ORAL PRESENTATIONS

High Contrast Imaging of Planetary Systems with NIRCam and MIRI

Marshall Perrin (STScI)

For studies of nearby planetary and brown dwarf companions and circumstellar disks, JWST offers a suite of coronagraphs optimized for wavelengths from 2 to 24 microns. Planning high contrast observations requires both performing the usual calculations of signal to noise and exposure times, as well as assessing observatory-level factors such as available roll angles and selection of PSF calibrator stars. I will describe two science cases from the Telescope Scientist GTO program as worked examples of developing high contrast investigations with JWST. As an example of characterizing a substellar companion, I'll present our goals and observing plan for MIRI coronagraphy of the 700 K methane-rich brown dwarf GJ 758 B. As a more complex example observing an extended source with multi-instrument coverage, we will use NIRCam and MIRI together to obtain eight band coronagraphy of the prototypical debris disk around Beta Pictoris, with filters chosen to allow characterization of disk constituents such as ices and organic tholins. This is part of a larger coordinated collaboration across the NIRCam, MIRI, and Telescope GTO teams that will obtain consistent datasets for several bright archetypal debris disks.

SN 1987A: The Formation and Evolution of Dust in a Supernova Explosion

Margaret Meixner (STScI)

From Supernova to Supernova Remnant, SN 1987A, has given us a unique opportunity to study the mechanics of a supernova explosion and now to witness the birth of a supernova remnant. With JWST, we wish to understand how massive stars age and explode, how their ejecta forms dust and molecules and how the blast wave from their violent explosion affects their surroundings. In this talk, I will describe the scientific goals of the joint 9 hour program between the MIRI European Consortium and Meixner's US MIRI Science Time allocation to capture the time evolution of SN1987A using JWST MIRI imaging, MRS spectroscopy and NIRSpec IFU spectroscopy.

Brown dwarfs in star forming clusters
(NIRCam imaging + NIRSpec MOS – same cycle)

Catarina Alves de Oliveira (ESA)

Brown dwarfs represent by number a sizeable fraction of the stellar content of the Galaxy and their masses populate the transition between the stellar and planetary mass regime. There is not an accepted explanation for how they form, making them a key element in understanding the origin of stellar masses and their distribution. The new observational frontier is therefore the discovery and spectral characterization of the least massive brown dwarfs to test formation theories. This is the main driver behind this example NIRSpec/JWST proposal. We propose to obtain NIRCam imaging data to search for new candidate brown dwarfs down to the mass of Jupiter in the IC 348 cluster, followed by low and medium resolution spectra of those with NIRSpec MOS to confirm the nature of the candidates therefore improving constraints on the minimum mass of the initial mass function, and to search for spectroscopic signatures of their formation mechanism.

NIRSpec Multi-Object Spectroscopy of Distant Galaxies

Pierre Ferruit (ESA)

The study of the formation and evolution of galaxies is at the core of the JWST NIRSpec Guaranteed Time Observer (GTO) program. More than 80% of the NIRSpec GTO time allocation is allocated to a spectroscopic survey mixing multi-object and integral-field spectroscopy (MOS and IFS) and focusing on the physics of galaxy assembly. In this talk, I will focus on the deep and medium parts of the MOS survey that are conducted in collaboration with the NIRCam GTO team. I will describe their scientific goals, main characteristics and how they were constructed, trying to highlight the key elements of the preparation of a NIRSpec MOS proposal. The Near-Infrared Spectrograph (NIRSpec) is one of the four instruments on the James Webb Space Telescope (JWST), scheduled for launch in 2018. NIRSpec has been designed and built by the European Space Agency (ESA) with Airbus Defence and Space Germany as prime contractor and contributions from NASA. The instrument covers the wavelength range from 0.6 to 5.3 micron and features a multi-object spectroscopy (MOS) mode, an integral field unit (IFU) and a suite of slits for high contrast spectroscopy of individual objects. In this talk, I will give an overview of NIRSpec capabilities and performances with a strong focus on information useful for future observers.

Planning a Deep NIRCam Survey

Marcia Rieke (University of Arizona)

The design and rationale for the NIRCam GTO Deep Survey program will be examined in this talk with an emphasis on why a particular suite of filters and exposure times were chosen. MIRI imaging will be collected in parallel to the NIRCam exposures, and the acquisition of these data imposed additional constraints on the observing plan. The actual observations that the NIRCam GTO Team intends on executing will serve as an example of how to layout mosaics with parallel observations to maximize observing efficiency for surveys with JWST.

