Welcome
This workshop will bring together experienced JWST users who have improved, extended, or superseded the STScI calibration pipeline.

The first two days will be a plenary session, where participants will concisely summarize specific issues with recent versions of STScI software/products and solutions they developed. Invited and contributed talks will cover issues and solutions that impact a broad segment of the astronomical community. Recorded talks, presentations, and supplementary material will be posted online as a reference for the community.

The second two days will be an optional hands-on session where participants will quantitatively compare output from their software with output from other participants and the STScI calibration pipeline. Relevant datasets will be made available before the event. We expect this exercise to motivate pipeline enhancements that will yield better products and/or better performance. We will make publicly available results from this session, with the goal to publish them in a peer reviewed publication.

The overarching objective of this workshop is to inform near term efforts to improve JWST data products and software for the benefit of the entire astronomical community. Separate events will provide data analysis training for the community at large.
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Connection Information

**Virtual Sessions**
The workshop sessions can be streamed on YouTube.

The link to view the workshop virtually:

**YouTube:** [https://www.youtube.com/@stsciresearch6722/streams](https://www.youtube.com/@stsciresearch6722/streams)

**Slack**
There is also a Slack workspace for registered workshop participants where you can discuss beyond the Q&A of each session, discuss Posters, to connect with other participants, and reach out for assistance and logistics. There will be insufficient time between plenary talks for questions and discussion. A substantial fraction of participants will be virtual. Thus, we will ask participants to pose questions and make comments in the appropriate Slack channel during and after each talk. Presenters will answer questions in Slack after their talk. STScI technical experts will actively participate in these Slack discussions. Since this is a technical workshop, we expect questions and discussions to be more extensive and more technical than is usual for a science conference. Slack discussions will be archived after the workshop.

Slack will also be used to plan the hands-on activities that will occur on days 3 and 4. There will be one channel per analysis topic (e.g., 1/f noise) and general channels. During the hand-on activities, interactions will generally be in person, but Slack will be available to coordinate with any virtual participants, when practical. Results of the hands-on activities will be captured in TBD reports.

If you are a registered workshop participant and require access to the Slack workspace, please contact the workshop organizers via email.
Shuttle Schedule

For your convenience, STScI will provide morning and evening courtesy shuttle service to and from the Inn at The Colonnade Hotel to STScI for participants. The shuttle will pick up in front of the hotel. All shuttle drivers will be identified by their name badges. You may refer to the shuttle schedule inserted below for details:

Shuttle Schedule between the Inn at The Colonnade Hotel and STScI.
Tuesday, November 14th, 2023 – Friday, November 17th, 2023

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<tr>
<th>DATES</th>
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<td>9:00 AM</td>
<td>Welcome Message</td>
<td>Nancy Levenson</td>
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<td>Agenda &amp; Logistics</td>
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<td>Scalability &amp; Automation: Challenges &amp; solutions using the JWST pipeline to mass process public data</td>
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<td>CEERS challenges and approaches for NIRCam, NIRSpec and MIRI data reduction</td>
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<td>PHANGS-JWST: Lessons learned from nearby galaxies in the first year of JWST operations</td>
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<td>Pipeline Enhancements for NIRCam Imaging</td>
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<td>12:15 PM</td>
<td>The JWST HST Alignment Tool (JHAT)</td>
<td>Armin Rest</td>
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<td>JWST Tweakreg Frame Misalignment</td>
<td>Savannah Gramze</td>
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<td>12:40 PM</td>
<td>Improving NirCAM and MIRI astrometric registration and background matching</td>
<td>Varun Bajaj</td>
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<td>Extending the JWST Pipeline for Variability Studies in Resolved Stellar Populations Imaging</td>
<td>Meredith Durbin</td>
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<td>12:50 PM</td>
<td>Lunch</td>
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<td>1:50 PM</td>
<td>Exploring Uncharted Territory with JWST Wide Field Slitless Spectroscopy</td>
<td>Gabriel Brammer</td>
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<tr>
<td>2:20 PM</td>
<td>Flickerings in MIRI-MRS observations</td>
<td>Gabriel Luan Oliveira</td>
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<td>2:25 PM</td>
<td>Overcoming Telegraph Pixels</td>
<td>Timothy Brandt</td>
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<td>MIRI and NIRSpec IFU observations of the HH46IRS protostar</td>
<td>Maria Navarro</td>
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<td>2:35 PM</td>
<td>A Kernel Phase Pipeline for High-Contrast Imaging below the Diffraction Limit with JWST</td>
<td>Thomas Vandal</td>
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<td>2:55 PM</td>
<td>Corrections and utilities for imaging and IFU data by the PDRs4All team</td>
<td>Dries Van De Putte</td>
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<td>3:00 PM</td>
<td>High-SNR Spectral Extraction Using Empirical PSF Fitting</td>
<td>Ian Wong</td>
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<td>3:20 PM</td>
<td>NSClean: An Algorithm for Removing Correlated Noise from JWST NIRSpec Images</td>
<td>Bernie Rauscher</td>
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<td>3:40 PM</td>
<td>PM Break</td>
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<td>4:00 PM</td>
<td>Obtaining Reliable Radial Velocities and Chemical Abundances from JWST NIRSpec Spectra</td>
<td>David Nidever</td>
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<td>4:20 PM</td>
<td>Supernova Observations with NIRSpec and MIRI: The Power of Low Resolution Spectroscopy</td>
<td>Lindsey Kwok</td>
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<td>Jdaviz: JWST Data Analysis and Visualization tool</td>
<td>Ori Fox</td>
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<td>Photutils PSF Photometry</td>
<td>Larry Bradley</td>
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<td>4:50 PM</td>
<td>A Public Python Package for Simple JWST Photometry</td>
<td>Justin Pierel</td>
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<td>4:55 PM</td>
<td>The ERS Resolved Stellar Population: benchmarking JWST data products with nearby stellar systems</td>
<td>Alessandro Savino</td>
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<td>5:00 PM</td>
<td>Day 1 Wrap Up</td>
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<td>The GA-NIFS initiative for a shared approach to refine JWST NIRSpec IFU data processing</td>
<td>Michele Perna</td>
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<td>9:40 AM</td>
<td>Advancements in JWST Data Reduction for MIRI/MRS Point Sources with Complex Backgrounds</td>
<td>Melissa Shahbandeh</td>
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<td>10:00 AM</td>
<td>Haute-Couture: an optimized tool for stitching MIRI-MRS cubes.</td>
<td>Amelie Canin</td>
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<td>10:20 AM</td>
<td>Achieving direct spectroscopy of faint substellar companions next to bright stars with the NIRSpec IFS</td>
<td>Jean-Baptiste Ruffio</td>
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<td>11:00 AM</td>
<td>Desaturation and 'flat field' correction for MIRI/MRS and NIRSpec/IFU observations</td>
<td>Oliver King</td>
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<td>11:20 AM</td>
<td>Wideband fusion from MIRI for High-Resolution images</td>
<td>Francois Orieux</td>
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<td>11:25 AM</td>
<td>A custom, interoperable linearity correction for MIRI</td>
<td>David Grant</td>
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<td>11:45 AM</td>
<td>Forward modelling NIRSpec: issues and (some) solutions for the MOS mode</td>
<td>Anna De Graaf</td>
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<td>12:05 PM</td>
<td>PEARLS: Improved flux calibration for NIRCam</td>
<td>Zhiyuan Ma</td>
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<td>12:10 PM</td>
<td>Calibrating the clock of JWST</td>
<td>Aarran Shaw</td>
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<td>12:15 PM</td>
<td>Exploiting JWST TSO data's full potential with FGS guidestar data</td>
<td>Nestor Espinoza</td>
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<td>Lunch</td>
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<td>1:30 PM</td>
<td>The Galactic Center: Analysis of NIRSpec IFU data in crowded fields</td>
<td>Anna Pusack</td>
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<td>1:50 PM</td>
<td>Creating MSA spectral cubes from MSA &quot;slitlet-stepping&quot; mode data.</td>
<td>Jane Morrison</td>
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<td>2:10 PM</td>
<td>The power of MSA Slit-Stepping: time efficient high-resolution pseudo-IFU observations at z=0.5-1.5</td>
<td>Ivana Barisic</td>
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<td>SpaceKLIP: A data reduction pipeline for JWST high-contrast imaging</td>
<td>Eli Bogat</td>
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<td>Eureka! An End-to-End Pipeline for JWST Time-Series Observations</td>
<td>Taylor Bell</td>
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<td>Improving Grism Time Series Performance with 1/f Noise Mitigations and Other Systematic Corrections</td>
<td>Everett Schlawin</td>
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<td>Enabling Transit Spectroscopy of Exoplanets Using MIRI/MRS</td>
<td>Drake Deming</td>
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<td>Improving TSO sampling cadence and precision via Correlated Double Sampling (CDS)</td>
<td>Nestor Espinoza</td>
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<td>Optimal Fitting, Debiasing, and Cosmic Ray Rejection for Detectors</td>
<td>Timothy Brandt</td>
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<td>General Introduction - (Auditorium + Bluejeans)</td>
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<td><strong>Breakout Session 1. - floating Break</strong></td>
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<td>- TSO pipeline [Cafecon]</td>
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<td>- Outlier detection [Cafecon]</td>
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<td>- MOS Slit Stepping [Boardroom]</td>
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<td>- Ramp Fitting [Cafecon]</td>
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<td>- Image Alignment [Boardroom]</td>
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Invited Talks

