Joint Nuclear and Astrophysics Seminar

- When: Friday April 5th at 2:00 PM
- Where: Cyclotron Institute seminar room 228
- Speakers: Robert Bartsch and Justin Cole

A New Detector Array, TexNAAM, and its Near Future Applications in the Astrophysics Reaction O-15 (alpha, gamma) Ne-19

The Texas NaI(Tl) Array for Astrophysical Measurements (TexNAAM) is a new apparatus here at Texas A&M University for nuclear astrophysics experiments. The array was designed to study sub-Coulomb alpha transfer reactions in inverse kinematics using rare-isotope beams on a thick target, so as to extract the Asymptotic Normalization Coefficients (ANCs) of sub-threshold states in nuclei of astrophysical relevance. A single Si detector in conjunction with 16 NaI(Tl) detectors each coupled with a PMT comprise TexNAAM. The Si detects charged particles ejected from our target, while the NaI(Tl) detectors detect the gamma rays, gated to be in coincidence with the particle hit on the Si. In our first experimental test of the apparatus, we measured Be-11 beta- decay to calibrate the NaI(Tl) detectors' efficiency, which will be discussed in greater detail in the presentation. The next two planned experiments are O-15 (Li-6, D) Ne-19 and its mirror reaction, N-15 (Li-6, D), F-19, although they will be run in the opposite order, because N-15, as a stable beam, can be obtained in much greater intensity. The O-15 reaction is important for constraining the behavior of X-Ray Bursts' (XRBs) second phase. The three most relevant resonance states in Ne-19 that govern the reaction rate are 4033, 4140, & 4197 keV. We intend to measure these states' widths (and the widths in the F-19 mirror states), so as to more accurately constrain the reaction rate so as to better understand and predict XRB behavior.

Disentangling Star Formation Rate Timescales with CEERS: A Bayesian Analysis of Star Formation in the Early Universe

We present the star-formation-rate—stellar-mass (SFR-M_*) relation for galaxies in the CEERS survey at $4.5 \leq z \leq 12$. We model the JWST and HST rest-UV and rest-optical photometry of galaxies with flexible star-formation histories (SFHs) using BAGPIPES. We consider SFRs averaged from the SFHs over 10 Myr (SFR10) and 100 Myr (SFR100), where the photometry probes SFRs on these timescales, effectively tracing nebular emission lines in the rest-optical (on $\sim$10 Myr timescales) and the UV/optical continuum (on $\sim$100 Myr timescales). We measure the slope, normalization and intrinsic scatter of the SFR–M_* relation, taking into account the uncertainty and the covariance of galaxy SFRs and M_*. From $z \sim 5-9$ there is larger scatter in the SFR10 − M_* relation, with σ(logSFR100) = 0.4 dex, compared to the SFR100 − M_* relation, with σ(logSFR10) = 0.1 dex. This scatter increases with redshift and increasing stellar mass, at least out to $z \sim 7$. These results can be explained if galaxies at higher redshift experience an increase in star-formation variability and form primarily in short, active periods, followed by a lull in star formation (i.e. “napping” phases). We see a significant trend in the ratio RSFR = SFR10/SFR100 in which, on average, RSFR decreases with increasing stellar mass and increasing redshift. This yields a star–formation “duty cycle” of $\sim$40% for galaxies with $\log M_*/M_\odot \geq 9.3$, at $z \sim 5$, declining to $\sim$20% at $z \sim 9$. Galaxies also experience longer lulls in star formation at higher redshift and at higher stellar mass, such that galaxies transition from periods of higher SFR variability at $z \gtrsim 6$ to smoother SFR evolution at $z \lesssim 4.5$