Emory University
Saturday November 8th, 2025

Made possible by Emory University Department of Physics
and the Georgia Space Grant Consortium

EMORY COLLEGE OF ARTS AND SCIENCES
Department of Physics

GEORGIA Space Grant Consortium

Attendees

Georgia Regional Astronomy Meeting, 2025

Name	Institution
Shameer Abdeen	Georgia State University
Akshay Agarwal	Kennesaw State University
Marcelo Alvarez	Newton High
Sasha Arbogast	Agnes Scott College
Alek Attard	Newton High
Navila Azad	Georgia State University
Alissa Bans	Emory University
Dixie Baronofsky	Emory University
Merida Batiste	Emory University
India Bey	Spelman College
Elijah Blesch	University of North Georgia
Adonis Bloodsaw	Newton High
Tamara Bogdanovic	Georgia Institute of Technology
Rohan Bolle	Georgia Southern University
Erin Wells Bonning	Emory University
Miles Bransford	Emory University
Caleb Breaux	Newton High
Kalinda Brock	Agnes Scott College
Elizabeth Bryce	Emory University
Emily Burns-Kaurin	Georgia State University
Ross Cawthon	Oxford College of Emory University
Lani Chastain	University of Tennessee at Chattanooga
Akshat S. Chaturvedi	Georgia State University
Kyle Chen	Emory University Oxford College
Natalia Considine	Georgia State University
Aarshia Datta	South Forsyth High School and Center for Relativistic Astrophysics, Georgia Institute of Technology
Madeline Davis	Georgia State University
Skye DeCicco	Emory University Oxford College
Russell DeLecuona	Emory University
T. Heath Dobson	University of North Georgia
Donovan Domingue	Georgia College & State University
Jay Dunn	Georgia State University - Perimeter College
Ross Echols	Emory University
Vi Eicher	Emory University
Ieva Evaltaite	Georgia Southern University
Gregory Feiden	University of North Georgia
Ethan Fincher	Georgia State University
Francisco Guzman Fulgencio	University of North Georgia
Kate Futrowsky	Georgia Institute of Technology
Atul Gautam	Georgia Institute of Technology
Sena Ghobadi	Georgia Institute of Technology

Name	Institution
Idan Ginsburg	Georgia State University
Philip Groce	Helping Planetariums Succeed, LLC, Mark Smith Planetarium, Macon, GA
R. Scott Harris	University of Georgia
Zara Hossain	Georgia State University
Matt Howard	Newton High
Jianghao Huyan	University of South Carolina
Jibek Ibraeva	Agnes Scott College
Davyn Isler	Newton High
Makaila Jennings	Agnes Scott College
Layton Johnson	Newton High
Jeremy Jones	Georgia State University
Antonio Joyner	Newton High
Gabe Kaderli	University of North Georgia
Colin Kane	Georgia State University
Shay Kelly	University of North Georgia
Stewart Key	Emory University
Riley Klein	Emory University
Kaylee Klein	Georgia State University
Larry Kohse	Retired (Mercer University, Macon GA)
Ulrike Lahaise	Georgia State University - Perimeter College
William Lahaise	Georgia State University Perimeter College
Mai Ngoc Le	Agnes Scott College
Faith Lewis	Agnes Scott College
Grant Lichtman	Emory University
Zihan Liu	Emory University
Alexander Lomashvili	Georgia State University
Isha Maini	Emory University
Julie Malewicz	Georgia Institute of Technology
Dominic Mantone	Emory University
Madison Markham	Georgia State University
Cheryl Kaye Marshall	Emory University
Joshua Martinez	University of North Georgia
Alisa Matthews	N/A
AJ Matthews	N/A
Sabrina Matthews	N/A
Andy Maughon	Kennesaw State University
Tyreek Maynard	Newton High
Juvis B. Mbeng	University of Georgia
John "Jack" P. McGuire	Georgia State University
Marta Dark McNeese	Spelman College
Mariel Meier	Oglethorpe University
David von Meyer	University of North Georgia
Amanda Moffett	University of North Georgia
Alex Murphy	Georgia State University
Leza Nadeem	Agnes Scott College

Name	Institution
Lane Nichols	University of North Georgia
Mahir Patel	Georgia State University
Adrian Pelaez	Georgia State University
Demario Pettis	Newton High
Ken Poshedly	Assn of Lunar & Planetary Observers
David Raudales	Georgia Institute of Technology
Evelyn Ross	Georgia State University
Tamima Saba	Georgia State University
Viacheslav Sadykov	Georgia State University
Eden Schapera	Georgia Institute of Technology
Richard W. Schmude, Jr.	Gordon State College
Paul Sell	Georgia Institute of Technology
Krish Shah	Emory University
Robin Shelton	University of Georgia
Lily Grace Sheram	Georgia Institute of Technology
Zhanna Shorokhova	Agnes Scott College
Logan Snyder	The University of Georgia
Jim Sowell	Georgia Institute of Technology
Piper Spraker	University of North Georgia
Annika Starks	University of North Georgia
Sofia Stepanoff	Georgia Institute of Technology
Nick Sterling	University of West Georgia
Shahram Talei	Georgia College and State University
Alexa Tapia	Agnes Scott College
Vishal Tiwari	Georgia Institute of Technology
Andrew Tran	University of Georgia
Evan Tuckley	Emory University
Jonathan Uhlenberg	Emory University
Vishnu Santhigiri Unni	University of South Carolina
Jack Vogel	University of North Georgia
Russel White	Georgia State University
Josh Whitman	University of West Georgia
Rowan Woodson	Amateur Astronomer
Bin Xia	Georgia Institute of Technology
David Yenerall	Georgia State University
Alexandra Yep	Agnes Scott College
Alassandra	Agnes Scott College
Nigel	Emory University
TyKell	Oglethorpe University

Schedule

All talks are in Math & Science Center (MSC) E208, meals and poster sessions in the MSC in the atrium

8:30 – 9:00 AM — Light Breakfast and Poster Setup
9:00 – 9:10 AM — Welcome and Opening Remarks

Session I (9:10 AM – 10:20 AM)

R. Scott Harris, University of Georgia
Discovery of Ejecta Deposits from the 800-Million-Year-Old Roosevelt Impact Structure in Central Georgia: Implications for a Neoproterozoic Asteroid or Comet Bombardment in the Earth–Moon System
We previously have reported evidence that a large asteroid or comet collided with west-central Georgia approximately 800 million years ago excavating the Roosevelt Impact Structure (RIS). Melt rocks in the region, including massive layered charnockites and 30-meter-wide altered pseudotachylitic dikes, contain mineralogical and geochemical evidence that they were formed by a hypervelocity impact. And the uplifted basement rocks of the Pine Mountain massif exhibit deformation, including shatter cones, shatter cleavages, and multiply striated surfaces, consistent with the passage of a shockwave through the crust.
More recently, we have reviewed seismic data collected across Georgia in the 1970s and 1980s by the Consortium for Continental Reflection Profiling (COCORP). Combining those subsurface data with surface imagery derived from the Space Shuttle Radar Topography Mission (SRTM) reveals that the RIS is a nearly circular structure with a diameter close to 220 kilometers. It extends north-south from Atlanta to Andersonville, Georgia and east-west from east of Macon, Georgia to Auburn, Alabama.
Visualizing the full extent of the structure in the geophysical data has allowed us to make predictions about where deformation or deposits associated with different impact facies might be found. The predicative value of our model is demonstrated by the resulting discovery of suevite flows and impact spherule/accretionary lapilli-rich airfall ejecta around the periphery of the structure. Investigations of these materials also has allowed us to suggest that they may be correlated with early Neoproterozoic breccias in Scotland, Argentina, Virginia, and India. Some of those more distant breccias have well-established associations with the Bitter Springs negative δ13C anomaly that likely resulted from a global decline in cyanobacteria. Successfully correlating a major extinction event with the RIS would make sense given its enormous size. And it makes the possible link to a protracted asteroid or comet shower in the Earth-Moon system c. 800 Ma, proposed by Terada et al. (2020) based on the nearly synchronous ages of a group of large lunar craters at that time (including Copernicus), plausible.

