TRANSIENTS FROM SPACE

March 11-13 , 2025

STScI

Workshop Description:

Transient science is entering an exciting new era of discovery. The 2020 Decadal Survey named Time Domain Astronomy (TDA) as a top priority, and NASA's Physics of the Cosmos (PCOS) program has prioritized Time Domain And Multi-Messenger (TDAMM) astrophysics. New discoveries will be greatly impacted by space-based telescopes, including, but not limited to, HST, JWST, Swift, Chandra, Fermi, TESS, Euclid, UVEX, ULTRASAT, LISA, and Roman. These telescopes probe new phase space in time, wavelength, and redshift, thereby opening up new sub-fields. This STScI workshop will explore novel research made possible by these telescopes and discuss how the community can optimize scientific output in the future. It will feature invited talks, contributed talks, posters, discussion panels, and fun social activities.

Workshop Objectives:

- Highlight and build off successful science driven by space telescope data and policies;
- Uncover regions of overlap among telescopes and discuss opportunities for cross-mission synergies;
- Identify community needs for research and collaboration, particularly in the upcoming era of big data;
- Optimize future space-based observations for the entire community.

Workshop Topics:

- Early-Time Observations: SNe Ia, Fast Transients, Shock Breakout
- High-Energy Transients: GRBs, GW
- Progenitors: pre-explosion variability, stellar evolution
- Infrared Transients: dust, SNRs, echoes, TDEs, AGN
- High-z Transients: Lensed SNe, extreme explosions (SLSNe, PISNe), TDEs, AGN
- Survey Science: Euclid, Roman, UVEX, Big Data
- Theory of explosive transients and compact objects

Working Groups:

This STScI workshop will explore exciting time-domain research made possible by space telescopes and discuss how the community can optimize scientific output in the future. Throughout the workshop, we will facilitate discussions on related topics. At the end of each day, we will have three distinct working groups that will consider the following questions:

- What were some of the most exciting opportunities enabled by space telescopes, both hardware and policies?
- What were some of the biggest challenges faced when using space telescopes?
- Is there any policy, infrastructure, software, or hardware that could have made the experiment easier or better?
- What are some of the biggest opportunities and challenges that the field faces in the next five years? And what can we, as a community, do now to prepare?

SOC Members:

- Ori Fox (Space Telescope Science Institute, Chair)
- Suvi Gezari (Space Telescope Science Institute, Co-Chair)
- Armin Rest (Space Telescope Science Institute, Co-Chair)
- Lou Strolger (Space Telescope Science Institute, Co-Chair)
- Jennifer Andrews (Gemini Observatory)
- Isobel Hook (Lancaster University)
- Rebekah Hounsell (Goddard Space Flight Center)
- Patrick Kelly (University of Minnesota)
- Takashi Moriya (National Astronomical Observatory of Japan)
- Robert Quimby (San Diego State University)
- Tea Temim (Princeton University)
- Yossef Zenati (Johns Hopkins University/Space Telescope Science Institute)

Important Information:

- Website: www.stsci.edu/events/transients-workshop
- Welcome Packet
- In-Person Registrant List
- Event Shuttle Schedule
- Slack Channel (Workshop Communication)

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Workshop Agenda

STScI

Tuesday, March 11, 2025

Time	Title		Speaker	Location
8:00am	Breakfast + Posters	**Speaker Tech Check for Session 1**		Café
8:30am	Conference Welcome		Jen Lotz, STScI Director	Auditorium
8:45am	Workshop Logistics and Goals		Ori Fox, Chair	
Session 1: The State of the Field, Chair: Ori Fox				
9:00am	Transients from Space: Where We Are and Where We Are Going		Saurabh Jha (I)	Auditorium
9:25am	ACROSS: Enabling Time Domain and Multi-messenger Astrophysics		Jamie Kennea (C)	
9:40am	The landscape of the high-energy transient sky		Andrew Levan (C)	
9:55am	A Gold Sample of Young and Nearby Transients from the UV to the NIR		Manisha Shrestha (C)	
10:10am	Poster Pops		Yaron, Mo, Kirshner, Crawford, Baer-Way, Lazzati, Parra, Liu, Larison, Su, Eracleous, Ryder, Jeong, Paek, Dimitrova	
10:40am	Coffee Break + Posters	**Speaker Tech Check for Session 2**		
Session 2: Early Time Observations, Chair: Pat Kelly				
11:10am	Early Ultraviolet Observations of Supernovae		Azalee Bostroem (I)	Auditorium
11:35am	Transient science with high cadence survey: Kepler, TESS, and future missions		Qinan Wang (I)	
12:00pm	Ultraviolet Spectroscopy of a Luminous Fast Blue Optical Transient		Dan Perley (C)	
12:15pm	Ultraviolet observations of infant Supernovae		Erez Zimmerman (C)	
12:30pm	Lunch	**Speaker Tech Check for Session 3**		Café
Session 3: Dusty SNe and SNRs, Chair: Tea Temim				
1:45pm	Supernovae and the Dust Budget: A JWST Review		Melissa Shahbandeh (I)	Auditorium
2:10pm	Space observations of supernova remnants & the unique case of SN 1987A		Josefin Larsson (I)	
2:35pm	Dust formation in massive stars, before and after supernova explosion		Arkaprabha Sarangi (C)	
2:50pm	SN2023fyq: The first Type Ibn Supernova with a Detected Progenitor System & Silicate Dust Formation		Kirsty Taggart (C)	
3:05	Coffee + Posters			Café
Session 4: Splinter Working Groups				

Early Time Observations and Target of Opportunity (ToO)	Stellar Transients and Mergers	Dust and SNR
Auditorium; Scribe: Suvi Gezari	*Bloomberg 462; Scribe: Lou Strolger*	*CaféCon, Scribe: Ori Fox*
3:45pm Spark Talks:	3:45pm Spark Talks:	3:45pm Spark Talks:
Facilitators: Jen Andrews, Robert Quimby, Armin Rest, Suvi Gezari	Facilitators: Yossef Zenati, Lou Strolger, Rebekah Hounsell, Takashi Moriya	Facilitators: Ori Fox, Tea Temim, Pat Kelly
Chair: Wynn Jacobson-Galan *Panchromatic Observations of Young Supernovae*	Chair: Danielle Frostig *WINTER: Advancing Infrared Time-Domain Surveys and Roman Preparatory Science*	Chair: Geoffrey Clayton *Very Late-Time JWST Observations of Dust in SN 1995N*
Bhagya Subrayan *Probing Shock Breakout and Cooling Emission of SN2024uwq with Early Swift UV Observations*	Andrea Antoni *Low-Energy Transients Following "Failed" Supernovae of Red and Yellow Supergiants*	Jacob Jencson *A JWST View of the Dynamic ISM with Thermal Echoes of Cas A*
Norbert Schartel *XMM-Newton: Scientific Policy and Target of Opportunities*	John Bally *Protostellar Mergers and Explosions: A New Class of IR Transients?*	Sam Rose *Confirmation of the first low-metallicity highly dust producing Wolf-Rayet system with JWST/NIRSpec*
Ryotaro Chiba *Exploring pre-supernova mass loss with modelling of double-peaked type Ibc SNe*	Michael Fausnaugh *The Unique View of TESS on Transient Astronomy*	Dan Milisavljevic Understanding Supernovae Via Their Remnants in the Era of JWST
4:30pm Discussion	4:30pm Discussion	4:30pm Discussion

5:30pm	Welcome Reception	Café
7:30pm	**OPTIONAL:** Social Outing at Union Craft Brewing	1700 W 41st St #420, Baltimore, MD 21211

