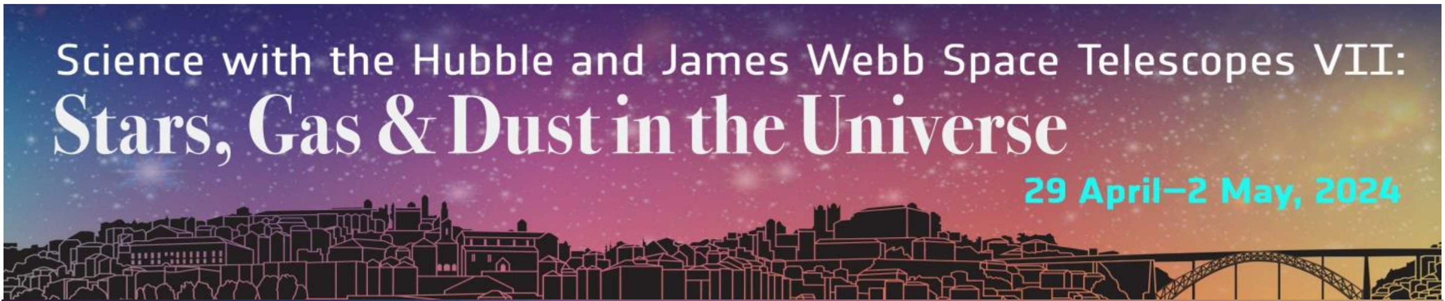

CONFERENCE BOOKLET

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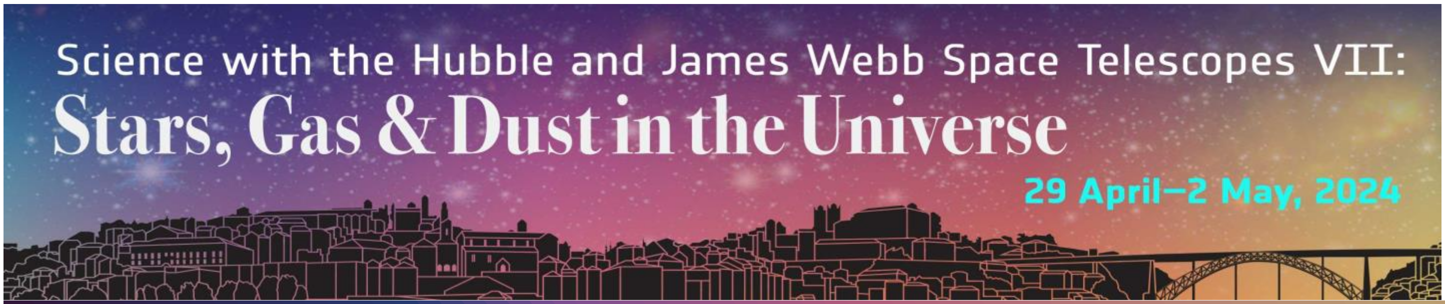


Welcome to the latest in a series of ESA-sponsored conferences, in collaboration with STScI, which highlight the scientific impact of the Hubble and James Webb Space Telescopes. After much anticipation of their complementary capabilities, we are now in the remarkable period of having these two pioneering observatories in science operations at the same time — the much-heralded Golden Age for UV-optical-IR space astronomy has arrived!

Hubble, a long-standing partnership between NASA and ESA, is continuing to surprise and inspire us with new results and breakthroughs. As we look ahead to the 35th year of science operations, its use and powerful complementarity with other facilities continues to evolve, with the community finding novel and innovative applications for its unmatched ultraviolet-visible capabilities.

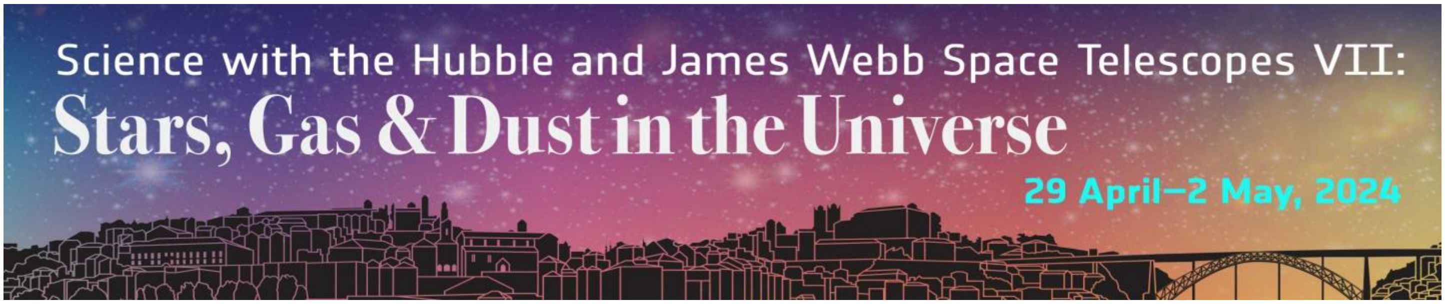
We are now also witnessing the first exciting results from JWST, a collaboration between NASA, ESA, and the CSA. With performance beyond our expectations, JWST is quickly transforming our view of the universe on all scales, from new insights in our Solar system and nearby exoplanets, to revealing the formation and growth of the very first galaxies and black holes.

These two observatories are now combining to give us unique views of stars, gas and dust in the universe. These span the processes of nearby star and planet formation, the properties of the interstellar medium in galaxies near and far, the production of dust in supernovae and evolved stars, and new insights into the dust content and star formation in the early Universe.

Of course, Hubble and Webb are far from working alone. A broad range of ground-based and space-borne facilities are helping to provide us with a multi-wavelength view to unlock our understanding of the Universe. These include the rich legacy from the Gaia mission, the start of science operations with Euclid to explore the dark Universe, the exquisite resolution and sensitivity of ALMA in the sub-mm, and the imminent first light of the Rubin Observatory. Looking ahead, the second half of the decade will bring major new space missions, such as Roman, PLATO and ARIEL, and the first light of the European Extremely Large Telescope.

The science program features a combination of invited and contributed talks, with the objectives to:

- Highlight the latest Hubble and Webb results in studies of stars, gas and dust over all scales, with a focus on results with strong synergies between the two missions and with other facilities.
- Identify key topics for new programs and initiatives that will harness the powerful combined capabilities of these two observatories.
- Explore future synergies of Hubble and Webb with other existing and planned facilities.
- Look ahead to the future scientific questions that will shape astrophysics into the 2030s and beyond.



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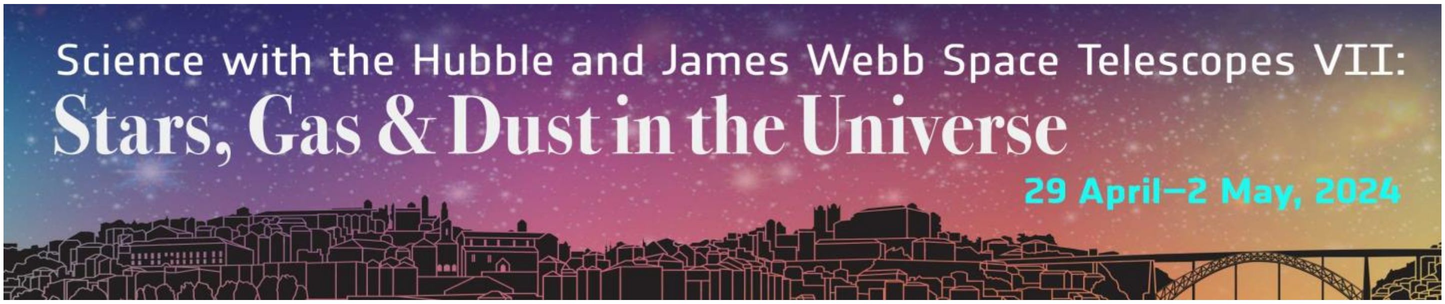


AGENDA

Monday 29 April

Session 1: Introduction

CHAIR: CHRIS EVANS

09:00 Introductions

09:15 Angela Adamo (invited)
Star clusters in the JWST era: A piece in the puzzle of galaxy evolution

09:40 Julia Roman-Duval (invited)
ULLYSES has landed

10:05 Ariane Lançon (invited)
Stars and galaxies in the Local Universe: First Euclid results

10:30 Coffee

Session 2: Mission Updates & Wider Context

CHAIR: STEFANIE MILAM

11:00 Tom Brown (invited)
Hubble in the time-domain decade

11:20 Macarena Garcia Marin (invited)
JWST status updates and science timeline

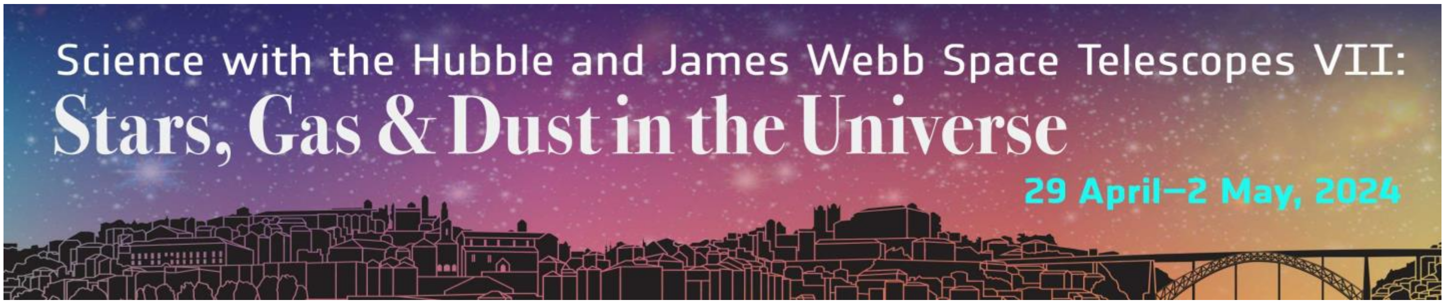
11:40 Christian Soto
Coordinated observations with JWST & HST

12:00 John Carpenter (invited)
Future developments at the ALMA Observatory

12:30 Cristina Oliviera
Stars, Gas, and Dust with the Nancy Grace Roman Space Telescope

12:45 Hugues Sana
The Ultraviolet Explorer (UVEX) mission

13:00 Lunch



Round-Table Discussion I

14:30 Maximising Hubble's Synergies & Legacy

16:00 Coffee

Session 3: Solar System & Exoplanets

CHAIR: NEILL REID

16:30 Heidi Hammel (invited)
Solar System Science with JWST and Hubble

17:00 Stefanie Milam
Insights to the physiochemical history of comets with JWST and ALMA

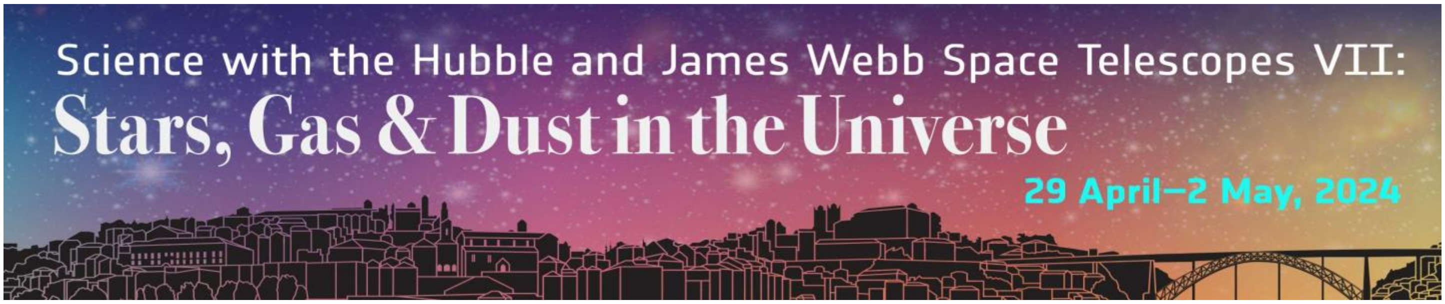
17:15 Elodie Choquet (invited)
Direct imaging of exoplanets and debris disks with HST & JWST

17:45 Valentin Christiaens
The first JWST images of protoplanets

18:00 Henrik Melin (remote)
Ionospheric irregularities at Jupiter observed by JWST

18:15 Poster lightning talks

18:30 Reception



Tuesday 30 April

Session 4: Planet & Star Formation

CHAIR: JENNIFER WISEMAN

09:00 Ruobing Dong (invited)
Planets form in gaseous protoplanetary disks around newborn stars

09:30 Francois Menard
Dust evolution and vertical settling in planet-forming disks: a game-changing HST-JWST-ALMA synergy

09:45 Polychronis Patapis
Gas and dust in the environment of planet formation: first spectra of planetary mass companion disks

10:00 Maria Navarro
PROJECT-J: the embedded jet and molecular flow of the HH46 IRS protostar observed with JWST

10:15 Poster lightning talks

10:30 Coffee

Session 5: Transients, SNe & GRBs

CHAIR: ANNALISA DE CIA

11:00 Sara Bonito (invited)
Transients & Variable Stars with the Vera Rubin Observatory

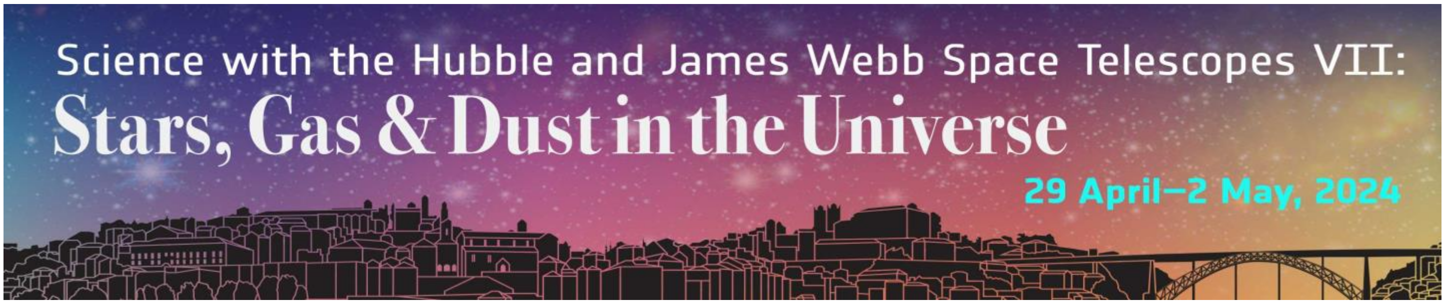
11:30 Andrew Levan (invited)
Explosive transients with Hubble & Webb

12:00 *Charlotte Wood*
Properties of the Local Dust Environment Around the Type Ia SN 2009ig

12:15 *Kirsty Taggart*
SN2023fyq: A Ibn supernova with the First Detected Progenitor System and Pre-Explosion Cold Dust

12:30 Melissa Shahbandeh
Unraveling Cosmic Dust Origins: JWST Revelations from Supernovae

12:45 Lunch



Session 6: Stars, Stellar Populations & the Distance Scale I

CHAIR: MEGAN REITER

14:30 Nolan Habel
JWST Imaging Study of Young Stellar Populations in Local Low-Metallicity Star-Forming Regions

14:45 Cristina Pallanca
The synergy of data from JWST and HST: the case of the Bulge globular cluster NGC 6440

15:00 Morten Andersen
The low-mass Initial Mass Function across Environments and cluster dynamics

15:15 Wolf-Rainer Hamann
The massive young cluster NGC 346 in the SMC: a template for starbursts in metal-poor galaxies

15:30 Brent Tully (invited)
A population II TRGB-SBF route to H_0 with HST and JWST

16:00 Coffee

Session 7: Stars, Stellar Populations & the Distance Scale II

CHAIR: ANNALISA DE CIA

16:30 Adam Riess (invited, remote)
JWST Weighs in on the Hubble Tension

17:00 Beena Meena
UV Legacy Project: High Resolution HST Imaging of Star-Formation in Nearby Galaxies

17:15 Sean Linden
Lifting back the veil: Quantifying feedback from dusty star clusters in nearby Galaxies

17:30 Close

18:30 **Public Talk:** Exploring the Universe with the Hubble & James Webb Space Telescopes
Jennifer Wiseman & Chris Evans
Salão Nobre, Rectory Building of the University of Porto

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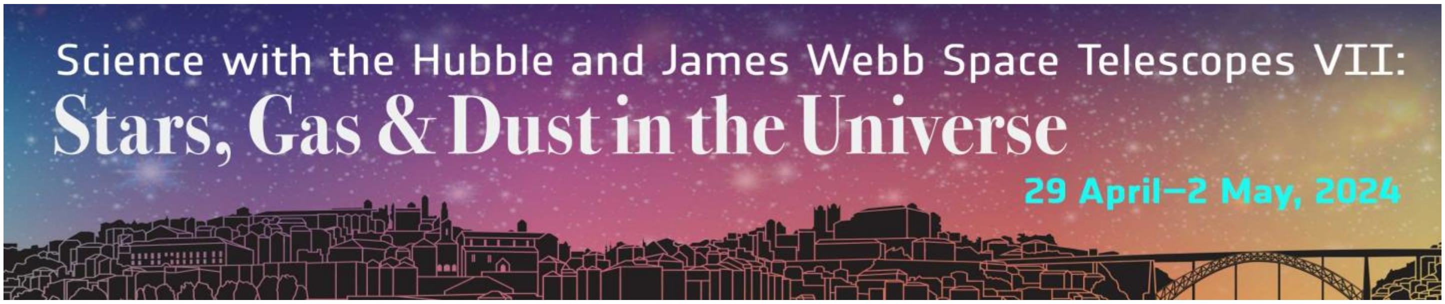


Wednesday 1 May

Session 8: ISM & Dust

CHAIR: JARLE BRINCHMANN

09:00 Emilie Habart (invited)
PDRs4All: JWST's NIR and MIR imaging and spectroscopic view of the Orion Bar photo-dissociation region

09:25 Irene Shivaei (invited)
Unveiling Dust Beyond Our Local Universe

09:50 Marjorie Decleir
MEAD: Measuring Extinction and Abundances of Dust

10:05 Andrew Fox
Gas and dust in the Milky Way Halo

10:20 Helena Faustino Vieira
Resolving the extragalactic ISM with HST extinction

10:35 Coffee

Session 9: Galaxies & Galaxy Evolution

CHAIR: ADI ZITRIN

11:00 Janice Lee (invited)
Star Formation in Nearby Galaxies: New Insights from ~100,000 Star Clusters and Associations.

11:25 Aaron Evans (invited)
The Great Observatories All-sky LIRGs Survey

11:50 Ana Paulino-Afonso
LAE size evolution from z~2 and z~6: insights from HST and JWST observations

12:05 Sangeeta Malhotra
Universal Peas

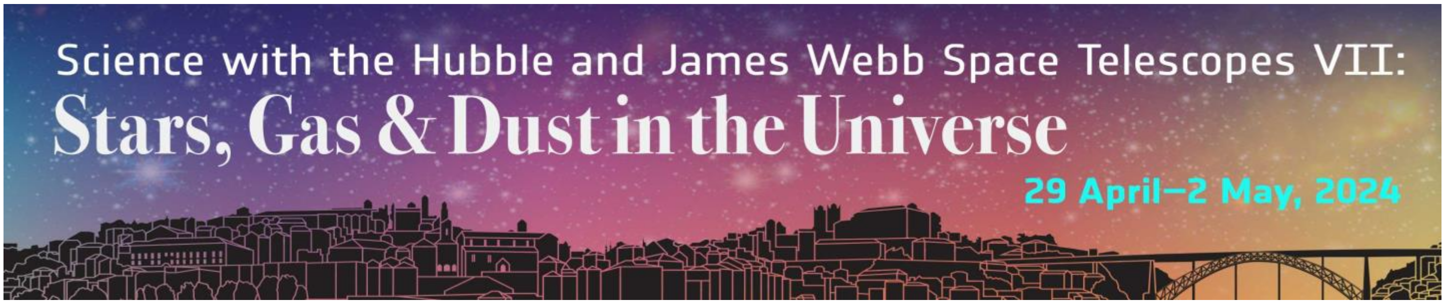
12:20 Kalina Nedkova
UVCANDELS: What drives the differences between UV and optical sizes of disk galaxies?