Richard W. Schmude, Jr., Gordon State College
A V-filter Photometric Model of Uranus' Brightness
Since the 1990s, bright polar hoods have been imaged on Uranus. These are especially bright in near-infrared light and undoubtedly affect that planet's brightness. The writer has compiled 1008 individual brightness measurements of Uranus from JUN 1991 to SEP 2025 made by several individuals. Except for recent measurements, these have been published in The Journal of the Association of Lunar and Planetary Observers. Mean normalized V-filter brightness measurements of Uranus, made during 1954-1975, are published in the professional journal Icarus. Since the distance of Uranus changes, a normalized magnitude is reported that represents the brightness that planet has if its distance to the Sun and Earth are 1.00 astronomical units and its phase angle, a, equals zero degrees. I have selected the symbol of V(1, a) for the normalized brightness. Three different sets of data are considered, and each are fit to an equation of the form V(1, a) = mx + b where x is the absolute value of the sub-Earth latitude in degrees, b is the V(1, 0) magnitude value when the sub-Earth latitude equals zero degrees and m is a constant to be determined in the linear fit. If all 1008 individual V(1, a) values are given equal weight, the resulting equation is V(1, a) = -0.0011x - 7.110. If mean apparitional values for 1954-1975 are given equal weight, the resulting equation is V(1, a) = -0.0011x - 7.096 and if all mean apparitional values for 1954-2025 are given equal weight the corresponding equation is V(1, a) = -0.0012x - 7.105. The close

agreement for the m and b values for all three equations shows that the data are consistent and this model is valid for 1954-2025.

Shameer Abdeen and Idan Ginsburg, Georgia State University
Integrating Augmented Reality into Astronomy: Enhancing Learning through Immersive Active Learning
Introductory Astronomy requires students to visualize and interpret complex, three-dimensional celestial phenomena which can be often challenging to visualize. The present study is dedicated to enhancing the learning experience in Introductory Astronomy by harnessing the potential of immersive learning through introducing augmented reality (AR) applications into the classroom. AR enables digital models of astronomical systems to be overlaid onto real-world spaces, allowing learners to explore spatially and temporally related content interactively. The project aims to (1) design AR pedagogical tools for astronomy using marker-based technology, developed through Blender, Unity, and the Vuforia Engine; (2) evaluate the relationship between the novelty of AR applications and their pedagogical effectiveness, ensuring alignment with learning objectives; and (3) assess the impact of AR-enhanced learning on student engagement, motivation, and conceptual mastery of astronomical phenomena.

Philip Groce, Helping Planetariums Succeed, LLC
Using Inexpensive Smart Telescopes for Formal and Informal Astronomy Education
Over the last year, several Colleges, Universities, and Planetariums have been using ZWO SeeStar S50 and other small, inexpensive "Smart" telescopes at public events and in astronomy labs. This presentation examines the potential of such scopes to do real science and introduce both students and the public to the deep sky objects of the night sky.

10:20 – 10:50 AM — Coffee Break & Poster Session 1

Flash Talk Session I (10:50 – 11:50 AM)

Lily Grace Sheram, Georgia Institute of Technology– *Trinity Neutrino Observatory Status*
The Trinity Demonstrator is an imaging atmospheric Cherenkov telescope that observes air showers from Earth-skimming tau neutrinos and is the first stage of the Trinity Neutrino Observatory. The final 18-telescope observatory will detect tau neutrino energies between 1 PeV to 10 EeV, filling the energy gap between water/ice Cherenkov telescopes and radio detection methods. These high-energy neutrinos provide a unique window into the most energetic cosmic accelerators. Deployed on Frisco Peak, Utah in Fall 2023, the Demonstrator uses the same technology, but on a smaller scale, to test the design and study background characterization, providing insight for the development of the full array. In this presentation, I discuss the status of the Demonstrator's operations and its initial analysis.

Makaila Jennings, Agnes Scott College – *Vetting TESS Exoplanet Candidates with TRICERATOPS and LEO-Vetter*
The TESS Science Processing Operation Center searches for transiting planets in 160,000 targets selected from the full frame images (FFI) each observing sector. The pipeline detects a couple thousand potential transit signals, or threshold-crossing events (TCEs) from these targets. The TCEs must be vetted to see if they are false positives or planet candidates. We vetted the TCEs from the FFI multi-sector search of sectors 56-69. We first selected TCEs that had ExoMiner machine-learning classification scores of greater than 0.5 (likely planet candidate) and then vetted them using the TRICERATOPS and LEO-Vetter vetting tools. We identified 9 objects of interest with radii between 1.26 and 8.19 Earth Radius and orbital periods between 1.22 and 36.91 days. We performed light curve modeling using the Allesfitter package to get the best-fit transit parameters for these nine targets.

Akshat S. Chaturvedi, Georgia State University – *Be Stars and Beyond: Unveiling the Legacy of Binary Mass Transfer with Observational Synergy*
Binary star evolution is able to explain the presence of exotic, high-energy astrophysical phenomena such as x-ray binaries, hydrogen-deficient supernovae and double compact objects. To understand binary evolution, we present a study of Be+sdO systems. These systems are prolific in our galaxy, and dozens are known to be nearby (<1.5 kpc). These systems are bright in the UV and the optical, and as such, make for excellent candidates to be studied

in a synergistic method tying together ongoing and archival space-based FUV spectroscopy from NASA's Hubble Space Telescope and International Ultraviolet Explorer missions, high resolution ground-based optical spectroscopy, as well as long-baseline optical interferometry. With all these observational domains, fundamental properties of these systems such as the individual component masses, component radii, as well as temperatures can be ascertained. These properties will then be used to calibrate existing evolutionary tracks and determine the evolutionary status of these stars and predict their eventual demise. This project will provide an incredible look assessment of objects that will be of great interest to the astrophysics community in the coming decades.

Russell DeLecuona, Emory University – *Assessing DiskFit's Usage in Identifying Recent Major Galactic Mergers*
I am conducting investigative research into the software DiskFit, which can fit non-axisymmetric models to either photometric or kinematic disk galaxy data. My goal is to see if DiskFit can analyze physical clues that may determine whether or not a galaxy is the result of a recent major merger. I have 6 galaxies under consideration, taken from a larger sample I've selected of 21 galaxies. Half of these samples (NGC 4573, NGC 5557, and NGC 7465) are believed to have endured a significant merger event within the past few billion years, and the other three (NGC 4429, NGC 4476, and NGC 4489) are believed not to have done so. In my investigation, I aim to determine whether the software can fit for physical characteristics indicative of these mergers, or whether it specifically falls apart in the midst of them (for example, past literature indicates that DiskFit has difficulty modeling dust lanes in a photometric fit). My data is taken from the Atlas3D Survey (Cappellari et al. 2011) and the Hubble Legacy Archive.