Wednesday, March 12, 2025

Time	Title	Speaker	Location
8:00am	Breakfast + Posters **Speaker Tech Check for Session 5**		Café
8:00am	Special Tutorial: Deploying Machine Learning in Time-Domain Astronomy	Michael Coughlin	
9:00am	The Roman Research Nexus (RRN)	Gisella de Rosa (C)	Auditorium
Session 5: High-z Transients, Chair: Armin Rest			
9:15am	Overview of high-z SNe with JWST	Justin Pierel (I)	Auditorium
9:40am	Discoveries of strongly lensed SNe with HST and JWST	Wenlei Chen (I)	
10:05am	The JADES Transient Survey: Discovery and Classification of Supernovae in the JADES Deep Field	Christa DeCoursey (C)	
10:20am	Transient Discoveries in the JWST Era	Haojing Yan (C)	
10:35am	Poster Pops	Sears, Suresh, Moriya, Pasham, Lu, Perkins, Skiathas, Pandey, Mishra	
10:50am	Coffee Break + Posters **Speaker Tech Check for Session 6**		Café
Session 6: Survey Science, Chair: Lou Strolger			
11:20am	Stories of stellar birth and death: The next decade of infrared transient discoveries	Kishalay De (I)	Auditorium
11:45am	Challenges and opportunities of Machine Learning and AI for the next-generation astronomical surveys	Federica Bianco (I)	
12:10pm	Investigating the Host Galaxy Properties of Spectroscopically and Photometrically Classified CCSNe	Anya Nugent (C)	
12:25pm	The Landscape of "Extreme" and "Exotic" Transients	Brian Metzger (I)	
12:50pm	Group Picture		Café
1:00pm	Lunch **Speaker Tech Check for Session 7**		Auditorium
Session 7: TDEs, AGN, Nuclear Transients, Chair: Suvi Gezari			
2:00pm	Overview of High-Energy Observations of Tidal Disruption Events	Yuhan Yao (I)	Auditorium
2:25pm	Identifying mid-IR nuclear transients and their connection to neutrino sources	Christos Panagiotou (C)	
2:40pm	A New Population of Mid-Infrared-Selected Tidal Disruption Events	Megan Masterson (C)	
2:55pm	New Developments in Late-Time Emission in Tidal Disruption Events	Yvette Cendes (C)	
3:10pm	Coffee + Posters		Café
Session 8: Splinter Working Groups			

High-Z SNE and Transients	High Energy Observations	Stellar Pops and Progenitors
Auditorium; Scribe: Armin Rest	*CaféCon; Scribe: Suvi Gezari*	*Bloomberg 462; Scribe: Ori Fox*
3:45pm Spark Talks:	3:45pm Spark Talks:	3:45pm Spark Talks:
Facilitators: Lou Strolger, Robert Quimby, Armin Rest, Pat Kelly	Facilitators: Suvi Gezari, Jen Andrews, Tea Temim, Rebekah Hounsell	Facilitators: Ori Fox, Yossef Zenati, Takashi Moriya
Chair: David Coulter *Discovery of a likely Type II SN at z=3.6 with JWST*	Chair: Leo Singer *Gravitational-Wave Follow-Up Strategy for the UltraViolet EXplorer (UVEX) Mission*	Chair: Nancy Elias-Rosa *Probing Supernova Precursors: Clues from Hubble Observations*
Matthew Siebert *Discovery of a Relativistic Stripped Envelope Type Ic-BL Supernova at z = 2.83 with JWST*	Chris Reynolds *TDAMM in the Era of the AXIS Probe Mission*	Kendall Shepherd *Stellar Winds & the Fate of Very Massive Stars: Impacts on Evolution, Supernova Types, and Remnants*
Christian Vassallo *Relation Between Core-Collapse Supernova Rates and Star Formation Rates Using JADES Data*	Sebastien Guillot *High-energy transients from space with the SVOM mission*	Emmanouil Zapartas *The population of binary companions next to stripped-envelope core-collapse supernovae*
Aadya Agrawal *Testing Lens Models with the Triply Lensed Supernova H0pe*	Brendan O'Connor *Characterization of a peculiar Einstein Probe transient EP240408a*	Charles Kilpatrick *Detecting the Massive Progenitor Starts of Core-Collapse Supernovae in Space Telescope Imaging*
4:30pm Discussion	4:30pm Discussion	4:30pm Discussion

5:30pm	Happy Hour SDAS	Café
7:30pm	**OPTIONAL:** Astronomy on Tap: Guilford Hall Brewery (Upstairs)	1611 Guilford Ave, Baltimore, MD 21202

Thursday, March 13, 2025

Time	Title	Speaker	Location
8:00am	Breakfast + Posters **Speaker Tech Check for Session 9**		Café
9:00am	High Level View from Goddard and Roman	Julie McEnery	Auditorium
Session 9: Roman and Space Missions, Chair: Rebekah Hounsell			
9:25am	Overview of the Time-Domain and Transient Discovery Program with Roman	Brad Cenko (I)	Auditorium
9:50am	Supernova Cosmology with Roman	Ben Rose (I)	
10:15am	RAPID Insights: Real-Time Transient Classification for Roman	Ashish Mahabal (C)	
10:30am	Leveraging Ground-based Surveys to Maximize Transient Science with Roman	Adam Miller (C)	
10:45am	Coffee Break + Posters **Speaker Tech Check for Session 10**		Café
Session 10: Euclid and Space Missions, Chair: Takashi Moriya			
11:15am	A transient discovery pilot program with Euclid (Virtual)	Maria Teresa Botticella (I)	Auditorium
11:40am	Space x Space Transient Discovery & Follow-up	Nao Suzuki (I)	
12:05pm	Synergies between Euclid and Ground-Based Surveys for Time-Domain Astronomy	Vincenzo Petrecca (C)	
12:20pm	Strongly Lensed Supernovae in Focus: Joint Analysis of gLSNe in ground and Space-Based Imaging	Charlotte Ward (C)	
12:35pm	Supernovae with ULTRASTAT: A Revolutionary Prospect	Avishay Gal-Yam (C)	
12:50pm	Lunch **Speaker Tech Check for Session 11**		Café
Session 11: Future Missions, Chair: Robert Quimby			
1:50pm	High-Energy Blinders: Gamma-ray Astrophysics in the 2030's	Jeremy Perkins (I)	Auditorium
2:15pm	Overview of the Future of Space-Based Transient Discovery Programs	Maria Drout (I)	
2:40pm	Transient Science with UVEX	Ryan Chornock (C)	
2:55pm	Transient Science with HabWorlds Observatory	Jason Tumlinson (C)	
3:10pm	Coffee + Posters		Café
Session 12: Splinter Working Groups			

Type IA SNe	Extreme SNe	Big Data, ML, and AI
Bloomberg 462; Scribe: Suvi Gezari	*Auditorium; Scribe: Armin Rest*	*CaféCon; Scribe: Lou Strolger*
3:45pm Spark Talks:	3:45pm Spark Talks:	3:45pm Spark Talks:
Facilitators: Yossef Zenati, Pat Kelly, Suvi Gezari	Facilitators: Tea Temim, Robert Quimby, Armin Rest, Takashi Moriya	Facilitators: Lou Strolger, Rebekah Hounsell, Ori Fox, Jen Andrews
Chair: Sahana Kumar *The Faint and the Furious: Nebular Phase SNe Ia in the Near-Infrared*	Chair: Sebastian Gomez *Finding Long Duration Transients with Roman*	Chair: Konstantin Malanchev *Classification and Anomaly Detection with Massive Time-Domain Catalogs*
Lindsey Kwok *JWST Observations of Peculiar Iax Supernovae*	Tuomas Kangas *H-rich superluminous supernovae: diversity and power sources*	Gautham Narayan *Detecting Young Transients to Understand Progenitors*
James DerKacy *Type Ia Supernova Physics from Nebular-phase JWST Observations in the MIR*	Steve Schulze *The tale of two PISN candidates and the implications of finding them at high redshift*	Estefania Padilla Gonzalez *Spectral Classification of Supernovae Using Deep Learning Neural Networks*
Or Graur *Late-time Hubble Space Telescope observations of Type Ia supernovae*	Francesco Gabrielli *The cosmic rate of pair-instability supernovae*	Michael Coughlin *Tutorial for deploying machine learning in time-domain astronomy*
4:30pm Discussion	4:30pm Discussion	4:30pm Discussion

5:30pm	Goodbye	Auditorium

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Workshop Abstracts

STScI

Invited Talks

Federica Bianco (University of Delaware/Rubin Observatory)

Challenges and Opportunities of Machine Learning and AI for the next-generation astronomical surveys

At the dawn of revolutionary surveys from upcoming projects like the Nancy Grace Roman Space Telescope, the integration of machine learning and AI into survey work offers both significant opportunities and unique challenges. This talk will provide an overview of the current landscape in working with large and complex astronomical datasets, with a specific focus on the tools, techniques, and preparations necessary for effectively managing and analyzing the expected influx of survey data.

With an eye on the Roman community's forthcoming data stream, I will explore the types of big data challenges commonly faced in survey work—ranging from data cleaning and integration to computational scalability—and discuss how machine learning and AI can be leveraged to unlock insights from vast datasets, such as identifying patterns, automating classification, enhancing predictive modeling, and forcing serendipitous discoveries. I will cover essential steps in preparing for the scale and complexity of these data, including cloud solutions, robust workflows for handling data from disparate sources, and address core AI challenges like bias, trustworthiness, and explainability, in context of astrophysics.

Finally, the talk will highlight some of the best practices for collaboration in interdisciplinary teams of astrophysicists, statisticians, and computer and data scientists, ensuring that the integration of machine learning techniques is both effective and meaningful within the context of survey work.