12:35 Ilias Goovaerts
Faint star forming galaxies towards the epoch of reionisation viewed with HST, JWST and VLT/MUSE

12:50 Allison Man (remote)
A panchromatic view of the circumgalactic medium surrounding a brightest cluster galaxy at z=0.4

13:05 Lunch, then free afternoon.

19:00 **Conference dinner**, starting at Taylor's Port Cellars Visitor's Centre (arrive: 18:30)



Thursday 2 May

Session 10: Future Look

CHAIR: CHRIS EVANS

09:00 Luigi Colangeli (invited)
Overview of the Future ESA Science Programme

09:25 Janice Lee (invited)
Stars, Gas & Dust with the Habitable Worlds Observatory

09:50 Michele Cirasuolo (invited)
ESO's European Extremely Large Telescope

10:15 Eros Vanzella
From JWST to ELT: What Studies Will Be Routinely Conducted on the High-z Universe After 2030?

10:30 Coffee

Round-Table Discussion II

11:00 Looking to the 2030s and Beyond

12:30 Lunch

Session 11: AGN

CHAIR: ADI ZITRIN

14:00 Yuichi Harikane (invited)
Galaxy evolution & AGN with HST & JWST

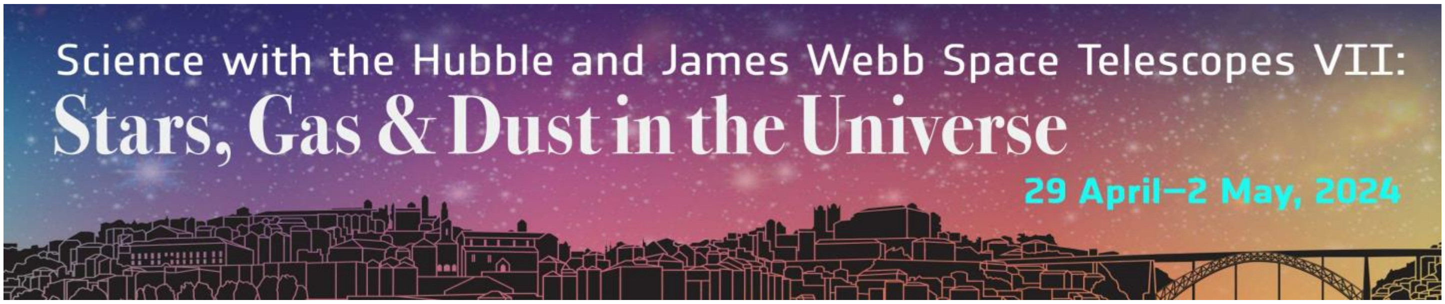
14:30 Cristina Ramos Almeida
Deciphering the interplay between young stars, multi-phase gas and dust in obscured quasars

14:45 Lorenzo Ulivi
Exploring the Nuclear Region of Arp220 with NIRSpec@JWST

15:00 Lukas Furtak
Little red dots – JWST uncovers a new population of dust-obscured AGN in the epoch of reionization

15:15 Varsha Kulkarni (remote)
Constraining Dust Grain Composition and Structure in Past ~10 Gyrs with mid-IR Quasar Spectroscopy

15:30 Coffee



Session 12: High-z Universe

CHAIR: JARLE BRINCHMANN

16:00 Pascal Oesch (invited)
High-redshift galaxies with HST & JWST

16:30 Adele Plat
Constraining the nature of strong CIV emitters at z>6 using a detailed emission-line analysis

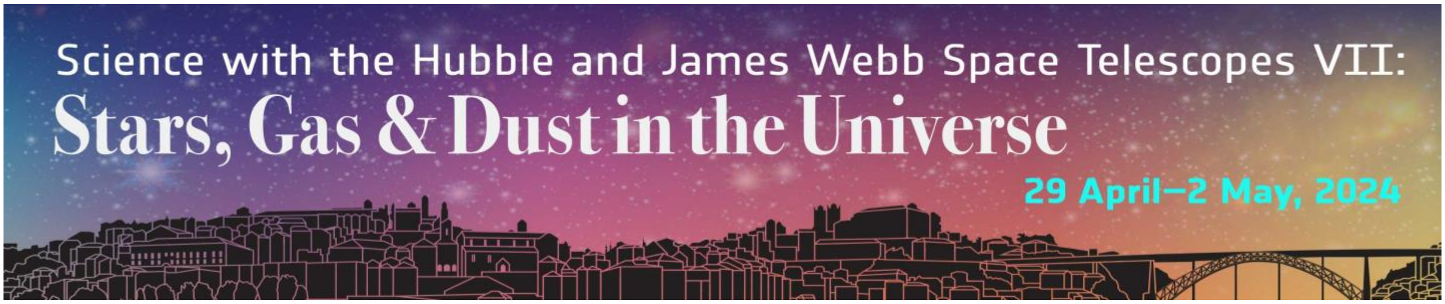
16:45 Polychronis Papaderos
On the challenge of interpreting color maps of high-z starburst galaxies with JWST

17:00 Nathan Adams
EPOCHS: Analysing the largest sample of high-z galaxies in HST+JWST's deepest fields

17:15 Daniel Langeroodi
Chemical Evolution of Stars and ISM from z ~ 10 to Cosmic Noon

17:30 Rogier Windhorst (remote)
The Crown Jewels of JWST PEARLS: Project Overview and Main Results

17:45 Closing Remarks



Posters

P01 Angela Adamo
An overview of the JWST FEAST programme

P02 Dori Blakely
The James Webb Interferometer: Joint model fitting to the accreting protoplanets and disk around PDS 70 reveals evidence for circumplanetary disk emission and additional asymmetric emission within the disk gap

P03 Giacomo Bortolini
Unveiling IZw18 age's mystery with JWST

P04 Rubén Fedriani
Unveiling Extreme Conditions Star Formation in the Galactic Center with JWST NIRCam

P05 Miriam Golubchik
A search for transients in the Reionization Lensing Cluster Survey (RELICS)

P06 Alec Hirschauer
I Zw 18: Dust Life Cycle at Very Low Metallicity

P07 Keri Hoadley
H2 with Hubble + JWST

P08 Caroline Huang
Measuring Mira Distances with HST and JWST

P09 Sarah Kendrew
The hidden stellar emission from ALMA-mapped sub-millimeter galaxies with JWST

P10 Nanda Kumar
Tracing the stars, gas and dust in young stellar clusters: The JWST potential

P11 Abigail Lee
An Independent Determination of H0 Based on the JAGB Method

P12 Franceso Massaro
Powerful radio sources in the southern sky: Entering the SKA era with HST & JWST

P13 Divakara Mayya
Sizes and ages of star clusters inside the bubbles traced in the JWST/MIRI images

P14 Stephen McKay
Identifying and Characterizing Faint DSFGs Using JWST NIRCam Priors

P15 Max Newman
Calibrating the Tip of the Red Giant Branch Distance Method in HST and JWST Near Infrared Filters

P16 Lidia Oskinova
High-Mass X-ray Binaries and what do the HST and the JWST teach us about them

P17 Abel Schootemeijer
Do massive stars in the Early Universe rotate rapidly? New horizons on metal-poor dwarf galaxies

P18 Ryo Tazaki
JWST observations of edge-on protoplanetary disks: the case of HH30

P19 David Thilker
Extragalactic dust filament network properties based on emission and attenuation via JWST and HST

P20 Daniel Vaz
Leo T Dissected with HST and MUSE

P21 Silvia Vicente
A JWST IFU deep study of gas, dust, and PAHs in a prototypical externally illuminated protoplanetary disk

P22 Peter Zeidler
Discovering planetary-mass brown dwarf candidates in the Small Magellanic Cloud

ABSTRACTS: TALKS

Star Clusters in the JWST era: A piece in the puzzle of galaxy evolution

Angela Adamo (Stockholm University)

JWST has initiated a new era for studying clustered star formation across cosmic times. In my talk, I will present recent results from the Feedback in emerging extragalactic star clusters (FEAST) project, a cycle 1 NIRCam and MIRI imaging program, which complements HST UV-optical observations 6 nearby star-forming galaxies (e.g., M83, M51, NGC4449, NGC628, NGC4485/4490). FEAST observations sample the 1 to 7 micron continuum, as well as recombination lines (Pa_alpha and Br_alpha) tracing HII regions and PAH emission (3.3 and 7.7 micron) tracing the photodissociation regions (PDRs) surrounding the emerging young star clusters (eYSCs) extracted in IR. Comparisons with giant molecular clouds (GMCs) extracted from ALMA data and young star clusters (YSCs) detected in HST observations show that about 70% of eYSCs are missed in standard HST optical-based YSCs catalogues, while only about less than 50% of the GMCs are associated with eYSCs. Only a small fraction of eYSCs are consistent with being deeply embedded, suggesting that this phase is very short with respect the emergence phase lasting up to 5 Myr. I will present some highlights of our initial results focusing on the emergence phases of star clusters, their physical properties, as well as PDR evolutions, PAH disruption, and PAH as star formation rate indicators. In the second part, I will present the recent discovery of proto-globular clusters in reionization-era galaxies, with particular focus on the Cosmic Gems arc, a remarkable lensed galaxy at redshift 10.2, already discovered as a z~10 candidate in the HST RELICS survey. JWST images resolve the HST light into five-star clusters with sizes of ~1 pc and masses around 10^6 Msun are detected in a few times 10^7 Msun metal poor and dust free host galaxy. These star clusters have elevated stellar densities and contribute at least to 50% of the FUV light of their detected host and 30% of its stellar mass. They have formed in a very compact region of about 40-50 pc, typical of the UV rest frames of early galaxies. They have stellar densities > 10^5 Msun/pc^2. The stellar densities of these proto-GCs at redshift 10 open new venues to explore black hole seed formation and super massive stars via stellar collisions in their cores and thus explain the potential polluters at the origin of chemical enriched stellar populations in globular clusters. Now, as never before, JWST has reshaped this field of research by revealing the importance of the clustered star formation process in regulating galaxy growth during any phase of their evolution.

EPOCHS: Analysing the largest sample of high-z galaxies in HST+JWST's deepest fields

Nathan Adams (Manchester)

I will present results from current efforts to uniformly reduce data from the deepest images taken of the Universe. With this dataset, which will continue to be expanded over the next 12 months, we have identified over 1000 robust galaxy candidates at z>6.5, spanning 200 square arcminutes of the sky and 6 survey programmes. The combined use of HST+JWST is critical for reliable Lyman break selections for our lower redshift candidates, as well as the assessment of UV vs optical morphologies across cosmic time. Using our ultra-high-redshift sample, we have measured the evolution of the Ultraviolet Luminosity

Function, the Stellar Mass Function, galaxy morphologies and identified the strongest Balmer break galaxies in these early times. We find that galaxy number densities are not as high as initially reported in early JWST studies, indicating that cosmic variance and sample contamination may have played a role in these early claims of unexpectedly high galaxy number counts. Similarly, our estimated stellar masses are not in strong tension with expectations from current cosmological models and we find that modelling assumptions (IMF, SFH etc.) can lead to systematic shifts of 0.4dex in stellar mass. Discussion will focus on implications for reionization, the efficiency of early star formation and the search for Pop-III stars. I will conclude by discussing early findings from new JWST surveys employing extensive use of medium band photometry, including a strong z~15 candidate, focusing on the benefits that ultra-deep, medium band photometry can provide.

The low-mass Initial Mass Function across Environments and cluster dynamics

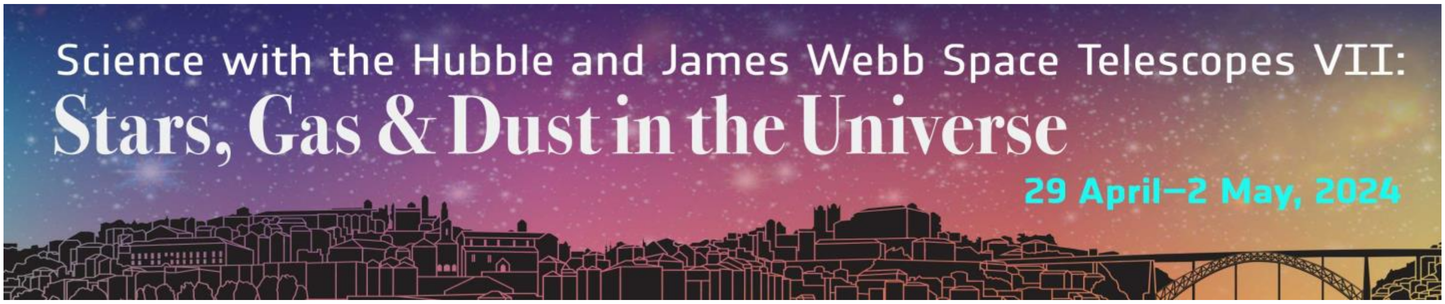
Morten Andersen (ESO)

Although substantial progress has been made in our understanding of star formation, the impacts of environment is still of great debate. In particular, does the environment have an impact on the Initial Mass Function, the binary fraction produced, and the evolution of circumstellar disks? The answers have profound implications for our understanding of planet formation, the mass to light ratios of stellar populations, and the dynamics of star clusters. To push the studies to more extreme (and more distant) regions than the typical low-mass star forming regions near the sun, sensitivity and spatial resolution is paramount to resolve the cluster content to low mass. Here we present observations of young massive clusters in the Milky way and the Large Magellanic Cloud using a combination of adaptive optics ground-based observations, HST, and JWST observations. Covering a range in cluster mass of over 10 and a factor of over three in metallicity, we have derived mass functions and disk fractions, reaching well into the brown dwarf regime within the Galaxy. We discuss the IMF as a function of cluster metallicity, the disk fraction as a function of metallicity, cluster mass, and age and show the effects of environment through comparison with nearby regions. Further, utilizing the synergy between HST and JWST, we present the velocity structure of the clusters based on long base-line imaging. We discuss the evidence for mass segregation and clustering hinting at the formation mechanisms of the clusters.

Transients & Variable Stars with the Vera Rubin Observatory

Sara Bonito (National Institute for Astrophysics/Osservatorio Astronomico Di Palermo)

I will present the Vera C. Rubin Observatory Legacy Survey of Space and Time (LSST) Transients and Variable Stars Science Collaboration (TVS SC) activities as well as a brief overview of Rubin LSST status. I will provide some examples of science cases of interest in the context of the very diverse range of scientific topics relevant for Rubin LSST TVS, HST, and JWST.



Hubble in the time-domain decade

Tom Brown (STScI)

Through 2030, and possibly beyond, the demand for Hubble's unique capabilities will persist, but the science program will shift focus as the entire field of astrophysics evolves with new facilities. Exoplanet science will remain an integral part of Hubble's science, but reflect the powerful synergy between Webb and Hubble to characterize exoplanet atmospheres alongside surveys expanding the census of known hosts. Time-domain science will become increasingly prominent, as high-energy transients discovered by Roman, Euclid, Rubin, and multi-messenger experiments drive demand for Hubble's UV sensitivity and expansive field of regard. Motivated by the most scientifically impactful use of Hubble, we are seeking new ways to align Hubble operations with the rising torrent of transient discoveries, including new avenues for selecting and executing transient science programs. These shifts in science program will continue against a backdrop of lifetime extension activities that are closing the gap between Hubble and the next UV/optical flagship, the Habitable Worlds Observatory.

Future Developments at the ALMA Observatory

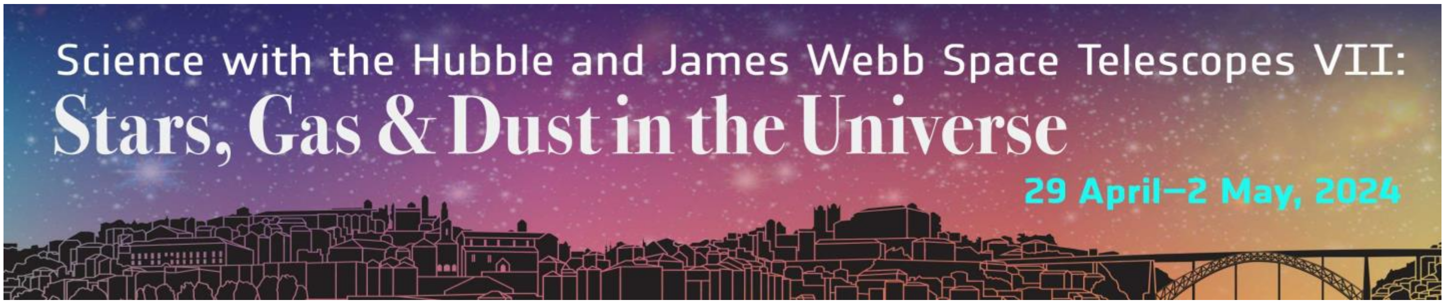
John Carpenter (ALMA)

In its first decade of operation, ALMA has produced ground-breaking to understand our cosmic origins, from the formation and evolution of galaxies to the formation of planets in circumstellar disks. As ALMA enters in second decade of operations, it has initiated an ambitious development program called the Wideband Sensitivity Upgrade (WSU) that will at least double and eventually quadruple ALMA's system bandwidth and deliver improved sensitivity and scientific capabilities. This goal requires upgrading the receivers (Front-End detectors) and most of the digital electronics, including the correlator, as well as the ALMA software that drives the system, and processes and stores the output. The WSU will afford significant improvements for every future ALMA observation. In this talk, I will summarize the science case for the WSU, the status of the project, and the synergies with HST/JWST.

Direct imaging of exoplanets and debris disks with HST and JWST

Elodie Choquet (Laboratoire d'Astrophysique de Marseille)

Space telescopes are exquisite facilities for the direct observation of exoplanetary systems. They provide the stability and sensitivity that ground-based instruments difficultly strive for to image these systems, tenuous objects at high contrasts and short separations from their host star. Through the late 1990's and all the 2000's, HST has been the prime facility to image and characterize debris disks in scattered light, providing valuable information about their population and dust properties. Now, JWST is also providing images of young giant planets, pinning down their thermal and atmospheric properties at high precision thanks to its unique IR sensitivity. The combination of both HST and JWST now offers unique opportunities to study the links and dynamical interactions between exoplanets and debris disks. In this review, I will review the main results and advances given by both telescopes, and discuss the prospects for combined observations of exoplanetary systems.