Madeline Davis, Georgia State University – *Disentangling the Kinematics of NGC 4258*
Active Galactic Nuclei (AGN) serve an important function for the evolution of their host galaxies. Gas outflowing from the AGN and other AGN winds, such as jets and shocks, can affect this evolution. We present a kinematic analysis of the galaxy NGC 4258 that distinguishes between rotational motion, kinematic disturbance, and outflowing motion of ionized gas. We observed the Narrow Line Region (NLR) of this AGN using data from Apache Point Observatory's (APO) long slit spectrograph. By fitting Gaussians to the spectrally resolved emission lines: Hα and Hβ; we identify evidence for rotational motion and kinematically disturbed motion, but we do not find any strong evidence for highly ionized, radiatively driven outflows. The velocity of the kinematically disturbed gas ranges from 50 km/s to 350 km/s. We find strong evidence which supports this AGN as a Low Ionization Nuclear Emission-Line Region (LINER) type AGN. This galaxy's Eddington Ratio of LBol/LEdd = $2.5 \times 10{-}4$, spectral resemblance to a type 2 AGN, and lack of highly ionized extended outflows are all characteristic of a LINER AGN.

Elizabeth Bryce, Emory University – *Improving Effective Radius Measurements for the Atlas3D Sample of Early-Type Galaxies*
In this talk I will introduce my project to use multi-component fitting to improve measurements of the bulge effective radius (r_e) for the ATLAS3D sample of quiescent early-type galaxies, using the software GALFIT. As an initial test of the method, I have fit a model to the dwarf-elliptical galaxy NGC 2778 and am comparing the effective radius measurement of the bulge to the ATLAS3D radius measurement. I plan to develop a batch processing code to fit all 260 galaxies in the ATLAS3D early-type sample with a bulge-disk model, in order to tighten constraints on r_e for the full sample.

Cheryl Kaye Marshall, Emory University – *A TRIPPY Analysis of 2025 FA22*
On September 18th, 2025, the potentially hazardous asteroid 2025 FA22 approached earth. I conducted a multi-day campaign in the Emory University Observatory and reduced the data using AstroImageJ . I then used TRIPPY, Trailed Image Photometry in Python, to create its light curve. The goals of this project are to study its phase angle and albedo.

Tamima Saba, Georgia State University – *The Role of Flare Ribbon and 3D Magnetic Field Topology in Flare Eruptivity*
Solar flares can be eruptive or confined depending on whether they are accompanied by a coronal mass ejection. Flare ribbons are a phenomenon occurring at the footpoints of magnetic field loops in the chromosphere. Based on the Standard Flare Model, it has long been argued that a two-ribbon flare is likely to result in an eruption. In

this work, we study the relation between eruptivity and two-ribbon topology in different soft X-ray (SXR) flare classes, using a catalog of 722 solar flares from Solar Cycle 24 from Kazachenko et al. (2023). Using observations in the 1600 Å channel from the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO), we generate desaturated GIF movies of flare ribbon dynamics for the events and quantify their two-ribbon nature based on experts' input. For C and M-class flares, observations indicate that the presence of a two-ribbon topology is positively correlated with the occurrence of eruptive behavior. The eruptivity probability does not seem to depend on the ribbon topology for the X-class flares. For a flare of a particular class, very confidently identified as two-ribbon, the eruptivity chances are ~45% (C-class) and ~70% (M-class and X-class). Given that flare ribbons trace the chromospheric footprints of coronal magnetic structures, we are extending this analysis by reconstructing the 3D coronal magnetic field using Non-Linear Force-Free Field (NLFFF) extrapolations. From these extrapolations, we compute quasi-separatrix layer (QSL) maps, which are regions of strong magnetic connectivity gradients and are expected to coincide with the flare ribbons.

11:50 AM – 12:50 PM — Lunch

Session II (12:50 PM – 2:20 PM)

Ross Cawthon, Oxford College of Emory University
Cosmology with the Dark Energy Survey
The Dark Energy Survey is nearly ready to release its final cosmological results. I will give an overview of the Dark Energy Survey, and how it studies galaxies to understand both dark matter and dark energy. I will also describe what questions are at the top of mind for cosmologists as they await this next analysis, giving a brief overview on the "sigma-8 tension" and what it may imply about our Universe.

Kate Futrowsky, Georgia Institute of Technology
A Preliminary Census of Galaxies in the LISA Localization Volume Using the Illustris-TNG100 Cosmological Simulation
The Laser Interferometer Space Antenna (LISA) will observe the gravitational radiation from the inspiral and merger of massive black hole binaries (MBHBs). Multi-messenger observations of MBHBs with LISA and electromagnetic observatories should be achievable prior to their merger. Using the TNG100 cosmological simulation, we investigate the number and characteristics of galaxies within the shrinking LISA localization volume as MBHBs with masses 3x10^5, 3x10^6, and 10^7 solar masses at redshifts z = 0.1, 0.3, and 1.0 approach merger. For a fiducial 3x10^6 solar mass MBHB at z = 0.3, we find that the number of galaxies in the volume decreases from hundreds of thousands to tens, one month to one hour prior to merger. The volume is dominated by low-mass, gas-rich, dim in X-rays and optical/near-IR bands galaxies with a wide range of star formation rates and central massive black hole (MBH) masses. When considering only galaxies with a central MBH mass that matches our fiducial MBHB mass, the number of galaxies in the volume decreases by 1.5 orders of magnitude, and they tend to be more massive and brighter in optical/near-IR bands. The NewAthena, AXIS, Rubin LSST, and Roman fields of view can encompass the sky localization uncertainty for this system prior to coalescence. Most galaxies with central MBHs within the relevant mass range will be detectable in a single pointing by Rubin LSST and Roman prior to merger.

Jianghao Huyan, University of South Carolina
The Evolution of Metals and Chemical Enrichment in the First Billion Years After the Big Bang
Direct observations of the first stars, which are believed to have formed from metal-free gas clouds, are extremely challenging. However, the intergalactic medium (IGM) and circumgalactic medium (CGM) around high-redshift galaxies can provide information about the signatures of chemical enrichment by the first stars or early generations of stars. Using absorption lines in the spectra of high-redshift quasars, one can study the IGM and the CGM of galaxies situated along the sightlines to the quasars. Here we present spectroscopic analysis of a survey of damped/sub-damped Lyman-alpha absorbers (DLA/sub-DLAs) at $z > 4.5$ based on our observations from Magellan/MIKE and Gemini/GHOST, complemented with archival VLT data. We measure the abundances for C, O, Si, S, Fe, and/or Mg, and investigate the metallicity-redshift relation at $z > 4.5$ (spanning the first ~1 billion years after the Big Bang). We find some cases of metal-poor absorbers that may show signatures of enrichment by early stars, while one case shows very high metallicity and dust depletion compared to most of the other

DLA/sub-DLAs s in our sample. This indicates a wide diversity of chemical enrichment in the first ~1 billion years of cosmic history. The carbon enhancement and alpha-element enhancement are also found in our survey, which imply the constraints to nucleosynthesis of early stars in the first ~1 billion years.

Julie Malewicz, Georgia Institute of Technology
X-ray Reflection Signatures of Supermassive Black Hole Binaries
Supermassive black hole binaries (SMBHB) will be prime multimessenger sources in the era of low-frequency gravitational waves (GW). With next-generation X-ray observatories (NewAthena, AXIS) planned for operation in the mid-2030s, it is crucial to understand how SMBHBs may be both identified and characterized through high signal-to-noise, high spectral resolution X-ray observations. To that end, we use relativistic reflection code relxill to compute the time-dependent spectra originating from mini-disks attached to two SMBHs at a separation of 100 gravitational radii. We examine the properties and time variability of the spectra and the Fe Kα line as a function of SMBHB mass ratio and mass accretion rate, and consider the prospects for their detection.

