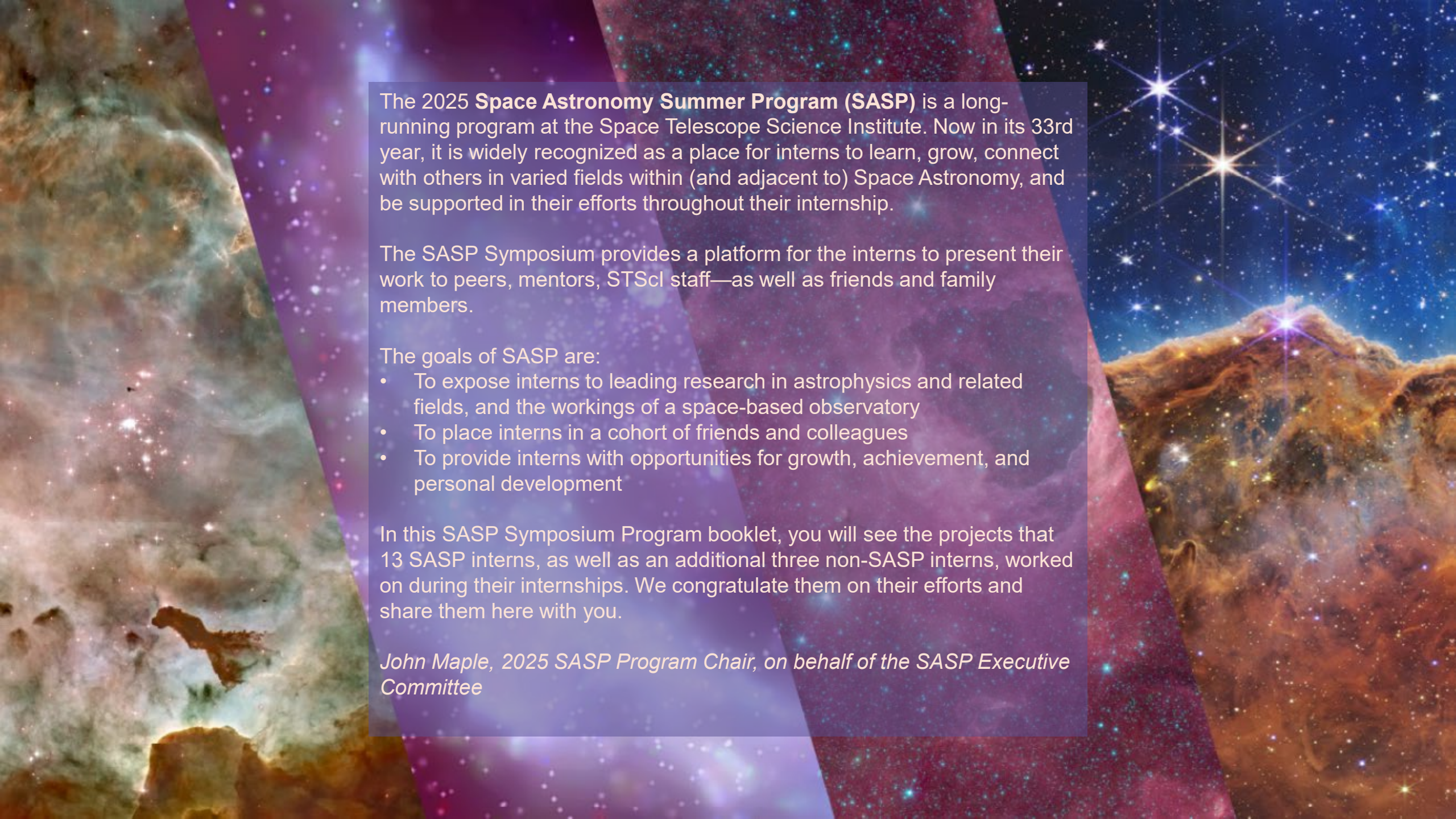

2025 SPACE ASTRONOMY SUMMER PROGRAM
SYMPOSIUM
THURSDAY, JULY 31, 2025
STScI | SPACE TELESCOPE SCIENCE INSTITUTE



The 2025 **Space Astronomy Summer Program (SASP)** is a long-running program at the Space Telescope Science Institute. Now in its 33rd year, it is widely recognized as a place for interns to learn, grow, connect with others in varied fields within (and adjacent to) Space Astronomy, and be supported in their efforts throughout their internship.