The first JWST images of protoplanets

Valentin Christiaens (University of Liège)

HST provided some of the first resolved images of protoplanetary disks. The resolution of these images was only recently surpassed by ALMA and a new generation of high-contrast imagers equipping the largest ground-based facilities, which enabled a detailed view of the birth environment of planets. In this contribution, I will present the first images of the PDS 70 b and c protoplanets obtained with JWST/NIRCam. The images were obtained upon leveraging a strategy originally developed to reach high contrast with HST, namely roll subtraction, and using the latest iterative algorithms developed in the field of high-contrast imaging. The high stability of the NIRCam PSF allowed us to produce images of the circumstellar environment of PDS 70 with exquisite quality, despite the lower angular resolution than ground-based imagers. Based on dedicated radiative transfer models of the disk and the use of appropriate image processing techniques, we could identify new extended features in the system, including a spiral accretion stream feeding the circumplanetary disk of PDS 70 c. Combining the new photometric measurements obtained in 2 NIRCam filters to ground-based data (and in the case of PDS 70 b with a HST measurement too) provides the largest wavelength coverage for the SED of a protoplanet. We compared the SED to a variety of atmospheric models, which provides tentative evidence for the presence of an IR excess tracing heated circumplanetary material - the potential building blocks of large moons.

ESO's European Extremely Large Telescope

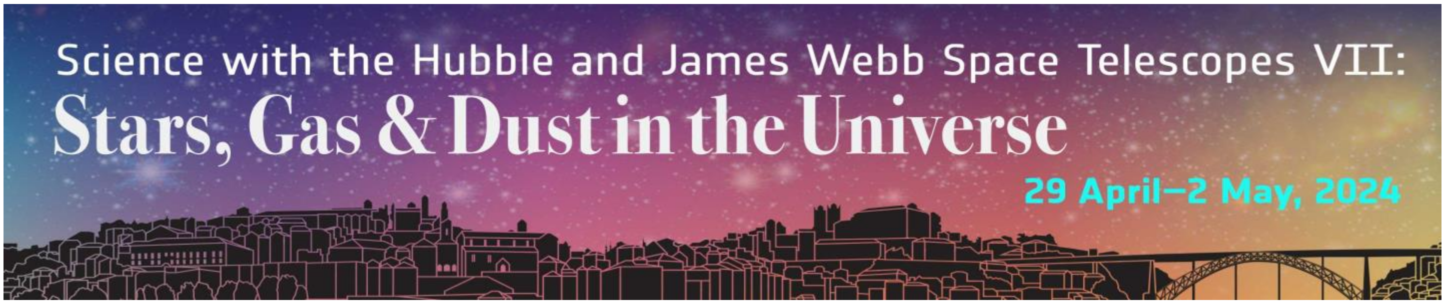
Michele Cirasuolo (ESO)

The Extremely Large Telescope (ELT) is a revolutionary scientific facility that will allow the ESO astronomical community to address many of the most pressing unsolved questions about our Universe. The ELT with its 39-metre primary mirror will be the largest optical/near-IR telescope in the world and will open a huge discovery space. I will present an overview of the ELT Programme, focusing on the latest status of the telescope, its instrumentation and the scientific drivers and synergies with HST and JWST.

Overview of the Future ESA Science Programme

Luigi Colangeli (ESA)

The Science Directorate is responsible for the definition, planning and implementation of the "Science Mandatory Programme" of the European Space Agency. Missions in operation continue to deliver top-quality data, enabling the scientific community to produce excellent scientific results in several fields. The current focus of the Programme is on the progress and completion of the ongoing "Cosmic Vision" plan, that has been recently characterised by the successful launches of JUICE and Euclid missions in 2023; LISA and EnVision missions have been adopted in January 2024 and have joint the family of missions in development towards launches in the next few years; NewAthena and Arrakihs are now advancing towards adoption in the next few years. Studies for the next generation of missions are now progressing in view of implementing the new "Voyage 2050" long term plan in the Science Programme.



All ESA science missions are characterised by scientific excellence and technology innovation, and blend in a harmonised way European leadership in several science domains and international partnership. The ambitions of the scientific communities translate into new technology challenges that the European industries are keen to capitalise on and support, building capacity for the European stakeholders and potentially producing applications to fields beyond space science. The presentation will report on the status of the Science Programme and the plans to continue implementing a robust, inspiring, and successful Science Programme.

MEAD: Measuring Extinction and Abundances of Dust

Marjorie Decleir (ESA/STScI)

Interstellar dust has a significant impact on many astronomical research fields, as it absorbs and scatters a large fraction of the star light, and influences star formation and galaxy evolution at all cosmic times. Understanding the properties of the dust grains is thus crucial to derive precise knowledge of any object in the Universe that is obscured by dust, as well as to constrain the initial conditions for star and planet formation.

We can gain insight into the properties of the interstellar dust by studying its extinction effect on the star light. Multi-wavelength continuum extinction contains information about the average dust grain size along the line of sight, while extinction features reveal the composition of the dust grains. In addition, abundances of the elements that make up the dust grains enable us to quantitatively measure the chemical composition of the grains. With the MEAD (Measuring Extinction and Abundances of Dust) project we are combining these two methods to constrain the dust properties in our Galaxy. We obtained ultraviolet spectra with the Hubble Space Telescope to measure dust abundances in a sample of Milky Way sightlines, that span a range of environments. Furthermore, we will combine these abundance measurements with literature UV extinction curves, as well as new near- and mid-infrared extinction curves that we are measuring with our James Webb Space Telescope observations, for the same sightlines.

In this talk, I will explain the goals of MEAD and walk you through the first results. I will also show how the synergy between multi-wavelength data from the HST and JWST, as well as other telescopes is advancing our understanding of interstellar dust properties and how they vary in our Galaxy.

Planets form in gaseous protoplanetary disks around newborn stars

Ruobing Dong (University of Victoria)

Planets form in gaseous protoplanetary disks around newborn stars. It has been challenging to directly detect young planets currently forming in disks, as they are embedded and faint. However, such planets can be identified through their interactions with the disk, where they may produce gaps, spiral arms, and vortices. These structures are much larger in size and much more prominent, thus a lot easier to identify than the planets themselves. Once detected and properly understood, disk features become signposts of planet formation, and help us infer the properties of protoplanets, crucial for testing their formation theory. I will discuss how JWST, HST, and ground-based instruments have advanced this field in recent years by discovering and characterizing structures, as well as protoplanets, in protoplanetary disks.

The Great Observatories All-sky LIRGs Survey

Aaron Evans (University of Virginia)

Low-redshift luminous Infrared Galaxies (LIRGs) are observed primarily to be interacting and merging galaxies. They are powered by energetic starbursts and active galactic nuclei (AGN) fueled by abundant supplies of molecular gas. While their strong infrared excesses have made the detection of a large population of LIRGs by far-infrared and sub-millimeter telescopes possible, it has also made them challenging to study - the majority of the UV and optical light from young, massive stars and AGN is absorbed by obscuring dust and re-emitted in the infrared. The Great Observatories All-sky LIRGs Survey, or GOALS, thus makes use of the diversity in wavelength coverage of both space- and ground-based telescopes to probe the activity in a large, flux-limited sample of LIRGs from the IRAS Revised Bright Galaxy Sample. The present talk will cover several highlights from our Early Release Science and early JWST cycle programs.

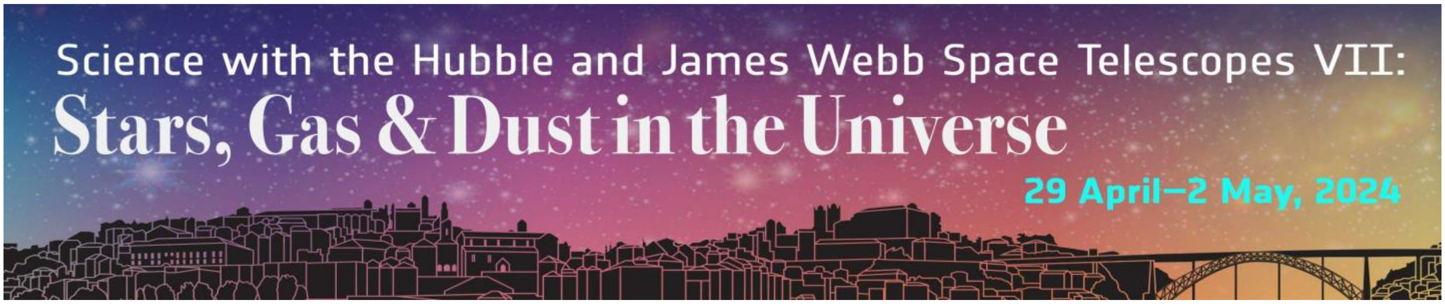
Resolving the extragalactic ISM with HST extinction

Helena Faustino Veira (Cardiff University)

The question of whether star formation (SF) is directly affected by the large-scale dynamics within a galaxy, or merely dependent on the local conditions of the interstellar medium (ISM), is a matter of long-standing debate. This is hindered by the difficulty in simultaneously probing the small-scales associated with the SF process, and the large-scales which might regulate the formation and evolution of molecular clouds, where stars form. Therefore, significant advancement can only be achieved with high-resolution imaging of entire galaxies, such that the inner properties of molecular clouds are resolved whilst maintaining the galactic context.

With this in mind, I present here our work on studying the resolved properties of the ISM by exploiting the high-resolution data from HST in nearby spiral galaxies to its full potential, in combination with new JWST data. I will showcase how, with a newly developed technique to derive dust extinction using optical HST data, we can retrieve maps of the dust (and gas) content across entire galaxies at unprecedented resolution. For our sample of nearby galaxies, our maps have resolution corresponding to a few parsecs, allowing us to study the extragalactic ISM with a level of detail typically only achieved with Galactic studies. Our study of M51 using this technique has shown that there are clear changes in the properties of the ISM depending on the galactic environment as well as on the type of spiral potential felt by the gas.

Furthermore, combining HST extinction with JWST mid-IR emission is now informing us about the physical conditions affecting the dust in galaxies, as well as revealing the embedded population of forming clusters, with which we can study the effects of early SF in molecular clouds. This work highlights the power of using HST data, in conjunction with JWST, to unravel environmental effects on the ISM and SF.



Gas and Dust in the Milky Way Halo

Andrew Fox (AURA/STScI for ESA)

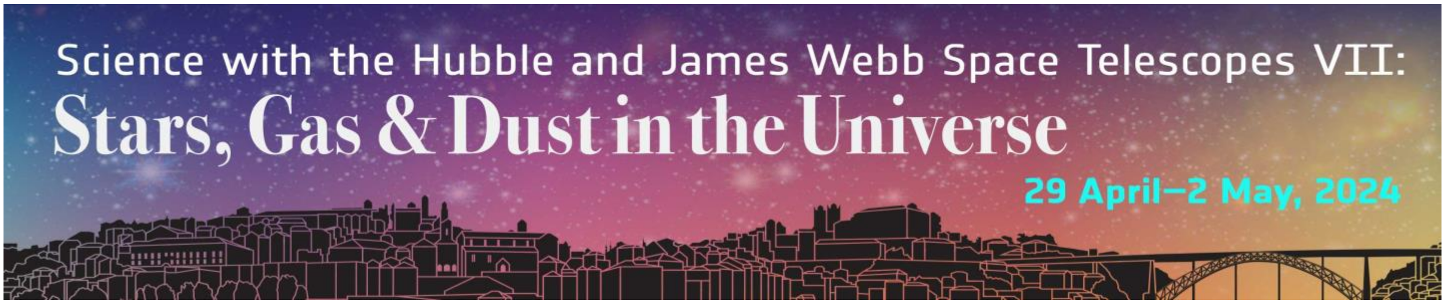
UV spectroscopy with the Hubble Space Telescope has revolutionized our view of the gaseous halo of the Milky Way. Inflows and outflows have been detected across the Galaxy, from a nuclear outflow at the Galactic Center, to a widespread wind across the Galactic Disk, to a giant inflow from the Magellanic System. These multi-phase gas flows play essential roles in cycling baryons and metals through the Galactic ecosystem and fueling the Galactic gas supply. Spectroscopic studies with COS and STIS have provided detailed information on the chemical abundances and dust content of these gas flows via observations of high-velocity clouds (HVCs) in metal-line absorption. This information provides crucial constraints on the origin and fate of gas clouds in the Milky Way halo. I will discuss recent results on HVC science from Hubble and outline future directions with JWST and ground-based telescopes.

Little red dots: JWST uncovers a new population of dust-obscured AGN in the epoch of reionization

Lukas Furtak (Ben-Gurion University)

Active galactic nuclei (AGN) at high redshifts, observed when the Universe was only a few hundred Myr old, are crucial for our understanding of black hole growth in the early Universe and their co-evolution with galaxies. In particular, if gravitationally lensed and multiply imaged by an intervening strong lensing galaxy cluster, distant AGN can yield precious insight into AGN properties. We can even use them to constrain cosmological parameters by studying the time delay between the multiple images through the varying AGN activity. The advent of the JWST and its phenomenal near-infrared sensitivity and spatial resolution has initiated a new era in observations of strong lensing galaxy clusters and the lensed background sources. JWST observations allow us to push the frontier of observability towards fainter magnitudes and higher redshifts -- and thus uncovered a new population of dust-obscured red AGN at high redshifts.

In my talk I will present these red point-source objects observed in strong lensing fields with JWST (and archival HST data) that represent new and hitherto unobserved populations of AGN at high redshift. For one case in particular, at z=7 and which is multiply-imaged by the massive galaxy cluster Abell 2744, we obtained the deepest JWST/NIRSpec spectrum taken of a single object to date and detected its broad emission lines. This object opens fascinating prospects for future studies of its black hole properties through reverberation-mapping and even cosmological parameters through strong lensing cosmography.



JWST status updates and science timeline

Macarena Garcia Marin (ESA/STScI)

Well into its second year of science operations JWST keeps delivering ground-breaking science results across all fields of astrophysics. Having already gone through three successful calls for proposals the community is fully engaged with the mission. This presentation will focus on updates to the observatory performance and operations, data products, and initiatives to improve engagement and communication with the community. We will also review the JWST future science timeline.

Faint star forming galaxies towards the epoch of reionisation viewed with HST, JWST & VLT/MUSE

Ilias Goovaerts (Laboratoire d'Astrophysique de Marseille)

Faint, star forming galaxies have been shown to play a major part in the process of cosmic reionisation. We access these populations using VLT/MUSE GTO and HST data of four Frontier Fields galaxy clusters, giving us access to Lyman-alpha emitters (LAEs) down to Lyman-alpha luminosities of 10^39 erg/s and Lyman break galaxies (LBGs) down to absolute UV magnitudes ~ -12 (2.9<z<6.7). We present the properties of these populations (~250 LAEs, ~1000 LBGs), comparing the LAE population to the general UV-selected population and assessing the LAE fraction, which can tell us about the progress of reionisation. A subset of our galaxies in the Abell 2744 lensing cluster have deep JWST/NIRCam imaging, from which we derive stellar masses, star formation rates and position these galaxies on the main sequence of star formation. Our analysis implies that while faint galaxies have an important role in reionisation, LAEs do not distinguish themselves among the general UV-selected population in their impact. We can also assess the Lyman-alpha escape fraction by comparing dust-obscured SFRs to SFRs derived from Lyman-alpha luminosities, as well as comparing the latest luminosity functions of LAEs and the UV-selected population. We constrain the evolution of the escape fraction with redshift and other galaxy properties. This, in turn allows us to make an assessment of the LAE contribution to reionisation from this angle, informed by our escape fraction estimates. This work highlights the power of HST and JWST to access extremely faint star forming galaxies around the epoch of reionisation, additionally underscoring the potential of these two telescopes to work with VLT/MUSE data.

PDRs4All: JWST's NIR and MIR imaging and spectroscopic view of the Orion Bar photo-dissociation region

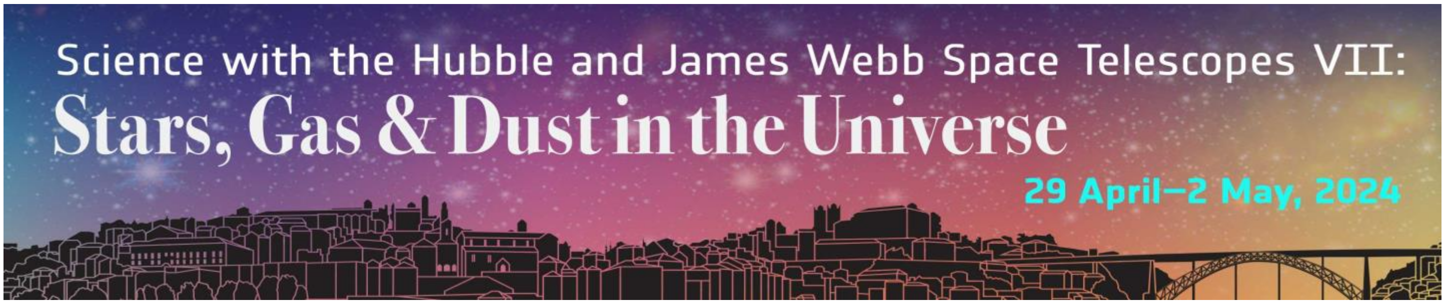
Emilie Habart (Université Paris Saclay)

The Orion Bar, situated in the nearest massive star formation regions, has been successfully observed in imaging and spectroscopy as part of the JWST Early Release Science program, PDRs4All (Berne et al. 2022; Habart et al. 2024; Peeters et al. 2024). This allows to study with great precision the effects of radiative feedback from massive stars on interstellar molecular clouds, and the dominant physical and chemical processes that lead to the infrared emission that JWST will detect in many Galactic and extragalactic environments. This presentation overviews the observations of PDRs4All and discuss several results relating to the highly sculpted interfaces and strong density gradients between the ionized, atomic and molecular phase. This dataset revisits the commonly adopted 2D physical structure showing a very intricate irradiated cloud surface with an incredible richness of substructures that were inaccessible to previous IR observations. A focus will be placed on the comparison with the HST and ALMA data and the fine atomic/molecular transition zone from which the emission of excited H_2 comes. It will be shown how to take advantage of the high spatial resolution and good spectral resolution of NIRSpec and MIRI to resolve the spatial distribution of excited H_2 line emission with that of small molecules in gas-phase organic chemistry and conduct detailed analysis of their excitation. Out of equilibrium excitation processes that are only possible in dense, warm and irradiated regions are revealed. The study of these processes allows us to put strong constraints on the environments, either on temperature, density and on our understanding of on-going warm chemistry.

JWST Imaging Study of Young Stellar Populations in Local Low-Metallicity Star-Forming Regions

Nolan Habel (NASA-JPL)

We present NIRCam and MIRI imaging and photometry of the low-metallicity star-forming regions NGC 346 located in the Small Magellanic Cloud and Spitzer I, the youngest and most active star forming region in the local group dwarf galaxy NGC 6822. With metalicities (~1/5 Z solar) analogous to that of cosmic noon, the peak era of star formation in the early Universe (z = ~2), these active star-forming regions provide local laboratories to test theories of early star and planet formation in unprecedented detail. In two GTO programs, JWST has imaged these nearby (60kpc & 490kpc) regions in multiple near- and mid-infrared wavelength bands from 1.15 to 21 microns across its NIRCam and MIRI instruments. We reach photometric depths over 10 magnitudes below Spitzer and 2 magnitudes below HST at comparable wavelengths. Using Starbug II, a new photometry tool built specifically for crowded dusty fields, we have obtained PSF photometry of ~200,000 sources in NGC 346 and ~900,000 in NGC 6822. In both regions, we identify several distinct populations of both evolved and young sources by examination of their color-magnitude diagrams and through fitting to model young stellar object (YSO) Spectral energy distributions (SEDs). In NGC 346, we detect sources with masses as low as ~0.1 solar masses, and find evidence of ongoing low-mass star formation concentrated along dust filaments. We identify with high confidence ~200 YSOs and pre-main sequence stars, including those showing IR excess and evidence of accretion. In the Spitzer I region of NGC 6822, we identify 129 YSOs, including those fainter and less massive than any previous study with Spitzer. In both regions, we identify dusty, deeply-embedded YSOs with detections at both NIRCam and MIRI wavelengths, rising SED slopes at 21 microns and absorption at 10 microns indicative of dusty silicates in their protostellar envelopes. Such evidence suggests that even at low metallicities, the dust required for the creation of rocky planets is already present, indicating that they may have formed earlier in the universe than previously thought.