Observing galaxies in and behind massive lensing clusters with NIRISS slitless spectroscopy and NIRCam imaging

Chris Willott (Dominion Astrophysical Observatory, Canada)

I will describe a JWST spectroscopy and imaging survey of five massive galaxy cluster and ten parallel fields using the NIRISS low-resolution grisms, NIRCam imaging and NIRSpec multi-object spectroscopy. The primary goal is to understand the evolution of low mass galaxies across cosmic time. The resolved emission line maps and line ratios for many galaxies, some at resolution of 100pc, will enable determining the spatial distribution of star formation, dust and metals. Other science goals include the detection and characterization of galaxies within the reionization epoch, using multiply-imaged lensed galaxies to constrain cluster mass distributions and dark matter substructure, and understanding star-formation suppression and morphological transformation in the most massive galaxy clusters.

Pandeia: Introduction to the Exposure Time Calculator (ETC)

Klaus Pontoppidan (STScI)

STScI just released the flight version of the Exposure Time Calculator for the James Webb Space Telescope. The ETC is based on a code called Pandeia. It includes a Python engine, which models astronomical scenes in three dimensions and simulates two-dimensional pixel-by-pixel signal and noise properties of the JWST instruments. This allows for appropriate handling of realistic point spread functions, MULTIACCUM detector readouts, correlated detector readnoise, and multiple photometric and spectral extraction strategies. Pandeia includes support for all the JWST observing modes, including imaging, slitted/slitless spectroscopy, integral field spectroscopy, and coronagraphy. Its highly modular, data-driven design makes it easily adaptable to other observatories. The ETC engine is accessed via a modern web application, which allows for detailed parameter studies, collaborative workflows and visualizations of results. It also uses a position- and time-dependent background model, developed specifically for JWST. I will describe all these aspects of the the JWST ETC, and discuss how it can best be used to plan JWST observations.

JDOX: Preparing Your Proposal with JWST User Handbook Documentation
Ori Fox (STScI)

The JWST User Documentation "JDOX" provides modern versions of instrument handbooks, data handbooks, and calls for proposals for JWST. Compared to the HST handbooks originally designed as lengthy PDFs, the new style is more like Wikipedia, including many smaller pages with links between them and each following the Every Page is Page One (EPPO) mantra — users may begin on any page (e.g., NIRCam Filters) and understand it without having read other material. Here I present an overview of JDOX and how to utilize it when preparing your JWST proposals.

JWST Help Desk
Dan Coe (STScI)

The JWST Help Desk has transitioned from e-mail to a new web-based service. As you type your question, useful links appear: answers to frequently asked questions (our Knowledge Base) and related documentation articles in JDOX. Signing in with your MyST account keeps track of all your conversations with STScI staff. We also have a public Community Forum where you can ask questions of other JWST users. These integrated Help Desk tools may all be accessed via jwsthelp.stsci.edu.

Introduction to the Astronomer's Proposal Tool and Target Visibility Tools
Bill Blair (STScI)

Proposers with HST experience are no doubt familiar with the Astronomers Proposal Tool (APT), which is really a GUI-interface into a suite of tools used to propose for and ultimately schedule observations on the telescope. Despite the numerous differences between the HST and JWST missions, it has been possible to adapt and/or re-purpose many aspects of APT to handle both HST and JWST proposals. I will outline some of the main differences that drive APT development for JWST and describe both the state of the development and plans going forward prior to the Cycle 1 Call for Proposals. APT is still being developed and improved even though the latest version just released, APT 25.0, has the vast majority of the expected functionality! APT and its associated s/w systems will be able to assess all relevant schedulability aspects of specified observations, but it is not particularly well-suited for providing overview information on target visibilities versus time and/or availability or limitations in allowed position angles of instrument fields of view on the sky. Hence, to assist users with this complementary view into potential observations, two visibility calculators have been developed, a general tool that provides information for all JWST instruments and a detailed tool for supporting coronagraphy proposals with MIRI and/or NIRCam. These tools can effectively be used as time-saving "pre-planning tools" prior to doing detailed work in APT, by identifying potential observability issues up front in the proposal planning process.