The SASP Symposium provides a platform for the interns to present their work to peers, mentors, STScI staff—as well as friends and family members.

The goals of SASP are:

- To expose interns to leading research in astrophysics and related fields, and the workings of a space-based observatory
- To place interns in a cohort of friends and colleagues
- To provide interns with opportunities for growth, achievement, and personal development

In this SASP Symposium Program booklet, you will see the projects that 13 SASP interns, as well as an additional three non-SASP interns, worked on during their internships. We congratulate them on their efforts and share them here with you.

John Maple, 2025 SASP Program Chair, on behalf of the SASP Executive Committee

2025 Space Astronomy Summer Program

9:30 - 9:40 **John Maple, Introduction**

9:40 - 9:50 **Caitlin Begbie [Mentors: Rachael Beaton, Sten Hasselquist]**
Developing Architecture for Measuring Chemical Abundances from UV Stellar Spectroscopy

9:50 - 10:00 **Sophie von Coelln [Mentors: Munazza Alam, Leonardo Dos Santos]**
Exploring Wavelength-Dependent Systematic Slopes in Exoplanet Transit Light Curves

10:00 - 10:10 **Mariane Diby [Mentor: Megan Sosey]**
Sustainable Software Infrastructure for STScI Open-Source Repositories

10:10 - 10:20 **William Grant [Mentors: Leonardo Dos Santos, Joshua Lothringer]**
UV Time-Series Observations with the Habitable World Observatory

10:20 - 10:30 **Natalie Haugen [Mentor: Julie Imig]**
Jupyter Notebook Tutorials for the SDSS Legacy Archive at MAST

10:30 - 10:50 **Break**

10:50 - 11:00 **Daniel Jimenez [Mentors: Ryan Logue, Melissa Hoffman, Kristen Wymer, Jesse Averbukh]**
Roman Suggested Science Schedule

11:00 - 11:10 **Birendra Karki [Mentor: Néstor Espinoza]**
JWST Atmospheric Characterization Avenues for the Habitable-Zone Rocky Exoplanet TRAPPIST-1 e

11:10 - 11:20 **Bhoomika Khatri [Mentor: Munazza Alam]**
Revisiting the Mass Step of Type Ia Supernova Host Galaxies with Near-Infrared and Infrared Data

11:20 - 11:30 **Klara Matuszewska [Mentors: Laurent Pueyo, Emily Rickman, William Balmer]**
petitRADTRANS Retrievals of HIP 99770 b Using Subaru CHARIS and JWST NIRSpec Spectra

11:30 - 11:40 **Enora Mech [Mentor: Eddie Schlafly]**
The Deepest WISE Images

11:40 – 1:00 **Lunch**

1:00 - 1:10 **James Minter [Mentors: Sam Bianco, Brian Cherinka]**
Astrocut Jupyter Widget

1:10 - 1:20 **Melnick Nebart [Mentor: Rebecca Levy]**
Identifying and Cross-Matching Star Clusters in the Archetypal Starburst Galaxy M82 with JWST MIRI Imaging

1:20 - 1:30 **Shoshana Shapiro [Mentor: Marcio Meléndez]**
What Is That Galaxy? Finding Active Galaxies in a JWST Calibration Field

1:30 - 1:40 **Jason Virts [Mentor: Ricky O'Steen]**
Enhancements to the Jdaviz Markers Plugin

1:40 - 1:50 **Mila Vukonich [Mentors: Munazza Alam]**
Searching for He on LP714-47 b

1:50 – 2:00 **Taylor Webb [Mentor: Jinmi Yoon]**
Refactoring the CASPER Pipeline for Improved Scientific Software Engineering and Usability

2:00 – 2:10 **John Maple, Closing Remarks**

SASP

Developing Architecture for Measuring Chemical Abundances from UV Stellar Spectroscopy