Azalee Bostroem (University of Arizona)

Early Ultraviolet Observations of Supernovae

Ultraviolet wavelengths contain a wealth of information about the metalicity, temperature, and density of the outer supernova ejecta as well as progenitor signatures such as interaction with circumstellar material or a non-degenerate companion star. However, UV observations are challenging to obtain as the UV flux of most supernovae fades rapidly with time and observations cannot be done from the ground. Understanding the UV characteristics of local supernovae is critical for interpreting high redshift supernovae from Roman, JWST, and LSST as the rest UV shifts to longer wavelengths. I will discuss early UV observations of supernovae, beginning with the International Ultraviolet Explorer and continuing with the Swift and Hubble Space Telescope which reveal information about the progenitor system, the composition, density, and temperature of the ejecta, and which can be used to test model predictions. I will close with a discussion of the promise of future UV missions: ULTRASAT, UVEX, and eventually the Habitable Worlds Observatory.

Maria Teresa Botticella (Istituto Nazionale di Astrofisica)

A transient discovery pilot program with Euclid

The Euclid mission, primarily designed for cosmological studies, also provides wide-field, high-resolution, deep-sensitivity, multi-wavelength capabilities, making it an invaluable resource for time-domain astronomy. Although Euclid's observing strategy and cadence are not specifically optimized for transient detection, selected sky fields—such as the Self Cal field (1 square degree) and the Euclid Deep Fields (approximately 50 square degrees)—are revisited multiple times throughout the mission. In these fields, difference imaging allows the detection of thousands of transients, significantly contributing to the study of transient phenomena and strengthening synergies with other upcoming surveys, such as the Vera C. Rubin Observatory and the Nancy Grace Roman Space Telescope. We will present preliminary results from a pilot key project conducted in the Self Cal field, which includes both optical and NIR data collected during the performance verification phase and the first months of the nominal mission.This project demonstrates Euclid's potential to detect and study transients and serves as a preparatory step for the transient search in the Euclid Deep Field, in synergy with the Vera C. Rubin LSST survey.

Brad Cenko (NASA's Goddard Space Flight Center)

Overview of the Time-Domain and Transient Discovery Program with Roman

I will describe the broad range of science enabled by the Roman High-Latitude Time-Domain Survey (HLTDS), with a fastidious avoidance of any cosmology from (non-lensed) type Ia supernovae. I will summarize the community input received as part of the HLTDS Definition Committee, as well as the survey implementation recommended by this group. Finally, I will discuss preparatory efforts necessary to undertake in advance of Roman launch, in order to maximize the time-domain/transient science return from this transformative facility.

Wenlei Chen (Oklahoma State University)

Discoveries of strongly lensed SNe with HST and JWST

Strong gravitational lensing occurs when the gravitational field of a massive object, such as a galaxy or galaxy cluster, bends and magnifies the light from a distant source. This effect causes the light to travel along multiple paths around the lensing mass, resulting in multiple images of the same source. Due to differences in geometric path lengths and gravitational potentials along these paths, the arrival times of light from each image differ. In the case of a strongly lensed supernova (SNe), these time delays allow astronomers to observe different stages of the explosion across the multiple images in a single exposure. In 1964, Sjur Refsdal proposed that the relative time delays between the multiple images of a gravitationally lensed SN could be used to measure cosmological parameters, specifically the Hubble constant, which quantifies the rate of expansion of the universe. Despite the theoretical promise of this method, practical application remained elusive for over half a century until the discovery of SN Refsdal in 2014. To date, due to the rarity of such events and the observational challenges involved in detecting them, only nine strongly lensed SNe have been reported. Among these, five SNe are lensed by galaxy clusters, with two of them used to measure the Hubble constant. In this talk, I will provide an overview of the discoveries of strongly lensed SNe with the Hubble Space Telescope (HST) and James Webb Space Telescope (JWST). I will discuss the techniques used to measure

their time delays and lensing properties, as well as the implications of these findings for cosmology, particularly in the measurement of the Hubble constant.

Kishalay De (Columbia University/CCA/Flatiron Institute)

Stories of stellar birth and death: The next decade of infrared transient discoveries

The landscape of transient discovery in the infrared bands is on the verge of a revolution. By revealing hitherto unseen classes of dusty eruptions that remain hidden in the optical/UV/X-ray bands, these searches are beginning to reveal missing links in the life cycles of stars. In this talk, I will provide an overview of recent results that are fundamentally re-writing stories of stellar birth, growth and death — focussing on i) the ubiquity of eruptive mass loss before the deaths of massive stars, and its effects on the nature of the remnant, ii) the role of tidal captures of stars in the growth of supermassive black holes, iii) the effects of unstable mass transfer in the shaping the remnants of binary stars and iv) the importance of accretion outbursts in the very formation of stars. I will end with an overview of the exciting upcoming decade of infrared surveys — from the near to far-infrared bands — that is poised to finally reveal a complete roadmap from stellar birth to the stellar graveyard.

Maria Drout (University of Toronto)

Overview of the Future of Space-Based Transient Discovery Programs

In this talk, I will give an overview of future spaced-based transient discovery programs, with an emphasis on UVOIR regime. While I will attempt to paint a global picture, given other sessions in this conference which focus on missions such as Roman, I will focus on three main pillars: (i) the immediate future of transient discovery offered by a number of both fully funded and proposed wide-field ultraviolet instruments with complementary capabilities (e.g. ULTRASAT, UVEX, QUVIK, and the Canadian-led CASTOR mission), (ii) feasibility and promise for using low-cost 'constellations' of satellites for transient science in the future and (iii) the prospects for multi-messenger science with these programs.

Saurabh Jha (Rutgers University)

Transients from Space: Where We Are and Where We Are Going

We are in the midst of a revolution in the study of astrophysical transients -- both in the kinds of transients, now multi-wavelength and multi-messenger, and in their exploding numbers, approaching a new inflection point. Ground-based discoveries have traditionally led the way, while space-based observations have provided crucial follow-up with enhanced wavelength coverage, spatial resolution, and sensitivity. I will discuss our current and expanding capabilities for space-based transient follow-up, their applications in understanding these phenomena, and their broader significance for astrophysics and cosmology. We are also entering a new era in space-based transient discovery with unprecedented depth and breadth that promise to reshape our understanding of cosmic history and evolution. However, these opportunities come with challenges that the community must navigate -- we cannot simply keep our heads above the clouds.

Josefin Larsson (KTH Royal Institute of Technology)

Space observations of supernova remnants & the unique case of SN 1987A

I will give an overview of what we can learn from space observations of supernova remnants, with a particular focus on SN 1987A and new opportunities with JWST. As the most nearby SN in the era of modern telescopes, SN 1987A provides an opportunity to study the birth and early evolution of a supernova remnant in unprecedented detail. It has been monitored regularly by all major space telescopes, including Chandra, HST and Spitzer, which has created a unique observational record of the shock interaction between the ejecta and surrounding medium. Most recently, JWST has opened a new window on SN 1987A and revealed the first unambiguous electromagnetic signal from the compact object. Specifically, IFU observations with NIRSpec and MRS showed narrow emission lines from ionized argon and sulphur at the very center of the remnant, which arise from ejecta ionized by a neutron star and/or pulsar wind nebula. New Cycle 2 observations have now enabled the identification of additional emission lines from this region and provided new insights about the innermost ejecta and compact object. The NIRSpec IFU observations have also allowed us to create 3D maps of the freely expanding ejecta in emission lines from Fe, Si, He, H and H_2. The highly asymmetric 3D morphology and mixing of different elements provides a unique probe of the explosion mechanism. I will also put the lessons learnt from SN 1987A into a broader context and discuss opportunities and challenges with space observations of supernova remnants in general.

Julie McEnery (NASA's Goddard Space Flight Center)

Coming soon!

Brian Metzger (Columbia University/CCA/Flatiron Institute)

The Landscape of "Extreme" and "Exotic" Transients

The light curves of most astrophysical transients are powered by one of three energy sources: (1) radioactivity; (2) shock interaction; (3) central engine (e.g. magnetized neutron star or accreting black hole). I will overview some examples of each, contrasting when possible better-known cases with more "extreme" and "exotic" events that are less frequently discussed. Time permitting, topics of discussion could include: X-ray QPEs from star-disk collisions in galactic nuclei; minutes-long kilonova-like transients from magnetar giant flares; luminous supernovae powered by young magnetars; fast blue optical transients from black hole-He star mergers; and short-lived transients from white dwarf-neutron star mergers.