Robin Shelton, University of Georgia
It Looks Hot, But It's Not
There is more material between galaxies than in galaxies. This material is important because 1.) it is the Universe's single largest reservoir of baryons and 2.) it can give birth to galaxies and help them grow. Astronomers have been looking at this material for many years and in many ways. Most of this material looks quite hot. But, it's not. In this presentation, I will show you how the gas fakes us out, giving off signals of being 100 times hotter than it actually is. I'll also tell you how this affects the actual amount of baryons in the universe and the characteristics of the gas.

2:20 – 2:55 PM — Coffee & Poster Session 2

Flash Talk Session II (2:55 PM – 3:55 PM)

Bin Xia, Georgia Institute of Technology – *Multi-modal Foundation Model for Cosmological Simulation Data*
We present a multi-modal foundation model for astrophysical galaxy data, designed to map between simulation- and observation-based galactic features. Our encoder only transformer flexibly ingests scalar quantities (e.g., redshifts, galaxy masses) and vectors (e.g., star formation histories, spectra), supporting multi-task training that includes within-modality reconstruction and cross-modality prediction. With a dynamic masking strategy, the model can query arbitrary galaxy properties from partial inputs—including predicting spectra from redshift and mass, or estimating photometric redshifts from broadband magnitudes—while also recovering missing segments within a modality. Trained on 185,000 simulated galaxies from a gigaparsec-scale Cosmology simulation, the model yields a 50% improvement in redshift estimation when combining LSST and SPHEREx photometry over LSST photometry alone, and a 63% improvement in stellar mass inference when combining late-time SFH with LSST photometry over early-time SFH with LSST photometry. The model demonstrates strong generalization across multi-modal tasks and lays the groundwork for future integration of higher-dimensional and structured data such as images, merger trees, and 3D fields. This approach provides a unified framework for connecting simulations and observations, advancing the development of generalizable astrophysical foundation models.

Madison Markham, Georgia State University – *Cepheid-based Distances to Two Canonical AGN*
We present Cepheid-based distances to two canonical AGN: NGC 4303 and NGC 1068. Data were obtained using the Hubble Space Telescope with nonredundant time spacing over 12 visits for each target, and observations were made with the F555W and F814W filters. We found 32,694 point sources in NGC 4303, and 130 of these were determined to be strong Cepheid candidates with periods ranging ~13 − 93 days. In NGC 1068, we found 20,207 point sources, where 51 of these were strong Cepheid candidates with periods ~14 − 91 days. We fit the period−luminosity relationship, calibrated with the LMC by Riess et al. (2019), to our Cepheid candidates in each galaxy and correct for potential effects of metallicity. Using a distance constraint for the LMC given by Pietrzyński et al. (2019), this yields a distance modulus of $\mu = 31.083 \pm 0.038$ mag for NGC 4303 and $\mu = 30.150 \pm 0.104$ mag for NGC 1068. Thus, we measure distances of $D = 16.50 \pm 0.29$ Mpc to NGC 4303 and $D = 10.72 \pm 0.51$ Mpc to NGC 1068.

Evan Tuckley, Emory University – *Investigating the Importance of Radiative Effects in Dynamical Asteroid Family Evolution*
The current understanding of asteroid evolution comes primarily from breakup events in which asteroid families form with similar compositions. Dynamical families are the defined groups of asteroids which have similar orbital elements (i.e. inclination, semi-major axis, eccentricity, etc.) sorted using algorithms. The key dynamical processes that influence long term asteroid orbits are gravitational perturbations, resonance effects from planetary orbits, and non-gravitational effects specifically radiative effects such as the Yarkovsky effect. In this project we seek to understand the impacts of the Yarkovsky effect on long term evolution and mixing of dynamical families. The Yarkovsky effect arises as a consequence of thermal inertia with two primary elements being the diurnal (rotation dependent) and seasonal (axial tilt dependent). The Diurnal effect comes from the heated point on the asteroid rotating with (prograde) or against (retrograde) the direction of orbit and subsequently causing a force that increases or decreases the semimajor axis over time respectively. To simulate this, I followed the long-term perturbation equations from Bottke et al (2006) and used a fourth order Runge Kutta integrator over 1 billion years with a 100,000-year time step. My current simulation is a good approximation of the simulation made by Xu et al (2020). In the future I hope to incorporate the YORP effect which accounts for spin, eccentricity, and spin axis changes. I also seek to fine tune my simulation and eventually incorporate gravitational effects so that I can integrate over the entire orbit and simulate the full evolution of dynamical families.

Emily Burns-Kaurin, Georgia State University – *Proton Peculiarities and Detector Disagreements: Viewing the Gannon Storm from Geostationary Orbit*
During May 10-15, 2024, a series of strong geomagnetic storms was induced by several coronal mass ejections (CMEs) from a particularly active region of the Sun. This became known as the Gannon Storm, and with aurora reaching as far south as Georgia, also produced a treasure trove of tasty heliophysics data. Some of the data sources close to home are the Geostationary Operational Environmental Satellites (GOES), each carrying two Solar and Galactic Proton Sensors (SGPS). Magnetic field conditions can lead to anisotropy between the east and westward facing sensors on one spacecraft. We use SGPS along with magnetic field data from the DSCOVR spacecraft at Lagrange-1 to analyze proton anisotropy variations during the Gannon Storm, focusing on the strongest solar proton event of May 11. CME impact shows abrupt increases in anisotropy, with interesting energy-based changes occurring during the passage of magnetic features. We also examine the readings between GOES -16 and -18, which were at different locations in the magnetosphere. Long-term exposure to radiation from events like this can pose a health risk to flight crew and others at high altitudes, so understanding what factors affect particle measurements could lead to better being able to predict them in the future.

Juvis B. Mbeng, University of Georgia – *Reconstructing Images of Protoplanetary Discs Using Principal Component Analysis*
Reconstructing high-fidelity images of protoplanetary discs remains challenging due to atmospheric variability, calibration errors, and incomplete u–v coverage in interferometric data. In this work, we explore Principal Component Analysis (PCA) as a statistical tool to reconstruct and analyze synthetic ALMA images of the 3 protoplanetary discs. By decomposing a time-series of simulated observations into orthogonal eigenimages, we isolate the dominant spatial and temporal patterns linked to disc morphology and potential planet–disc interactions. The resulting PCA reconstructions enhance image clarity and reduce noise while preserving physical structure. We further examine correlations between the PCA amplitudes and the planet's orbital position, revealing promising connections between dynamical evolution and observable features

Sena Ghobadi, Georgia Institute of Technology – *Evolution of Supermassive Black Hole Pairs on Inclined Orbits in Post-Merger Galaxies*
Theoretical models of the evolution of supermassive black hole (SMBH) pairs in post-merger remnant galaxies are necessary to motivate observational searches for dual active galactic nuclei (AGN) and gravitational wave sources. Studies have explored the dynamical evolution of SMBH pairs under the influence of dynamical friction to calculate pairing times and predict the expected population of dual-AGNs at various redshifts. We formulate a three-dimensional dynamical model of SMBH pairs in the innermost kiloparsec of a post-merger galaxy to investigate the impact of orbital inclination with respect to the galactic disk on pairing times. The SMBH pairs are evolved in 81 different galaxy configurations initialized using a Gauss-Seidel Poisson solver. The dynamics are calculated for 12 distinct initial inclinations ranging from 0 to 75 degrees in each of the galaxies to gauge the

impact of inclination on pairing time. Orbits characterized by initial inclinations greater than 20 degrees frequently require longer pairing times when compared to uninclined orbits. Pairing times for orbits with inclinations $\gtrsim 45$ degrees often exceed 14 Gyr. Galaxies with higher mass SMBH pairs and faster rotating disks generally shorten pairing times relative to galaxies with less massive or slower rotating disks when the inclination is $\lesssim 45$ degrees. The model suggests that SMBH pairs that form from mergers at inclinations $\lesssim 20$ degrees are likely progenitors of dual-AGN and gravitational wave sources.