Exploring Uncharted Territory with JWST Wide Field Slitless Spectroscopy by Gabriel Brammer

Eureka!: An End-to-End Pipeline for JWST Time-Series Observations by Taylor Bell

Eureka! is a data reduction and analysis pipeline for exoplanet time-series observations (TSOs), with a particular focus on JWST data. Eureka! is capable of reducing JWST TSO data (starting from raw, uncalibrated FITS files) and turning it into precise exoplanet transit, eclipse, and/or phase-resolved emission spectra. The pipeline has a modular structure with six stages, and each stage uses a “Eureka! Control File” to allow for easy control of the pipeline’s behavior and easy reproducibility. At each stage, the pipeline creates intermediate figures and outputs that allow users to compare Eureka!’s performance using different parameter settings or to compare Eureka! with an independent pipeline. While Eureka! has been optimized for exoplanet observations (especially in stages 5 & 6 of the code), much of the core functionality could also be repurposed for JWST TSOs in other research domains thanks to Eureka!’s modularity. In my talk, I will give an overview of the Eureka! pipeline and give some specific examples of key Eureka! methods or features developed for TSO analyses which differ from methods typically used for non-TSO observations.

The GA-NIFS initiative for a shared approach to refine JWST NIRSpec IFU data processing by Michele Perna

The JWST/NIRSpec GTO programme ‘Galaxy Assembly with NIRSpec IFS’ (GA-NIFS), with a substantial allocation of 273 hours of JWST prime observation time, is targeting an extensive sample of distant sources. GA-NIFS includes clumpy star-forming galaxies, dual AGN, high over-density systems, and luminous QSOs at z = 3-9, observed with plenty of data acquisition configurations. I will demonstrate the GA-NIFS’ contribution to the enhancement of data processing methods, resulting in improved data quality from the NIRSpec IFU. In particular, I’ll present our modifications to the official STScI calibration pipeline. They include, among others, an edge-detection algorithm to identify outliers (D’Eugenio et al. 2023), and a novel method to eliminate spectral artefacts at the spaxel level (wiggles) in the data cubes of bright point sources (Perna et al. 2023).
CEERS challenges and approaches for NIRCam, NIRSpec and MIRI data reduction by Micaela Bagley

I will discuss some of the data reduction challenges we've encountered with the Cosmic Evolution Early Release Science Survey (CEERS) from the first year of science observations. I will primarily focus on NIRCam imaging, including our struggles and methods related to wisp subtraction, 1/f noise removal, outlier detection, and astrometric alignment. I'll also summarize our NIRSpec MSA reduction efforts -- including issues related to slit loss corrections, optimal spectral extraction, and artifact masking -- and our MIRI imaging reduction and background subtraction.

JWST Calibration Pipeline Design and Architecture by Howard Bushouse

The JWST calibration pipeline uses a flexible, modular approach to applying corrections and calibrations to data from all supported JWST observing modes. Structurally, it is divided into three main stages of processing: 1) detector-level corrections and the conversion of ramp data to count rate images; 2) mode-specific calibrations for imaging and spectroscopic data; and 3) the creation of combined products from multiple exposures. The pipeline software is implemented in Python, using C extensions in places where numerical speed is needed. In this talk I will describe the high-level design and layout of the software, including the use of Step and Pipeline classes, parameter reference files, the use of software data models for performing I/O and accessing the data and meta data, the concept of Associations and how they’re used in the pipeline processing flow, as well as the interface to the Calibration Reference Data System (CRDS) for accessing calibration reference files.