Jeremy Perkins (NASA's Goddard Space Flight Center)

High-Energy Blinders: Gamma-ray Astrophysics in the 2030's

The Compton Gamma-ray Observatory was a one of the four original NASA Great Observatories and changed our view of the high energy universe. Its successors expanded this view, enabled the major discoveries in multimessenger astrophysics, and ushered in a new era of time domain astronomy. Swift and Fermi in particular are critical time-domain observatories; the major time-domain and multimessenger discoveries of the last decade were initiated by these two large-scale gamma-ray missions. There is no replacement in the pipeline that can provide the capabilities of Fermi and Swift. Without these capabilities, time-domain astrophysics would miss seeing several orders of magnitude of the electromagnetic spectrum; effectively ignoring what's going on in the high energy sky. Right now, there is an effort underway to identify the needs for the future and it's critical that the full astrophysics community engage in the planning process and advocate for a next-generation gamma-ray observatory.

Justin Pierel (Space Telescope Science Institute)

Opening a New Frontier in High-z Supernova Discovery with JWST

The high-redshift transient universe has been an unexplored field of astrophysics due to the vast amount of resources required to discover supernovae (SNe) at z>1. Even with the Hubble Space Telescope (HST), discoveries of the most distant stellar explosions have been restricted to z~2, including with the aid of gravitational lensing. Spectroscopy is critical to both classification and characterization of high-redshift SNe, but it is even more difficult than imaging and has been limited to z~1.5. With the launch of the James Webb Space Telescope (JWST), we have entered a new era of high-redshift SN discovery and understanding. In a relatively short time JWST has expanded our view of the transient universe to z~5, including hundreds of SNe and dozens of rest-frame UV-IR spectra for transients reaching z=3.6. The JWST SN sample with both imaging and spectroscopy now includes the most distant Type Ia SNe (used for cosmological measurements) yet discovered, three strongly lensed SNe, and a wide variety of core-collapse SN sub-types from a previously unexplored phase of the transient universe. I will summarize the range of discoveries made in the first ~2 years of JWST observations, the constraints gleaned from these exciting new objects, and ongoing efforts to build the first statistical samples of high-redshift SNe. Looking ahead, these SNe give us a glimpse at what we can expect from the upcoming Nancy Grace Roman Space Telescope, which will revolutionize the discovery of distant stellar explosions.

Ben Rose (Baylor University)

Supernova Cosmology with Roman

One of the Roman's core community data sets will be a cosmological sample of Type Ia Supernovae (SNe Ia). Presently, we use a few dozen SNe Ia above a redshift of one. With Roman, we expect to have around 10,000 above redshift one! This unprecedented data set presents unique challenges for SN Ia cosmology as well as the ability to follow up on recent hints of evolving dark energy. In this talk, I will discuss the expected cosmological sample, the new challenges we will face analyzing the data, and how we are preparing today.

Melissa Shahbandeh (Space Telescope Science Institute)

Supernovae and the Dust Budget: A JWST Review

Dust is one of the fundamental building blocks of the universe, shaping the formation of galaxies, stars, and planetary systems. Yet, its origins remain one of the biggest open questions in astrophysics. While asymptotic giant branch (AGB) stars were once thought to be the primary contributors to cosmic dust, the discovery of massive dust reservoirs in the early universe—before AGB stars could have enriched their surroundings—suggests that supernovae (SNe) play a key role in dust production. However, before JWST, the sensitivity and infrared coverage needed to trace dust formation from its earliest stages to large dust masses in evolved supernova ejecta were lacking. With its unprecedented infrared capabilities, JWST has transformed our ability to study dust formation in SNe across different evolutionary stages. From detecting the emergence of molecular precursors to measuring substantial dust masses in decades-old remnants, JWST observations provide critical insight into the efficiency and mechanisms of dust production, reinforcing the idea that supernovae are major contributors to the interstellar medium. Looking ahead, the Roman Space Telescope will complement JWST by enabling large-scale surveys of SNe, placing JWST's detailed findings into a broader statistical context. Together, these missions will refine our understanding of how supernovae shaped the dust content of the early universe.

Nao Suzuki (Lawrence Berkeley National Laboratory)

Space x Space Transient Discovery & Follow-up

In the era of the JWST, Euclid, HST and the Roman Space Telescope, we now have the opportunity to discover transients that are observable exclusively from space. While each telescope operates its own transient program, it is crucial to consider cross-platform discovery and follow-up strategies. Advances in AI and machine learning now enable multi-platform detection, and it is essential to develop a systematic approach for executing follow-ups. I will present examples and explore the potential breakthroughs on the horizon.

Qinan Wang (Massachusetts Institute of Technology)

Transient science with high cadence survey: Kepler, TESS, and future missions

Initially designed as exoplanet hunters, Kepler and TESS telescopes have also proven their ubiquitous advantages in the field of transient science in the past decade thanks to their sub-hour cadence, enormous field-of-view and unique observation strategies. In particular, Kepler and TESS has provided valuable information into the realm of rapidly evolving transient phenomena at their earliest time, such as the early excess of SNe Ia, shock breakout and cooling of CCSNe, and GRB afterglows, and thus put important constraints on the progenitors and explosion mechanisms of those transients. The upcoming ULTRASAT telescopes will further extend the high cadence observing capability into the ultraviolet range, where many of those fast-evolving features are expected to dominate. In this talk, I'll provide an overview of Kepler and TESS's contributions to transient science, with a focus on early-time supernovae, and a preview of future space-based high cadence missions.

Yuhan Yao (University of California, Berkeley)

High-energy Observations of Tidal Disruption Events

Tidal disruption events (TDEs) provide unique laboratories to study the demographics, immediate stellar and gaseous environments, and accretion physics of the massive black hole population. In this talk, I will present an overview of high-energy observations of TDEs. First, I will summarize key findings from X-ray time domain surveys (eROSITA, Einstein Probe), including the discoveries of numerous TDEs in galaxy centers and intermediate-mass black hole candidates in satellite galaxies. Next, I will highlight targeted X-ray observations with Chandra, NICER, NuSTAR, Swift, and XMM-Newton, which have revealed new phenomena such as the connection between TDEs and quasi-periodic eruptions, as well as detailed inflow and outflow properties across different black hole accretion regimes. Finally, I will discuss the exciting capabilities of new X-ray missions for studying TDEs and other nuclear transients.

Contributed Talks

Aadya Agrawal (University of Illinois Urbana-Champaign)

Testing Lens Models with the Triply Lensed Supernova H0pe

There exists a ~5σ tension between measurements of the Hubble constant (H0) obtained through local probes and those derived from the cosmic microwave background (CMB). Strongly-lensed, multiply-imaged supernovae (glSNe) like SN H0pe enable an independent, one-step measurement of H0 by leveraging the time delays between images and lens models of the system. These systems also serve as a test for the lens models themselves. This study evaluates the lens models applied to SN H0pe for consistency with ΛCDM cosmology predictions by comparing the dust-corrected photometry of SN H0pe to the magnifications predicted by each model. Results indicate that the lens models overestimate magnification, suggesting underlying systematic biases in the lens modeling process. Refining these models could significantly reduce errors in H0 measurements from lensed transients, advancing efforts to resolve the Hubble tension.

Andrea Antoni (Flatiron Institute/ Center for Computational Astrophysics)

Low-Energy Transients Following "Failed" Supernovae of Red and Yellow Supergiants

When core collapse does not lead to a neutrino-driven supernova (SN) explosion, a large fraction of the star will fall in towards the black hole (BH) unavoidably formed from the collapsing core in what is called a "failed SN". I will show that when red and yellow supergiants undergo failed SN, their turbulent hydrogen envelopes cannot accrete onto the newborn BH. Instead, infall of a small fraction of the envelope drives an outflow that unbinds the rest of the hydrogen envelope in an explosion of at least 1e48 erg. These events should appear quite similar to luminous red novae (LRNe) with supergiant progenitors that may result for the inspiral and possible merger of a massive star with its binary companion. I will discuss my ongoing work using radiation hydrodynamic simulations to study these low-energy explosions of red and yellow supergiants. Such modeling is important for disentangling luminous red novae that could arise from binary interaction versus those signifying BH births in failed SN. Finally, I will discuss how my results pertain to the failed SN candidates in M31 and N6946.

John Bally (University of Colorado, Boulder)

Protostellar Mergers and Explosions: A New Class of IR Transients?

The nearest site of on-going massive star formation, the OMC1 region located behind the Orion Nebula, experienced a 10^48 erg explosion about 550 years ago (that's when the light would have reached Earth). This event was triggered by an N-body interaction among at least 4 protostars which resulted in the formation of a compact binary or led to a stellar merger. The resulting object has a mass of ~15 Solar masses. The binary or merger remnant and two other stars were ejected from the parent cloud core with speeds of 10, 30 and 55 km/s. The site of the explosion is marked by shock-excited fingers of molecular hydrogen and streamers of carbon monoxide and plasma expanding away with speeds up to 400 km/s in a "Hubble flow" pattern. Fossil remnants of explosions have been found in several other Galactic star forming regions. Because star formation occurs in the highly obscured environs of molecular clouds, such explosion produce luminous transients in the infrared. Observations suggest that Orion-like events occur roughly once a century in the Milky Way. Models indicate that their luminosities can range up to 10^51 ergs and be visible at extragalactic distances.