Caitlin Begbie, *University of California, Berkley*
Mentors: Rachael Beaton, *Assistant Astronomer, Deputy Branch Manager*
Sten Hasselquist, *Senior Staff Scientist*
Chris Hayes, *Software Engineer*

The ultraviolet (UV) spectrum (1,500– 3,500 Å) provides the best access to absorption lines from heavy metals in the atmospheres of stars. Despite a wealth of literature spectroscopy, there exists no broad framework for the measurement of chemical abundances from high-resolution UV spectroscopy. Our goal is to generalize stellar parameter and chemical abundance techniques from the optical and infrared into the UV with the ultimate aim of understanding the nucleosynthetic sites of the heavy metals. This process involved the identification of all available data on a set of about 40 Sun-like stars, and the subsequent download of high-resolution STIS spectra and parameters for each star from the Mikulski Archive for Space Telescopes (MAST) and SIMBAD. We developed a consistent cross-correlation and continuum normalization technique using Gaussian Process prediction models, allowing the establishment of common wavelength and flux grids to compare our stars. We then explored how regions of spectra change with respect to stellar parameters, such as effective temperature, surface gravity, and metallicity. Further steps toward our goal include identifying spectral lines for heavy metals that are measurable in this sample group of stars.

SASP

Exploring Wavelength-Dependent Systematic Slopes in Exoplanet Transit Light Curves

Sophie von Coelln, *Case Western Reserve University*
Mentors: Munazza Alam, *Assistant Astronomer*
Leonardo Dos Santos, *Assistant Astronomer*

Observations of transiting exoplanets have the power to unlock key information about the compositions of their atmospheres as well as how these planets formed and evolved. But measuring the minuscule atmospheric of these signals (as small as a fraction of a percent!) requires carefully analyzing the data. In this project, we explored the effect of systematic slopes seen in exoplanet transit light curves taken with JWST's NIRSpec instrument. With a sample of high-resolution (G395H) transit observations that are dispersed across NIRSpec's NRS1 and NRS2 detectors, we used open-source Python packages like ExoTiC-LD and batman to fit the transit light curves and measure the visit-long slopes. We explored the wavelength dependence of these slopes to determine how they varied across targets due to target properties (e.g., brightness) and/or observatory/detector read properties (e.g., date, groups, integrations).

SASP

Sustainable Software Infrastructure for STScI Open-Source Repositories

Mariane Diby, *Adelphi University*
Mentor: Megan Sosey, *Chief Engineer, Instruments Division*

STScI maintains a large number of open-source repositories on GitHub under the “spacetelescope” organization. While some of these repositories already use GitHub workflows for continuous integration and testing, many either lack robust workflows or have none at all. What’s currently missing is a centralized repository that contains generic, reusable workflow templates that follow best practices and incorporate security considerations.

The goal of this project was to build that central repository of reusable testing for use with public repositories in the “spacetelescope” organization. To achieve this, we explored and applied a variety of software tools and frameworks, including GitHub Actions, Python testing and packaging, shell scripting, and modern testing and documentation practices. With enough time, this work may also be extended to include documentation and default package templates that help developers implement these standards more easily, promoting healthy, sustainable community practices. Creation of this shared resource will contribute directly to improving the quality, safety, and consistency of open-source development at STScI.

SASP

UV Time-Series Observations with the Habitable World Observatory

William Grant, *Amherst College*
Mentors: Leonardo Dos Santos, *Assistant Astronomer*
Joshua Lothringer, *Assistant Astronomer*

In preparation for the launch of the Habitable Worlds Observatory (HWO) in the early 2040s, the astronomical community is already developing the science cases that will drive the design of NASA's next flagship mission. Time-series observations with HWO's UV spectrograph are of particular interest, since this will be the only UV instrument widely available to the whole community beyond the 2030s. In this project, we aimed to use the readily available Exposure Time Calculator (ETC) of the HWO's UV spectrograph to simulate time-series observations of exoplanet transits and analyze the precision with which narrow-band fluxes can be measured. Additionally, we studied what the required spectral resolution is to resolve features of particular interest to exoplanet science. Our results will help develop the ETC and inform the design of the UV spectrograph to be installed on HWO.