The ERS Resolved Stellar Population: benchmarking JWST data products with nearby stellar systems by Alessandro Savino

I will present recent and ongoing work of the ERS stellar population team. This program acquired NIRCam/NIRISS imaging of three nearby stellar systems, with the goal of prototyping the JWST analysis pipeline for photometry of resolved stars, validating the NIRCam/NIRISS calibration products, and disseminating tools to the community. I will describe the status of JWST data products in the context of resolved-star photometry, including flux zero-points, PSF models, data-quality arrays, and fidelity of the ETC. I will review improvements over the last 18 months of JWST activity and identify currently outstanding limitations. I will also present our public software for performing PSF-photometry on NIRCam/NIRISS imaging of resolved stellar systems.
The power of MSA Slit-Stepping: time efficient high-resolution pseudo-IFU observations at z=0.5-1.5 by Ivana Barisic

GO-2136 NIRSpec **MSA slit-stepping** survey is first to provide high resolution pseudo-IFU observations at the epoch of modern thin disks emergence (0.5 < z < 1.5). We sample the main diagnostic rest-optical emission lines of 43 main sequence galaxies, achieving a remarkable time efficiency of approximately 30 minutes per source, totaling 21 hours of integration time. In sharp contrast, an equivalent IFU survey would require 8 hours / source to reach an equivalent sensitivity. The MSA slit-stepping technique proves to be over 15 times more time efficient than conventional IFU. The pattern consists of 63 pointings (9 dispersion steps of 0.2" and 7 bar-width 0.075" cross dispersion dithers), designed to uniformly sample the area. As slit-stepping methodology is an uncharacteristic mode of observation, it currently lacks full support by the standard pipeline. This requires substantial development on our part: to handle the complexity of the program, we tailor each stage in the standard processing pipeline (stage 1 through 3) and in post-processing develop an original pseudo-IFU cube building class.

SpaceKLIP: A data reduction pipeline for JWST high-contrast imaging by Eli Bogat

High contrast imaging enables the detection of faint astrophysical signals in the vicinity of a much brighter point source, with the most common science case being the direct observation of substellar objects in circumstellar orbits. In our presentation, we will showcase the Python package spaceKLIP (https://readthedocs.org/projects/spaceklip/), an open-source, community developed end-to-end reduction and characterization pipeline for the JWST NIRCam and MIRI coronagraphy modes. It is built upon the official JWST pipeline maintained by STScI as well as the Python package pyKLIP, which has significant heritage in PSF subtraction for high-contrast imaging with ground-based instruments. In addition to wrapping and optimizing the JWST pipeline for coronagraphic imaging, spaceKLIP includes custom/enhanced routines for outlier correction, 1/f noise correction, NIRCam median subtraction, frame alignment, and central PSF subtraction. Furthermore, spaceKLIP contains features such as off-axis PSF fitting (for photometry and relative astrometry) and contrast curve calculation (for sensitivity analysis) which allow the user to generate publication-ready products from the calibrated and reduced data.
Forward modelling NIRSpec: issues and (some) solutions for the MOS mode by Anna De Graaf

Although one of the most popular modes in extragalactic astronomy, the NIRSpec MOS mode is also one of the most challenging. The complex and strongly wavelength-dependent PSF of JWST, the geometry of the MSA, and the highly undersampled detector pose challenges not faced before in ground-based spectrographs. Two key problems for scientific analyses are the slit losses due to the relatively small spatial extent of the microshutters and wavelength varying PSF, and the morphology-dependent line spread function. In this talk I will present the public msafit software[1]: this python package performs a complete forward modelling of a user-specified source through JWST and the NIRSpec instrument, onto a simulated NIRSpec detector. I will discuss how these models outperform both WebbPSF and the slit loss correction step in the STScI JWST pipeline, and demonstrate how this software may help to test reduction pipelines. Moreover, I will highlight some outstanding problems with NIRSpec and present suggestions for possible ways forward.

NSClean: An Algorithm for Removing Correlated Noise from JWST NIRSpec Images by Bernie Rauscher

NSClean is an algorithm and python package for removing faint vertical banding and `picture frame noise' from JWST Near Infrared Spectrograph (NIRSpec) images. NSClean uses known dark areas to fit a background model to each exposure in Fourier space. When the model is subtracted, it removes nearly all correlated noise. Compared to simpler strategies like subtracting the rolling median, NSClean is more thorough and uniform. NSClean is computationally undemanding, requiring only a few seconds to clean an image on a typical laptop. The NSClean package is freely available from the NASA JWST website.

A custom, interoperable linearity correction for MIRI by David Grant

The Mid-Infrared Instrument (MIRI) Si:As impurity band conduction detectors exhibit a debiasing effect as charge accumulates within a given pixel. This leads to a decrease in sensitivity during an integration, leading to non-linear up-the-ramp samples. Moreover, this effect depends on the fluence of a given pixel, as well as its adjacent pixels, and this makes a general, uniform linearity correction suboptimal. We investigate alternative linearity solutions, where the pixels are segmented into groups of similar fluence and a self-calibrated solution is then derived. We find our algorithm leads to ramps with 58 percent less dispersion from the ideal linear form, when compared to the default pipeline solution. Additionally, we find evidence for (1) a time-dependence to the debiasing effect, and (2) coupling to the odd-even detector rows, with important consequences for time-series observations (e.g., relative brightness measurements during an exoplanet occultation). Our findings are primarily based on data from the low resolution spectrometer, and the algorithms are available as custom, open-source JWST pipeline steps which interoperate with the default pipeline.
Improving Grism Time Series Performance with 1/f Noise Mitigations and Other Systematic Corrections by Everett Schlawin

The NIRCam grism time series mode is a powerful tool for exoplanet and other time domain studies and has a niche for bright sources that saturate other modes. I will discuss several techniques to address systematics in the data. First, I will discuss how to mitigate 1/f noise and pre-amplifier resets to improve the performance of the NIRCam grism time series mode, which has applications to other near-infrared instruments. The simple ROEBA (row-by-row odd/even by amplifier) algorithm extends the reference pixel correction to use sky pixels. There are also modifications to ROEBA to mitigate the effects of kTC noise, extrapolate one amplifier's behavior to another and predict 1/f noise on source pixels with a Gaussian process. I will also discuss some additional systematic correlations that can address wavefront variations and a visit-long trend on bright targets.