The massive young cluster NGC 346 in the SMC: a template for starbursts in metal-poor galaxies

Wolf-Rainer Hamman (Universität Potsdam)

Massive stars are among the main cosmic engines driving the evolution of star-forming galaxies. Their powerful ionizing radiation and stellar winds inject a large amount of energy, mass and momentum into their environment.
The most massive young star cluster in the Small Magellanic Cloud (SMC) is NGC 346. This cluster contains more than half of all O stars yet discovered in this galaxy.
We mapped the central part of NGC 346 by long-slit UV observations with the STIS spectrograph on board of the Hubble Space Telescope (HST) and complemented these new datasets with archival observations. These data were augmented by integral-field optical spectra with MUSE at ESO's Very Large Telescope (VLT). All early-type star observations have been comprehensively analyzed, using the Potsdam Wolf-Rayet (PoWR) non-LTE model atmospheres. The feedback from the early-type inventory of NGC 346 to the associated HII region has been discussed on the basis of HST images in H-alpha.

Solar System science with JWST and Hubble

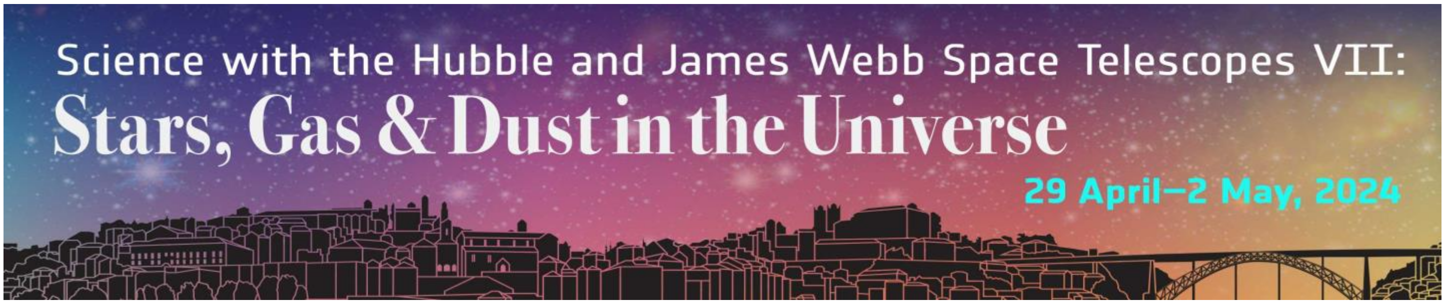
Heidi Hammel (AURA)

James Webb Space Telescope's exquisite sensitivity produced a science bonanza for objects within our own Solar System in the initial years, which complements decades of Hubble observations of local targets. Many early JWST Solar System observations took place under my Guaranteed Time Observations (GTO). My Solar System GTO program was supplemented with: GTO contributions from Science Working Group members primarily for Kuiper Belt Objects (KBOs) and Titan; Jupiter-system Early Release Science (ERS) data; Early Release Observations (ERO) images of ice giants; and of course, GO programs. JWST imaging enabled detailed mapping and characterization of atmospheres (giant planets, Titan), planetary surfaces (Europa, Mars), giant planet rings, and small bodies (main-belt comets, Enceladus). But perhaps most revolutionary has been the extraordinary Solar System spectra. JWST has been dubbed a "molecular machine," and its exceptional spectroscopy revealed myriad mineral features, gases, and ices from the nearest asteroids to the most distant KBOs. In this review, I will provide a sampler of JWST Solar System science; discuss how these data complement the past and current Hubble observations; and conclude with thoughts about programmatic aspects of my GTO (and the ERS) observations.

Galaxy evolution and AGN with HST and JWST

Yuichi Harikane (University of Tokyo)

Recent JWST observations are finding high redshift galaxies at $z>10$ whose number density is higher than theoretical models calibrated with previous HST observations at $z<10$. In addition, JWST is finding abundant AGN populations at $z>4$ from spectroscopy. I will review recent JWST results of high redshift galaxies and AGNs, including luminosity functions, star formation rate densities, and MBH-M* relation. Also, I will present new spectroscopic results of bright galaxies and their physical properties.



Constraining dust grain composition and structure in the past ~10 Gyrs with mid-IR quasar spectroscopy

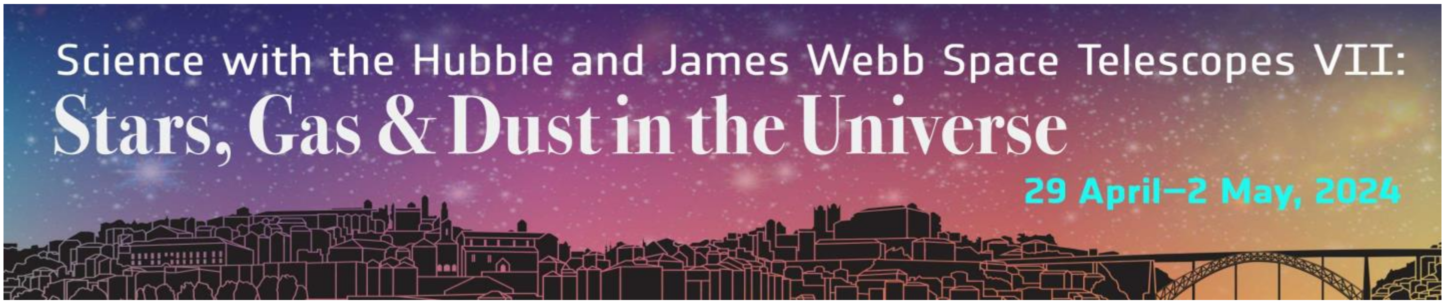
Varsha Kulkarni (University of South Carolina)

Dust grains have a major influence on the physical and chemical properties of the interstellar medium (ISM) in galaxies. Extinction by dust grains also affects the appearance of distant galaxies, and thereby the properties we infer for them from observations. Unfortunately, the composition and structure of dust grains in cosmologically distant normal galaxies are not well-constrained. To improve this situation, we have been using mid-IR spectra of background quasars to measure spectral features of dust grains in intervening galaxies. Our team's earlier work using this approach with the Spitzer IRS revealed silicate 10- and 18-micron absorption in distant galaxies, and suggested that the silicate absorption in distant galaxies is stronger than expected based on extrapolations from the tau_9.7 vs. Av trend observed in the Milky Way diffuse ISM, and that the silicate grains in some distant galaxies may be crystalline, as opposed to the amorphous grains inferred in the Milky Way diffuse ISM. Our JWST MIRI/MRS observations are now allowing us to investigate the silicate absorption in distant galaxies at far higher sensitivity and spectral resolution compared to the Spitzer IRS. We describe results from our Cycle 1 JWST observations aimed at accurately measuring the silicate features in distant galaxies. We will present the measurements of absorption profiles and fits to them with templates for various grain mineralogies and structures. We also examine trends between the silicate properties, other dust properties, and gas properties for these galaxies. These measurements spanning the past ~10 billion years provide interesting constraints on models of cosmological evolution of dust grains.

Stars and galaxies in the Local Universe: first Euclid results

Ariane Lançon (Université de Strasbourg)

The Euclid Space Telescope has started its 6-year survey program, that will provide a homogeneous near-infrared image of 14,000 square degrees of the sky, as well as deeper observations of selected fields. Designed to provide constraints on dark energy on cosmological scales, the Euclid instruments provide a spatial resolution and near-infrared sensitivity that enable Local Universe studies previously impossible on such a spatial scale. While HST and JWST provide exquisite new detail on the early stages of galaxy evolution, Euclid will, in combination with ground-based surveys such as UNIONS, DES, LSST, redefine the end point of this evolution: our current Universe. I will summarize the first few months of the Euclid mission, review some of the exciting perspectives, and present a few early results from Local Universe observations.



Chemical Evolution of Stars and ISM from z ~ 10 to Cosmic Noon

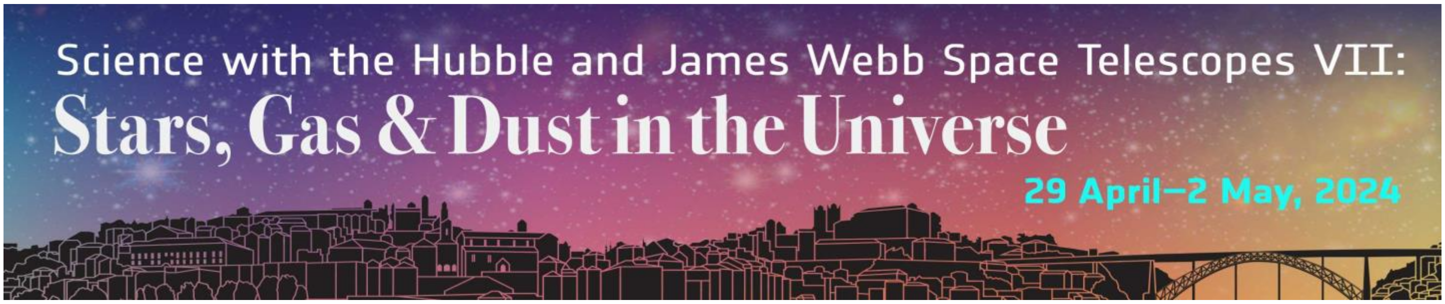
Daniel Langeroodi (University of Copenhagen)

The cosmic evolution of gas-phase and stellar metallicities of galaxies as well as their dependence on stellar mass, star-formation rate, and environment are some of the most readily testable predictions of theoretical models of galaxy formation and evolution. The complex interplay between the processes that regulate chemical enrichment, including mergers, accretion, star-formation, and feedback-driven outflows is expected to become simpler at early times and easier to model. Therefore, high-redshift constraints on the gas-phase and stellar metallicities of galaxies are crucial to inform the theoretical models. At $3 < z < 10$, NIRSpec has enabled gas-phase metallicity measurements through rest-optical emission lines, while HST & NIRCam have enabled stellar metallicity estimates by probing the rest-UV continuum slopes. In this talk, I will present these measurements based on large compilations of HST, NIRCam, and NIRSpec data. In particular, the NIRSpec emission line sample contains 800+ galaxies at $z > 3$, the largest of such compilations to date. I will highlight established correlations, including the mass-metallicity relation and its redshift evolution, the fundamental metallicity relation, the correlation between UV magnitudes and UV slopes, and the redshift and stellar mass evolution of Balmer decrements. Moreover, I will highlight new findings such as the cosmic evolution of ISM escape fraction and the correlation between compactness and metal deficiency. The revolutionary combination of depth and spatial resolution afforded by NIRCam, and wavelength coverage afforded by NIRSpec has brought morphological and chemical analysis to the forefront of high-z studies. However, we are already facing the limitations of space telescopes: i) their limited spatial resolution, and ii) the long exposure times required to acquire deep high-spectral resolution spectra. I will discuss these shortcomings in light of the upcoming class of ELTs, and highlight the improvements expected in the coming decade.

Star Formation in Nearby Galaxies: New Insights from ~100,000 Star Clusters and Associations

Janice Lee (STScI)

The combination of Hubble and JWST capabilities is essential for advancing our understanding of star formation. I will present results from the PHANGS collaboration which is conducting Hubble and JWST Treasury surveys of stars, gas, and dust across 74 nearby galaxies. With Hubble, we have conducted the largest census to-date of ~100,000 visible stellar clusters and associations. Exploration of the observational properties of this large sample has greatly expanded the utility of the UBVI color-color diagram as a diagnostic reference tool for stellar, cluster, and galaxy evolution studies. With JWST, we are conducting an analogous census of the earliest stages of star formation, which are enshrouded by dust and obscured from our view in the optical. The sensitivity and resolution of JWST's infrared capabilities are finally allowing us to step beyond the Local Group, and observe dust embedded star formation on 10-100 parsec scales across environments characterized by physical conditions not found locally. Combined with PHANGS observations across the electromagnetic spectrum that capture all major stages of the star formation cycle, we can follow the progression of star formation – from molecular clouds to embedded and unembedded stellar populations – to provide new constraints on star formation efficiencies and timescales for theoretical models



Stars, gas and dust with the Habitable Worlds Observatory

Janice Lee (STScI)

The Habitable Worlds Observatory (HWO) will be the next flagship-class mission after the Roman Space Telescope. In the spirit of both Hubble and JWST, HWO will be a transformative tool for community-driven astrophysics, planetary, and exoplanet observations. This talk will cover the science considerations that drive the trade space the mission development teams will explore, and will give an overview of the progress to date of the Great Observatories Maturation Program (GOMAP), of which HWO is currently the primary focus.

Explosive transients with Hubble and Webb

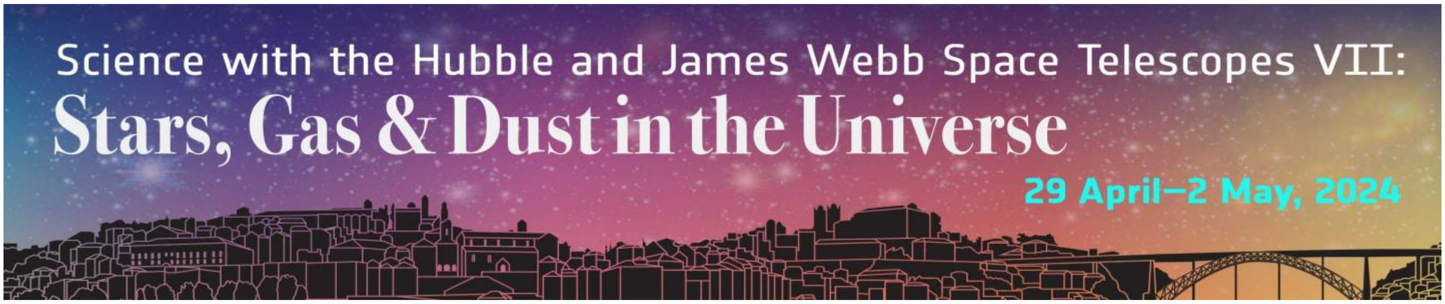
Andrew Levan (Radboud University)

The combined wavelength coverage to both the UV and mid-IR with unparalleled spatial resolution has enabled Hubble and now JWST to make pivotal contributions to our study of explosive astrophysical transients. These insights span from the identification of supernova progenitors to the discovery of transients in the distant Universe to the ability to probe the formation of dust or heavy elements in exotic explosions. In this talk, I will outline some of the (necessarily selective) highlights, focusing on some of the most recent breakthroughs, and consider how both Hubble and Webb can answer many pressing questions for the field in the next few years in the era of the Vera Rubin Observatory and multi-messenger astronomy.

Lifting Back the Veil: Quantifying Feedback from Dusty Star Clusters in Nearby Galaxies

Sean Linden (University of Arizona)

Young massive star clusters (YMCs) host the majority of all massive stars, and therefore represent a fundamental unit of star formation and stellar feedback in galaxies. Due to JWST's unprecedented capabilities, the critical but poorly understood process of YMC emergence from their natal birth clouds can be observed in a variety of nearby galaxies for the first time. Here I will present ongoing work to identify and characterize emerging YMCs in both normal and starburst galaxies in the local Universe. By combining observations from 0.3-4.4um we have fit the spectral energy distributions (SED) of all 2207 YMC candidates in NGC 628 to derive physical quantities (age, mass, extinction, and dust properties), finding evidence for a rapid change in the dust grain size distribution as YMCs emerge from their birth clouds. Further, with multi-band NIRCam observations in combination with the NIRSpec IFU we find variations in the near-infrared colors with both the Pa-alpha and 3.3um PAH line strength, suggesting a rapid evolutionary sequence (~3 Myr) as YMCs destroy their surrounding dust in the nucleus of NGC 3256. The wide range of ISM physical conditions seen amongst nearby galaxies affords us a high-resolution look at how star formation activity evolves with environment.



Universal Peas

Sangeeta Malhotra (NASA-GSFC)

Extreme emission line galaxies show striking similarities over the full span of observable cosmic evolution. We have demonstrated such similarities in metal abundance, size, luminosity, and ionization parameter, by comparing a reference sample of nearby green pea galaxies with JWST early release observations. This kinship allows us to use green peas as proxies for their high-redshift kin, at distances where we can make measurements that are impossible in the early universe. Such measurements include ionizing photon escape (critical for understanding reionization), and the mass and distribution of neutral gas (critical for fueling star formation). In this talk, I will summarize the evidence that green peas are analogs of the galaxies that drove reionization, and summarize results from ongoing multiwavelength studies of their nature. This topic is an excellent example of the synergy between HST, whose UV spectroscopy is crucial for measuring Lyman continuum and Lyman alpha properties of the nearby samples; and JWST, which provides equally critical observations of rest-optical emission lines in the epoch of reionization, enabling ionization parameters and metal abundances to be derived reliably during cosmic dawn for the first time. This underscores the value of a continued UV spectroscopic capability both on Hubble and on future UV-capable missions.

A panchromatic view of the circumgalactic medium surrounding a brightest cluster galaxy at z=0.4

Allison Man (University of British Colombia)

Star formation within galaxies is regulated by the circumgalactic medium (CGM) through gas inflows and outflows. I will present an analysis of the comprehensive view towards the multiphase (warm and cold molecular + ionized) gas and dust analysis of a BCG at z=0.4. The target harbours one of the largest known H2 reservoirs, elevated star formation, and a strong radio AGN. We obtained new JWST/MIRI MRS observations that detect warm H2 lines, indicating that the molecular CGM is warmer than the interstellar medium within the BCG. I will present preliminary results a joint analysis of the warm and cold molecular gas in the CGM and BCG, using ALMA and single-dish observations of CO and [CI] emission lines. Archival HST and VLT/MUSE observations enable us to tie the gas and dust conditions to the resolved stellar populations. I will discuss the implications of this work on the possible link between the enhanced star formation in this BCG and its CGM, as well as the role of AGN feedback in regulating star formation. This case study serves as a pathfinder for using JWST to complement existing multi-wavelength observations of the gas, dust and stars of massive galaxies and their CGM using JWST.

