SACRAMENTO STATE

Department of Physics and Astronomy

FALL 2026 Colloquium Series

Summer Research Experience

Sac State Physics and Astronomy Majors

A Parameterized Graph Neural Network for Heavy Resonance Searches in High Energy Physics

- **Noah Wheeler**

Resonance searches at CERN have a successful history, being instrumental in the discovery of the W, Z, and Higgs bosons. This method plays a central role in ongoing searches targeting new physics at higher energies, prompting a demand for advanced machine learning classifiers capable of handling complex, multivariate analysis problems. However, earlier classifiers are only effective across a narrow range of masses, posing a problem for heavy resonance searches, for which it is impractical to train many classifiers to cover a broad energy spectrum. Instead, we propose a parameterized classifier trained on a discrete set of mass points, but capable of interpolating between them. Using the transformer-based GN2 jet-flavor tagging algorithm, we show that a parameterized graph neural network (PGNN) performs comparably to a GNN across a small array of signal masses in an extended Higgs-sector search $SH \rightarrow b\bar{b}\tau^+\tau^-$, for which the existing ATLAS di-Higgs analysis framework is repurposed. Additionally, our work provides a baseline for a future study which may demonstrate that a PGNN can interpolate effectively between mass points on which it is trained. This makes it a promising choice of classifier for future resonance searches on high-energy frontiers.

Development and Testing of Temperature Control for the Low Temperature Cryostat Systems

- **A.J. To**

For temperature-sensitive experiments, such as semiconductor characterization, it is crucial for the testing environment to hold a reliably stable temperature. Sac State's low temperature lab uses a closed-cycle cryostat system and a cryogenic temperature controller to regulate the temperature of its experiments. This summer, I worked with both hardware and software, including sensor calibration and LabVIEW coding, to improve the performance and usability of the cryostat system, readying the lab for future low temperature experimentation.

Reconnection Micro- and Macrophysics in the Striped Jet Model

- **Olga Skuyeva**

The striped-jet model is one plausible explanation for how gamma-ray bursts are produced. Inside this already obscure theory lies another uncertainty— the rate of magnetic reconnection. In the original derivations, this parameter is a constant-value ansatz, which is known to be one of the most uncertain parameters in the model. In my mostly analytical exploration, I used one of the microphysical reconnection theories to make this rate a function rather than a constant and propagated it through the equations. I alsocompared observations to theoretical predictions to uncover bigger uncertainties in this model.

Thursday, Sept. 17, 2026

4:00 – 5:20PM

MND1015

Open & Free to all students, faculty and public