Yvette Cendes (University of Oregon)

New Developments in Late-Time Emission in Tidal Disruption Events (TDEs)

Recently, we have discovered a surprising population-level phenomenon in TDEs whereby ~40% of all TDEs that are not radio bright in the first few months are radio bright years after the initial event, or even produce second flares after an initial detection. The origins of this emission is not understood, although some possibilities include off-axis jets, a second outflow from the TDE, a change in density, or others. In this talk, I will first place this late-time radio emission into a multi-wavelength context, discussing correlations between optical and X-ray properties seen in the late TDE population. I will also discuss new results for several TDEs in our long-term monitoring campaign, such as the remarkable AT2018hyz which was first detected in radio at 970 days post-optical disruption and is still rising, and a new population of TDEs with secondary radio flares. I will conclude with the future of late-time TDEs in the context of future telescopes and missions, such as the Nancy Grace Roman Telescope and the ngVLA/SKA.

Ryotaro Chiba (National Astronomical Observatory of Japan)

Exploring pre-supernova mass loss with modelling of double-peaked type Ibc SNe

Recent high-cadence surveys have uncovered a rare subclass of Type Ibc supernovae (SNe) with an early, blue luminosity peak with the timescale of a few days that precedes the main, radioactive-powered peak. Since Type Ibc SNe lack an extended hydrogen envelope, this early peak is generally considered to be a consequence of interaction between the SN ejecta and confined circumstellar matter (CSM). Therefore, these SNe provide a unique opportunity to constrain the pre-explosion activity of SN progenitor stars.

We modelled the interaction between the SN ejecta and confined CSM using 1D radiation-hydrodynamic simulation code STELLA for a range of SN and CSM properties, such as total mass and radius of CSM, nickel mass, and explosion energy. We then compared the synthesised multi-band light curves to observations of Type Ibc SNe with early peaks to derive the properties of their CSM. Our results will serve as a template to be compared against SN light curves with early, blue peaks that are expected to be found in future transient surveys utilising space telescopes such as ULTRASAT.

Ryan Chornock (University of California at Berkeley)

Transient Science with UVEX

The Ultraviolet Explorer (UVEX) is a NASA Midex mission selected to be launched in 2030. The spacecraft will have wide-field imaging capabilities in the near and far ultraviolet, as well as a sensitive ultraviolet spectrograph. The mission is designed to respond to target of opportunity triggers on timescales of hours. The key science goals of UVEX will include follow-up observations of gravitational wave sources and rapid-response UV spectroscopy of infant supernovae and other transients. I will describe the current plans and capabilities of the mission for time-domain and transient science, as well as opportunities for community involvement.

Michael Coughlin (University of Minnesota)

Tutorial for deploying machine learning in time-domain astronomy

In this tutorial, we will introduce technology surrounding training neural nets in an astronomical context. We will give an example from ml4gw, a PyTorch-based Python library designed to streamline the process of doing machine learning in gravitational-wave physics. If we have time, we will also demo an example focused on light curve classification from ZTF data. Though the library is focused on gravitational wave applications, many of the features are broadly useful for time series data, and we invite anyone interested in machine learning to attend, regardless of background. The tutorial notebook and the relevant data will be available for participants who want to try things for themselves.

David Coulter (Space Telescope Science Institute)

Discovery of a likely Type II SN at z=3.6 with JWST

Transient astronomy in the early, high-redshift (z > 3) Universe is an unexplored regime that offers the possibility of probing the first stars and the Epoch of Reionization. During JWST's first two Cycles, the JADES program imaged nearly 30 arcmin^2 to a depth of 30th AB mag with multiple epochs – allowing for transients to be discovered in this field. One of the supernova candidates discovered, AT 2023adsv, was found in a galaxy with a spectroscopic redshift of 3.61, and is best matched by a spectral template of SN 2006kv, an SN IIP. AT 2023adsv had a peak absolute magnitude of -18.2 mag in the rest-frame B-band, accompanied with bright UV flux at the time of discovery. To fit both this luminosity and UV flux, our best-fit model to AT 2023adsv is a 20 M_sol, red supergiant progenitor with a metallicity of 0.4 Z_sol, an explosion energy of 2.0x10^51 ergs, and 0.14 M_sol of confined circumstellar material at a radius of 10^15 cm. If AT 2023adsv is indeed a SN, it is slightly over-luminous compared to local SNe IIP, but consistent with an SN IIP drawn from a lower metallicity environment. AT 2023adsv's host is also over-massive with respect to the local mass-metallicity relationship, similar to other JWST-selected galaxies. This SN may represent a global shift in SN IIP properties as a function of redshift, and demonstrates the need for facilities like JWST to understand the poorly constrained relationship between progenitor metallicity and massive star evolution.

Geoffrey Clayton (Space Telescope Science Institute)

Very Late-Time JWST Observations of Dust in SN 1995N

SN 1995N, a type IIn, was discovered in May 1995 about 10 months after its explosion. It is among the very few SNe with IR observations stretching over almost 30 years since it exploded. SN 1995N was observed and detected by Spitzer/IRAC+MIPS (2009), WISE (2010), Spitzer/IRAC (2018), and JWST/MIRI/MRS (2023). The new MRS spectrum shows strong continuum emission to the red of 8 microns. These epochs of observations provide a test of whether dust in SN Type-II ejecta forms quickly after the explosion or whether there is continuous dust formation. Radiative transfer models of the Spitzer/WISE photometry from 2009-2010 estimate a dust mass of ~0.4 Solar Masses. Modeling of the new JWST data suggest an even greater mass of ~2 Solar Masses. The dust mass is not well constrained due to the limited wavelength range of JWST but this suggests that continuing dust formation between 2009 and 2023 is likely.

Christa DeCoursey (University of Arizona)

The JADES Transient Survey: Discovery and Classification of Supernovae in the JADES Deep Field

The JWST Advanced Deep Extragalactic Survey (JADES) is a multi-cycle JWST program that has taken among the deepest near-/mid-infrared images to date (down to ~30 ABmag) over ~25 arcmin^2 in the GOODS-S field in two sets of observations with one year of separation. This presented the first opportunity to systematically search for transients, mostly supernovae (SNe), out to z>2. We found 79 SNe: 38 at z<2, 23 at 2<z<3, 8 at 3<z<4, 7 at 4<z<5, and 3 with undetermined redshifts, where the redshifts are predominantly based on spectroscopic or highly reliable JADES photometric redshifts of the host galaxies. At this depth, the detection rate is ~1-2 per arcmin^2 per year, demonstrating the power of JWST as a supernova discovery machine. We also conducted multi-band follow-up NIRCam observations of a subset of the SNe to better constrain their light curves and classify their types. Here, we present the survey, sample, search parameters, spectral energy distributions (SEDs), light curves, and classifications. Even at z≥2, the NIRCam data quality is high enough to allow SN classification via multi-epoch light-curve fitting with confidence. The multi-epoch SN sample includes a Type Ia SN at z-spec=2.90, Type IIP SN at z-spec=3.61, and a Type Ic-BL SN at z-spec=2.83. We also found that two z~16 galaxy candidates from the first imaging epoch were actually transients that faded in the second epoch, illustrating the possibility that moderate/high-redshift SNe could mimic high-redshift dropout galaxies. Finally, we compare the detected SN rates in luminous infrared galaxies (LIRGs) with their star formation rates, assessing their IMF and missing SN fraction.

James DerKacy (Space Telescope Science Institute)

Type Ia Supernova Physics from Nebular-phase JWST Observations in the MIR Transient

Nebular-phase observations of Type Ia supernova from JWST have transformed our understanding of the physics and origins of these cosmologically important events. Here, I will discuss JWST MIRI/MRS observations of two SNe Ia; the normal-bright SN 2021aefx and the underluminous SN 2022xkq. Both SNe show spectral lines indicative of high density burning, including line from multiple ionization states of 58Ni and hints of electron-capture isotopes such as Ti, V, Cr, and Mn. The high-density burning necessary to produce these lines require a massive progenitor for both SNe, which has important implications for which explosions scenarios are viable models of SNe Ia. Finally, I discuss how JWST SNe Ia observations at ultra-late phases (> 750 days) to create long-baseline time-series data inform our understanding of the flux redistribution within the ejecta and help us probe the conditions of the highest density burning in the explosion.