JWST Overheads

Jeff Valenti (STScI)

JWST observers will receive a time allocation that includes science photon collection, direct overheads associated with a visit, and indirect overheads that apportion generic observatory activities to all visits. APT can export a times report, which tabulates overheads for each visit, including initial slew, guide star acquisition, target acquisition, exposure overheads, dithers, mechanism moves, script compilation, direct scheduling overheads, and observatory overheads. I will describe the overhead categories reported by APT and give specific examples of each. Observing templates generally constrain how visits execute, but in some cases observers can trade robustness or science data quality for efficiency. I will give examples. Finally, I will describe ongoing work to reduce overheads.

The JWST Calibration Pipeline

Karl Gordon (STScI)

Abstract: The JWST calibration pipeline is a modular, flexible collection of processing steps and pipelines that are used to remove detector artifacts, calibrate, and reduce data from all JWST instruments and provide products that are ready for scientific analysis. Unlike the HST calibration pipelines, which were very instrument-specific and mostly monolithic in nature, the JWST calibration pipelines are organized by observing mode (imaging, spectroscopic, coronagraphic, etc.) and take advantage of commonalities across the JWST instruments. The various calibration steps and pipeline modules are contained within a common "jwst" python package and are organized into several levels of calibration activity. The lowest level does the standard work of removing most detector artifacts and consists of specific steps that are common to most instruments. The next level of processing applies final corrections and calibrations to individual exposures based on their observing mode. A third level of processing then works on associations of multiple exposures to combine the data into final, high-level products. The architecture and design of the "jwst" python package allows the code to be used and manipulated in very flexible ways, including operations executed from the command line, from within a python shell, or built up into custom series of operations in a python notebook.

JWST Data Analysis Tools and Community Software

Harry Ferguson (STScI)

Abstract: This talk will outline some of the tools that JWST users may wish to use in analyzing their data. Specifically, I will focus on tools being developed in the python program language, well-integrated with Astropy, and distributed withthe AstroConda distribution. The tools are being developed in part at STScI, with a focus on JWST science use cases, and in part by a much broader community with overlapping needs. I will provide and overview of the JWST tool development plans, examples of some JWST uses, along with examples, and an outline of overlapping community efforts.

POSTER PRESENTATIONS

Star clusters as footprints of star formation in local galaxies: first year results from the LEGUS treasury program.

Angela Adamo (Stockholm University)

I will present the first year results of the Legacy ExtraGalactic Uv Survey (LEGUS). LEGUS is a Hubble treasury program designed to provide a complete UV and optical homogeneous coverage of a sample of galaxies selected to be representative of the star forming galaxies present within the Local Volume. The census of the stellar and cluster populations is opening an unprecedented opportunity to study star formation from stellar to cluster complex scales. I will show some of the most interesting results that are shedding light into the formation process of young star clusters in local galaxies. I will include a showcase to outline the legacy value of this treasury program for the upcoming infrared-focused space facility, JWST, and the key role played to provide a coherent picture of the star formation process in the local universe.

Estimating exposure times for lensed SMGs using JWST ETC

Kedar Phadke (Astronomy Department University of Illinois at Urbana-Champaign)

Over the past decade, new millimetre-wavelength facilities like South Pole Telescope (SPT) and the Atacama Large Millimeter Array (ALMA) have opened a new window on the dusty, high redshift Universe. We have identified a set of high-redshift ($2<z<7$) strongly-lensed dusty, star-forming galaxies from the 2500 square degree SPT survey. Using the gravitational lensing to increase our spatial resolution, we have been observing these objects with high spatial and spectral resolution using ALMA with CO, H2O, and [CII]. JWST has the capability to spatially and spectrally resolve key star formation indicators, such as H-alpha, Paschen-alpha, and PAH lines, at small scales (100s of parsecs) in these galaxies and addresses a key aspect in the theme of “Assembly of galaxies”. In this poster, I will describe the methodologies used to estimate line fluxes of star formation tracers and their exposure times based on redshift and star formation rate. I will also discuss the incorporation of lens geometry inside the JWST ETC to estimate appropriate exposure times for NIRISpec and MIRI IFU spectroscopy of these galaxies.

Mapping the Large-Scale Structure of Colliding Wind Interaction Regions with Forbidden Emission Lines

Richard Ignace (Department of Physics & Astronomy, East Tennessee State University)

Colliding Wind Interaction (CWI) regions from massive star binaries have been prime targets for mutli-wavelength studies owing to the opportunity to constrain fundamental wind and stellar properties, as well as for studying radiative hydrodynamical effects. X-ray studies probe the shock physics; UV resonance and optical/IR recombination lines are used to explore the geometry of CWIs; radio continuum studies can be used to infer non-thermal processes. For single WR stars, forbidden lines, which are optically thin and form at large radii (characterized by low critical densities), have long been used to infer ionic abundances. For WR+O binaries, resolved forbidden lines can also be used to "map" the large-scale structure of the CWI. This contribution summarizes the modeling approach for using multiple forbidden lines with different critical densities to study the CWI regions from massive star binaries.

