Contribution ID: **40** Type: **Talk**

High precision mass measurement of 24Si and a final determination of the rp-process at the A=22 waiting point

Monday 27 June 2022 14:53 (22 minutes)

Type I X-ray bursts occur at astrophysical sites where a neutron star accretes H/He-rich matter from a companion star, leading to nuclear burning on the neutron star surface. The only observable is the X-ray burst light curve, which is used as a unique diagnostic of the outer layers of accreting neutron stars such the accretion rate and fuel composition. In addition to the astrophysical conditions, the main determinant of the shape of the light curve is the nuclear physics involved. Variations within the uncertainty of the ^{23}Al(p,γ)^{24}Si reaction rate lead to significant shifts in simulated X-ray light curves, where the ground state mass of ^{24}Si is currently the dominant source of the reaction rate uncertainty (19 keV). A beam of ^{24}Si was produced at the National Superconducting Cyclotron Laboratory and delivered to the LEBIT facility, where Penning trap mass spectrometry was used to improve the mass uncertainty by a factor of 5 (3.7 keV). The impact of this new mass value on the reaction rate and the onset of the αp-process at the ^{22}Mg waiting point will be presented, settling the rp-process at the $A = 22$ mass region.

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Session Classification: Nuclear Physics

Track Classification: Nuclear Physics