Mahir Patel, Georgia State University – *Ages of the Nearest Open Clusters*
Open clusters have served as long-standing benchmarks for testing how stellar evolution models depend upon stellar mass; they contain stars spanning a broad range of masses (including substellar masses and even planets) at the same age and composition. Despite this, their value remains limited because their absolute ages are uncertain by 20% in most cases. However, this uncertainty can be reduced by providing new and independent age estimates of these clusters based on CHARA measured diameters of cluster giants. Angular diameter measurements ($\theta > 0.4$ mas) have been estimated for three Ruprecht-147 cluster giants and the Alpha Persei giant, α-Per. These measurements, coupled with precise Gaia distances and bolometric fluxes, will enable accurate comparisons with stellar evolutionary models. The rapid stellar evolution at this stage provides a more sensitive measure of the cluster age than techniques that rely solely on main sequence populations. Here I show age estimates for these two clusters based on their angular diameter measurements.

Aarshia Datta, South Forsyth High School and Center for Relativistic Astrophysics, Georgia Institute of Technology - *Prospects of Constraining Beyond Standard Model Physics with the Trinity Neutrino Observatory*
Lorentz Invariance Violation (LIV) is the hypothetical breaking of a fundamental symmetry of spacetime—the symmetry asserting that the laws of physics are identical for all observers in uniform motion. Detecting LIV would reshape our view of modern physics. The effects of LIV can be seen in extremely small scales, making neutrino oscillation patterns a sensitive probe for detecting such effects. Specifically, LIV effects increase as the energy of a neutrino increases. Therefore, oscillation patterns of Ultra-high-energy (UHE, > 1 PeV) neutrinos are an important tool for setting constraints on LIV parameters. Such objectives require a measurement of the flavor composition of the diffuse neutrino flux at Earth, but current UHE neutrino telescopes do not hold the capacity for such measurements. To effectively measure the flavor composition of neutrinos at Earth, we combine the sensitivities of an all-flavor sensitive neutrino telescope and a tau-sensitive neutrino telescope, Trinity. The Trinity telescope is a proposed instrument that can detect Earth-skimming tau neutrinos with energies ranging from 1 PeV to 10 EeV using air-shower imaging techniques. LIV has not been constrained in this energy range before, and through a joint analysis, we forecast improved constraints on LIV.

3:55 – 4:10 PM — Coffee Break

Session III (4:05 PM – 5:15 PM)

Viacheslav Sadykov, Georgia State University
Machine Learning for Space Weather: Overview of Research Efforts at Georgia State University
Over the past decade, the Heliophysics community has increasingly explored machine learning (ML) techniques, as reflected in the exponential growth of peer-reviewed publications, conference presentations, and funding opportunities. Among the key areas of ML application, space weather forecasting stands out as a field with tremendous potential for data-driven decision-making. This contribution highlights some of the ongoing ML research efforts at Georgia State University, including: (1) ML-driven forecasting of solar transient events (STEs) such as solar flares, coronal mass ejections, and solar energetic particles; (2) intertwining the ML with physics-based simulations for further enhancement of predictions of STEs; (3) the development of ML-ready datasets and data exploration tools for improved forecasting of STEs, radiation exposures at aviation altitudes, and other applications.

Andrew Tran, University of Georgia
Stellar Flare Study of NYMG Stars with TESS Data
We analyze TESS data to explore stellar flares and rotational characteristics in members of Nearby Young Moving Groups (NYMGs). Our study focuses on 596 members of NYMGs aged 10-150 Myr. Using detrended

light curves from the TESS Science Office Quick-Look Pipeline, coupled with our own detrending scheme for fast rotators, we systematically detect and characterize 6,288 stellar flares from 27,416 flare candidates across 2,240 unique light curves from Cycles 1-4 of the TESS mission, finding that for each NYMG member analyzed, at least one stellar flare was present. Flare candidates are initially detected using the AltaiPony flare package, followed by a recovery flare amplitudes, durations, and local continuum background levels. We examine the relationship between flare energy, age, and mass, finding a reduced flaring rate for late-type stars with age for high energy flares, as well as 5.5 times more flares detected in the 10-minute cadence TESS data compared to 30-minute cadence data. Additionally, flare events with extreme energies ($E \geq$ 10^34 erg) on M-dwarf and solar-type stars, providing implications for further exploration into exoplanet habitability.

Vishal Tiwari, Georgia Institute of Technology
Radiation Magnetohydrodynamic Simulations of Accretion Flows Around Merging Massive Black Hole Binaries
The recent detection of a low-frequency gravitational wave background by Pulsar Timing Arrays has confirmed a population of inspiraling massive black hole binaries (MBHBs). The multi-messenger detection of these sources with their electromagnetic (EM) counterparts promises to test general relativity and put better constraints on the expansion rate of the universe. However, realizing this potential is hindered by the poor sky localization of gravitational wave detectors, creating an urgent need for theoretical models that can predict the EM signatures of MBHBs to guide observational searches. Modeling the accretion flows that power these EM signatures is computationally challenging, requiring a detailed understanding of the interplay between gas, magnetic fields, and radiation. In this talk, I will present the first global, three-dimensional radiation magnetohydrodynamic (RMHD) simulations of the circumbinary and minidisks that form around massive black hole binaries. I will demonstrate how including radiation physics is essential for accurately modeling disk structures and then use these models to calculate the observable EM signatures of such systems from first principles. I will explore the dynamics of sub-Eddington circumbinary disks in both equal-mass and 10:1 binary systems, highlighting how mass ratio governs their accretion behavior and observational properties. These RMHD models are critical for identifying EM counterparts for LISA and PTA binaries.

Colin Kane, Georgia State University
How to Find Nearly Pole-on Intermediate Mass Stars
Inclination is one of the most difficult stellar parameters to determine in stars, but it can have a profound impact on observables of a star and its planetary system. For intermediate-mass stars that are rapidly rotating and have low inclinations (<20 degrees), such as Vega, gravity darkening causes peculiar line profiles for weak metallic lines. These line profiles can be used as a tool to measure the inclination of these stars. The spectral synthesis code fastrot-spec was developed to model the stellar parameters for the prototypical nearly pole-on rapidly rotating star Vega, using its peculiar line profiles, and is now being implemented to determine stellar parameters of similar stars. As a case study, we present (1) results for the nearly pole-on rapidly rotating A1V star, beta PsA, and (2) our goals to expand this work to a survey of “slowly” rotating A stars.

5:20 – 5:30 PM — Closing Remarks, Group Photo

Posters

Investigating the Elusive Nature of Dark Matter Using Gamma-Ray Detectors
Jibek Ibraeva, Agnes Scott College
This project explores the possibility that Axion-Like Particles (ALPs) interact with high-energy gamma rays and could explain the persistent gamma-ray excess observed in the Galactic Center. We analyzed open-source data from NASA’s Fermi-LAT and the HAWC observatory using Python-based tools to create flux maps and examine spatial distributions in order to identify potential ALP signatures.

