Modernization of Detector Readout and DAQ for Laboratory Astrophysics

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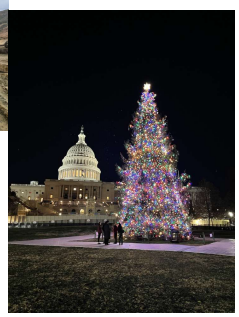
ABOUT ME

- **Major:** Electrical Engineering
- **Career Goals:** Pursue space science research through instrumentation.
- **Why did you choose to have a fellowship at LLNL?** I chose LLNL because I wanted to surround myself with experts that work on the missions that inspire me. LLNL is also close to home, so I get to see my family every weekend.
- **Interests:**
  - Exploring/wandering
  - History



SUMMER RESEARCH

Abstract: X-ray space observatories are our main avenue for studying hot, energetic environments in astrophysical objects like supernova remnants, active galactic nuclei, and black holes. The highly charged ions in these objects emit characteristic spectral signatures in the X-ray band. To interpret the observed spectra, accurate reference atomic data are required. The Electron Beam Ion Trap (EBIT) is a versatile instrument enabling accurate measurements of the needed atomic physics parameters for each ion in a controlled laboratory environment. A suite of spectrometers is available to observe the X-ray emission generated with EBIT. For my summer project, I am modernizing the data acquisition system responsible for digitizing the signal of some of these spectrometers.

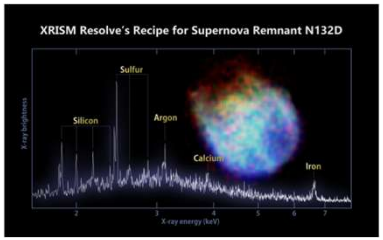


Figure 1: Observations of astrophysical objects at high spectral resolution allow us to study the composition, dynamics, and evolution of these objects. Shown above is the supernova remnant N132D observed with XRISM (background: Xtend CCD image; foreground: Resolve calorimeter X-ray spectrum with characteristic lines from Si, S, Ar, Ca, Fe).

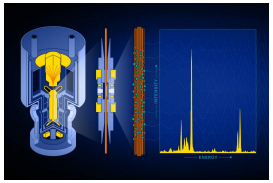


Figure 2: In an EBIT, a focused, monoenergetic electron beam collisionally ionizes and excites material injected into the trap region. The ions are trapped by a potential well created by 3 electrodes and by the space charge potential of the electron beam. Characteristic spectra are emitted following the electron-ion interaction.

Methods: We're setting up and characterizing a new, VME-based data acquisition system for EBIT. Using a function generator and Nuclear Instrumentation Modules (NIM), we generate synthetic signals simulating solid state detectors and position-sensitive gas proportional counters. The simulated signals are used to configure and test Mesytec analog-to-digital converter (ADC) and time digitizer (TDC), processed with the MVME software. Upon completion, we will field-test the new setup with live EBIT measurements.

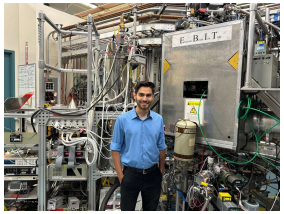


Figure 3: Photo of the LLNL EBIT-I

LLF AWARD

- LLF Funds are directly supporting my accommodations while I carry out research during the summer and helping with my tuition for the upcoming fall quarter.
- This fellowship has given me an opportunity to work hands on in an experimental astrophysics lab while simultaneously networking with fellow students across the LLNL.

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