Nancy Elias-Rosa (INAF - Astronomical Observatory of Padua)

Probing Supernova Precursors: Clues from Hubble Observations

Some of the most massive stars end in supernovae with intense circumstellar interaction. Many of these explosions are preceded by powerful outbursts occurring weeks to years beforehand, suggesting an unknown phase before stellar death. The cause of these outbursts and their link to a potential final collapse remains unclear, raising the question of whether they instead represent extreme but non-terminal eruptions as "supernova impostors". To address these questions, we used HST+WFC3 data on four transient events after their fading to determine if these cases signify core-collapse supernovae. We present our results and emphasize the essential role of HST in this field of research.

Michael Fausnaugh (Texas Tech University)

The Unique View of TESS on Transient Astronomy

The Transiting Exoplanet Survey Satellite continuously takes images at a 200 second cadence, meaning that any transient discovered in its field of view automatically has a TESS light curve before, during, and after the initial transient detection. With its wide field of view, TESS has also observed over 8,000 astrophysical transients during the time of discovery, and new data are available every 7 days. TESS data therefore opens new windows in transient astronomy, and I will highlight some of the unique science cases that the community is pursuing with continuous TESS light curves. These science cases includes a) measuring the shapes of early-time supernova light curves and constraining supernova progenitors/progenitor systems, b) classification of transients reported to the IAU without spectroscopic observations, c) multiwavelength monitoring of the sky with widefield instruments, and d) identification of poorly localized transients, as from Fermi-GBM and LIGO-Virgo-Kagra triggers. Continuous coverage from TESS also provides surprising and powerful synergies with other space-based missions. For example, TESS light curves of GaiaAlerts in the Galactic plane provide a preview of transients that will be found in Roman's Galactic Bulge Survey---TESS has already observed surprising variability patterns from outbursting accretion disks around stellar mass black holes, neutron stars, white dwarfs, and protostars. TESS will also contribute color information for the rise of the brightest ULTRASAT transients, which can be used to break degeneracies between photosphere temperature and dust extinction. A key component of the TESS light curves are how they interface with other space-based observatories, and I will end with a brief account of how TESS compliments the parameter space of existing and upcoming time domain facilities.

Danielle Frostig (Center for Astrophysics, Harvard University, & Smithsonian)

WINTER: Advancing Infrared Time-Domain Surveys and Roman Preparatory Science

The field of infrared time-domain surveys remains relatively underdeveloped, despite its unique scientific role and its importance in preparing for upcoming Roman Space Telescope science. WINTER (the Wide-Field Infrared Transient Explorer) is a new ground-based near-infrared survey telescope at Palomar Observatory, designed to address this gap by searching for Galactic and extragalactic transients and variables. The custom camera tiles six InGaAs detectors—new to astronomical applications—covering over 1 square degree with 1-arcsecond pixels in the Y, J, and Hs bands (0.9–1.7 microns). One year into operations, WINTER's Galactic plane and extragalactic surveys have enabled a range of science, including projects on gamma-ray bursts, kilonovae, luminous red novae, classical novae, and obscured supernovae. A notable early result from the WINTER Galactic plane survey is the detection of young stellar object (YSO) outbursts, which are undetected in optical surveys but identifiable through WINTER's near-infrared observations and complementary mid-infrared data from NEOWISE. This work lays the groundwork for key science cases anticipated in the Roman Galactic plane survey, particularly the study of the resolved structures of YSO outbursts and their associated outflows. With the conclusion of NEOWISE, WINTER's time-domain observations are preparing critical datasets, such as the identification of new FU Orionis stars and the establishment of active young star outbursts, to enhance the scientific output of future Roman surveys.

Francesco Gabrielli (Scuola Internazionale Superiore di Studi Avanzati)

The cosmic rate of pair-instability supernovae

Pair-instability supernovae (PISNe) are explosions developing in the core of massive stars due to a thermonuclear, runaway process, ultimately leading to the total disruption of the progenitor. They are expected to be the endpoint of the evolution of low-metallicity stars in the mass range between ~ 140 and 260 solar masses, and responsible for the existence of the upper mass gap in the black hole mass spectrum. Despite the robust theoretical understanding of the pair-production mechanism, and their crucial implications for many astrophysical topics, PISNe have never been confidently observed. However, they are expected to be up to 2 orders of magnitude more luminous than typical core-collapse supernovae (CCSNe), for which we have hundreds of observations. This leads to naturally wonder what could be the reason of their missed detection. In this talk, I will present new results on the PISN rate as a function of redshift, obtained by adopting state-of-the-art stellar evolution tracks from the PARSEC code, and an up-to-date semi-empirical determination of the galaxy star formation rate and metallicity evolution throughout cosmic history. The goal is to provide a robust theoretical framework to understand where PISNe are across cosmic time, and study their detectability with instruments such as JWST, Roman and Euclid. I will show estimates for the relative rate of PISNe and CCSNe, and discuss how the PISN rate is affected by various assumptions in the theoretical models, including the criterion to identify stars undergoing pair production, the maximum stellar metallicity to have PISNe, the upper limit of the stellar initial mass function, and the dispersion of the galaxy metallicity distribution in redshift. Finally, I will discuss the relative PISN rate contribution coming from single stellar and binary evolution, and how possible (or lack of) future PISN observations can help us constrain stellar and galaxy evolution models.

Avishay Gal-Yam (Weizmann Institute of Science)

Supernovae with ULTRASAT: a revolutionary prospect

I will review the revolutionary results expected from the ULTRASAT wide-field, continuous, and sensitive UV surveys. In particular, ULTRASAT would provide regular access to the very early phases of supernova explosions, including the shock breakout and early interaction phases with CSM. The large sample of ULTRASAT-discovered events would provide a unique set of events with coverage "from start to finish" that would provide a new benchmark data set for supernovae of all types. ULTRASAT would also provide unique data to probe phenomena, such as short-timescale flares or periodic undulations, that are currently very difficult to obtain, as well as probing a totally new observational phase space. I will present studies carried out in preparation for the mission and describe what the supernova community can expect from ULTRASAT.

Sebastian Gomez (Center for Astrophysics, Harvard University & Smithsonian)

Finding Long Duration Transients with Roman

I will discuss the prospects of discovering, classifying, and characterizing long-duration transients with the Nancy Grace Roman Space Telescope's High Latitude Time Domain Survey. Roman's unprecedented depth and uniformity will open up new parameter space for detecting some of the most distant transients ever observed. Given its relatively slow cadence, Roman will be perfectly placed to discover long-duration transients such as superluminous supernovae, tidal disruption events, and potentially pair-instability supernovae, alongside general high-redshift transients whose durations are extended by cosmic time dilation. I will present the latest estimates of our expectations for how many and which kinds of transients we expect to discover based on simulations that incorporate the most up-to-date parameters of Roman and the HLTDS.

Estefania Padilla Gonzalez (Johns Hopkins University)

Spectral Classification of Supernovae Using Deep Learning Neural Networks

We present a method for supernovae (SNe) classification using autoencoders, motivated by the need for efficient classification tools capable of handling the large volume of data generated by modern and upcoming astronomical surveys. We apply deep learning techniques, specifically Wasserstein autoencoders, to reduce the dimensionality of SNe spectra and extract relevant features for classification. Public SNe templates are used for training, while data from the Las Cumbres Observatory (LCO) serves as an independent test set. The model demonstrates 99% accuracy on the validation set and up to 96% accuracy on the test set when subclasses are considered at maximum light. Our results highlight the effectiveness of autoencoders in classifying SNe and suggest their potential for improving follow-up observations. Future work will focus on expanding classification to earlier SNe phases and incorporating attention models to enhance sequential data learning.

Sebastien Guillot (IRAP / CNRS / UPS)

High-energy transients from space with the SVOM mission

Launched in June 2024, SVOM (Space-based multiband astronomical Variable Objects Monitor) is a Chinese-French space mission dedicated to the study of Gamma-Ray Bursts (GRBs) and other high energy transient phenomena. The satellite carries a gamma ray spectrometer (15 keV to 5 MeV), a wide-field coded-mask hard X-ray imager (4-150 keV), a soft X-ray telescope (0.2-10 keV) and a dual-channel visible telescope (400-650 nm and 650-1000 nm). The instrumentation of SVOM permits detection and localisation of transient emission in multiple bands and transmitting alerts to the ground, via a VHF communication system, within minutes. The SVOM mission also includes a ground segment composed a wide-angle cameras, and two 1-m class telescopes in China and Mexico. The pointing strategy of the satellite has been optimized to favor the detection of GRBs located in the night hemisphere. This strategy enables the study of the optical emission in the first minutes after the GRB with robotic ground observatories and the early spectroscopy of the optical afterglow with large telescopes to measure the redshifts. The study of GRBs in the next decade will benefit from a number of large facilities in all wavelengths that will contribute to increase the scientific return of the mission. SVOM's operations coincides with the current and upcoming runs of gravitational wave detectors, greatly contributing to searches for the electromagnetic counterparts of gravitational wave triggers at X-ray and gamma-ray energies. In addition to the core program focused on broad GRB science, SVOM can detect many other types of high-energy transients, including outbursts from X-ray binaries, magnetar bursts. The mission also includes a general program with broad scientific goals. Finally, SVOM is be contemporary with other multi-wavelength and multimessenger time-domain instrumentation, and therefore a ToO program to respond to triggers is also in place. In this talk, we present the mission, the operations, its instruments and their performance, its science capabilities, as well as the early results from the mission.

