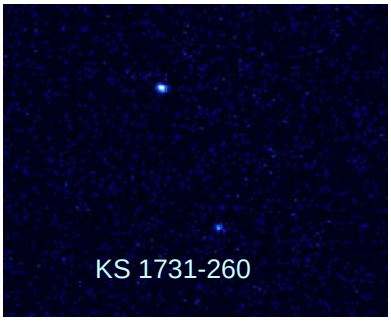
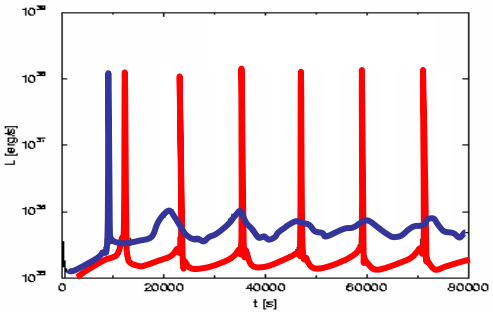
The Trigger of x-ray Bursts



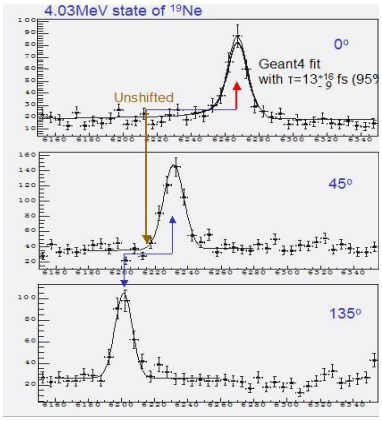


Thermonuclear explosions in accreting neutron stars such as observed in KS 1731-260 are triggered by break-out reactions from the hot CNO cycles (HCNO). A break-out from the HCNO increases the energy release significantly and triggers the rapid proton capture process which drives the thermonuclear runaway in the neutron star atmosphere. The most likely break-out is via the $^{15}O(\alpha,\gamma)^{19}Ne$ reaction. The reaction rate depends on single resonance level at 4.03 MeV in ^{19}Ne. Simulations with a multi-mass zone accretion model shows that the strength of the resonance directly impacts the recurrence of the bursts. If the rate is strong the bursts are strongly recurrent, for a low rate the burst amplitude rapidly diminishes.

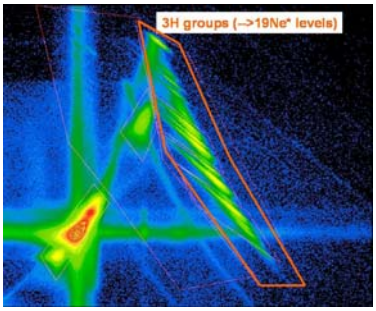
The reaction rate of $^{15}O(\alpha,\gamma)^{19}Ne$ is inverse proportional to the lifetime of state and scales with the α-decay probability. Measurements at the Notre Dame KN accelerator succeeded for the first time in a measurement of the nuclear life time by observing the Doppler shift of the γ-decay transition. The results have been published in Physical Review Rapid Communication. In a further experiment the Notre Dame TwinSol facility was used for measuring the α-decay probability of the 4.03 MeV level. The state was populated by the $^{19}F(^3He,^3H)^{19}Ne$ reaction and the α decay particles were measured with a Si strip detector array.

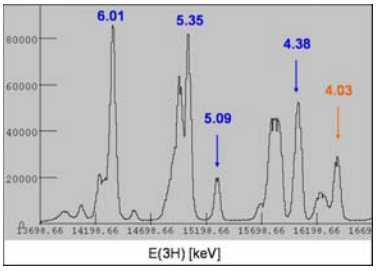
This new results remove substantial uncertainties from previously published rate and ensure that the x-ray bursts do occur as recurrent stellar x-ray beacons.

This work was supported by the Joint Institute for Nuclear Astrophysics under NSF Grant PHY0216783



The Doppler shift and the shape of the γ-decay transition from the 4.03 MeV resonance state corresponds directly to the lifetime of the state





Particle identification and triton spectra of the $^{19}F(^3He,^3H)^{19}F$ reaction at the TwinSol system, populating possible resonance states in $^{15}O(\alpha,\gamma)^{19}Ne$

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