UV Legacy Project: High Resolution HST Imaging of Star-Formations in Nearby Galaxies

Beena Meena (STScI)

The Galaxy UV Legacy Project (GULP) is a large treasury program, which utilizes the unique spatial resolution and ultraviolet capabilities of the Hubble Space Telescope. We have acquired Far-UV (FUV) and Near-UV (NUV) imaging of 27 nearby star-forming galaxies, spanning a wide range of masses, metallicities, star formation rates, and morphological types. These observations enable us to trace the regions of most recent star formation, detailing the characteristics of resolved massive stars, OB associations, and young clusters. Simultaneously, these data allow for an examination of the effects of UV dust attenuation in various extragalactic environments. Leveraging the GULP photometry and Bayesian techniques, we have derived robust age estimates for massive stars and star clusters, which will play a pivotal role in refining the calibration of high-mass initial mass functions and enhancing the accuracy of stellar population synthesis models. This presentation provides an overview of the GULP program, focusing on recent findings related to the star formation properties of young stellar groups for a subset of galaxies. Our investigation includes an analysis of the impact of UV radiation on dust in correlation with varying star-formation rates. Additionally, we explore the fractal and hierarchical nature of star and cluster formation, contributing to a broader investigation of global clustering behavior across different stages of galaxy evolution. This FUV+NUV study of 27 star-forming galaxies in the local Universe serves as a crucial reference for interpreting ongoing and future high redshift galaxy surveys with the James Webb Space Telescope and understanding their role in cosmic reionization.

Ionospheric irregularities at Jupiter observed by JWST

Henrik Melin (University of Leicester)

The charged particle ionosphere of Jupiter, forming part of the upper atmosphere, is an important interface region between the atmosphere below, the magnetic field, and the space environment. It is formed via the ionisation by both auroral electron precipitation at the poles and by solar extreme ultraviolet (EUV) radiation across the sunlit disk. Since the incoming solar radiation is smooth across the disk of Jupiter, the expectation was that the ionosphere at low latitudes should be very smooth and feature-less in nature. Here, we present JWST NIRSpec IFU observation (ERS #1373) of the low-latitude ionosphere in the region of the Great Red Spot, showing surprising structures within the ionosphere. There are arcs, bands, and spots covering the entire field-of-view, showing variability of a factor of four, indicating that once produced by solar EUV, the structure of the low-altitude ionosphere is externally forced, altering its structure. The GRS is surrounded by fierce troposphere turbulence that can generate gravity waves which can propagate up in altitude and alter the structure of the observed ionosphere. We propose that these observations provide evidence of string coupling between the lower and upper atmosphere.

Dust evolution and vertical settling in planet-forming disks: a game-changing HST-JWST-ALMA synergy

Francois Menard (Institut de Planetologie et d'Astrophysique de Grenoble)

Protoplanetary disks are the birth sites of exoplanets. To form planetary embryos, dust must rapidly grow by several orders of magnitude in size. Although the details of the process(es) remain largely unclear, most of this growth likely happens in the dense midplane of protoplanetary disks. Recent observations from HST, JWST, and ALMA now provide critical support to this view. ALMA high-resolution continuum images of highly inclined disks have revealed the high concentration of (large) mm-dust in the disk midplanes, located in a flat layer much thinner than the gas scale height, as delineated by CO gas measurements in the same disks. This midplane distribution of large dust grains is in stark contrast with HST broad-band scattered light imaging in the optical and near-infrared where small dust is seen to extend up to high altitudes above and below the midplanes. This is clearly indicative of vertical dust settling, a necessary ingredient in current planet formation scenarios. But HST and ALMA trace extremes only: the small and large dust populations, respectively distributed up to high altitudes or only in the midplane in disks. To fully characterise the evolution of dust, the level of turbulence, and vertical settling, it is necessary to also get a view of the distribution of intermediate-size dust. This can be provided very efficiently by JWST, and only by JWST! In this presentation we will show results from HST imaging as well as JWST programme #4290 from cycle 2, targeting over 10 very inclined, Edge-On disks. We will discuss how the NIRCam and MIRI broadband images critically complement the results from HST and ALMA and reveal the wavelength evolution of the vertical dust distribution. This project will empirically quantify for the first time how the dust concentration increases toward the disk midplane as a function of size, a necessary condition to efficiently form planetesimals.

Insights to the physiochemical history of comets with JWST and ALMA

Stefanie Milam (NASA-GSFC)

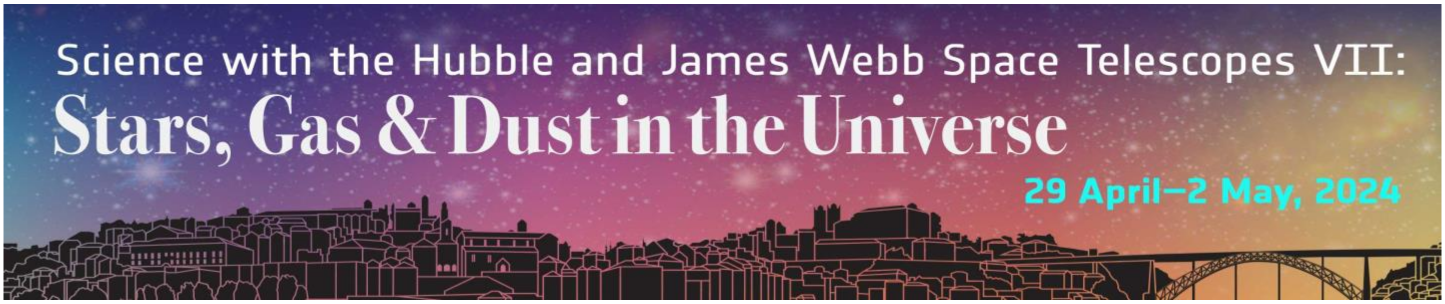
We present results from JWST and ALMA towards comets C/2022 E3 (ZTF) and C/2017 K2 (Pan-STARRS) and will discuss the distribution and composition of materials in these objects.

PROJECT-J: the embedded jet and molecular flow of the HH46 IRS protostar observed with JWST

Maria Navarro (INAF - Observatory of Rome)

PROtostellar JEt's Cradle Tested with JWST (PROJECT-J) is a 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. JWST offers, for the first time, a view of the innermost region that remained obscured in previous HST near-IR observations, allowing us to study the origin and evolution of the atomic jet and molecular outflow.

After a general overview of the main observational findings, I will focus on a detailed analysis of the molecular outflow traced by the H2 emission. Line maps of pure-rotational lines unveil the complex structure of the molecular flow and cavity affected by the interaction with the atomic jet. Comparison with previous HST-NICMOS and recent JWST-NIRCam images suggests that the jet and the H2 flow are driven by two sources within a binary system. Maps of H2 temperature, velocity, and column density have been generated and used to infer the excitation conditions and flow dynamics and ultimately gain insight into the outflow driving process.



UVCANDELS:
What drives the differences between UV and optical sizes of disk galaxies?

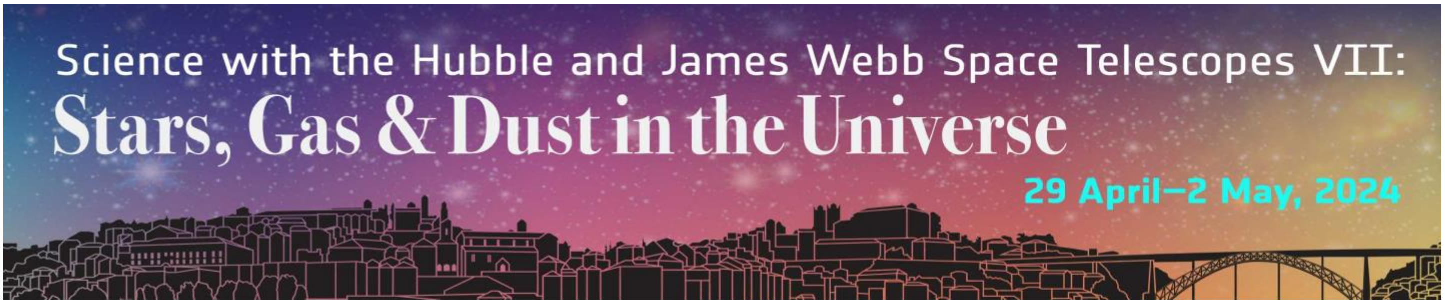
Kalina Nedkova (Johns Hopkins University)

The build-up of stars in galaxies is believed to occur through inside-out growth, whereby galaxies grow their central regions first and their outskirts later on. This is supported by measurements of larger galaxy sizes in the rest-frame UV than optical, as the UV traces recent star-formation while the optical is sensitive to the older underlying stellar population. However, dust complicates the interpretation of such observations. We present rest-frame UV and optical galaxy sizes at $0.5 \leq z \leq 3.0$ measured from high resolution UVCANDELS imaging that allows these comparisons to be made over a larger redshift range than previously possible. Our results show that massive disk galaxies ($>10^{10}$ Msun) are typically much larger in the UV, which is consistent with the literature. To understand if this difference is driven by dust or inside-out growth, we perform an analysis of mock disk galaxies from the VELA simulations in the same multi-wavelength fashion as the observations. We find that when dust is included, the simulations reproduce our UVCANDELS results. However, once dust is accounted for, the difference between the rest-frame UV and optical sizes of disk galaxies is consistent with zero. Since dust alone can account for differences between the rest-frame UV and optical sizes of star-forming galaxies, we find that variations in galaxy size with wavelength do not constitute evidence for specific galaxy growth scenarios. With JWST, sizes are now being obtained for large samples of high-redshift galaxies. Understanding how dust affects these measurements will allow us to constrain how the earliest galaxies build up their stellar mass.

High-redshift galaxies with HST and JWST

Pascal Oesch (University of Geneva)

Similar to the Hubble Space Telescope (HST) that had started a golden era for astronomy in the 1990s, JWST is now transforming our view of the Universe. From day one, JWST produced one surprise after another: from unexpectedly luminous candidate galaxies at $z>10$, to an abundant, new class of obscured black holes, to massive quiescent galaxies when the Universe was only 1-2 Gyr old. With its unparalleled imaging and spectroscopic capabilities, JWST immediately extended our cosmic horizon into uncharted territory, with galaxies spectroscopically confirmed to $z\sim13$ and candidates identified out to $z\sim14$-16, only ~250-300 Myr after the Big Bang. We are thus at the brink of finding the first galaxies that ended the cosmic Dark Ages and started the reionization of the Universe. Furthermore, JWST finally provides deep rest-frame optical observations to $z\sim10$ -- a huge leap from the previous limit at $z\sim3$. This finally allows us to select mass-complete samples of galaxies in the first 1 Gyr of cosmic history and measure their redshifts. In this talk, I will show how far we have come in understanding early galaxy build-up over the last years. I will start with the state of knowledge from three decades of Hubble and Spitzer Space Telescope datasets, and will review our current understanding of early galaxies based on the first two years of revolutionary JWST data.



Stars, gas and dust with the Nancy Grace Roman Space Telescope

Cristina Oliveira (STScI)

The Nancy Grace Roman Space Telescope will revolutionize many areas of astrophysics. Planned for launch in late 2026, Roman will perform near-infrared imaging and spectroscopic surveys over large contiguous areas on the sky that will rival the scope of ground-based surveys, but with the sensitivity and resolution similar to that of HST. With a field of view 100 times larger than JWST and 200 times larger than that of HST+WFC3/IR, and with a survey speed approximately 1000 times faster than HST, Roman's survey capabilities will enable broad scientific investigations in both the near and far universe. The transformational power of Roman can be further increased via synergistic work with other facilities. In this talk, I will highlight some of what will be possible combining observations of stars, gas, and dust from three simultaneously operating flagship space missions from NASA: Roman, HST, and JWST.

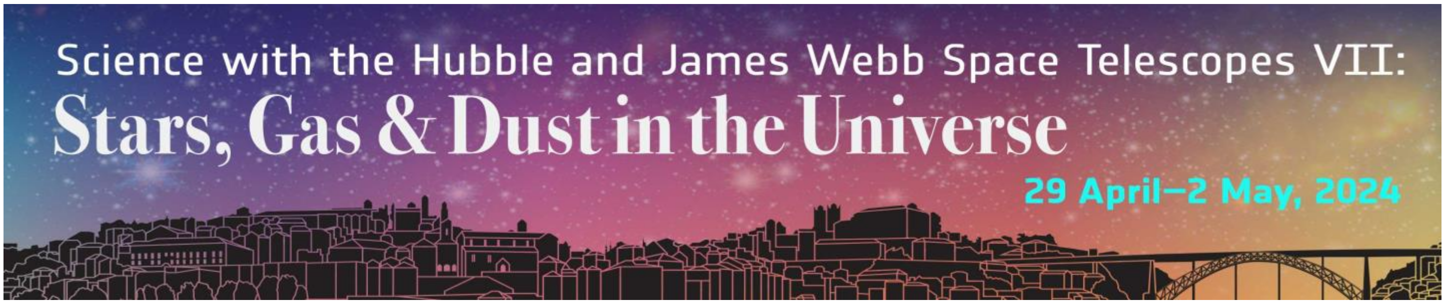
The synergy of data from JWST and HST: the case of the Bulge globular cluster NGC 6440

Cristina Pallanca (University of Bologna)

NGC 6440 is one of the first galactic globular clusters observed with the JWST NIRcam during cycle 1. NGC 6440 is a very dense and massive cluster, located in the Galactic bulge, affected by large and differential extinction, and contaminated by field interlopers. The advanced capabilities of JWST allowed all these challenges to be overcome, providing an unprecedented opportunity to construct a decontaminated and extinction-free color-magnitude diagram of the system down to very low-mass main-sequence stars.

First, I will briefly describe the benefits of the synergistic approach used to analyze the proprietary JWST data coupled with the archival HST images. This method provided the opportunity to fully exploit the capabilities of both instruments, as they were mutually strengthened by the complementary information derived from each other.

I will then focus on the main scientific results obtained with the presented multi-instrument analysis: (i) the first result I'll present concerns the correction for differential reddening, decontamination by field interlopers, and the study of cluster internal kinematics (Pallanca C. et al., in preparation). (ii) I will then show how the obtained high quality photometric color-magnitude diagram allowed to reveal a "double bimodal" main sequence (Cadelano M., Pallanca C. et al., 2023, A&A, 679,13C). By comparing the morphology of the colour–magnitude diagram with a suitable set of isochrones, we argue that the upper main sequence bi-modality is likely due to the presence of a He-enriched stellar population. The lower main sequence bi-modality can be attributed to variations in the abundance of water (i.e., oxygen). This is the first evidence of both helium and oxygen abundance variations in a globular cluster purely based on JWST observations. These results demonstrate how JWST offers the opportunity to study the multiple population of bulge globular clusters, which were previously unfeasible with near-UV observations, due to prohibitive reddening and crowding conditions.



To summarize, I will show how the joint efforts of HST and JWST data analysis have enriched our understanding of NGC 6440, mainly due to the ability to extract additional information from over 25 orbits of HST observations thanks to a few hours of science with JWST.

On the challenge of interpreting color maps of high-z starburst galaxies with the JWST

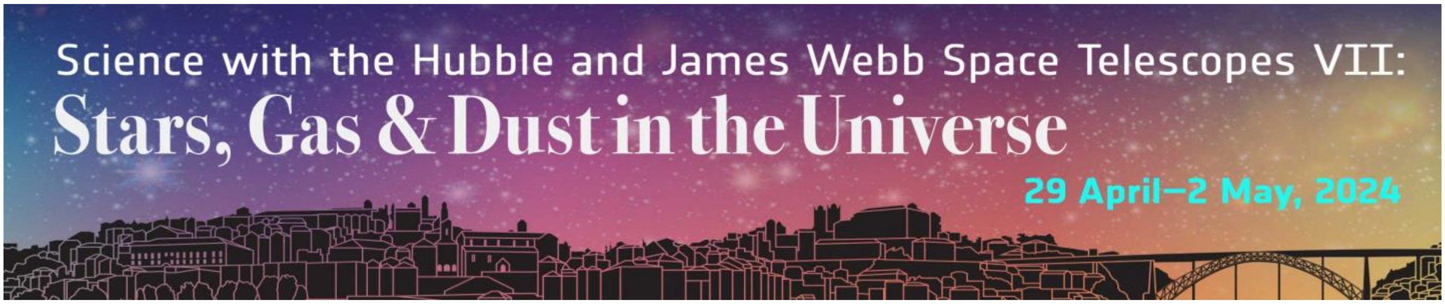
Polychronis Papaderos (Universidade do Porto)

Morphology and color patterns provide fundamental insights into the early formation history of starburst galaxies at high z. However, a 2D reconstruction of rest-frame color maps of such systems from multi-band imaging data is a highly non-trivial task. This is mainly due to the fact that the spectral energy distribution of starburst galaxies is spatially inhomogeneous, thus the usual practice of applying a spatially constant "morphological" k-correction is generally inadequate and can lead to serious misinterpretations with respect to the nature and physical properties (e.g. intrinsic extinction) of these systems. The significance of this problem is demonstrated using simulated color maps of the blue compact galaxy Haro 11 out to z~5.

Gas and dust in the environment of planet formation: first spectra of planetary mass companion disks

Polychronis Patapis (ETH Zurich)

The process of planet formation is still largely unconstrained by observations due to the lack of detections of forming planets and sensitivity of instruments in the mid-infrared, where these disks emit the most. Understanding the early stages of planet formation and interaction with the circumplanetary disk (CPD) material is crucial, since it sets the initial conditions for the evolution and bulk properties of mature planets detected with various methods. We present the first constraints on the geometry, dust, and gas properties of disks around two young planetary mass companions (GQ Lup B, TWA-27 B) observed with the JWST/MIRI Medium Resolution Spectrometer (MRS). The MRS has the spatial resolution and sensitivity to measure the spectra of these disks, despite the high contrast imaging observations required. With complimentary HST measurements of H-alpha emission from these planets, and limits on the dust mass by ALMA, we can also correlate the disk properties and accretion tracers in order to get insights into the mechanisms of which material is accreted onto the planetary atmosphere. Altogether, these new measurements help paint a picture of the complex environment following planet formation, the evolution of CPDs and how they connect to protoplanetary disks and disks around isolated brown dwarfs.



LAE size evolution from z~2 and z~6: insights from HST and JWST observations

Ana Paulino-Afonso (Instituto de Astrofísica e Ciências do Espaço)

The James Webb Space Telescope (JWST) has unveiled a new window into the rest-frame optical light emitted from early-universe galaxies, offering a perfect complement to prior Hubble Space Telescope (HST) observations and furnishing a comprehensive perspective on galaxy evolution in the early cosmos.

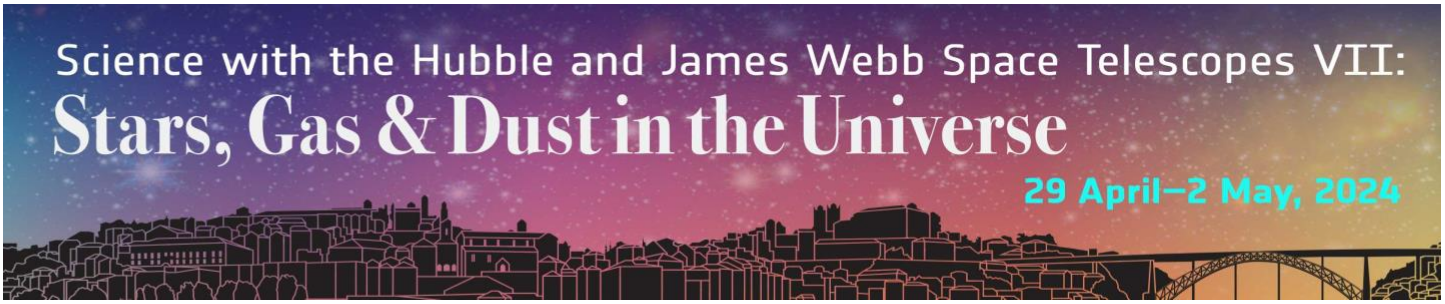
We present a comparative analysis of Lyman-a emitter (LAE) sizes, harnessing the capabilities of both HST and JWST. Our extensive dataset, sourced from the full COSMOS field, comprised 3045 LAEs analysed through HST observations, highlighting their consistent compactness with average sizes around ~1 kpc (Paulino-Afonso et al., 2018). Additionally, we observe that LAEs with higher rest-frame equivalent widths tend to be more compact, suggesting a correlation between intense emission and high star-formation rate densities.