High-SNR Spectral Extraction Using Empirical PSF Fitting by Ian Wong

The capabilities of JWST are expanding the horizon of spectroscopic study throughout the universe, enabling detailed compositional explorations of faint objects that were entirely inaccessible just a few years prior. Solar system astronomy, particularly the study of small primitive asteroids and distant icy planetesimals in the Kuiper belt, has benefitted enormously from the huge leap in precision and wavelength coverage that JWST provides. During Cycle 1, JWST observed more than 100 solar system minor bodies with NIRSpec and MIRI, with the vast majority of observations utilizing the integral field spectroscopy modes. In support of these programs, I have developed an empirical PSF fitting methodology that produces significant improvements in precision over standard circular aperture extractions. This technique allows for the detection of minor spectral features and yields substantially more diagnostic constraints on surface chemistry and atmospheric properties than the default spectral extraction routine in the official JWST pipeline. In this talk, I will provide a technical overview of the PSF fitting process, showcase some results of this method and compare them to the standard pipeline outputs, and discuss ongoing challenges and future avenues for further refinement.

A Public Python Package for Simple JWST Photometry by Justin Pierel

Accessibility to accurate photometry tools is critical to enabling science from the general community with all JWST imaging instruments. While creating accurate PSF models for each JWST instrument has been a major and successful effort since launch, easily installable and runnable codes to measure aperture and/or PSF photometry on JWST images has not been readily available to the public. Here I present the Space Photometry Tool (space_phot), which is a pip-installable Python package that provides a simple interface to measure photometry with JWST, leveraging the JWST pipeline, WebbPSF, and Photutils to ensure calibration files are up-to-date and to enable both aperture and PSF photometry. The code is flexible, has documentation, and provides the capability to work with both level 2 and level 3 data. I will show some accuracy tests of the package, and demonstrate some of the useful aspects of the package.
Enabling Transit Spectroscopy of Exoplanets Using MIRI/MRS by Drake Deming

MIRI/MRS offers some unique capabilities for transit spectroscopy of exoplanets, but there are systematic effects in the instrument and detectors that can potentially frustrate spectroscopy using MRS time series observations. To better understand those systematic effects we executed calibration observations of a bright eclipsing binary system in Cycle-1. The brightness of this binary (R CMa, V=5.7) makes those systematic effects very noticeable relative to the photon noise. We are developing custom data analysis methods to correct for these systematic effects, including better ramp fitting, and methods to mitigate the brighter-fatter effect in the detectors. These methods have allowed us to measure the spectral properties of the secondary stellar component in R CMa, including the discovery of prominent emission in the N=7 to N=6 line of atomic hydrogen at 12.37 microns, in contrast to a lack of emission in the visible and near-IR hydrogen lines.

The JWST HST Alignment Tool (JHAT) by Armin Rest

JWST and HST image alignment has proven to be challenging at times. The JWST HST Alignment Tool (JHAT) is an open-source Python tool for providing relative and absolute astrometric alignment for JWST and HST level 2 and level 3 images. The tool has a novel source finding and matching algorithm that is excellent for alignment images to either other images or reference catalogs, even in sparse fields. The code has been tested on JWST NIRCam, FGS, and MIRI, as well as HST WFC3 (IR+UVIS) and ACS. The JHAT package is pip installable, and the development version can be found on GitHub at https://github.com/arminrest/jhat
PHANGS-JWST: Lessons learned from nearby galaxies in the first year of JWST operations by Thomas Williams

The PHANGS collaboration have been building an inventory of local (D<20Mpc) star forming galaxies, and JWST is rapidly becoming an integral part of the PHANGS project. With our Cycle 1 Treasury, we have observed 19 galaxies over the last 12 months of JWST operations, in a range of NIRCam and MIRI imaging filters. As part of our Treasury efforts, we have developed a custom pipeline (pjpipe) for rapid, automated data processing that wraps around the STScI pipeline. Whilst this pipeline is tailored towards our PHANGS-JWST observations, it is modular, flexible, and should be generally useful for the community. It includes a number of improvements and additional features over the standard pipeline, including automated MAST downloads, destriping of NIRCam tiles, better background matching in the presence of extended, diffuse sources and more granular control over both relative and absolute astrometry.

I will describe the efforts that have led to our nearly complete full first data release, showing improvements over both our early science release from late last year and the MAST products that are currently available to download. I will also show the particular challenges of removing the 1/f noise for our data, but this will affect any observations in which much of the field of view is full of extended sources. I will show the philosophy behind our pipeline and how we have made it as end-user friendly as possible. With 19 galaxies now observed in Cycle 1 and a further 55 as part of another Treasury to be observed in Cycle 2, we are aiming for as close to real-time data processing as possible to get these fantastic observations out to the community.

Deep field NIRCAM observations: wisps and other features by Benjamin Johnson

I will describe the motivation and current plans for the wisp template and flat field construction proposed in the Calibration Archival program PID 3905. I will also describe data features and calibration challenges encountered in the deep field NIRCAM data obtained as part of the JADES program, and strategies employed by the JADES team to address them. This includes persistence, astrometric registration, scattered light effects, flat fields, and 1/f noise.
Supernova Observations with NIRSpec and MIRI: The Power of Low Resolution Spectroscopy by Lindsey Kwok

Over the past year of science with JWST, novel near- and mid-infrared spectra of white-dwarf supernovae have revealed information that is helping us answer widely-debated questions about their origins. Our first observations of SN 2021aefx with MIRI/LRS in the slit mode revealed that there was an error in the JWST pipeline’s wavelength calibration of roughly half a micron at 6 microns. I will discuss our efforts to improve the wavelength calibration and assist the MIRI team in constructing a correction to the wavelength solution which is now applied to all previous and subsequent MIRI/LRS slit data. Beyond the wavelength calibration, I will highlight ways our team uses tools such as Jdaviz’s Specviz2d and Cubeviz applications to improve the spectral reduction of our NIRSpec Fixed Slit and MIRI LRS+MRS observations. Additionally, I will demonstrate data analysis techniques that we use to identify emission lines, measure line velocities and fluxes, and constrain the supernova ejecta geometry from the data. To conclude, I will suggest future functionality for the Jdaviz applications that would aid our science goals.

