Contribution ID: **10** Type: **Poster**

Search for Two-Proton Decay from the 6.15 MeV Resonance in 18Ne with ACTAR TPC

Type I X-ray bursts are among the most frequent thermonuclear explosions we can observe, and can reveal important properties of accreting neutron star systems. Understanding their light curves requires detailed knowledge of the nuclear reactions that enable the transition from the hot CNO cycle towards explosive burning and the rp process. One such key breakout reaction is the 14O(α,p)17F reaction, which at typical burst temperatures proceeds predominantly through a 6.15 MeV resonant state in 18Ne. Although the energy and spin of this resonance are well established, its decay scheme remains uncertain. In particular, previous studies have reported inconsistent results for a possible two-proton decay branch, spanning several orders of magnitude, which could significantly affect the resonance's astrophysical contribution.

To resolve this discrepancy, we recently performed a resonant scattering experiment at TRIUMF using the Active Target and Time Projection Chamber (ACTAR TPC), a gaseous active target that enables precise reconstruction of charged-particle tracks and reaction vertices. A 5.5 MeV/u 17F beam was delivered into ACTAR TPC that was filled with pure hydrogen (95%) mixed with isobutane (5%) gas, serving as a proton target. This measurement provides the first direct search for the two-proton decay of the 6.15MeV resonance in 18Ne and aims to determine the branching ratios between the 2p, p, and α decay channels.

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Session Classification: Poster session