LABS)

Presenter: Mr LONG, Alexander (Universty of Notre Dame)