Dusty stellar populations of the Local Volume Galaxies with JWST/MIRI

Olivia Jones (STScI)

The Mid-Infrared Instrument (MIRI) for the James Webb Space Telescope (JWST) will revolutionize our understanding of infrared stellar populations in the Local Volume. Using the rich Spitzer-IRS spectroscopic data-set and spectral classifications from the Surveying the Agents of Galaxy Evolution (SAGE)-Spectroscopic survey of over a thousand objects in the Magellanic Clouds, the Grid of Red supergiant and Asymptotic giant branch star ModelS, and the grid of YSO models by Robitaille et al. 2006, we calculate the expected flux-densities and colors in the MIRI broadband filters for prominent infrared stellar populations. We use these fluxes to explore the MIRI colours and magnitudes for composite stellar population studies of Local Volume galaxies. MIRI colour classification schemes are presented; these diagrams provide a powerful means of identifying young stellar objects, evolved stars and extragalactic background galaxies in Local Volume galaxies with a high degree of confidence. We examine which filter combinations are best for selecting populations of sources based on their JWST colours.

Planning your JWST/NIRSpec Observation: NIRCam pre-imaging visualization tool for NIRSpec

L. Ubeda, T. L. Beck, and the NIRSpec Team (STScI)

Most NIRSpec multi-object spectroscopy observations will require having source catalogues with highly accurate relative astrometry (15 milli-arcsec or less) due to target acquisition restrictions. When such fine catalogues are not available, NIRCam pre-imaging of the field of interest will be required. We developed a Python visualization tool that allows users to display NIRCam and NIRSpec apertures using DS9 regions on a given image with accurate WCS information. This interactive tool helps users visualize possible configurations of the NIRCam Long and Short Wavelength Channels on top of the NIRSpec Micro Shutter Array apertures, for properly planning a NIRCam observation. Three NIRCam dither patterns as well as two-tile mosaics are available features.

The JWST NIRSpec Calibration Pipeline

C. Pavlovsky and the NIRSpec Team (STScI)

The JWST Near Infrared Spectrograph will be capable of observing the sky at 0.6 - 5.0 microns in three modes: fixed slits, the integral field unit and the micro-shutter array. The Space Telescope Science Institute (STScI) is currently building a data reduction pipeline that will provide not only basic calibrated data but also higher level science products. The pipeline is divided into three main levels. Level one will produce calibrated slope data for individual integrations (ramps). Level two will create the calibrated spectra for an integration and level three will combine data from multiple integrations. Details of the NIRSpec pipeline steps will be presented.

Optimizing Your NIRSpec MOS Observations: MPT Performance Statistics

E. Wislowski, T. L. Beck, D. Karakla (STScI)

For NIRSpec Multi-Object Spectroscopy, observation plans are generated by the MSA Planning Tool (MPT) in APT. We present how several key MPT parameters affect the number of competed sources in these plans. The parameters include catalog density, shutter centering constraint, number of MSA configurations, search grid step size, and dither size. We also explore how the search grid step size affects the trade-off between multiplexing (how efficiently the sources are packed) and runtime. These realistic examples of performance can act as a guide when choosing parameters to optimize results for your science case.

Pointing Requirements and Acquisition Procedures for JWST/NIRSpec Observations

Charles D. (Tony) Keyes, C.R. Proffitt, C. Alves de Oliveira, T.L. Beck, D. Garland, R. Koehler, and D. Karakla (STScI)

The JWST Near-Infrared Spectrograph (NIRSpec) includes a variety of science modes including a Micro-Shutter Assembly (MSA) that will be used for simultaneous observations of 100 or more stars for multi-object spectroscopy (MOS), an Integral Field Unit (IFU), and 5 fixed slits.
Pointing requirements and target acquisition procedures for NIRSpec will vary depending on both the scientific requirements and the mode used for a particular observation. We review the target acquisition algorithms available for each template, and discuss the practical details of planning observations of various kinds. Standard target acquisition using the MSA will be discussed, as will the acquisition of objects into the large S1600A1 aperture which will be used for bright object time series (BOTA) observations. We will also review the circumstances under which no acquisition is needed.