The Half-Century Optical Search for the Wow! Signal Trigger

Mai Ngoc Le, Agnes Scott College

The 1977 Wow! Signal has remained one of the most intriguing unexplained phenomena in Search for Extraterrestrial Life (SETI) research. Méndez et al. (2024) recently proposed a new astrophysical explanation: the signal was caused by a magnetar flare that triggered sudden hydrogen brightening in interstellar clouds. We hypothesize that if a magnetar flare caused the Wow! Signal, we should find optical evidence of this high-energy event in archival sky surveys.

Our research seeks to answer key questions: (1) Did any stars suddenly brighten near the Wow! Signal location on August 15, 1977? (2) Can we detect magnetar-like optical flares in the Big Ear telescope field? (3) Do our findings support this new astrophysical explanation?

We conducted a systematic search of 45+ years of optical archives for transient sources that match the timing and location of the original radio detection, testing the magnetar trigger hypothesis through optical observations.

The ALPO and Its Importance to the Professional Astronomy Community

Ken Poshedly, Assn of Lunar & Planetary Observers

The ALPO was founded in 1947 as a means for serious observers of solar system objects to record and exchange their own observational data because, at that time, the professional astronomy community pretty much shunned amateur contributions. Now, all these years later, we (the amateur astronomy community worldwide) are actively sought out by professional astronomers for our images and other data.

A Closer Look at the Variability of Classical Be Stars with NASA's TESS and the Emory Observatory

Vi Eicher, Emory University

We investigated a subset of candidates from NASA's Disk Detective project in search of new and previously confirmed variable classical Be (CBe) stars. A CBe star is a main sequence star that rotates so rapidly that mass is "flung out" into a decretion disk in which the viscosity of the matter continuously forms the disk. We analyzed several CBe candidates from Disk Detective with data from NASA's Transiting Exoplanet Survey Satellite (TESS), uncovering new variability among the CBe star candidates and allowing us to categorize the trends of variability seen among the subjects. Based on the TESS analysis, we found candidates whose variability may be confirmed with the Emory observatory during spring 2025. Since TESS' cameras have a large pixel coverage, our follow-up with Emory's 24-inch telescope is a critical step in confirming variability. We present a case study of several nights of data on an object of interest: HD 256943. The findings of this study will contribute to the understanding of variability mechanisms in CBe stars.

Planetary Peek-a-Boo: Exoplanet Transit Tracking at Emory

Dixie Baronofsky, Cheryl Kaye Marshall, Emory University

During the 2024-25 school year, the Emory Observatory has collected data on 8 different exoplanet systems. While some of these exoplanets are confirmed planets (CP), this year we lead a new observatory effort to also observe both planet candidates (PC) and ambiguous planet candidates (APC). Through this data, we have been able to detect exoplanets, many of which have been identified by the Transiting Exoplanet Survey Satellite (TESS) using transit photometry. When a planet transits in front of its host star, a decrease in the star's flux can be detected. It is important to follow up on candidates using a ground-based telescope for multiple reasons, and the Emory Observatory seeks to contribute to this continued confirmation of candidates. For CPs NGTS 10b, HAT-P-30b, WASP 52b, and TOI 1728b, we fitted models to our data sets to obtain measurements of planet properties and transit timing variations. For PC TOI 1855b, signs of a planet were seen and for APC TOI 5253.01, signs point to it being an eclipsing binary; however, for APC TOI 5425, no transit has been detected. We will be analyzing the light curves and modeling these transits that we have detected via photometry.

Illustris Histories of Major Merger Galaxy Pairs

Donovan Domingue, Georgia College & State University

Galaxies interacting with each other as pairs have been shown to display both increases and decreases in star formation rates with dependence on both morphology and the stage of interaction leading towards merger. Multiwavelength observational methods can be used to examine pair selections which are limited to galaxies of similar size, so-called "major merger candidates". The results of these observations and the proposed links to star formation are generally limited by comparisons to morphological one-on-one interaction simulations in order to determine their merger stage. In this study we utilize a selection of “major merger candidates” selected from the catalogs of the Illustris TNG simulation. We analyze the proximity of each pair member over the course of the TNG universe timesteps to get the statistical measure of simulated interaction stage at the present day. Such a history of galaxy orbital dynamics can be used as a baseline comparison for observational studies.

From dark matter halo to stellar halo, with more accurate particle tagging

Shahram Talei, Georgia College and State University

Particle tagging is a method to create stellar populations using dark matter only (DMO) simulations. DMO simulations do not include the baryonic effects; Excluding the baryons, the tagged particles do not represent a realistic kinematics. Coupling Semi-Analytic and N-body Galaxies (CoSANG) is a novel approach that includes these baryonic effects in a DMO model in every time step and produces the stellar halo population using an updated particle tagging scheme with a post-processing package, Van Gogh. We present the three stellar haloes produced with this technique and compare these predictions with observations of the Andromeda galaxy. We also show that the metallicity gradients produced with this model are consistent with the observations from the GHOSTS survey.

Using X-ray Reflection Spectra as Diagnostics of Supermassive Black Hole Binary Parameters

Julie Malewicz, Georgia Institute of Technology

Supermassive black hole binaries (SMBHB) are the next frontier in multimessenger astrophysics. We show here that prominent discrete features of the X-ray reflection spectra of SMBHBs encode information about their source, and that simple, model-independent measurements of those features may be used to place constraints on source parameters like inclination, mass ratio and orbital phase, and even possibly spin. These results highlight the potential for X-ray spectroscopy to complement GW measurements by Pulsar Timing Arrays (PTAs) and the Laser Interferometer Laser Antenna (LISA).

AGB Post-Mass-Transfer Spectroscopic Ratios as WD tracers

John "Jack" P. McGuire, Georgia State University

Barium, CH, and CEMP-s stars obtain their chemical signatures from past-mass-transfer from an asymptotic giant branch (AGB) star, a process that leaves a white dwarf (WD) companion. However, these WDs are directly confirmed and cataloged in less than 50% of systems. To address this, our project will find and characterize these hidden WDs. We are analyzing archived data from spectroscopic surveys (GALAH, LAMOST) and Gaia astrometry to identify candidate main-sequence systems. For these candidates, we will use GALEX NUV excess to confirm the WD and estimate its temperature, and use forthcoming Gaia DR4 radial velocities to determine orbital separations and masses. We are also cross-matching archived data to discover new systems by selecting field stars with heightened RUWE values, a known binary indicator, and spectral types similar to known Ba, CH, and CEMP-s populations.

Multi-modal Foundation Model for Cosmological Simulation Data

Bin Xia, Georgia Institute of Technology

We present a multi-modal foundation model for astrophysical galaxy data, designed to map between simulation- and observation-based galactic features. Our encoder only transformer flexibly ingests scalar quantities (e.g., redshifts, galaxy masses) and vectors (e.g., star formation histories, spectra), supporting multi-task training that includes within-modality reconstruction and cross-modality prediction. With a dynamic masking strategy, the model can query arbitrary galaxy properties from partial inputs—including predicting spectra from redshift and mass, or estimating photometric redshifts from broadband magnitudes—while also recovering missing segments within a modality. Trained on 185,000 simulated galaxies from a gigaparsec-scale Cosmology simulation, the model yields a 50% improvement in redshift estimation when combining LSST and SPHEREx photometry over LSST photometry alone, and a 63% improvement in stellar mass inference when combining late-time SFH with LSST photometry over early-time SFH with LSST photometry. The model demonstrates strong generalization across multi-modal tasks and lays the groundwork for future integration of higher-dimensional and structured data such as images, merger trees, and 3D fields. This approach provides a unified framework for connecting simulations and observations, advancing the development of generalizable astrophysical foundation models.