SASP

Jupyter Notebook Tutorials for the SDSS Legacy Archive at MAST

Natalie Haugen, *University of Maryland*
Mentor: Julie Imig, *Data Scientist*

The SDSS Legacy Archive at MAST (SLAM), first published in October 2024, is the collection of data from the Sloan Digital Sky Survey (SDSS) hosted at MAST(http://archive.stsci.edu/sdss). As new datasets are added into the archive, it becomes important to teach users (both scientists and students alike) how to access and analyze the data for their projects.

Two notebooks developed this summer highlight some of the scientific applications of SLAM data: One explores how to calculate the Hubble constant using spectroscopic data from the eBOSS survey, while the other uses photometric data from the newly released SDSS Legacy Imaging Survey to estimate the age of a star cluster.

The MAST notebook library is public on GitHub and used by a large audience, from professional researchers to undergraduate astronomy students, making this a high-impact, high-visibility project.

SASP

Roman Suggested Science Schedule

Daniel Jimenez, *Arizona State University*
Mentors: Ryan Logue, *Staff Scientist*
Melissa Hoffman, *Staff Scientist*
Kristen Wymer, *Branch Deputy*

Unlike HST and JWST scheduling, where schedulers must weigh multiple constraints and considerations when scheduling visits, Roman will be more prescriptive in its visit scheduling. Most of the decision-making about a given Roman schedule of visits will be made upstream of the Science Planning and Scheduling Branch, and it will be on the schedulers to implement it. Among schedulers' considerations for the visit order are where to place planned engineering activities, such as station-keeping maneuvers and momentum unloads, and slew timings between groups of visits. With such relatively simple constraints to take into account, we propose that a script, written in Python, can be developed that could take a candidate list of visits, the DSN schedule, the proposed engineering activities, and other constraints into account and create a suggested ordering of visits for the scheduler to use. The output from the tool would be used operationally by schedulers every week as a framework upon which to build a schedule.

SASP

JWST Atmospheric Characterization Avenues for the Habitable-Zone Rocky Exoplanet TRAPPIST-1 e

Birendra Karki, *Maryville University*
Mentor: Néstor Espinoza, *Mission Scientist*

TRAPPIST-1 e is one of the few habitable zone rocky exoplanets that is amenable for detailed atmospheric characterization with JWST. With four observations already obtained from a JWST GTO program and 15 new transits being obtained between Cycles 3 and 4, the observatory will be able to put the strongest constraints yet on a rocky exoplanet in the habitable-zone of its host star. In this project, we performed atmospheric retrieval experiments to study what kind of constraints these programs would be able to put on its atmospheric properties, as well as the impact of different modelling assumptions.

Revisiting the Mass Step of Type Ia Supernova Host Galaxies with Near-Infrared and Infrared Data

Bhoomika Khatri, *Case Western Reserve University*
Mentor: Estefania Padilla Gonzalez, *Postdoctoral Fellow, Johns Hopkins University*
Lou Strolger, *Observatory Scientist*

Type Ia supernovae (SNe Ia) are used as standardized candles as their intrinsic brightness can be calibrated. Previous studies have shown that SNe Ia exhibit an important relationship with their host galaxies' properties, specifically their mass and age. Historically, mass-luminosity relationships between SNe Ia and galaxies have been measured with optical data, pointing to brighter SNe Ia being produced in more massive galaxies. Whether this is a physical relation or arises from limitations on mass constraints solely on optical data is not well understood. In our work, we will make use of the near-infrared (NIR) and infrared (IR) data from Hubble and JWST from the Pantheon+ sample to better constrain the mass estimates and revisit this "mass step" relation. We estimated the magnitudes of the SNe Ia host galaxies with source extractor and cross referenced with Sloan Digital Sky Survey (SDSS) to obtain the host galaxy photometry across the optical and NIR. Finally, we calculated the mass from its spectral energy distribution (SED) fits and compared the masses from solely the optical data to the combination of optical, NIR, and IR data.

petitRADTRANS Retrievals of HIP 99770 b Using Subaru CHARIS and JWST NIRSpec Spectra