Scalability & Automation: Challenges & solutions using the JWST pipeline to mass process public data by Nathan Adams

I will present an update on the EPOCHS project, which aims to rapidly and uniformly reduce most public deep-field data in order to generate the largest, and most robust, possible sample of high-z galaxies. To date, this programme has reduced NIRCam imaging from the PEARLS, GLASS, SMACS-0723, CEERS, JADES & JEMS programmes, work is underway on processing Abell-2744, COSMOS-Web and PRIMER. Discussion will centre on the challenges and solutions that we have found when attempting to use the JWST pipeline to process data en masse (e.g. parallelisation of stages 1/2, issues with RAM efficiency, custom backgrounds, masking large mosaics) before progressing to some comparisons between our reductions and those of other teams. Our pipeline is designed to increase automation, enabling products to be made with minimal user input, from the raw uncalibrated image right the way through to catalogs of robust high-z candidates. In our comparisons, I will highlight any systematics that are present and the implications for high-z SED fitting. I will round off the discussion by describing our first data release and the products that will be made available. To conclude, I will show some highlight science results using the data currently processed and plans for future expansion of the project over the next couple of years.
Corrections and utilities for imaging and IFU data by the PDRs4All team by Dries Van De Putte

The "PDRs4All" ERS program observed the Orion Bar with imaging using NIRCam and MIRI, and IFU mosaics using NIRSpec and MIRI MRS. The PDRs4All data reduction team developed several corrections for these data, of which some were applied between two pipeline stages (e.g. 1/f correction, NIRCam wisp removal), and others were implemented as post-pipeline additions (e.g. additional fringe and artifact removal in the MRS spectra). During the time following the acquisition of the data, significant updates to the JWST pipeline were frequently provided by STScI. Therefore, the pipeline was rerun frequently by our team, to investigate how the final data products were improving at every relevant update. To make this reprocessing straightforward and consistent, our team developed a command line script which calls the JWST pipeline with our preferred settings. This tool also generates the right association files on-the-fly, depending on the files and options that were passed on the command line. This allows us to easily make adjustments such as including or excluding the dedicated background observations.

The above are in a git repository that is currently private to the team. During the practical sessions, we aim to clean up the code and the repository, and make the scripts public. The PDRs4All pipeline script and correction tools can serve as a starting point for reducing imaging and IFU mosaic data of extended sources.

PEARLS: Improved flux calibration for NIRCam by Zhiyuan Ma

The Prime Extragalactic Areas for Reionization and Lensing Science (PEARLS), a JWST GTO program, finished a set of unique NIRCam observations that revealed an unexpected problem in the existing NIRCam calibration. The observations were three epochs of 4-band (F150W, F200W, F356W, and F444W) NIRCam imaging in the Spitzer IRAC Dark Field (IDF). The three epochs were six months apart and spanned the full duration of Cycle 1. As the IDF is in the JWST CVZ, we were able to design the observations such that the two modules of NIRCam, modules A and B, were flipped by 180 degrees and completely overlapped each other's footprints in between epochs. We find significant residuals on the difference images in between epochs in all the four bands, with the largest amounting to ~4% in some detectors/bands. This indicates that there are significant calibration offsets between the two modules. Moreover, there are multiplicative gradients present in the data obtained in the two long wave (LW) bands. The problem is less severe in the data reduced using the latest pmap, however, it still persists and is non-negligible. A recipe to correct for this systematic effect and bring the modules onto a consistent common calibration is provided.
Creating MSA spectral cubes from MSA "slitlet-stepping" mode data by Jane Morrison

We demonstrate how the NIRSpec micro-shutter array (MSA) can be used in "slitlet-stepping" mode to create IFU-like maps of galaxies.

Combining the multiplex abilities and high sensitivity of the MSA, slitlet-stepping across the galaxies can efficiently obtain spatially resolved spectroscopy. MSA "slitlet-stepping" is not a JWST supported mode. Regardless, in Cycle 1, this mode has been used, albeit in different manners, by GO2123 and GO2136. Here we present the MSA cube building software developed for GO2123, also known as GARDEN: Galaxies at All Redshifts Deciphered and Explained with the NIRSpec MSA. GARDEN has observed 56 galaxies at redshifts between 1 and 5 with specialized MSA stepping configurations depending on their morphologies and instrumental artifacts. We present a specialized set of software routines to create IFU-like data cubes for these galaxies.

Improving TSO sampling cadence and precision via Correlated Double Sampling (CDS) by Nestor Espinosa

Ramp-fitting algorithms were primarily introduced in near-infrared detectors as a way to beat various forms of read-noise, as well as to properly handle cosmic rays in exposures requiring long integrations. They do have, however, one big disadvantage: they erase information that could be of astrophysical interest occurring over the time scale of a ramp. In this work, I will introduce how analyzing data via correlated double sampling (CDS), i.e., using only group differences, offers several advantages over classic "ramp-fitting" analyses in particular for TSOs. I will share work on both simulated and real data showcasing the regions of the parameter space on which CDS is optimal as well as how it allows to handle in a much more intuitive way several detector-level systematics. I will share strategies on how to handle challenges seen on real data such as curved ramps, and provide example science cases on which this technique --- which replaces the ramp-fitting step --- might be critical to understand and study TSO datasets.

https://github.com/nespinoza/transitspectroscopy

Exploiting JWST TSO data's full potential with FGS guidestar data by Nestor Espinosa

All scientific datasets obtained by JWST come with auxiliary data products produced by the Fine Guidance Sensor (FGS), which helps keep the telescope's exquisite pointing stability. In this work, I will show how this data is an excellent tracker of time-dependant systematic trends observed in Time Series Observations (TSOs), and how it can be used to significantly improve JWST TSO data products in order to extract precise and accurate astrophysical signals --- in particular from transiting exoplanets. I will share pip-installable software our team has developed to download and analyze this guide star data, and will discuss potential usages on science modes outside TSOs.
Desaturation and 'flat field' correction for MIRI/MRS and NIRSpec/IFU observations by Oliver King

We present custom JWST data reduction pipelines, developed for JWST NIRSpec/IFU and MIRI/MRS observations of Solar System objects. The pipelines simplify the process of reducing the JWST observations and include custom steps to significantly improve the data quality. Our custom processing routines include a ‘desaturation’ routine to reduce the effect of saturation while still maintaining high SNR for observations of high dynamic range targets (e.g., planetary atmospheres). This desaturation routine uses data reduced with using different numbers of groups to replace saturated parts of cubes with unsaturated versions of the data. We have also developed custom flat field correction code to remove the significant artefacts (appearing as regular banding patterns, stripes, and swirls) found in MIRI/MRS observations of bright extended targets. Our flat field correction code uses dithered sets of observations to automatically identify detector artefacts, and construct ‘synthetic flat fields’ which can be used to remove the artefacts. These custom JWST pipelines can be downloaded from https://github.com/JWSTGiantPlanets/pipelines.