The integration of recent JWST data enables a broad-spectrum analysis of the size evolution of LAEs from redshift z~2 to z~6. By synthesising observations from both telescopes, our research confirms the compact nature of LAEs across both UV and optical rest-frames and indicates minimal size evolution in these galaxies during the early epochs of the universe (Paulino-Afonso et al., in prep; see also Ning et al. 2024). This collaborative approach underscores the pivotal importance of multi-wavelength studies in unravelling the complexities of galaxy formation, bolstering the hypothesis that LAE sources are indicative of an initial phase in early galactic formation.

Constraining the nature of strong CIV emitters at z>6 using a detailed emission-line analysis

Adele Plat (EPFL)

Observations of galaxies from the epoch of reionization have revealed strong carbon emission lines, suggesting the presence of strong ionizing radiation. To understand the nature of these high-redshift galaxies, we can rely on photoionisation modelling. I will present a detailed analysis of two z>6 galaxies, examining their properties using their rest-frame ultraviolet and optical spectra obtained with JWST NIRSpec. These galaxies exhibit prominent CIV and NIV] emission, indicative of the presence of ionizing photons with energy exceeding 47eV. By comparing a comprehensive set of emission lines with model predictions, we can infer the physical properties of these galaxies, including the nature of the ionizing radiation source (stars or active galactic nuclei) and the properties of their interstellar medium. This analysis reveals intriguing features, such as high electron densities as well as low metallicities with strong nitrogen enrichment. These properties have some similarities with another high-redshift galaxy, GN-z11, and contrast with the properties of typical low-redshift star-forming galaxies.



Deciphering the interplay between young stars, multi-phase gas and dust in obscured quasars

Cristina Ramos Almeida (IAC)

Different modes of AGN feedback are now considered key processes in the evolution of massive galaxies by regulating black hole and galaxy growth. Indeed, a wealth of observational evidence demonstrates that feedback from supermassive black holes impacts the galaxies and the halos they inhabit on a wide range of scales: from the central parsecs to hundreds of kpc. What we are still far from understanding is how AGN feedback couples with the host galaxy, which is what ultimately determines its efficiency. The aim of the QSOFEED project is to answer this question by quantifying the impact of multi-phase quasar-driven outflows and jets on the spatially resolved properties of the young stellar populations, molecular gas and dust of nearby galaxies. I will present recent results based on high angular resolution data from cutting-edge telescopes including HST, Keck, GTC and ALMA. Although we do not find evidence for a significant impact of quasar-driven outflows/jets on the total molecular gas reservoirs and star formation (constrained from stellar populations modelling and polycyclic aromatic hydrocarbons; PAHs), they are undoubtedly modifying the distribution of molecular gas and young stellar populations in the central kiloparsec(s) of the galaxies. In the coming months, data from our Cycle 2 JWST/MIRI/MRS proposal 3655 will serve to further investigate the impact of quasar feedback on the multi-phase gas, young stars (PAHs) and dust in a subset of the QSOFEED sample.

JWST Weighs in on the Hubble Tension

Adam Riess

We present high-definition observations with the James Webb Space Telescope of Cepheid variables used to calibrate the luminosity of Type Ia Supernovae and the Hubble constant. The superior resolution of JWST negates crowding noise, the largest source of variance in the NIR Cepheid Period-Luminosity relations (Leavitt laws) measured with HST. Together with the use of two-epochs to constrain Cepheid phases and three filters to remove reddening, we reduce the dispersion in the Cepheid PL relations by a factor of 2.5. We find no significant difference in the mean distance measurements determined from HST and JWST, with a formal difference of -0.01 +/- 0.03 mag. This result is independent of zeropoints and analysis variants including metallicity dependence, local crowding, choice of filters, and slope of the relations. We can reject the hypothesis of unrecognized crowding of Cepheid photometry from HST that grows with distance as the cause of the ``Hubble Tension'' at 8.2 sigma, i.e., greater confidence than that of the Hubble Tension itself. We conclude that errors in Cepheid measurements across the distance ladder are not the source of the decade-long Hubble Tension.

ULLYSES has landed

Julia Roman-Duval (STScI)

ULLYSES has landed! Overview and initial results of the largest Hubble program. Specifically selected to leverage Hubble's unique ultraviolet (UV) capabilities, the Hubble Ultraviolet Legacy Library of Young Stars as Essential Standards (ULLYSES) is a large Director's Discretionary program of approximately 1000 orbits --- the largest ever executed. The ULLYSES program recently completed an ultraviolet spectroscopic library of young high- and low-mass stars in the local universe, leveraging a considerable amount of archival observations. Half of the program is dedicated to the study of accretion physics through UV-optical-NIR spectroscopy of young, low mass accreting (T Tauri) stars in 8 star-forming regions in the Milky Way. UV-optical-NIR spectra of T Tauri stars contain a plethora of diagnostics of accretion, disk evolution, and planet habitability that will be needed to interpret the powerful probes of disk chemistry observed with ALMA, Spitzer, and JWST. The other half of the program is focused on the characterization of the winds and photospheres of massive stars as a function of stellar parameters, through UV spectroscopy toward O and B stars sampling temperature, luminosity class, and metallicity in nearby galaxies. The ULLYSES spectral library of massive stars provides the templates needed to 1) test and update theoretical models of stellar evolution, particularly at a range of metallicities, and 2) for the synthesis of integrated stellar populations both local and at high redshift, the latter becoming accessible to JWST and the next generation of Extremely Large Telescopes (ELTs). Results from ULLYSES will ultimately be critical to advancing our understanding of Lyman-continuum escape and the re-ionization of the Universe. In this talk, I will provide important information related to the objectives and design of the program, its execution, the generation and dissemination of high-level science data products, which are available through three platforms on MAST, and exciting initial results.

The Ultraviolet Explorer (UVEX) mission

Hugues Sana (Leuven)

UVEX is a new ultraviolet NASA Medium Explorer with an expected launch date in 2030. Equipped with a near and far-ultraviolet wide-field camera and a long-slit spectrograph and 50 times more sensitive than GALAX, UVEX aims at addressing important questions on the dynamic ultraviolet universe. These include low mass low metallicity galaxies, UV transients and cadenced galactic and extragalactic synoptic surveys. In this talk I will present the mission, its key objectives and expected synergies with other observatories. I will focus on time domain aspects of the UVEX mission and a subset of its key science objectives.

Unraveling Cosmic Dust Origins: JWST Revelations from Supernovae

Melissa Shahbandeh (STScI)

Dust has seeded the Cosmos with galaxies, stars, and planets since the Universe was young. Despite its critical role, the origins of this cosmic dust have remained shrouded in mystery. AGB stars were originally considered the primary candidates for dust production, but large dust reservoirs have been observed to exist before AGB stars had time to produce them. Core-collapse supernovae (CCSNe) resulting from the death of massive, short-lived stars, offer an alternative explanation, but prior to JWST, we had no instrument with both the sensitivity and wavelength coverage required to test this theory. The focal point of this presentation will be JWST observations of several CCSNe that span from dust precursors formation to massive dust accumulation decades post-explosion. Previously, measurements of molecular dust precursors and dust reservoirs over five years post-explosion have only been achievable for SN 1987A due to its exceptional proximity. We will present NIRSpec and MIRI early spectroscopy of a "once in a decade" nearby stripped-envelope supernova (SESN), SN 2023dbc, which, remarkably, has captured the emergence of dust precursors CO and SiO and allowed us to uniquely probe the poorly constrained ejecta composition of SESNe (DD-4436, DD-4520, PI: Shahbandeh). We will also present JWST observations of two other early-stage SNe, SN 2023ixf and SN 2022acko (DD-4522, GO-2122, PI: Ashall), as well as late-stage observations of SN 2004et, SN 2017eaw, and SN 2005ip (GO-2666, GO-1860, PI: Fox), all five of which are nearby extragalactic Type II SNe. Our analysis of MIRI images and spectroscopy of these three late-stage SNe reveals the highest SN dust mass observed since SN 1987A. SN 2004et is particularly notable, because its dust reservoirs rival those of SN 1987A, despite being significantly younger. These JWST observations have helped us constrain the geometry, origin, and heating mechanism of dust and support the theory that supernovae played a key role in supplying dust to the early Universe.

Unveiling Dust Beyond Our Local Universe

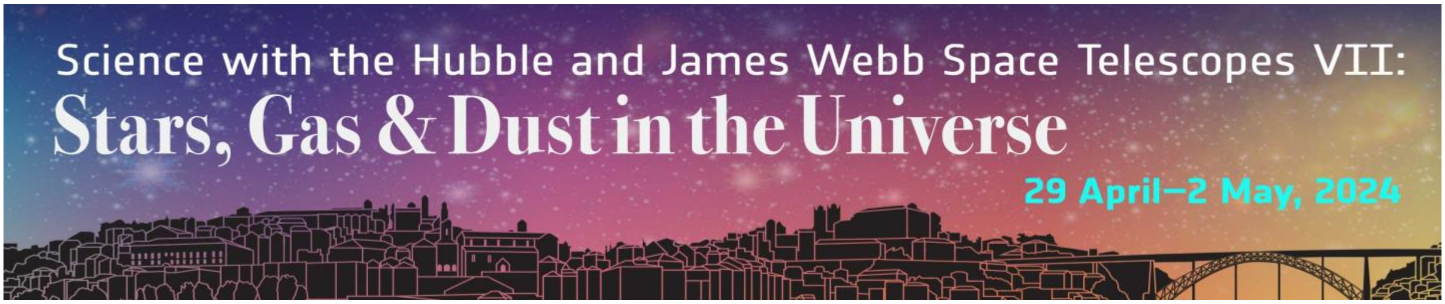
Irene Shivaei (Centro de Astrobiología/Spanish National Research Council)

At the core of galaxy evolution is the evolution of the baryonic components that modify the observable properties of galaxies. A crucial component of baryonic matter is the interstellar medium (ISM) that consists of gas and solid-phase metals called dust. Interstellar dust determines how galaxies look like from UV to sub-mm, how the ISM behaves, and the very process of star formation that creates the stellar component that defines a galaxy. We are now at the beginning of an exciting journey with the unprecedented infrared capabilities, high sensitivity, and high angular resolution of JWST compared to its infrared predecessors such as Spitzer. For the first time, we are able to detect warm dust emission in individual typical galaxies across masses and star formation rates (SFRs) and resolve the dust-obscured SFR at cosmic noon ($z\sim1$-3), and detect UV dust attenuation features at $z>4$. In this talk, I will show recent advantages that have become possible with JWST about properties of dust at high redshifts: from PAH emission at cosmic noon to UV dust attenuation of galaxies at the reionization era.

Coordinated observations with JWST & HST

Christian Soto (STScI)

The successful deployment of the James Webb Space Telescope on Christmas Day in 2021 ushered a new and exciting era in space astronomy. We are spoiled to have two of the greatest space observatories ever built to be in service at the same time, JWST and HST. This unique capability brings forth a lot of exciting opportunities for observers and scientists around the world, specifically the opportunity for science synergies of both missions and coordinated observations. In this talk, I will describe each observatory's constraints, the timeframe during which to arrange coordination in



advance of the observing window and the compromises that the observer may need to successfully implement the observations into the Long-Range Plan. Furthermore, I will explore the idea of how this capability also leads to coordinated efforts with other facilities both from space and in the ground (i.e., XMM, Chandra, ALMA, and more). I will briefly highlight the constraints of those observatories and describe what it takes to include them in a coordinated campaign with JWST and/or HST.

SN2023fyq: A Ibn supernova with the First Detected Progenitor System and Pre-Explosion Cold Dust

Kirsty Taggart (UC Santa Cruz)

We present JWST and HST observations of SN 2023fyq, the closest (~18.2 Mpc) Type Ibn supernova (SN Ibn). SNe Ibn are a rare class of stellar explosion characterised by a lack of H lines and the presence of narrow P-Cygni He emission lines in their optical spectra. These events are thought to arise from the SN shock interacting with pre-existing, dense and H-poor/He-rich circumstellar material (CSM). This CSM was likely formed from mass loss from the progenitor star shortly before core collapse.

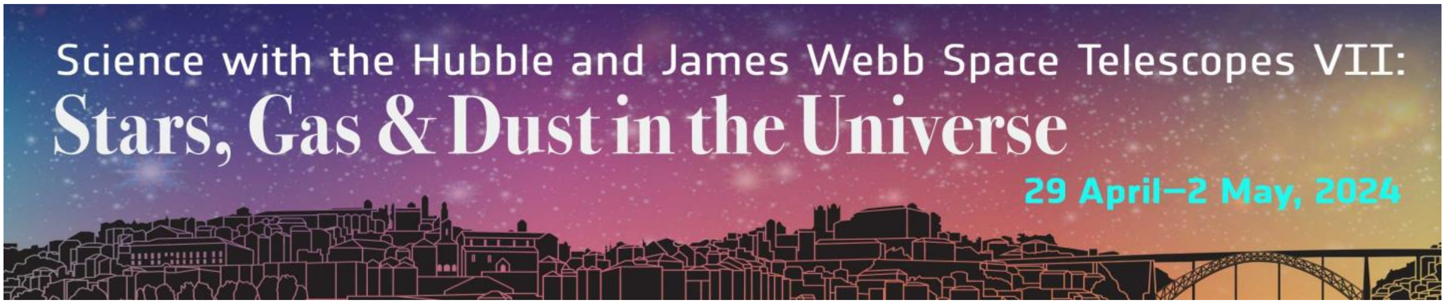
We identified a likely progenitor candidate for SN 2023fyq in archival UV through NIR HST images taken a decade before explosion. The progenitor star is blue (B-V=0.2) and luminous -9. In addition to HST, we acquired a complementary ground-based optical light curve spanning the 10 years prior to discovery. This data showed a gradual increase in brightness to -12, consistent with some LBVs and SN impostors. SN 2023fyq then began to brighten rapidly before a jump in luminosity to -15, likely corresponding to a terminal explosion peaking at -18. SN 2023fyq was serendipitously imaged by JWST/MIRI during this period of faster luminosity increase one month before peak, but before the nominal time of explosion. This MIRI imaging revealed emission consistent with two thermal components (120 K and 300K; too cold to be early SN emission) of carbonaceous dust totalling 0.1 M at the SN location before the explosion. This is among the largest dust masses ever observed in any SN or stellar system, suggesting that extreme mass loss at the end of a star's life plays a key role in dust formation.

We will discuss SN 2023fyq in the context of its progenitor system, progenitor mass loss, and dust properties. Furthermore, we advocate for future JWST/HST follow-up observations to provide insights into the destruction of dust by SN 2023fyq and any potential new dust formation.

A Population II TRGB-SBF Route to H_0 with HST and JWST

R Brent Tully (IfA, Hawaii)

The Population I cepheid-supernova path to a value of the Hubble constant can be complemented by an equally accurate Population II path coupling the tip of the red giant branch and surface brightness fluctuation methodologies. Programs with HST are now being carried forth with JWST. The linkage between TRGB and SBF can be made with simultaneous observations of the high surface brightness cores and low surface brightness halos on individual early-type galaxies with JWST NIRCam. Further SBF observations can be made to large numbers of targets at redshifts in the Hubble flow regime. Preliminary results will be presented across the full range from zero-point calibration to the TRGB-SBF transfer to distances acquired at z=0.03.



Exploring the Nuclear Region of Arp220 with NIRSpec@JWST

Lorenzo Ulivi (University of Florence)

Arp 220 represents the closest prototypical ultraluminous infrared galaxy (ULIRG) in an advanced phase of major mergers. This study leverages the NIRSpec@ JWST to unravel the intricate kinematics within the nuclear region of Arp 220. Thanks to integral field data and NIR observations, we can penetrate the dust enshrouding the nuclear region, enabling a detailed exploration of Arp 220's nuclear environment. This work focuses specifically on the complex kinematics of Arp 220, with a detailed examination of both stellar and gas kinematics across various phases, encompassing ionized and molecular states.

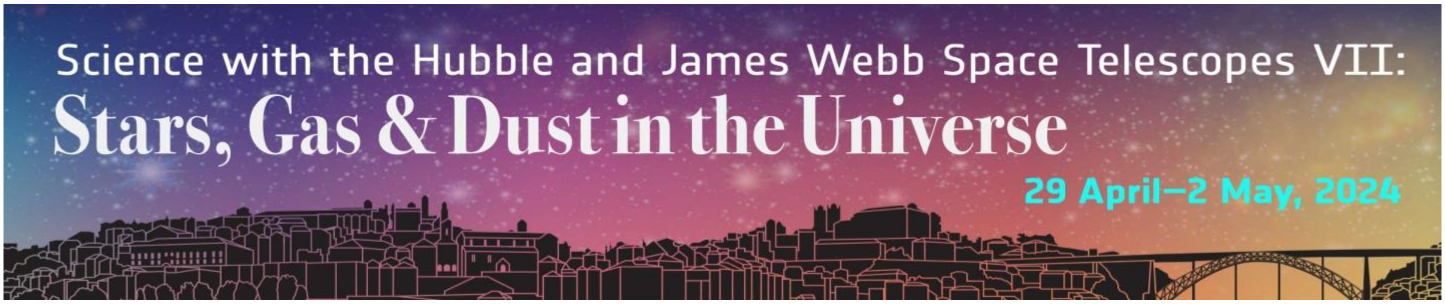
Employing Gaussian multi-fitting techniques, we disentangle the complex kinematic components within the nuclear region of Arp 220. Through decoupling processes, we isolate contributions from disc rotation, outflows, bubbles, streams and filaments due to the merging, confirming the previous scenario of two counter-rotating nuclei with a rotational disc observed at larger scale. Clear signatures of the presence of AGN have not been detected.

Our analysis reveals the presence of a high-velocity bubbles emerging to the western nucleus originated from shock. We also show the presence of extended outflow from the eastern nucleus both in ionized and molecular gas, and we compare it with outflows detected at larger scale with MUSE. We compute the mass, the mass outflow rate and the energetics of the outflowing gas finding connection with the extreme star formation occurring in the compact nuclei.

From JWST to ELT: What Studies Will Be Routinely Conducted on the High-z Universe After 2030?

Eros Vanzella (INAF-OAS)

The simultaneous operation of the Hubble and James Webb Space Telescopes is making the study of the early Universe an exciting endeavor. Unprecedented results have emerged in the last two years. Building on the recent and astonishing findings we obtained with JWST/NIRSpec and NIRCam in strongly lensed fields, this presentation will focus on the scientific endeavors anticipated for 2030 and beyond, leveraging the capabilities of the Extremely Large Telescope (ELT) and new instrumentation planned for the Very Large Telescope (such as MAVIS). In light of these recent results, predominantly JWST-based, some science cases previously outlined for the ELT now require revisitation. As an example, looking beyond 2030, the common scientific pursuit concerning high-z galaxies will be the characterization of the population of their stellar clusters, eventually representing the key agents for reionization and seeds of the globular cluster formation.