Klara Matuszewska, *Amherst College*
Mentors: Laurent Pueyo, *Staff Scientist*
Emily Rickman, *ESA Astronomer*
William Balmer, *PhD student, Johns Hopkins University*

Robust atmospheric parameters for directly imaged brown dwarfs and super Jovian companions are critical calibration points for evolutionary models and help inform formation theories for these enigmatic objects. As part of the JWST Program (GO 6362), we present a two-part petitRADTRANS v3 retrieval analysis of the benchmark object HIP 99770 b, using its low-resolution discovery spectrum from Subaru/CHARIS together with the new JWST/NIRSpec IFU data. Our study had two goals: (i) deliver the most precise atmospheric constraints to date for HIP 99770 b, and (ii) assess the impact of continuum subtraction, a necessary step for JWST observations of this faint companion due to bright host star glare that blends with the intrinsic continuum.

We first fit the CHARIS data alone to obtain a set of parameters. Using the posterior as a forward model, we simulated a noise matched JWST spectrum and performed two independent retrievals, on the absolute flux spectrum and on a version that has been continuum subtracted by spline fitting polynomial, to investigate how retrieved parameters will be impacted by continuum subtraction. I will apply our retrieval technique to NIRSpec observations of HIP 99770 b that will be taken in August.

SASP

The Deepest WISE Images

Enora Mech, *University of Maryland*
Mentor: Eddie Schlafly, *Associate Astronomer*

The WISE satellite completed its survey of the sky in the mid-infrared in the summer of 2024, after scanning the sky for more than 10 years. Its observations will be the deepest mid-infrared map of the sky for the next five years. The depth of WISE images, however, is currently limited by an analysis issue where image backgrounds were misestimated due to the inclusion of faint stars and galaxies. New catalogs are available that identify these faint stars and galaxies. This project used these new catalogs to improve the background estimation in WISE to fix the WISE image backgrounds, allowing us to produce the deepest images of the mid-infrared sky.

SASP

Astrocut Jupyter Widget

James Minter, Towson University
Mentors: Sam Bianco, Software Engineer
Brian Cherinka, Staff Scientist

The astrocut Python package is a powerful tool for generating cutouts from astronomical data products. This project focused on developing a Jupyter widget for astrocut that allows users to visualize and interact with their data and cutouts as they create them. The widget provides live previews of 2D cutouts, offering dynamic visual feedback as users adjust parameters like region of interest, cutout size, and shape. Through interactive widgets and visualization tools, users will be able to intuitively explore datasets and refine their cutout selections on the fly. The widget will be built using Python libraries such as anywidget, ipywidgets, and matplotlib for interactivity and plotting, combined with astrocut's existing cutout and image normalization functionality. The result will be a streamlined, interactive interface that empowers astronomers, data scientists, and students to efficiently generate and inspect cutouts, making astrocut more accessible and exploratory than ever.

SASP

Identifying and Cross-Matching Star Clusters in the Archetypal Starburst Galaxy M82 with JWST MIRI Imaging

Melnick Nebart, *Columbia University*
Mentor: Rebecca Levy, *Fellow, STScI*

The formation and evolution of stars governs a galaxy's life cycle. In regions of brief elevated star-formation rates (i.e., starbursts), the majority of stars form in massive, dense clusters. Recently, JWST has transformed our ability to count and measure these massive star clusters in nearby starburst galaxies. In this project, we used new imaging data from the Mid-Infrared Instrument (MIRI) onboard JWST to identify very young star clusters in the center of the canonical starburst galaxy M82. We then cross-matched these clusters with those already identified in the optical, near-infrared, and submillimeter. This complete census of star clusters will enable investigations of the entire cycle of star cluster formation and evolution.

SASP

What Is That Galaxy? Finding Active Galaxies in a JWST Calibration Field

Shoshana Shapiro, *SUNY New Paltz*
Mentor: Marcio Meléndez, *Principal Astronomical Optics Scientist*

JWST observed a calibration field selected for its bright target star, essential for assessing the telescope's optical performance. As a by-product of this calibration, the final mosaics revealed a rich field of galaxies, most of which are previously unrecorded in existing catalogs.