Or Graur (University of Portsmouth)

Late-time Hubble Space Telescope observations of Type Ia supernovae

Due to their use as standardizable candles, most Type Ia supernovae (SNe Ia) are only observed for a few weeks around maximum light. However, late-time observations of SNe Ia with the Hubble Space Telescope (HST) taken hundreds of days after maximum light have revealed a wealth of new information about these explosions. In my talk, I will review the last decade of HST late-time observations and show how they have led us to discover that: (1) there is a year-long near-infrared plateau at 150-500 days past maximum light that captures a change in the ionization state of the ejecta; (2) the optical and near-infrared light curves fade at a slower rate starting at ~800 days past maximum light; and (3) there may be a correlation between the rate at which the light curves slow down and the intrinsic luminosities of the SNe, similar to the peak width-luminosity relation used to standardize SNe Ia. I will finish by showing the latest results from these observations: the absence of a near-infrared plateau in the 1991bg-like SN 2021qvv, and the independent discovery that 1991bg-like SNe Ia are also standardizble candles.

Wynn Jacobson-Galan (California Institute of Technology)

A Panchromatic View of Shock Power in Type II Supernovae

Late-time observations of type II supernovae (SNe II) are a window into the uncertain mass-loss history of their red supergiant (RSG) star progenitors as well as a direct probe of the physics of shock interaction as SN ejecta collide with distant circumstellar material (CSM). At >2 years post-explosion, the radioactive decay power in SNe II will be come subdominant and, for certain CSM densities, these events will shine in the UV through shock power alone. Here we present multi-wavelength (X-ray to radio) observations of SNe II using space-based instruments such as HST, Chandra, XMM-Newton and JWST in order to probe shock power at extremely late-time phases. Through this panchromatic synthesis of late-time observations, we can place robust constraints on the mass-loss histories of RSGs in their final decades, centuries and millennia as well as constrain the unknown thermalization fraction of shock power during CSM-interaction.

Jacob Jencson (California Institute of Technology/IPAC)

A JWST View of the Dynamic ISM with Thermal Echoes of Cas A

The complex environment of interstellar gas and dust around the young supernova remnant Cassiopeia A hosts a spectacular system of thermal infrared echoes powered by the burst of radiation from the historical explosion. Building on nearly two decades of observations by Spitzer and NEOWISE, JWST now offers the ability to see these echoes in unprecedented detail. We present results of a new imaging (NIRCam; 0.9-4.5 micron) and spectroscopic (MIRI/MRS; 5-24 micron) observing campaign (JWST-GO 5451) that, with angular resolution of ~400 AU, provide a path-breaking view of the 3D structure of the typical Galactic cold neutral medium. The ongoing spectrophotometric time series reveals the compositions and physical conditions of the echoing clouds, constrains our picture of Cas A's massive progenitor through the luminosity, hardness and duration of the incident shock-breakout radiation, and will provide a real-time view of the dynamic effects of this radiation field on the dust and molecular content of the interstellar medium.

Tuomas Kangas
(Finnish Centre for Astronomy with ESO, University of Turku)

H-rich superluminous supernovae: diversity and power sources

Superluminous supernovae (SLSNe) are rare and exotic stellar explosions whose unusual luminosity and slow evolution result in energy requirements beyond the usual power sources of core-collapse supernovae. While H-poor SLSNe are, in the literature, mostly attributed to the birth and spindown of a millisecond magnetar, in the less-studied H-rich SLSNe interaction with a dense circumstellar medium (CSM) is mostly obvious through the presence of narrow emission lines. However, there is considerable diversity within this class of SLSNe, and there are some that do not show clear evidence of CSM interaction as the dominant mechanism. As a result, magnetars and even the combination of CSM and magnetars have also been considered. I will present recent results that highlight the diversity within H-rich SLSNe and, possibly, a need for multiple power sources, exemplified through SN 2023gpw, which neither CSM interaction alone nor a magnetar model can explain.

Jamie Kennea (Pennsylvania State University)

ACROSS: Enabling Time Domain and Multimessenger Astrophysics

The U.S. Astro2020 Decadal Survey recommended an investment in Time Domain and Multi-Messenger Astrophysics (TDAMM) as the top-priority sustaining activity in space for the coming decade. One aspect of NASA's response to this recommendation is a pilot project, the Astrophysics Cross-Observatory Science Support (ACROSS) Initiative, designed to provide support to both missions and observers as they pursue TDAMM science. In this talk, we present our observations of needs in the community and initial plans for ACROSS activities, including services to facilitate and improve cross-mission follow-up planning and execution; a multi-messenger web portal with links to existing mission resources, community tools, and information targeted for TDAMM General Observers; development of "Smart Target of Opportunity submission page" proof-of-concepts; and ongoing development of a potential TDAMM general observing competitive grant solicitation. While the initial focus has been to enhance coordination between NASA missions, we are eager to work with ground-based and international partners as well. We invite discussion with both missions and observers to better understand their needs and concerns as ACROSS progresses. Here we present our efforts on the web-portal and API, along with our development to support NASA's BurstCube mission.

Charles Kilpatrick (Northwestern University)

Detecting the massive progenitor stars of core-collapse supernovae in space telescope imaging

Core-collapse supernovae are the luminous, terminal explosions of massive stars and are responsible for chemical enrichment of the Universe, injection of energy into galaxies, and production of compact objects observed via their mergers in gravitational waves. Every year, dozens of these supernovae are discovered in nearby galaxies with deep pre-explosion imaging that can be used to detect or place strong limits on the physical nature of their massive star progenitor systems, providing a direct connection between stars and their cataclysmic explosions observed throughout the Universe. I will discuss recent results from Hubble and Spitzer Space Telescope observations of Type II supernovae such as SN2023ixf and 2024ggi, the extreme variability and mid-infrared excess they reveal, and evidence for enhanced mass loss immediately before core collapse. In the next few years, we will be able to use new imaging from JWST, Euclid, and the Roman space telescope to better understand the latest stages of massive star evolution, dust production, and massive star binary interactions.

Sahana Kumar (University of Virginia)

The Faint and the Furious: Nebular Phase SNe Ia in the Near-Infrared

The rise of automated transient searches has increased the number of known Type Ia supernovae (SNe Ia) to the point where follow-up resources can only observe a small fraction of the total SN Ia population at nebular phases. Identifying key observables and their evolutionary timescales is necessary to strategically plan late time observations and ensure efficient use of spectroscopic resources. I use 93 late-time NIR spectra to examine the distribution of material within the innermost region of the SN to test theoretical predictions for multiple origin scenarios. The detection and time evolution of the NIR [Ni II] 1.939 micron and [Fe II] 1.644 micron lines can be used to constrain the progenitor's mass and may yield additional clues regarding possible explosion mechanisms. I also search for NIR H and He emission lines to gauge the likelihood of SNe Ia with surviving material from non-degenerate companion stars. Finally, I will discuss the advantages of NIR spectroscopy and share optimized follow-up strategies for different subtypes of SNe Ia.

Lindsey Kwok (Northwestern University)

JWST Observations of Peculiar Iax Supernovae

Not all type Ia supernovae (SN Ia) are "normal"; in fact, there is an entire "thermonuclear zoo" of peculiar white-dwarf SN, the most common being the type Iax (SN Iax) subclass. SN Iax are weaker thermonuclear explosions than "normal" SN Ia, displaying lower observed luminosities, energies, and velocities, along with far greater diversity in brightness – spanning over 5 magnitudes (>100-fold in brightness). While the progenitor systems and explosion mechanisms of "normal" SN Ia remain inconclusive and widely debated, SN Iax are more securely linked to the pure deflagration of a Chandrasekar-mass white dwarf (WD). We present the first JWST near- and mid-infrared (NIR+MIR) spectra of SN Iax, specifically of the intermediate-luminosity SN Iax 2024pxl and the extremely faint SN Iax 2024vjm (the nearest SN Iax ever discovered!). We unveil the evolution of their unique MIR spectral signatures and highlight similarities and differences between these objects which differ in brightness by ~4.5 mag. While SN Iax optical spectra never go fully nebular (optically thin), we show that they indeed become nebular in the MIR, even at early times, and demonstrate that a single spectrum can transition from photospheric to nebular as a function of wavelength. Finally, we compare the JWST data to existing deflagration models, offering insights for refining SN Iax theories.