MIRI Observations of Nearby Galaxies

Macarena Garcia Marin, Torsten Böker, Gillian Wright, Almudena Alonso-Herrero, Dan Dicken, Fabian Walter, Alvaro Labiano-Ortega, Ruyman Azzollin, and the MIRI Team.

Using unprecedented sensitivity and angular resolution, the Mid-Infrared Instrument (MIRI) for the JWST will offer imaging, coronagraphy, low-resolution slit and slitless spectroscopy, as well as integral-field spectroscopy at medium spectral resolution for a wide variety of astronomical programs. For observations of nearby galaxies, in particular, MIRI will unveil faint and diffuse structures that cannot be detected with Spitzer or 10-m class ground-based telescopes. New details about galactic nuclei, AGN fuelling, stellar populations and gas dynamics and kinematics will be learned. MIRI MRS (IFU) spectroscopy will provide access to a wealth of emission lines that can be used as diagnostics for detecting AGN, star formation and extinction, abundances and excitation conditions studies. These new capabilities pose some interesting challenges from the observer's point of view: designing scientific proposals of bright nuclei surrounded by circumnuclear star forming regions, gas streams and faint gas emission is challenging, and the observations will have to be carefully planned.

MIRISim

Pamela Klaassen (UK ATC) on behalf of the MIRISim team, Part of the MIRI European Consortium.

MIRISim is a simulator package designed to simulate photon propagation through MIRI. It has been written in python and delivers detector images consistent with the expected on orbit performance. The outputs of MIRISim are consistent with the MIRI sensitivity model, and return the same uncalibrated data format that will be made available to JWST observers. All relevant metadata are included to be able to ingest the outputs of MIRISim into the JWST calibration pipeline being developed by STScI. Here we describe the information contained in the data pack, and a more general description of MIRISim itself.

MIRI, the Mid-IR instrument for the James Webb Space Telescope

Macarena Garcia Marin, Gillian Wright, George Rieke, Alistair Glasse, Mike Ressler and the MIRI Team.

Abstract: Covering a range of about 5 to 28 μm, MIRI is the sole mid-IR instrument for the JWST. Developed as a collaboration between European and USA institutions, it provides four key scientific functions: imaging, coronagraphy, low-resolution slit and slitless spectroscopy, and integral-field spectroscopy at medium spectral resolution. A dedicated (closed-cycle) cooler system keeps MIRI at its operating temperature of less than 6.7 K. Compared with 8-m ground-based telescopes, the angular resolution is similar, but imaging sensitivity could improve by a factor of about 3000, and for moderate resolution ($R = \lambda/\Delta\lambda \sim 3000$) spectroscopy by factor of about 1000. Compared with Spitzer, the potential gain in the mid-IR in the JWST background limited regime (roughly 5 - 12 μm) is about a factor of 50 in sensitivity and 7 in the diffraction limit. With its unprecedented sensitivity and angular resolution at mid-IR wavelengths, MIRI will cover a wide selection of astronomical programs, from exoplanets characterization to high redshift studies, opening the window to a wealth of new and exciting astronomical findings.

MSA Spectral Visualization Prototype

Graham Kanarek (STScI)

The “Spectrum View” tool in APT is intended to provide the user with a visualization of where the spectral traces produced by a given MSA configuration will fall on the NIRSpec detector, particularly with respect to the detector gap. However, the existing tool is insufficient to the task. This poster presents a prototype tool designed for this purpose. The tool was written in Python, and will either be integrated into APT in a future build, or released as a standalone tool to the astronomical community.

CHANDRA X-ray observatory and Hubble Space Telescope observations of the intermediate-age cluster GLIMPSE-C01

Jeremy Hare (The George Washington University), Oleg Kargaltsev, Blagoy Rangelov, Leisa Townsley, Patrick Broos

The heavily obscured cluster, Glimpse-C01, has been suggested to be one of the most massive open cluster in the Milky Way. We have observed it with HST WFC3 IR and UVIS to look for NIR counterparts to the 10 X-ray sources discovered by Chandra X-ray Observatory within the cluster's half-light radius. Here we show the results of these HST observations and analyze the X-ray source and star populations in the cluster. We have also used the multi-band HST data to constrain the cluster's age and distance. We demonstrate the impact of confusion apparent in the WFC3/IR images of the cluster's core. Future observations of Glimpse-C01 with JWST's superior angular resolution will alleviate the confusion, allowing for the detection of fainter sources.