The figure shows example cube slices showing JWST/MIRI observations of Saturn (Fletcher+2023) at different stages of our custom data reduction process. The first column shows the output of the standard JWST pipeline, which contains saturation (missing data around Saturn’s North pole in panel i), partial saturation (dark pixels on Saturn in i), significant flat fields effects (a and g), and limb darkening caused by the instrument PSF (m). The second column shows the data after the application of the desaturation step, the third column shows the data after flat field correction, and the fourth column shows the ‘final’ version of the data after PSF correction. The application of the custom data reduction steps significantly improves the data quality, such as revealing banded structure of Saturn's atmosphere (panels d and h) that is impossible to see in the standard pipeline output.

The Galactic Center: Analysis of NIRSpec IFU data in crowded fields by Anna Pusack

The capabilities of JWST have already proven themselves to be instrumental to the advancement of our understanding of the universe. However, most of the Space Telescope pipeline’s capabilities were optimized for sparse fields and its abilities in crowded environments presents unique challenges. Cycle 1 NIRSpec IFU observations of the Galactic Center processed by the standard pipeline before 2023 May showed several issues with pixel masking, jump detection, and saturation that compromised more than 5% of the detector pixels. We will present work on the Galactic Center that has proven to be difficult, likely because of the crowded field we observe. We find that we need to tune by adjusting Stage 1 parameters in the saturation and jump detection steps (specifically three parameters with respect to cosmic ray detections), to be able to get viable data to do our science. In addition, the critical nature and proper application of leakcal exposures is yet unclear. The results are still not optimal as we see issues such as the sinusoidal spectrum patterns, among others. The data thus far show comparable results with the ETC predictions for RVs and SNR. We believe building in functionality for crowded fields will further enhance the impact of JWST NIRSpec data.
Calibrating the clock of JWST by Aarran Shaw

JWST, despite not being designed for observing high time-resolution phenomena, can be an unparalleled tool for such studies, opening wide the sub-second infrared timescale regime, if timing systematics can be controlled. Rapid time-domain studies, such as lag measurements in accreting sources and Solar System occultations, require both precise inter-frame timing and knowing when a time series begins to an absolute accuracy to small fractions of a second. We present here results from our JWST clock calibration program. We observed ZTF J153932.16+502738.8 - a double white dwarf system that eclipses on a period of 6.91 minutes - over two ~9hr epochs with JWST's NIRCam. The well-known ephemeris of ZTF J1539 allows us to compare the expected time of the eclipses with the observed eclipse times as measured by JWST, providing us with strong constraints on the accuracy of JWST’s clock. We will also discuss discrepancies between flux uncertainties calculated by our software and those calculated by the JWST pipeline.

A Kernel Phase Pipeline for High-Contrast Imaging below the Diffraction Limit with JWST by Thomas Vandal

Kernel Phase Imaging (KPI) leverages data processing techniques from interferometry to enable high-contrast imaging below the diffraction limit with high-Strehl, full pupil images. With its 6.5-m diameter, and operating from space, the James Webb Space Telescope (JWST) is arguably the best observatory to push the limits of KPI. We therefore developed a custom KPI stage 3 pipeline, which follows the structure of the main JWST pipeline and could eventually be integrated into it. Our KPI pipeline includes extra pre-processing steps such as 1/f noise correction, enhanced outlier detection and bad pixel reconstruction. Further steps then enable the extraction of interferometric observables: Fourier phase, visibility amplitude and kernel phase. The results are saved in the recently defined KPFITS format, providing observers with data products ready for astrophysical modelling. I will present this JWST KPI pipeline using, as an example, a NIRCam survey of 20 Y dwarfs which revealed the first Y+Y binary, WISE J033605.05-014350.4. We also note that there is a strong synergy between KPI and the NIRISS Aperture Masking Interferometry (AMI) mode. While KPI is better suited for fainter targets than AMI, data processing is very similar for these two techniques. Pipeline improvements for KPI will therefore benefit AMI observations and vice-versa.
MIRI MRS observations of the radio galaxy IC5063 by Kalliopi Dasyra

A mosaic of MIRI MRS data targeting the nucleus of the nearby galaxy IC5063, has been acquired for the program 2004, with the purpose of studying the impact of radio jets on the interstellar gas they encounter. **Modifications with respect to the pipeline were needed with respect to the background subtraction, the removal of problematic pixels, and the flux calibration.** A 2d master background per detector had to be created and removed from the stage 1 pipeline products, and background-removed data were provided to the rest of the pipeline. This led to a much better cleaning of the data from problematic pixels. Problematic pixels were defined as outliers in the master background. In the stage 1 data of each exposure, their values were interpolated by that of neighbouring pixels following a convolution. Some flux calibration issues, remained after the time-dependent correction fix that was recently incorporated in the pipeline and after this sky-subtraction method. The corrections needed will be shown, which are very important, as the line ratios indicating the H2 excitation temperature using the H2 S(1) line flux, and on the density calculated from the [NeV] 24/14 μm flux ratio. Interesting preliminary results on the many winds driven by the radio jet of the nearby galaxy IC5063 will also be shown.

Haute-Couture: an optimized tool for stitching MIRI-MRS cubes by Amelie Canin

The MIRI-MRS spectrograph on the JWST produces twelve cubes (three for each one of the 4 channels of the MRS) in the 5-28 wavelength range. Those twelve cubes have different fields of view and resolutions (spatial and spectral). As part of the PDRs4All ERS program (#1288), we have investigated the **best ways to stitch these cubes in order to obtain a final data-cube combining all MIRI-MRS channels.** We thus developed the Haute Couture Python package which contains two separate algorithms:

1) A basic stitching algorithm, which relies on spatial and spectral interpolation, multiplicative or additive calibration based on a reference channel. This stitching method also includes error propagation.

2) A sharpening-stitching algorithm, which uses non-negative matrix factorization on incomplete matrices to reconstruct a cube at the resolution of channel 1 (i.e. the best resolution) over the complete wavelength range. These algorithms are coded in Python and use data-products delivered from the JWST pipeline as inputs, hence they can, in principle, be integrated to the pipeline or be used independently by the community readily. These algorithms have been tested on synthetic and real data from the PDRs4All ERS program.
Infrastructure for extending and improving the JWST calibration pipeline by James Davies

The JWST pipeline was designed to be modular and flexible. Creating new pipelines or adding new pipeline steps to existing pipelines is straightforward using the `stpipe` infrastructure. I will demonstrate how this infrastructure frees the developer from having to worry about input/output formats, command-line interfaces, and makes it easy to focus on the algorithms. Let `stpipe` handle everything else. We will look at how to create your own step, package it using entry points so `stpipe` can find it, and make it installable so it is easy for other scientists to use in their own workflows using the pipeline's built-in pre- and post-hooks. I will show a worked example (snowblind) and a template for easy step creation and packaging.