The Crown Jewels of JWST PEARLS: Project Overview and Main Results

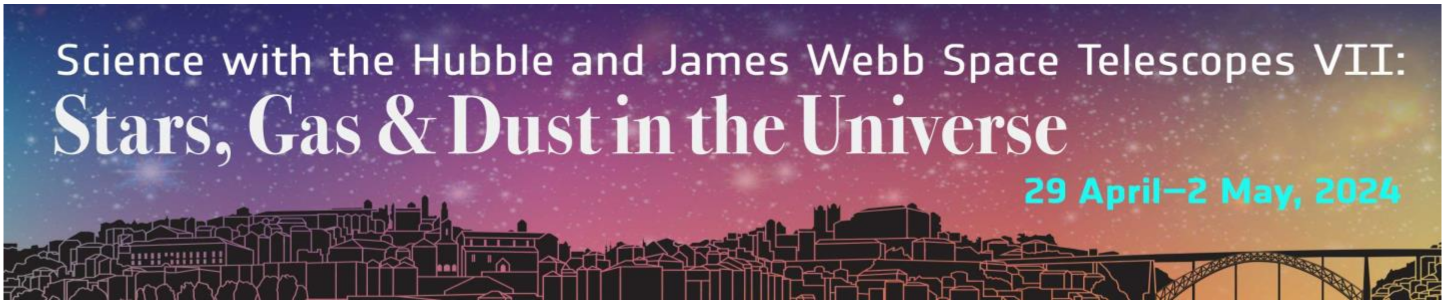
Rogier Windhorst (Arizona State University)

We present the main results from the combined HST+JWST data of the PEARLS project (``Prime Extragalactic Areas for Reionization and Lensing Science"). PEARLS used up to 13 NIRCam filters to survey 13 prime extragalactic survey areas with deep HST coverage. The main goal of PEARLS is to study the epoch of galaxy assembly, AGN growth, and First Light. Six PEARLS fields – the JWST North Ecliptic Pole (NEP) Time-Domain Field (TDF), the NEP IRAC Dark Field (IDF), and four lensing clusters – have now been observed in up to four epochs over a year, designed to find faint variable objects such as weak AGN, high-redshift supernovae (at z>1.5), and cluster caustic transits. PEARLS also includes NIRISS spectra for one of the NEP fields and NIRSpec spectra of two high-redshift quasars.
PEARLS images of the El Gordo, CLG1212, G165, and MACS0416 clusters showed a number of highly lensed dusty star-forming galaxies at z=2.3-4.3 at pc resolution, a lensed proto cluster or -group at z=4.3, and the first luminous Red Super Giant discovered at cosmological distances. The Planck selected proto-cluster G191 showed a number of objects with very high SFR at z=2.56. The protocluster TNJ1138 shows a very high, partly jet-induced SFR of 1800 $M_\odot$/yr in one of the most massive radio galaxies known at z=4.1. PEARLS found a triply lensed Supernovae at z=1.78 in the Planck cluster G165, where its 9-epoch time-delay observations constrain the Hubble constant at z=1.78. The collective lensed SFR behind these clusters is high enough that steady monitoring will yield a regular supply of future lensed high-z SNe during JWST's lifetime. The iconic combined 122-hr HST+22-hr JWST color images of MACS0416 over 6 epochs provided more than a dozen caustic transits of luminous stars beyond z=1-2, including a binary star at z=2.091, starting to constrain the bright end of the IMF at z>1 directly.
The PEARLS NEP fields delineated the high redshift LF and SFR, traced high redshift Balmer break galaxies, as well as high-z Direct Collapse Black Hole candidates, and showed that galaxy-galaxy lensing is not uncommon to JWST. PEARLS also provided the 0.9-4.5-micron galaxy counts and their Integrated Galaxy Light: analyzing the JWST sky brightness in 13 NIRCam filters yields our first strong constraints to truly diffuse light at 0.9-4.5 micron. PEARLS also imaged the overlapping galaxy pair VV191 at z=0.0513: the foreground spiral has a reddening law with R~1.1-2, suggesting a different grain population than in our Galaxy, while the back-lighting elliptical has a rather uniform globular cluster population. Most PEARLS observations are public in Spring 2024. PEARLS will be of lasting benefit to the community.

Properties of the Local Dust Environment Around the Type Ia SN 2009ig

Charlotte Wood (Iowa State University)

Light echoes can provide important insights into the progenitor systems and the local dust environments of type Ia supernovae (SNe Ia). Using the specific geometry of light echoes to map the dust in three dimensions, we can distinguish local, circumstellar dust from the interstellar medium and determine the dust properties of each separately. Here, we present results from analysis of the light echo around SN 2009ig. The structure of this light echo is complex, featuring a complete ring caused by a sheet of interstellar dust, two clumps caused by dust clouds, and a potential inner disk caused by circumstellar material associated with the SN itself. With a combination of ground-based and Hubble Space Telescope data, we compare the spectral energy distribution of the SN near peak to that of the light echo and determine the density and line-of-sight thickness of the dust sheet and clouds.



ABSTRACTS: POSTERS

The James Webb Interferometer: Joint model fitting to the accreting protoplanets and disk around PDS 70 reveals evidence for circumplanetary disk emission and additional asymmetric emission within the disk gap

Dori Blakely (U. Victoria)

With NIRISS interferometry, we observed the planet hosting system PDS 70 with the F480M filter (4.8 μm). We re-detect the accreting protoplanets PDS 70 b and c, at an SNR of 21 and 11, respectively. The measured photometry of the two planets provides evidence for circumplanetary disk emission, which we explore with SED model fitting to our new measurements along with literature photometry. We also find residual emission within the disk gap, at an SNR of ~4, at a position angle of 207 ± 11 degrees, and an unconstrained separation within 200 mas. Determining the nature of this residual emission will require follow-up observations. We place a 5σ upper limit of Δmag = 7.56 on the contrast of the candidate PDS 70 d at 4.8 μm, which indicates that if the previously observed emission is due to a planet, it has a different atmospheric composition compared with PDS 70 b and c. Finally, we calculate upper limits on emission from any additional planets in the disk gap and find an azimuthally averaged 5σ upper limit of Δmag ≈ 7.5 at separations greater than 125 mas, which are the deepest limits within ~250 mas at 4.8 μm.

Unveiling IZw18 age's mystery with JWST

Giacomo Bortolini (Stockholm)

The blue compact dwarf galaxy IZw18 is among the most enigmatic system known in the local universe (at a distance of approximately 18 Mpc). Since its discovery by Zwicky in 1966, the true nature of this system has sparked debates within the astronomical community. Indeed, with its blue color, high gas content, and extreme metal deficiency ($Z \sim 1/30\ Z_{Sun}$), IZw18 resembles a young galaxy at high redshift forming its first generation of stars. However, according to Legrand (2000) IZw18 is an old system that has formed stars for a prolonged period of time at a rate too low to efficiently enrich its interstellar medium. The most reliable method for estimating the age of nearby galaxies involves analysing the color-magnitude diagram (CMD) of their resolved stellar populations. Given IZw18's distance, this analysis was only feasible with the Hubble Space Telescope (HST), albeit pushing the limits of the telescope resolution. Consequently, a definitive consensus on the age of IZw18 remained elusive until the advent of James Webb Space Telescope (JWST).

I will present the first JWST/NIRcam 1.1- and 2.0-micron data of IZw18. We performed PSF-fitting photometry on these images to probe the galaxy's stellar populations with unprecedented sensitivity. Our analysis of its Near-infrared CMD reveals a very young stellar population, comprised of bright massive stars; but also, a faint population of red low-mass stars, linked to the underlying halo of the galaxy. I will also present our state-of-the-art CMD fitting technique that we used to derive IZw18's star formation history. In conclusion, I will discuss how our study contributes to the ongoing effort of unraveling the underlying mechanisms responsible for the low metal abundance in IZw18, as well as shedding light on star formation processes within low metallicity environments.

Unveiling Extreme Conditions Star Formation in the Galactic Centre with JWST NIRCam

Rubén Fedriani (Instituto Astrofisica Andalucia)

Massive stars are significant throughout the universe, however the mechanism by which they form is poorly understood. Here we present JWST-NIRCam observations of the Galactic Center molecular cloud Sagittarius C (Sgr C) in order to take a census of its star formation activity and test theoretical models of massive star formation in this extreme environment. In conjunction with ancillary NIR, MIR, FIR, and sub-mm data from Spitzer, SOFIA, Herschel, and ALMA, we characterise the massive protostar G359.44-0.102 via SED fitting as well as its neighbouring cores. The NIRCam data reveals in high resolution the outflows from these protostellar sources in the form of atomic and molecular hydrogen shocked material as well as large-scale ionised (HII) gas structures surrounding the main protocluster as traced by Brackett Alpha. Analysis of the spatial distribution and number density of YSOs surrounding G359.44-0.102, with the extraordinary sensitivity and FOV of JWST-NIRCam, place important constraints on theories of massive star formation and the initial mass function (IMF). Global color analysis also indicates the presence of YSO candidates across the field and helps shed light on the protocluster environment in this extreme region. Finally, we report the discovery of a new star-forming region ~1' to the west of the main protocluster, hosting two prominent bow shocks visible in H2 emission driven by at least two actively forming YSOs.

A search for transients in the Reionization Lensing Cluster Survey (RELICS) and some prospects

Miriam Golubchik (Ben-Gurion University)

Strong lensing of transient sources such as caustic crossing events of lensed stars, supernovae or varying AGN, has risen in interest in recent years due to the ability to teach us about the lensed sources, but also constrain the dark matter composition of the lens. Lensed SNe have been attracting much interest, in part since they are expected to be found up to larger redshifts - and thus potentially improve the constraints on the cosmological parameters through their contribution to the Hubble diagram and on the Hubble constant from measured time delays. The rate of SNe in galaxy clusters in particular has also spurred much interest. The distribution of delay time between a burst of star formation and the explosions as SNe in galaxy clusters acts as a key role in characterizing the process of chemical or metal enrichment of the instracluster medium and the galaxies within it and may shed light on the progenitors of Type Ia SNe which still remains an open research question. Here we report the results from a search for transients in Hubble Space Telescope (HST) images taken for the RELICS program. We find a number of prominent supernova (SN) candidates over the 41 fields - three of them reported for the first time. Those findings lay the groundwork for a future SN rate study. In addition, our search supplies empirical bounds for the rate of caustic crossing events in galaxy cluster fields to typical HST magnitudes.

Thanks to its unprecedented NIR sensitivity and spatial resolution, the JWST will play an important role in future time domain studies using strong-lensing, extending the range of observable objects to fainter magnitudes and higher redshifts, as was already demonstrated by various high-redshift lensed stars or multiply imaged supernovae. Recently, JWST has been uncovering new populations of supermassive high redshift black holes, such as the 'little red dots', some of them multiply imaged. We make forecasts for the expected numbers of multiply imaged AGN in strong lensing clusters that may be found with JWST or other new facilities (e.g., Euclid, Roman), and discuss the possibility to exploit the time-delays for a more efficient reverberation mapping of high-redshift AGN.

I Zw 18: Dust Life Cycle at Very Low Metallicity

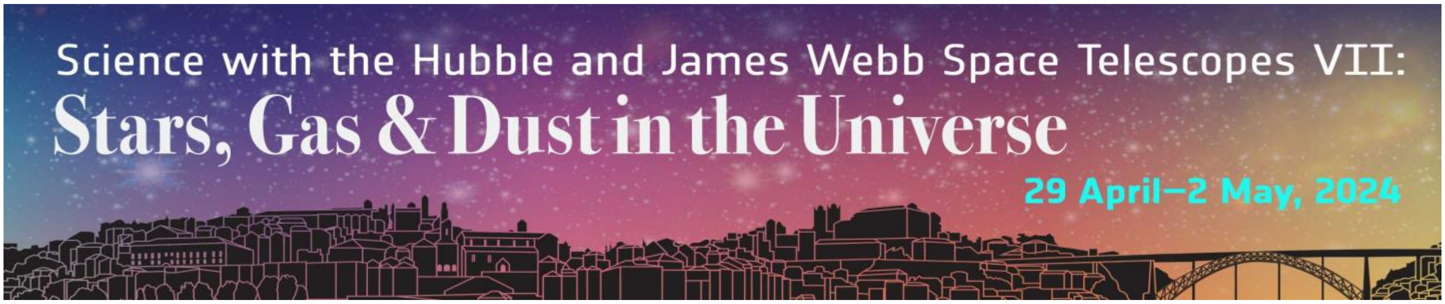
Alec Hirschauer (STScI)

A James Webb Space Telescope (JWST) imaging survey of I Zw 18, an archetypal extremely metal-poor (XMP), star-forming blue compact dwarf (BCD) galaxy, has been conducted. With a metallicity of only ~3% solar, I Zw 18 is an excellent analog for galaxies at high redshift, including during the epoch of peak star formation. The study aims to understand the origins of dust and dust-production mechanisms in the metal-poor environments typical of the early Universe by characterizing its evolved star population. The JWST data provide a comprehensive infrared (IR) view of I Zw 18, utilizing four filters each of NIRCam and MIRI photometry. The analysis reveals a recent starburst spatially concentrated in the northwest SF region, an intermediate-aged population of oxygen- and carbon-rich AGB stars spatially concentrated in the southeast SF region, and an older underlying population of red supergiant (RSG) stars populating the galaxy's halo. Additionally, we detect YSOs which trace the massive star formation taking place in I Zw 18, as well as evidence for a possible recent gravitational interaction with its companion system known as Component C. As I Zw 18 is among the furthest galaxies for which observations with JWST's magnificent spatial resolution are capable of resolving individual stars, these important results set the standard for future stellar populations studies of star-forming systems, including those at XMP levels of enrichment.

H2 with Hubble + JWST

Keri Hoadley (University of Iowa)

Molecular hydrogen (H2) is the most abundant molecule in the universe, yet it remains notoriously difficult to observe. With its presence vitally important to many astrophysical processes, it is important that we understand its role in cosmic ecosystems and the delicate balance between the formation and dissipation of environments where stars and planets form. The combination of HST and JWST provides a unique window into the physical state of molecular hydrogen: in the ultraviolet (UV), non-thermal transitions cause H2 to fluoresce, leading to signatures that can be probed by HST in the UV through absorption and line emission spectra, while in the infrared (IR), the continued fluorescence cascade and weaker transitions linked to thermal H2 populations are observed via emission. In this poster, we present how H2 populations could be fully characterized (e.g. density, temperature) with the combined UV + IR signatures observed with HST + JWST. We'll present one case study, using the "Blue Ring Nebula", an H2-emitting nebula whose key nebular properties (e.g., mass) are currently



unconstrained but would be measured with combined UV absorption line spectroscopy + JWST H_2 band imaging/spectroscopy.

Measuring Mira Distances with HST and JWST

Caroline Huang (Harvard CfA)

Precise, cosmic distance ladder measurements made with Cepheids have revealed a 5σ discrepancy in the observed rate of expansion of the universe at the present day (the Hubble Constant) and the rate predicted by observations of the Cosmic Microwave Background assuming a standard Lambda-Cold Dark Matter cosmology. With no obvious solutions to the tension, this discrepancy has been one of the strongest indications of physics beyond the Standard Model of Cosmology. As a result, the use of multiple, independent methods measuring the Hubble Constant is integral to resolving or solidifying the tension. Mira variables – highly-evolved asymptotic giant branch stars – have gained attention as an alternative precision distance indicator and calibrator of Type Ia supernovae to the more widely-used Cepheid or Tip of the Red Giant Branch stars. In addition to being highly luminous and ubiquitous, they are capable of being easily detected and characterized using only near-infrared and infrared observations, which is particularly advantageous in the era of JWST and Roman. My poster will highlight current progress in the development of the Mira distance ladder and its Hubble Constant measurements using HST and JWST. In particular, I will show recent HST and JWST observations of Mira variables in M101, the nearest recent host galaxy of a Type Ia supernova.

The hidden stellar emission from ALMA-mapped sub millimeter galaxies with JWST

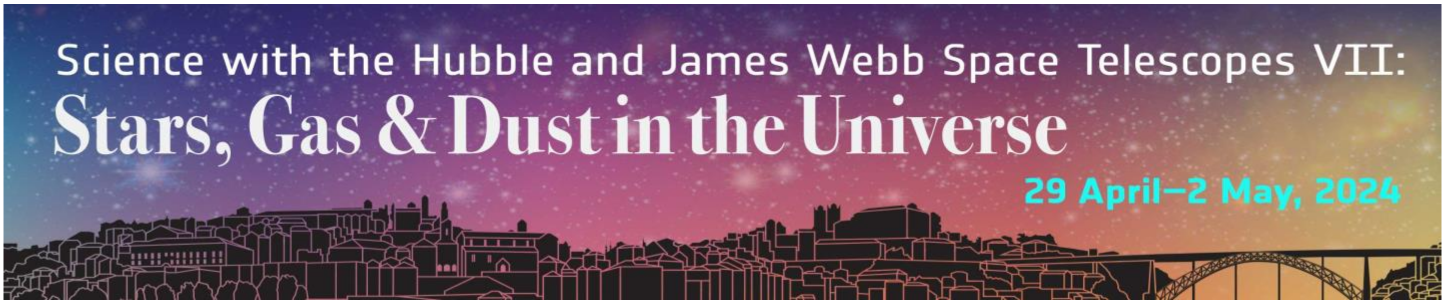
Sarah Kendrew (ESA/STScI)

We present JWST imaging of a sample of ALMA-mapped star-forming galaxies at redshifts ~1-4. The nature of the most highly star-forming galaxies in the Universe remains something of a mystery: despite forming stars at 100s-1000s of Msol per year, submillimeter-bright galaxies (SMG) are notoriously difficult to study with optical telescopes due to their extreme dust obscuration. ALMA' s supreme spatial resolution has revolutionized the study of these objects, revealing the dust-obscured star formation in SMGs in unprecedented detail. With JWST, we targeted the rest-frame ~500 nm to 2 μm with NIRCam and MIRI to reveal for the first time the hidden stellar emission for a sample of 12 SMGs, at a resolution matched to high-S/N ALMA imaging. The data allow us to visualize for the first time the morphologies of these galaxies in stellar emission, and, in combination with ALMA imaging, providing the necessary context to interpret their bursty star formation. Our results demonstrate the power of combining JWST with submm observations from ALMA at matched resolution for studying the spatially resolved properties of these highly star-forming galaxies in unprecedented detail.

Tracing the stars, gas and dust in young stellar clusters: The JWST potential

Nanda Kumar (Centro de Astrofisica da Universidade do Porto)

Clusters are the most prominent mode of star formation in our galaxy. Hub-filament systems are the progenitors of star clusters, and all massive star formation take place in the hubs. Understanding the



relation between the stars and cold molecular filaments in the hub-filament systems is fundamental to distinguish between fast vs slow star formation and the long vs short life-time of molecular clouds. It is also the key to explore the exact mechanism of massive stars and cluster formation. I will show the stellar, gas and dust content in the nearby star forming region Mon R2 and demonstrate the JWST/HST/ALMA potential to examine the above key issues in star formation.