Revisiting Column Density Measurements in QSO0318-0600 with a New Physical Absorption Model

Navila Azad, Georgia State University

The quasar QSO0318-0600 shows evidence that it hosts a series of 11 distinct outflows with radial velocities between ~-2000 km/s and -7400 km/s. One of the outflows exhibits absorption troughs from metastable, excited state ionic species, which suggests a distance of more than 5 kpc from the host galaxy's nucleus. This evidence is dependent upon the reliability of the measured ionic column densities. We revisit these troughs in VLT spectra with a new approach to fitting using troughs that can be constructed from overlapping outflows and show that these outflows do not require this approach, which implies that these troughs may not be directly spatially associated with one another in the host galaxy.

Prospects of Constraining Beyond Standard Model Physics with the Trinity Neutrino Observatory

Aarshia Datta, South Forsyth High School and Center for Relativistic Astrophysics, Georgia Institute of Technology

Lorentz Invariance Violation (LIV) is the hypothetical breaking of a fundamental symmetry of spacetime—the symmetry asserting that the laws of physics are identical for all observers in uniform motion. Detecting LIV would reshape our view of modern physics. The effects of LIV can be seen in extremely small scales, making neutrino oscillation patterns a sensitive probe for detecting such effects. Specifically, LIV effects increase as the energy of a neutrino increases. Therefore, oscillation patterns of Ultra-high-energy (UHE, > 1 PeV) neutrinos are an important tool for setting constraints on LIV parameters. Such objectives require a measurement of the flavor composition of the diffuse neutrino flux at Earth, but current UHE neutrino telescopes do not hold the capacity for such measurements. To effectively measure the flavor composition of neutrinos at Earth, we combine the sensitivities of an all-flavor sensitive neutrino telescope and a tau-sensitive neutrino telescope, Trinity. The Trinity telescope is a proposed instrument that can detect Earth-skimming tau neutrinos with energies ranging from 1 PeV to 10 EeV using air-shower imaging techniques. LIV has not been constrained in this energy range before, and through a joint analysis, we forecast improved constraints on LIV.

Stellar flare study of NYMG Stars with TESS Data

Andrew Tran, University of Georgia

We analyze TESS data to explore stellar flares and rotational characteristics in members of Nearby Young Moving Groups (NYMGs). Our study focuses on 596 members of NYMGs aged 10-150 Myr. Using detrended light curves from the TESS Science Office Quick-Look Pipeline, coupled with our own detrending scheme for fast rotators, we systematically detect and characterize 6,288 stellar flares from 27,416 flare candidates across 2,240 unique light curves from Cycles 1-4 of the TESS mission, finding that for each NYMG member analyzed, at least one stellar flare was present. Flare candidates are initially detected using the AltaiPony flare package, followed by a recovery flare amplitudes, durations, and local continuum background levels. We examine the relationship between flare energy, age, and mass, finding a reduced flaring rate for late-type stars with age for high energy flares, as well as 5.5 times more flares detected in the 10-minute cadence TESS data compared to 30-minute cadence data. Additionally, flare events with extreme energies ($E \geq$ 10^34 erg) on M-dwarf and solar-type stars, providing implications for further exploration into exoplanet habitability.

Preparations for Confirmation of Candidate Hot Jupiters

Joshua Martinez, University of North Georgia

Gas Giant planets, like Jupiter, are expected to form far from their host star, where there are more raw materials to be collected during planet formation. However, the discovery of so-called "hot Jupiter planets" in 1995 upended our understanding of Gas Giant planet formation processes. Hot Jupiters are gas giants that orbit their host star in about 3-10 Earth days, implying an orbital distance that contradicts existing planet formation theories. There are three leading hypotheses on hot Jupiter formation: in situ formation, disk migration, and high-eccentricity tidal migration. Each may account for some fraction of observed hot Jupiters, but a primary method for hot Jupiter formation has yet to be identified. The identification of a dominant formation method will require analysis of the statistical distribution of hot Jupiters and their stars, highlighting a need for further discovery of hot Jupiters to add to the current population. With data collected by NASA's Transiting Exoplanet Survey Satellite (TESS), and spectral observation and analysis from the North Georgia Astronomical Observatory, we seek to confirm the presence of one or more hot Jupiters among candidate systems. Adding to the known population of hot Jupiters, aiding our understanding of planet formation, and distinguishing between hot Jupiter formation scenarios.

Constructing the Orbits of Eclipsing Binary Stars with MCMC Fitting

David von Meyer, University of North Georgia

Binary star systems are key to understanding the formation, evolution, and dynamics of stars because stellar surveys show that a large fraction of stars exist in binary or multiple star systems. Binary systems are used by astronomers to constrain the masses and radii of main-sequence stars in general. Eclipsing binary (EB) systems present a unique opportunity to understand more about these stars due to their eclipsing geometry. In this study we constructed orbital models of two eclipsing binary star systems (TIC 233722938 and TIC 396655059) using archival photometric data from the Transiting Exoplanet Survey Satellite (TESS). We retrieved and processed the short-cadence TESS light curves using the lightkurve python package and phase-folded the data to each system's orbital period. We then developed a physical model for each system using the batman python package and determined the best-fit parameters using the Markov Chain Monte Carlo (MCMC) sampler python package emcee. Our analysis yielded precise measurements for all modeled parameters, and we present the full posterior distributions. This work demonstrates the effectiveness of combining TESS photometry with MCMC techniques to precisely characterize EBs.

Heavy Element Abundances in Southern Planetary Nebulae Observed with Magellan/FIRE

Josh Whitman, University of West Georgia

We present abundances of neutron(n)-capture elements (atomic number Z >30) in four southern planetary nebulae (PNe) observed with the FIRE near-infrared spectrometer on the 6.5-m Baade Telescope. PNe can be enhanced in these elements if their progenitor stars experienced slow n-capture nucleosynthesis (the s-process) during the asymptotic giant branch (AGB) evolutionary stage. The spectra cover wavelengths 0.83–2.5 μm, home to several transitions of trans-iron elements as well as forbidden lines of S, Cl, and P. We detect at least four n-capture element lines (from Se, Br, Kr, Rb, Cd, Te, and Xe) in each PN, from which we derive ionic abundances. To compute elemental abundances, ionization correction factors (ICFs) are needed to estimate the fractional populations of the observed ions. These ICFs (e.g., Sterling et al. 2015, ApJS, 218, 25) rely on the abundances of light elements, which we determine both from the FIRE data for S and Cl and published optical line intensities. The metallicities of our targets, as represented by [Cl/H] and [Ar/H], range from 20% solar (–0.7 dex) to solar. We find large s-process enrichments in the C-rich PNe Hen 2-26, J900, and M 1-12, by factors of 3–6 for Se to as high as 40 times solar for Kr, Te, and Xe. IC 4191 is not enhanced in n-capture elements, despite the large number of detected transitions: 4 in the FIRE data, and 12 in the optical spectrum of Sharpee et al. (2007, ApJ, 659, 1265). The heavy element abundances of IC 4191 and J900 are accurate to within 0.15 dex (40%), but the lower quality published optical data for Hen 2-26 and M 1-12 limit the accuracy of the n-capture element abundances to approximately a factor of two. The detection of 2–3 ions of individual trans-iron elements in IC 4191 and J900, particularly of Rb and Xe, are also valuable for constraining ionization balance solutions and hence ICF formulae. This enables more accurate abundances to be determined even when only one ion is observed. This work is supported by NSF awards AST 2307116 and 2307117.

TIC 403027066: Super Jupiter or Eclipsing Binary?