Wideband fusion from MIRI for High-Resolution images by Francois Orieux

Wideband images suffer from blurring by the PSF, blur that increases with the wavelength. We will show how the fusion of several wideband images at several wavelengths can increase the spatial resolution of all the images, outperforming classical deconvolution algorithm, with a great impact at large wavelengths where blurring is more important. Results on real data from MIRI imager on Carina and NGC628 will be shown.

Achieving direct spectroscopy of faint substellar companions next to bright stars with the NIRSpec I by Jean-Baptiste Ruffio

High-contrast science, such as studying faint substellar companions next to bright stars, is particularly challenging because it requires subtracting the stellar host point spread function very accurately to uncover the planet signal. We have developed a framework to forward model the astrophysical scene directly in the NIRSpec detector images ("cal"). This made it possible to model and fit the companion signal, subtract the stellar PSF, or extract the companion spectrum without reconstructing a spectral cube ("s3d"). This allowed us to break the current systematics floor of the NIRSpec IFU by mitigating the effects of bad pixels and the spatial undersampling. I will feature the outstanding results of this technique that is enabling the subtraction of a bright host star PSF (e.g., K=5.4) down to the photon noise limit. Using NIRSpec IFU data (R~2,700, 3-5um; 35 min) of the brown dwarf companion HD19467B, we demonstrate a sensitivity to cool planets (<1000K) that are about a million times fainter than their host star at ~1” projected separation. This approach is opening new science opportunities for JWST. NIRSpec may enable the direct detection and characterization of old, cool, and closely separated exoplanets that are less massive than Jupiter. By studying the atmospheres of non-transiting planets detected by radial velocity surveys, or astrometric accelerations from Gaia, NIRSpec may bridge the gap between direct and indirect exoplanet detection methods.
Pipeline Enhancements for NIRCam Imaging by Ryan Endsley

I am happy to describe and discuss my efforts over the past year to improve the NIRCam imaging reduction using the existing JWST Calibration Pipeline as a starting point. I have implemented several custom Python routines (with slight modifications to the source code of the pipeline itself) with the aim of yielding NIRCam mosaics from deep extragalactic surveys with robust background and 1/f noise subtraction, minimal impact from outliers, wisps, and snowballs, and minimal correlated noise from the resampling stage 3 step while at the same time yielding reliable astrometric alignment to Gaia. I gladly welcome the opportunity to discuss my pipeline and compare its products with others to help build a legacy public pipeline for the community. At the same time, I would love to learn of any improvements that could be made to my pipeline that others have addressed or are working to address.

Overcoming Telegraph Pixels by Timothy Brandt

Telegraph pixels are two-level systems; this substantially increases the read noise associated with those pixels and can render them almost unusable. I show how to account for these pixels in the case of single-read resultants using a Gaussian mixture model. This approach, demonstrated on long NIRSPEC dark frames, can recover the pixels almost as well as if the telegraph noise were removed completely. This approach can be used either with or without knowledge of the gap between the two levels; the only required information is which pixels are telegraph pixels.

Optimal Fitting, Debiasing, and Cosmic Ray Rejection for Detectors Read Out Up-the-Ramp by Timothy Brandt

I implement the optimal fit to a pixel's count rate in the case of an ideal detector read out nondestructively in the presence of both read and photon noise. The approach is general for any readout scheme and has a computational cost that is linear in the number of resultants (groups of reads). I also derive the bias of the fit from estimating the covariance matrix and show how to remove it to first order. The new ramp-fitting algorithm provides the chi squared value of the fit of a line to the accumulated counts, enabling hypothesis testing for cosmic ray hits using the entire ramp. I show that this approach can be substantially more sensitive than one that only uses the difference between sequential resultants, especially for long ramps and for jumps that occur in the middle of a group of reads. It can also be implemented for a computational cost that is linear in the number of resultants. I have implemented a pure Python implementation of these algorithms that can process a 10-resultant ramp on a 2048x2048 detector in about 2 seconds with bias removal, or in about 5 seconds including iterative cosmic ray detection and removal, on a single core of a 2020 Macbook Air. This Python implementation, together with tests and a tutorial notebook, are available at https://github.com/t-brandt/fitramp.
Obtaining Reliable Radial Velocities and Chemical Abundances from JWST NIRSpec Spectra by David Nidever

I will describe my efforts over the last year to reduce JWST+NIRSpec stellar spectra using the JWST Calibration pipeline and my own custom SPyderWebb pipeline as well as perform higher level analyses. The current standard pipeline produces 1-D extracted stellar spectra that are not suitable for science analyses. In contrast, SPyderWebb produces reliable spectra using optimal extraction routines with an empirical, non-parametric profile and outlier pixel rejection. The background subtraction is improved and slit-corrections are incorporated that reduce radial velocities from uncertainties of 30 km/s to 8 km/s, although statistical uncertainties are at the 1 km/s level. I will also describe how SPyderWebb measures stellar parameters and alpha abundances using a grid of synthetic spectra.

https://github.com/dnidever/spyderwebb

Photutils PSF Photometry by Larry Bradley

Photutils is a coordinated Astropy package that provides tools for detecting and performing photometry of astronomical sources. Source detection includes routines for detecting stars and a more general method to detect and analyze sources using image segmentation. Photutils can perform aperture photometry (in six pre-defined apertures), PSF photometry, and segmentation-based photometry. It also includes many related tools to measure backgrounds, radial profiles, centroids, image depths, and elliptical isophotes. Photutils is used in the JWST calibration pipeline to generate the source catalog, but the source catalog does not include PSF photometry. In this talk, I will give an overview of PSF photometry tools in Photutils, discuss their recent improvements, and provide examples of how they can be used with JWST imaging data.
Flickerings in MIRI-MRS observations by Gabriel Luan Oliveira

In JWST observations, previously unknown issues can occur during observations or data reduction and affect the quality of the data acquired. In particular, observations of the nuclear region of the galaxy UGC8782 (ID 1928; PI: R. A. Riffel, co-PI: Nadia L. Zakamska), using the MIRI-MRS, showed peaks of brightness that are discontinuous in wavelength, hereafter referred to as "flickerings", in the stage 3 processed data cubes. These flickerings are numerous and are localized, both spatially and in wavelength, but their specific position and wavelength appear to be random. In the single exposures from each detector (stages 1 and 2 of the pipeline), pixels with a high relative value (outliers) are observed, which can increase the count rate values of neighboring pixels and create a cross-shaped pattern. We also analyze the outlier's ramps in the uncalibrated data, noticing that a significant number of them exhibit nonlinear behavior, with maximum values up to 4 times the maximum values of the nearby ramps. We have developed a script capable of detecting most of these outliers and removing them, despite their unknown origin. The outliers are detected using a comparison criterion based on the median and the median absolute deviation values of nearby pixels. The most effective results are obtained by using the stage 3 cosmic-ray flagged files after running the pipeline once with the outlier detection on, so the outliers are already partially removed. In total, an average of 2% to 5% of the science pixels (excluding gaps between slices and edges of the detector) per science exposure are removed. The outliers are flagged in the data quality extension of the images in stage 2, and stage 3 is redone. By removing these flickerings, we facilitate the identification of galaxy structures and avoid flux overestimations.