An Independent Determination of H_0 Based on the JAGB Method

Abigail Lee (University of Chicago)

One particularly powerful avenue for uncovering systematic errors in the local distance scale is to compare the TRGB and Cepheid distances with a third, equally accurate and precise yet still completely independent distance indicator. Until recently, no such distance indicator existed. However, the Chicago-Carnegie Hubble Program (CCHP) has recently developed an incredibly promising standard candle based on the constant-luminosities of carbon-rich asymptotic giant branch (AGB) stars in the J band, called the J-region asymptotic giant branch (JAGB) method, which is parallel to but independent of the Cepheid and TRGB distance scales. The JAGB method offers a number of advantages in measuring distances compared with the TRGB and Cepheids; these include: dust extinction is minimized in the near infrared observations, only one epoch of observations is requisite to measure JAGB distances, JAGB stars are about a magnitude brighter in the near infrared than the TRGB, JAGB stars are easily identified solely via their colors and magnitudes, and finally, JAGB stars are mostly ubiquitous, being found in all galaxies with intermediate-age populations. We first present a test for potential astrophysical systematics of the JAGB method in the galaxy M31 based on archival Hubble Space Telescope (HST) data. This test, as well as studies from ground-based imaging, showed the JAGB method is as accurate and precise in measuring distances as the TRGB and Cepheid distance scales in nearby galaxies. Next, we present distances to seven nearby SN Ia host galaxies (d < 23 Mpc), measured from the CCHP's James Webb Space Telescope (JWST) NIRCam imaging. The zero-point of this JAGB distance scale is set by the water mega-maser distance to NGC 4258. These distances set the basis for a new and independent determination of the local value of the Hubble constant (H0) based on a calibration of the JAGB method applied to Type Ia supernovae (SNe Ia).

Powerful Radio Sources in the Southern Sky: entering the SKA era with HST and JWST

Francesco Massaro (University of Turin)

Since the early sixties our view of radio galaxies and quasars has been drastically shaped by discoveries made thanks to observations of radio sources listed in the Third Cambridge catalog and its revised version (3CR). However, the largest fraction of data collected to date on 3CR sources was performed with relatively old instruments, rarely repeated and/or updated. Importantly, the 3CR contains only objects located in the Northern Hemisphere thus having limited access to new and innovative astronomical facilities. To mitigate these limitations, we present a new catalog of powerful radio sources visible from the Southern Hemisphere and based on equivalent selection criteria as the 3CR. This new catalog: G4Jy-3CRE, lists a total of 264 sources at declination below 5deg and with 9Jy limiting sensitivity at ~178 MHz. First, I will present all results obtained from radio, IR, optical archival observations to search for counterparts of radio nuclei as well as those recently achieved thanks to both (i) the optical spectroscopic campaign, carried out to obtain redshifts and classify all sources, and (ii) UV and X-ray follow up observations. Finally, I will show how surveying G4Jy-3CRE sources, at all frequencies but in particular with HST and JWST, will have a tremendous impact on the physics of radio-loud AGNs and their environments. This will be illustrated comparing HST results achieved in the past decades on the 3CR catalog as well as presenting future perspectives reachable with JWST observations.

Sizes and ages of star clusters inside the bubbles traced in the JWST/MIRI images

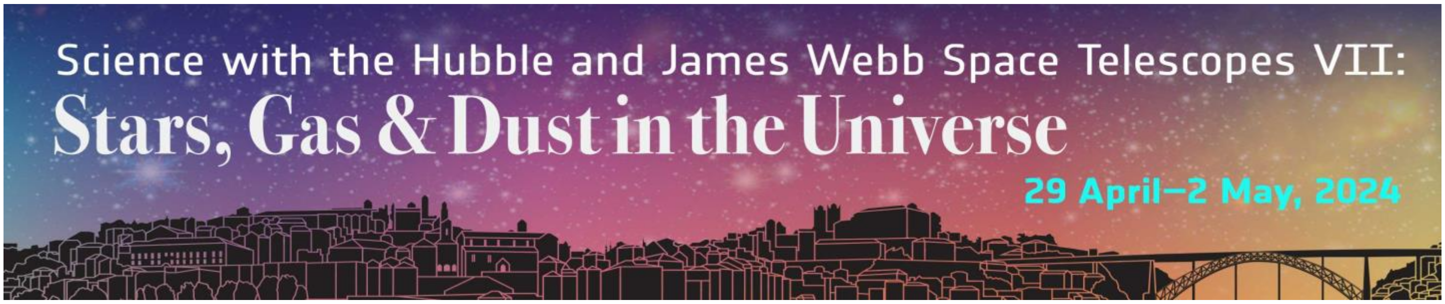
Divakara Mayya (INAOE)

JWST images in MIRI filters of nearby star-forming galaxies have changed the textbook description of the interstellar medium (ISM) as largely constituting static gas uniformly distributed with compact pockets of molecular clouds and HII regions. Instead, the MIRI images depict a dynamic ISM with expanding bubbles occupying most of the area between HII regions. The interarm regions are also filled with bubbles. Bubble formation requires massive stars, which are expected to be located in associations and clusters. We are carrying out a systematic search for the remnant clusters inside the MIRI bubbles in galaxies observed by JWST and HST. In the Spring symposium, I plan to summarize the results on the demographics of the stellar populations responsible for the creation of the bubbles in the late-type spiral galaxy NGC628. The spatial resolution of the JWST and HST images of NGC628 permits studying the remnant stellar population using the color-magnitude diagram of the resolved stellar population. The remnant stellar populations inside the bubbles are not clustered as anticipated, and instead are spatially distributed over the entire area of the bubble. The populations show an age spread as large as 50 Myr. The observations support a spatially-segregated scenario of star formation, with new stars successively formed in the dense expanding shell.

Identifying and Characterizing Faint DSFGs Using JWST NIRCam Priors

Stephen McKay (University of Wisconsin-Madison)

JWST NIRCam imaging provides a powerful complement to SCUBA-2 observations of dusty star-forming galaxies (DSFGs). Using deep SCUBA-2 450- and 850-micron imaging along with ALMA 1.2 mm data on the massive lensing cluster field Abell 2744, we assess how effective the combination of red JWST priors and the wider-field SCUBA-2 data is for finding faint DSFGs, compared to more expensive mosaicked ALMA observations. We cross-match our previously reported direct (> 5-sigma) SCUBA-2 sample and red JWST NIRCam prior-selected (> 3-sigma) SCUBA-2 sample to direct ALMA sources from the DUALZ survey, finding that 95% of the red counterparts are confirmed by ALMA. Next, we extend this method to GOODS-S and use the red JWST priors to increase the depth at which we can detect SCUBA-2 galaxies. These results emphasize the power of combining SCUBA-2 data with JWST colors to map the faint DSFG population.



Calibrating the Tip of the Red Giant Branch Distance Method in HST and JWST Near Infrared Filters

Max Newman (Rutgers University)

Accurate and precise distances to nearby galaxies are fundamental to placing myriad galaxy properties on absolute scales. Such distances are also a critical input for measuring the expansion rate of the Universe, the Hubble constant (H_0). To make these measurements techniques have been developed using extragalactic resolved stellar populations. Among these techniques, the Tip of the Red Giant Branch (TRGB) distance method become one of the leading distance indicators to nearby galaxies.

The TRGB is typically measured at optical wavelength, yet in the near infrared (NIR) the TRGB is brighter and offers significant observational gains. We present new, empirical calibrations of the TRGB in the NIR from both HST WFC3/IR and JWST NIRCam and NIRISS imaging. We first developed the calibration methodology using the HST F110W and F160W filters, anchored to robust distances measured in optical F814W filter. We then adopt this same approach to JWST imaging on the same galaxies to provide the community with calibrations for JWST instruments in 8 filters: (NIRCam F090W, F115W, F150W, F277W, F356W, F444W AND NIRISS F090W, F115W, and F150W.

I will present data and results from both great observatories and discuss how the TRGB brightness changes as a function of wavelength due to changes in stellar metallicity. In addition, I will highlight the impact of the quality of photometry due to the increased resolution in moving from HST to JWST imaging has on the precision of the TRGB calibration.

High-Mass X-ray Binaries and what do the HST and the JWST teach us about them

Lidia Oskinova (Universität Potsdam)

High-mass X-ray binaries (HMXBs) represent an important life-stage of compact objects, neutron stars and black holes, during which they accrete matter lost by their massive star companion. X-ray observations provide fascinating view on this process. But HMXBs also reveal a lot about lives of massive star donors and the binary star evolution in general. The HST UV observations are invaluable for the donor star studies. I will present our recent joint X-ray and HST observations of X-ray binaries, including the eclipsing black hole binary M33 X-7. These multiwavelength data allowed us to drastically revise the back hole mass, and elucidated the physics of accretion in very massive close binaries. Furthermore, I will present the HST spectroscopic observations of an ultra-luminous X-ray source (ULX), and discuss how the HST and JWST can help in the quest to find the potential progenitors of gravitational wave events in nearby galaxies. The multi wavelengths approach and combining the powers of great observatories is the only way forward to understand HMXBs and their role in cosmic history.

Do massive stars in the Early Universe rotate rapidly? New horizons on metal-poor dwarf galaxies

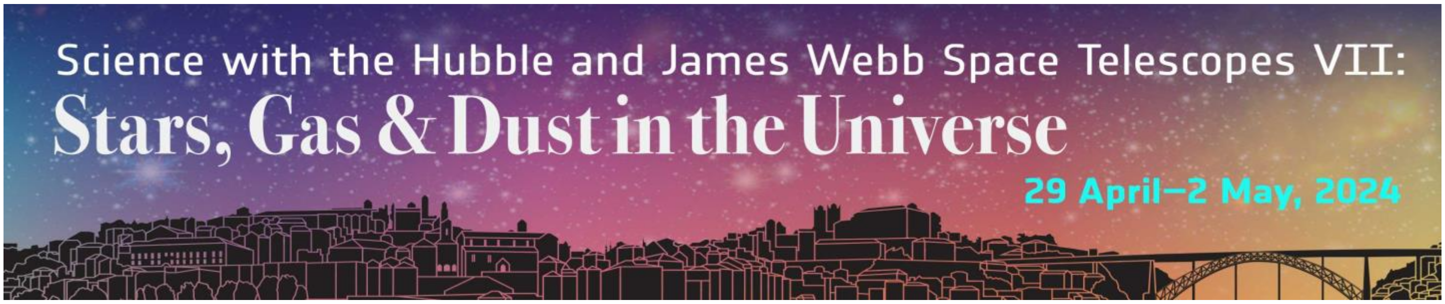
Abel Schootemeijer (Argelander Institut für Astronomie)

Extremely rapidly rotating massive stars tend to form decretion disks and manifest themselves as OBe stars. So far, OBe stars have been identified with spectroscopy and narrow-band H-alpha photometry. As such, studies were limited to sub-populations of the Milky Way and its nearby satellite galaxies up to ~0.06 Mpc away. Here, we present a novel method to identify OBe stars with broad-band photometry. This method allowed us to use archival data of the Hubble Space Telescope to identify the entire OBe star populations in much more distant metal-poor dwarf galaxies at the edge of the Local Group (Sextans A, 1 Mpc) and beyond the Local Group (Holmberg I and II, 3-4 Mpc). In their so-far unexplored metallicity regime of 0.1-0.2 Z_Solar, we find high OBe fractions of about 30%. This implies that among massive stars in the early universe, where the metallicity was also low, extremely rapid rotation was commonplace. This is thought to strongly affect the lives of these progenitors of supernovae, gamma-ray bursts, neutron stars, and black holes, and may explain why some of these phenomena arise mainly in low-metallicity environments. We will discuss potential future efforts to use JWST to probe even more primordial galaxies.

JWST observations of edge-on protoplanetary disks: the case of HH30

Ryo Tazaki (IPAG, Université Grenoble Alpes)

Protoplanetary disks are the sites of ongoing planet formation. The crucial initial step in this process is the vertical settling of dust grains, leading to the formation of a dense pebble layer in the midplane of the disk. The formation of this pebble layer is a prerequisite for efficient planetesimal formation. However, our understanding of this stage has been poorly informed by disk observations. Observationally studying the vertical structure of disks is best achieved through edge-on protoplanetary disks. Thanks to their unique viewing geometry, these disks provide a direct insight into the disk's vertical structure. The contribution of JWST is particularly important as it bridges the gap in wavelength (and grain size) between HST and ALMA.
Here, we will present results, in particular on HH 30, from our JWST Cycle 1 program (#2562) targeting four edge-on protoplanetary disks. We obtained the disk images at five different wavelengths ranging from 2 μm to 21 μm, utilizing NIRCam and MIRI instruments. The near-infrared image of the HH30 disk reveals the disk reflection nebula with the dark lane as well as intriguing disk structures, including the jet and outflow, a spiral-like structure, and a tail extending toward the southern region of the disk. The reflection nebula shrinks vertically and radially with increasing wavelength, but the nebula is still visible up to a wavelength of 12 μm, indicating the presence of about 10-μm-sized grains in the disk surface. We will also discuss how the wide wavelength coverage of the scattered light images, provided by the combination of HST and JWST, could be used to understand dust scattering properties and dust settling.



Extragalactic dust filament network properties based on emission and attenuation via JWST and HST

David Thilker (John Hopkins University)

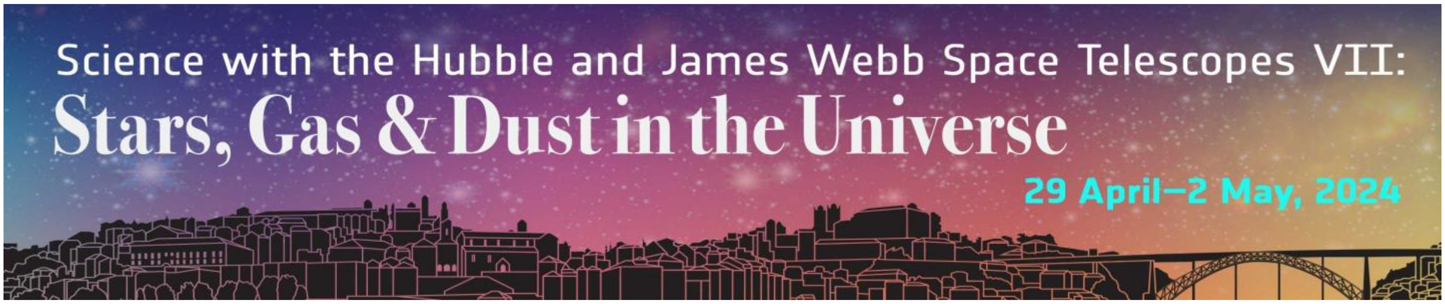
JWST observations of nearby galaxies reveal the dusty ISM to be intricately structured into filaments and bubbles, to a degree beyond that previously appreciated based on optical HST imaging alone. We transform each of the 19 PHANGS-JWST(+HST) galaxies into a set of flux-conserving multi-scale images for all observed bands. These images are then further processed to identify significant filamentary structures (on a continuum of scales, in emission and attenuation) that together constitute the dust filament network (DFN). We present the measured properties of the DFN, focusing on quantities such as filament length, aspect ratio, and estimated dust mass; and explore metrics for morphologically distinguishing between zones of quiescence, dynamical structuring, and mechanical feedback domination. Observed quantities are compared to equivalent measures from simulated galaxy disks.

Leo T Dissected with HST and MUSE

Daniel Vaz (Universidade do Porto)

Nearby, a subset of the earliest galaxies that persisted until the present day as relics of the early universe offers a unique glimpse into the past. They are known as Ultra-Faint Dwarfs (UFDs). These UFDs are essential objects to understand as they stand among the oldest galaxies known to exist and have undergone minimal evolution since their formation. They are invaluable probes of the early universe, shedding light on the early stages of galaxy formation and evolution. Moreover, they are excellent laboratories for studying star formation and feedback in the feeblest halos. They are ideal for placing constraints on dark matter models, given that dark accounts for up to 99% of their total mass. They represent the extreme low-mass end of galaxy assembly. Within the cohort of UFDs, Leo T has received considerable attention for a compelling reason: it is the faintest and least massive dwarf galaxy known to contain neutral gas and exhibit signs of relatively recent star formation. This sets it apart and positions Leo T as a natural 'Rosetta stone' for testing galaxy formation models, which have struggled to reproduce Leo T-like galaxies until very recently.

In this contribution we show results of a study of Leo T that we have done by combining data from the MUSE integral field spectrograph and photometric data from the HST. We have studied the age and metallicity of the stars. We identify two populations of stars, all consistent with similar metallicity. Within the young population sample, we discovered three emission line Be stars - a first for ultra-faint dwarfs. The high sensitivity of MUSE allowed us to obtain velocity measurements for stars as faint as magnitude ~24, which allowed us to increase the number of Leo T stars observed spectroscopically from 19 to 75. While looking for differences in the dynamics of young and old stars we find that they have different kinematics, with the young population having a velocity dispersion consistent with the kinematics of the cold component of the neutral gas. In this contribution we discuss these results and their implications for the origin and evolution of Leo T.



A JWST IFU deep study of gas, dust, and PAHs in a prototypical externally illuminated protoplanetary disk

Silvia Vicente (Instituto de Astrofísica e Ciências do Espaço)

JWST Cycle2 program GO 4332 (PI: S. Vicente) conducts a deep observational study of an EUV+FUV externally illuminated protoplanetary disk (proplyd) found in the Orion Nebula Cluster (ONC) using the IFU modes of NIRSpec and MIRI-MRS. The JWST IFU observations spatially resolve the disk, neutral cocoon and ionization front simultaneously over the 0.9 - 11.7 micron spectral range providing key line, continuum and PAHs diagnostics to trace the physical conditions, the chemical composition and abundances under the effect of the external FUV-radiation. It is the FUV radiation that changes the thermal structure and chemical composition of the disk and sets the mass-loss rate through photoevaporation. By comparing our results to those of protoplanetary disks (TTauris) found in nearby low-mass star forming regions one can start to assess the real effects of a FUV-dominant environment on protoplanetary disk evolution and planet formation. This poster introduces program GO 4332 and shows preliminary results of the recently acquired MIRI-MRS observations.

Discovering planetary-mass brown dwarf candidates in the Small Magellanic Cloud

Peter Zeidler (AURA/STScI for ESA)

We present a JWST study of the Small Magellanic Cloud (SMC) young star cluster NGC 602, a rare nearby low-metallicity example of massive star formation in isolation. Even with its unfavorable location in a remote, low gas-density region, the O and B-star rich cluster shows a high star for-mation rate, comparable to well-studied regions in the Milky Way and the Magellanic Clouds. Despite the rareness in the Local Group, star formation in galactic streams is a common phenom-enon at high redshifts and in interacting galaxies. The low-metallicity environment of the SMC is the closest stellar laboratory with conditions similar to the Cosmic Noon.

With our JWST NIRCam photometry we discovered the first bona-fide Brown Dwarf (BD) candi-dates at sub-Solar metallicity outside the Milky Way. These BD candidates have masses between 10 and 80 MJup following a spatial distribution similar to the rich cluster pre-main-sequence (PMS) showing "stream-like" features from the North toward the central cluster. Thus, we suggest that the newly discovered candidate BDs are from the same star formation episode as the PMS stars, which occurred about 2 Myr ago. The detection of these first BD candidates will allow us to ana-lyze the shape of the mass function at substellar masses.

In total we photometrically extracted over 16,000 point-sources from our NIRCam data. Here, the large field-of-view covering 3! × 6′ allows us to simultaneously probe the vicinity of the clus-ter region, which revealed, for the first time, numerous star-formation sites far outside the influ-ence of the massive cluster stars. This dataset will allow a detailed characterization of how star and star cluster formation occur in low-density galactic streams.