Using four NIRCam wide-band filters (F115W, F200W, F356W, and F444W), we performed aperture photometry on 1,781 detected sources and created color-color diagrams to provide an initial classification of these galaxies. To ensure each source was truly a galaxy, we performed PSF subtraction and manually verified all detections.

Cross-referencing with NED revealed that only 10 galaxies had been previously identified by DESI and 57 matched WISE infrared sources.

We compiled our results into a catalog containing flux measurements and galaxy types. Where possible, visual and color-based analysis allowed further morphological classification (e.g., spiral, elliptical, mergers). Others were categorized more generally as galaxies or active galaxies. In addition, we developed a variety of Python-based data visualization and analysis tools applicable to other JWST fields and adaptable for use with upcoming large-scale surveys such as Rubin and Roman.

Our overall goal is to maximize the scientific return from this underutilized JWST calibration field, with an emphasis on uncovering active galaxies for future study.

SASP

Developing Architecture for Measuring Chemical Abundances from UV Stellar Spectroscopy

Jason Virts, *Loyola University Maryland*
Mentor: Ricky O'Steen, *Senior Software Engineer, Data Analysis Tools Branch*
Jesse Averbukh, *Software Engineer*

Jason worked with Ricky and the rest of Team Indigo to implement improvements to the Markers plugin in Jdaviz, STScI's Jupyter-based data analysis and visualization package (https://jdaviz.readthedocs.io/en/stable/). The new features include measuring and displaying distances between existing markers or arbitrary points on both images and spectra, clearing markers and distance measurements, and outputting measured distances to a table in the UI.

Searching for He on LP714-47 b

Mila Vukonich, *Johns Hopkins University*
Mentors: Munazza Alam, *Assistant Astronomer*

While a large number of exoplanets have been discovered orbiting very close to their host stars, there is a deficit of known Neptune-sized planets with close orbits. One possible explanation for this could be that gas giants with hydrogen and helium rich atmospheres lose their atmospheres due to high irradiation from the host star, eventually becoming smaller, rocky planets, with the range of intermediate radii populated only by planets currently transitioning between these two stages. To test this theory, we can sample a variety of planets to see if their atmospheric compositions match our expectations. LP714-47 b is a planet with a comparatively small radius that receives relatively low irradiation from its host star. In this project, we analyzed transit spectra to see if it is losing helium from its atmosphere, a method of testing for photoevaporation.

SASP

Refactoring the CASPER Pipeline for Improved Scientific Software Engineering and Usability

Taylor Webb, *Towson University*
Mentor: Jinmi Yoon, *Senior Astronomical Data Scientist, MAST*

CASPER (Chemical Abundance and Stellar Parameter Estimation Routine) is a Python-based pipeline designed to analyze low-resolution (R~2,000) spectra of cool (<5,000K), metal-poor stars, particularly for use in Galactic Archaeology. It utilizes Maximum Likelihood Estimation and Monte Carlo Markov Chain methods to estimate stellar parameters.

The goal of this project is to enhance the CASPER codebase by incorporating best practices from software development. The intern will assist in refactoring the code to improve its maintainability, efficiency, and user-friendliness. Key tasks will include:

- Modularizing the code to make it more maintainable and scalable.
- Implementing automated unit tests using pytest to ensure the code is robust.
- Making the pipeline easy to install via pip for better accessibility.
- Setting up auto-documentation with Sphinx to generate clear and professional documentation.
- Optimizing code performance and ensuring compatibility with widely used tools and libraries.

Throughout this project, the intern will gain hands-on experience in key software engineering practices such as code organization, testing, and package distribution. If time allows, the intern will also have the opportunity to learn about stellar parameter fitting techniques and apply their theoretical knowledge to real-world scientific data.

This project will provide valuable experience in both software development and scientific computing, helping the intern develop skills that are essential for careers requiring expertise in both coding and scientific problem-solving.


For further information:
http://www.stsci.edu/opportunities/
space-astronomy-summer-program
STScI | SPACE TELESCOPE SCIENCE INSTITUTE
ROSETTE NEBULA