T. Heath Dobson, University of North Georgia

TIC 403027066 was a potential exoplanet host, with a candidate super Jupiter initially flagged by a citizen science campaign, who found evidence for a transit in three sectors of TESS data, with a period, P = 2.3385 days. While attention on this system was originally oriented as a potential exoplanetary candidate, the stellar properties were not well constrained in Gaia observations, with a super Jupiter (~0.2 RSOL) scenario only being possible if the star is very young (<15 Myr). However, this is inconsistent with the estimated age and mass of the primary star, which is likely a G-type main sequence star, with an age in 2 – 5 Gyr range, which suggests that the exoplanet candidate is more likely to be a main sequence M-dwarf companion. After investigating the sectors of TESS data more thoroughly, evidence was found for a secondary eclipse ½ a period away from the primary. Observations using UNG's CDK-600 telescope—capturing photometric data in the Bessel V and I-bands—hope to measure if there are wavelength-dependent eclipse depths which suggest a stellar companion. Models predicted the secondary depth very well, and we can therefore estimate the V and I depths to show variability consistent with an object with a stellar-like Teff. In the near future, we also hope to gather high-resolution spectra using 2-m class telescopes. Optical spectra to treat it as a single-lined binary and possible NIR spectra to get faint lines from the companion. Afterwards, we hope to model the system using PHOEBE in order to confirm the nature of TIC 403027066's companion.

A Space Symphony: On the Variability and Modes of a Survey of White Dwarf Subjects

Piper Spraker, University of North Georgia

White dwarfs are the remnant cores of dying sun-like stars. They start hot and cool over time. During the course of this cooling, it is observed that white dwarfs between 11,000K and 13,000K exhibit pulsational variability, which is called the ZZ Ceti instability strip. The mechanism driving the pulsational variability is broadly understood to be related to the ionization of the plasma, but the detailed picture of when this mechanism starts and stops is not well defined observationally. Therefore, we propose to observe subjects from a sample of over 14,000 white dwarf subjects at the hot and cool edges of the ZZ Ceti instability strip to better define its boundaries. In the observation of two targets, Gaia DR2 4539136259802013952 (Gaia-952) and Gaia DR2 2062283217823775488 (Gaia-488), we took measurements to help determine the boundaries of the ZZ Ceti instability strip, identify modes of stars that haven't undergone astereoseismological analysis, and determine in the case of Gaia-488 if the star is variable. Utilizing ETAMU's 27 and 24 inch Planewave telescopes and the ORM telescope in the Canary Islands, we took measurements over the course of two and a half months of observation during the summer of 2025, with a total of nineteen nights of observations . Of those nineteen nights, fourteen were spent on Gaia-952 and five were spent on Gaia-488. We plan to continue our observation of both targets at the UNG observatory and potentially observe other subjects on the edge of the ZZ Ceti instability strip. Through our analysis of data obtained during observations of Gaia-952, we have found several reliable independent modes with several consistently identifiable harmonics. Gaia-952 also displayed abnormal behavior for a variable white dwarf and thus must be observed further to ascertain the nature of the shifting peaks and low frequency variability. From Gaia-488, we found that the target displayed some form of potential rotational variability with multiple significant modes of variability appearing.

The Role of Flare Ribbon and 3D Magnetic Field Topology in Flare Eruptivity

Tamima Saba, Georgia State University

Solar flares can be eruptive or confined depending on whether they are accompanied by a coronal mass ejection. Flare ribbons are a phenomenon occurring at the footpoints of magnetic field loops in the chromosphere. Based on the Standard Flare Model, it has long been argued that a two-ribbon flare is likely to result in an eruption. In this work, we study the relation between eruptivity and two-ribbon topology in different soft X-ray (SXR) flare classes, using a catalog of 722 solar flares from Solar Cycle 24 from Kazachenko et al. (2023). Using observations in the 1600 Å channel from the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO), we generate desaturated GIF movies of flare ribbon dynamics for the events and quantify their two-ribbon nature based on experts' input. For C and M-class flares, observations indicate that the presence of a two-ribbon topology is positively correlated with the occurrence of eruptive behavior. The eruptivity probability does not seem to depend on the ribbon topology for the X-class flares. For a flare of a particular class, very confidently identified as two-ribbon, the eruptivity chances are ~45% (C-class) and ~70% (M-class and X-class). Given that flare ribbons trace the chromospheric footprints of coronal magnetic structures, we are extending this analysis by reconstructing the 3D coronal magnetic field using Non-Linear Force-Free Field (NLFFF) extrapolations. From these extrapolations, we compute quasi-separatrix layer (QSL) maps, which are regions of strong magnetic connectivity gradients and are expected to coincide with the flare ribbons.

Reconstructing Images of Protoplanetary Discs Using Principal Component Analysis

Juvis B Mbeng, University of Georgia

Reconstructing high-fidelity images of protoplanetary discs remains challenging due to atmospheric variability, calibration errors, and incomplete u–v coverage in interferometric data. In this work, we explore Principal Component Analysis (PCA) as a statistical tool to reconstruct and analyze synthetic ALMA images of the 3 protoplanetary discs. By decomposing a time-series of simulated observations into orthogonal eigenimages, we isolate the dominant spatial and temporal patterns linked to disc morphology and potential planet–disc interactions. The resulting PCA reconstructions enhance image clarity and reduce noise while preserving physical structure. We further examine correlations between the PCA amplitudes and the planet's orbital position, revealing promising connections between dynamical evolution and observable features

The Dynamics of the 2025 McDonough (Georgia) Meteorite Impact

R. Scott Harris, Department of Geology, University of Georgia
Sydney Bryan, Georgia Institute of Technology

On June 26, 2025, at approximately 12:24 p.m. EDT, a small asteroid about 1 meter wide streaked from northeast to southwest across the daytime sky over Georgia. Dozens of dashcams, cell phones, and even all-sky fireball cameras captured the bolide as it descended steeply and fragmented at least twice above Rockdale, Newton, and Henry Counties, SSE of Atlanta, Georgia. The resulting meteorites fell in an ellipse about 4 kilometers long and 2 kilometers wide just west of Interstate 75 in McDonough, Georgia.

More than 5 kilograms of material have been collected from the strewn field, the largest piece reported to be about 400 grams. Most of these meteorites likely fell in free fall from the last fragmentation and hit the ground at speeds less than 200 m/s.

But a relatively small piece, about three centimeters across, collided with a single-story home. Investigation of the house indicated that the meteorite ripped through a shingled particle-board roof, both sides of an HVAC duct, insulation, and a drywall ceiling before colliding with a laminate floor. Approximately 50 grams of an L5/6 ordinary chondrite (determined by electron microprobe analyses) were recovered from the resulting small "crater" and ejecta field that was spread through the living area. We estimate that between 15 to 20 grams on the leading edge of the impactor was pulverized to fine dust, much of which was dynamically emplaced into the fibers of nearby furniture. Approximately 23 grams of material were donated to the University of Georgia for classification and archiving.

The flight trajectory through the house appears to have been on the flight line of the original bolide and maintained a significant portion of its horizontal momentum. We preliminarily estimate that the stone was traveling between 700 and 800 km/s inside the house. We are planning hypervelocity experiments to empirically test these estimates. If this speed is correct, a portion of the bolide must have penetrated rather deeply into the atmosphere at cosmic velocities. The details of this small "impact" may be important for understanding aspects of the Carancas (Peru) impact event on September 15, 2007, when another meter-scale ordinary chondrite (H5/6) created a 15-meter-wide shock-excavated crater in the Andean Altiplano (Tancredi et al., 2009, *Meteoritics & Planetary Science*).