Advancements in JWST Data Reduction for MIRI/MRS Point Sources with Complex Backgrounds by Melissa Shahbandeh

We present a novel MIRI/MRS data reduction pipeline designed to enhance the precision and reliability of spectroscopic observations of point sources. Our pipeline represents a significant advancement over the standard JWST pipeline, particularly in scenarios where point source targets are situated in regions characterized by relatively bright or variable backgrounds. In these challenging conditions, the conventional approach, which disregards background nonuniformity, is often not effective enough at subtracting the background to enable reliable spectral extraction in practice. Our innovative pipeline addresses this limitation by offering a more representative background model, effectively mitigating the influence of complex background variations. Additionally, our pipeline enables reduced cube visualization, which is not a feature included in the standard pipeline. We provide a comprehensive demonstration of constructing and subtracting this background, culminating in extracting a refined spectrum. The pipeline's improved handling of the thermal background in channel 4 further solidifies its superiority over the standard JWST pipeline. This work not only refines data reduction for point sources in intricate backgrounds but also contributes to the broader goal of enhancing JWST data products and software for the astronomical community. The complete and detailed notebook/pipeline is publicly available on GitHub, fostering transparency and accessibility for the broader scientific community.

https://github.com/shahbandeh/MIRI_MRS
Poster Talks

MIRI and NIRSpec IFU observations of the HH46IRS protostar: a test case for the pipeline applied to a high contrast line to continuum emission by Maria Navarro

PROJECT-J: PROtostellar JEt’s Cradle Tested with JWST (#1706, PI B. Nisini), is an approved Cycle 1 project aimed at investigating the nature of the HH46 IRS protostellar source and its outflows through NIRSpec and MIRI Integral Field Spectroscopy mosaics from 1.6 to 28 micron. The object is a very bright source immersed in a dense environment where structures such as a jet and a wide-angle cavity take place. Due to the nature of the source, multiple problems were present in the data reduction process, such as the presence of warm pixels that are not flagged by the DQ masks, flux calibration inconsistencies when comparing with other data sets and between the different channels, among others. Due to the high source continuum, we explored different techniques to construct emission maps of weak lines close to the source. Here, we will present the solutions applied, highlighting the problems that eventually still affect the datacubes and the implied limits on the scientific performances.

JWST Tweakreg Frame Misalignment by Savannah Gramze

In very dense star fields, the JWST pipeline produces poor astrometric solutions, often resulting in “double stars” in level 3 mosaic images. This is attributed to an issue with the Fine Guidance System, where JWST guides on different stars for the mosaic frames. I will show the approach we have taken to diagnose the issue and achieve improved astrometric solutions in some pointings toward the Galactic Center. We find that the World Coordinate System assigned to the frames are offset by many arcseconds, preventing tweakreg from properly aligning them for combination. We attempt correcting the issue by adjusting the tweakreg parameters and using community tools, but these methods are insufficient. We solve this issue by manually adjusting the GWCS of the frames before stage 3 of the pipeline. Providing the tweakreg step with an improved initial guess results in properly aligned frames and improved astrometry.

https://github.com/SpacialTree/brick-jwst-2221/blob/main/reduction/PipelineRerunNIRCAM-LONG.py

Improving NirCAM and MIRI astrometric registration and background matching by Varun Bajaj

We present a workflow for using WebbPSF models to fit PSFs to imaging data for NirCAM and MIRI, and the use of these catalogs for the TweakReg step of the Level 3 Pipeline. These catalogs can be used to first perform relative alignment to the dataset and then further to absolutely align the data to other catalogs such as Gaia or those derived from HST. We further present a general crossmatching algorithm that can be used to make master catalogs from these outputs, which can be integral to aligning longer wavelength modes. In addition, we present a method for improving the background matching for both instruments, and specifically a new approach to further refine MIRI background matching to ensure continuous backgrounds across mosaics, and eliminate spurious gradients.
Jdaviz: JWST Data Analysis and Visualization tool by Ori Fox

Jdaviz is a package of astronomical data analysis visualization tools designed specifically for JWST, but able to work on almost all astronomical data sets. The GUI interfaces are based on the Jupyter platform and utilizes Astropy-affiliated analysis packages. They are designed to work within a Jupyter notebook cell, as a standalone desktop application, or as embedded windows within a website – all with nearly identical user interfaces. Different layouts currently support various data sets:

*Imviz: 2D astronomical images (JWST Imagers)

*Specviz: 1D astronomical spectra (MIRI/LRS, NIRSpec/FS)

*Specviz2D: Perform your own extractions (MIRI/LRS, NIRSpec/FS, WFSS data)

*Cubeviz: Spectroscopic data cubes, along with 1D spectra extracted from the cube (MIRI/MRS, NIRSpec/IFU)

*Mosviz: Multi-object spectra (NIRSpec/MOS, WFSS data), and includes viewers for 1D and 2D spectra as well as contextual information like on-sky views of the spectrograph slit.

Extending the JWST Pipeline for Variability Studies in Resolved Stellar Populations Imaging by Meredith Durbin

The standard JWST imaging pipeline combines multiple calibrated exposures into a single rectified Stage 3 product for non-time series observing modes. This poses a challenge for deep extragalactic observations of short-period variable stars such as RR Lyrae, where the total exposure time per filter may approach or exceed such stars’ typical periods, and where dithering is required to improve PSF sampling in crowded fields, preventing use of the TSO mode. **We present a modification of the JWST imaging pipeline that leverages the available integration data to produce a series of Stage 3 images at a user-specified cadence**, and demonstrate its application to RR Lyrae variables in ERS observations of WLM.
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