Andrew Levan (Radboud University)

The landscape of the high-energy transient sky

The past 30 years have seen the emergence of a generally accepted picture of the high-energy transient sky, focussed on the progenitors of long- and short-duration gamma-ray bursts. This textbook description ascribes long-GRBs to stellar core collapse and short-GRBs to compact object mergers. However, recent and ongoing observations are re-drawing this understanding and finding new diversity. I will present a series of discoveries from high-energy satellites (e.g. Swift, Fermi, the Einstein Probe, SVOM) followed up from the ground and with Hubble/JWST. I will show how these discoveries lead to a new progenitor paradigm for GRBs, which is not based strongly on duration, including JWST observations of kilonovae in long-GRBs. Furthermore, I will highlight how new observations of Fast X-ray Transients extend the population of relativistic transients to much lower-energy photons. These FXTs may form via related but also potentially new progenitor channels. These observational tools provide a new, richer, but more complex picture of the high-energy transient sky.

Ashish Mahabal (California Institute of Technology)

RAPID Insights: Real-Time Transient Classification for Roman

As part of the RAPID Project Infrastructure Team (PIT) for the Roman Telescope, we are developing advanced machine learning techniques for rapid and reliable transient classification, expanding Roman’s capabilities in time-domain astronomy. In collaboration with the Strategic Time-domain Research and Infrastructure Development for Roman Exploration (STRIDE) group, we are integrating community feedback to maximize the scientific yield of Roman's transient discoveries, especially for time-sensitive follow-up of critical events. This presentation will cover our machine learning-based approaches, current progress with simulated data, which support one of Roman’s core objectives of broadening our understanding of transient phenomena.

Konstantin Malanchev (Carnegie Mellon University/LINCC Frameworks)

Classification and Anomaly Detection with Massive Time-Domain Catalogs

I will review several projects focused on classification and both unsupervised and semi-supervised anomaly detection using ZTF light curve data. This presentation will showcase the LSDB package, developed by LINCC Frameworks, which enabled the analysis of over a billion light curves in just a few hours. Additionally, I will discuss adaptive machine learning algorithms from the SNAD team, which are designed to detect rare and anomalous transients such as super-luminous supernovae, microlensing events, recurrent novae, and stellar flares. These algorithms, implemented in the Coniferest package, are based on a modified Isolation Forest algorithm, incorporating a machine-expert iterative loop to enhance the efficiency of identifying objects of interest. I will also introduce SNAD Viewer, a light-curve portal that aids SNAD experts in data analysis and provides a toolset for broader interaction with ZTF data releases, serving both professional and amateur astronomers.

Megan Masterson (MIT Kavli Institute)

A New Population of Mid-Infrared-Selected Tidal Disruption Events

Tidal disruption events (TDEs) are powerful probes of the demographics and rapid growth of supermassive black holes (SMBHs). However, the use of TDEs to infer SMBH demographics requires sufficient knowledge of selection effects and biases. While TDEs are now routinely found in time-domain optical and soft X-ray surveys, there is growing evidence that these surveys reveal only a fraction of the total population, notably missing obscured sources. In this talk, I will present new efforts to search for these dust-obscured TDEs, namely using the infrared (IR) to search for dust echoes from these hidden TDEs. By applying novel difference imaging techniques applied to WISE mid-IR data, we found 12 new TDEs within 200 Mpc, roughly doubling the number of known optical TDEs in the same volume. Most of these IR-selected TDEs show no evidence for a variable optical counterpart, suggesting that this sample indeed represents a new population of obscured TDEs that have been historically missed by canonical TDE searches. I will discuss how this sample helps solve many of the open questions in the field of TDE physics, including host galaxy demographics, discrepancies between theoretical and observed TDE rates, and the so-called missing energy problem. Lastly, I will show the first JWST observations of TDEs with MIRI data for 4 of these IR-selected TDEs, which reveal new surprises and unlock detailed dust and accretion physics.

Dan Milisavljevic (Purdue University)

Understanding Supernovae Via Their Remnants in the Era of JWST

The superior resolution and sensitivity of JWST at near- and mid-infrared wavelengths open new pathways to answer critical questions about the nature of supernovae via investigations of young supernova remnants. This talk will outline JWST's potential to provide observations that can address fundamental questions about the progenitor systems, explosion mechanisms, and products of supernovae. Results of a JWST survey of the prototypical core-collapse supernova remnant Cassiopeia A will be discussed. Particular emphasis will be placed on the following science cases: 1) improving maps of shocked and un-shocked ejecta that can be directly compared to current supernova models; and 2) investigating the processes that govern the formation and final fate of the remnant compact object.

Adam Miller (Northwestern University/CIERA)

Leveraging Ground-based Surveys to Maximize Transient Science with Roman

The forthcoming Nancy Grace Roman Space Telescope promises to discover scores of new transient sources, including explosions that have only been probed at low redshift or never been seen before. To maximize the discovery potential of Roman's High Latitude Time Domain Survey, many lessons from ground-based time-domain surveys will need to be ported to this new mission. In this talk I will describe the La Silla Schmidt Southern Survey (LS4), a new time-domain survey to be conducted using the ESO 1m Schmidt Telescope. LS4 is being designed to interweave observations with the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST) by catching the bright and fast transients that will be missed by LSST. Deploying a similar strategy with Roman will enhance the science possible with (some) Roman discoveries. I will also discuss the utility of small aperture telescopes (such as LS4) for the development and rapid deployment of new (and in some cases experimental) machine learning systems that improve discovery efficiency. Working with smaller facilities allows for a greater risk profile in incorporating machine learning models into the telescope workflow, prior to adoption by more expensive missions such as LSST and Roman. To close I will highlight the recent deployment of such a machine learning model that facilitated the first fully automated discovery of a supernova (all of which happened while we were happily asleep).

Gautham Narayan (University of Illinois, Urbana-Champaign)

SCIMMA: Building a Software and Service Ecosystem for Time-Domain and Multi-Messenger Astrophysics

SCiMMA is building a suite of tools for time-domain and multi-messenger astrophysics supporting multiple experiments, surveys and surveys including the Vera C. Rubin Observatory's Legacy Survey of Space and Time, LIGO-Virgo-KAGRA, IceCube, SNEWS, the Transient Name Server, NASA GCN and more. SCiMMA's tools allow researchers studying transients to share data between different surveys and experiments (Hopskotch), report discoveries, archive data, and schedule follow-up observations (HERMES), perform inference on transients and their host-galaxies (Blast), and combine any of these surveys with a powerful Python API and full identity and access management. In other words, you can automate your discovery, follow-up, reporting, archiving and inference pipelines, which in turn enables anomaly detection, SN cosmology, multi-messenger astrophysics and any other science case you can dream up with reliable and robust software that is simple for a grad student to get up to speed with. SCIMMA is also working to support future ground- and space-missions such as LS4 and Ultrasat. Interested in making your time-domain transient experiment work more smoothly, robustly, and cheaply, while enabling new science cases?

Anya Nugent
(Center for Astrophysics, Harvard University & Smithsonian)

Investigating the Host Galaxy Properties of Spectroscopically and Photometrically Classified CCSNe

We are quickly approaching an era of rapid transient discovery, with upcoming missions such as the Vera Rubin Observatory and NASA's Roman expected to discover thousands of transients per night. The vast majority of these transients will only have scarce photometric coverage, leaving transient identification extremely challenging and progenitor inference even more so. Thus, before entering this era, we require comprehensive analyses of transients to uncover unique qualities that will be helpful in correctly identifying them when there are few photometric probes. Indeed, transient host galaxy stellar population properties (stellar mass, stellar population age, star formation rate, metallicity, etc.) may be crucial in distinguishing transient classes and understanding when they are misclassified from traditional machine-learning algorithms focused on transient emission alone. Here, I discuss using Blast, a web application designed to associate newly discovered transients to their host galaxies and determine the hosts stellar population properties with data from public imaging surveys, to study the host galaxies of ~180 spectroscopically classified core-collapse supernovae (CCSNe) and another ~500 photometrically classified CCSNe from the YSE DR1 catalog. I examine whether the photometrically classified events exhibit differences in their host properties than the spectroscopically confirmed population, thereby suggesting misclassification. I conclude with how host galaxy properties can be used for transient classification in Rubin and Roman surveys.

Brendan O’Connor (Carnegie Mellon University)

Characterization of a peculiar Einstein Probe transient EP240408a

We present the results of our multi-wavelength (X-ray to radio) follow-up campaign of the Einstein Probe transient EP240408a. The initial 10 s trigger displayed bright soft X-ray (0.5-4 keV) radiation with a peak luminosity of 1e49 (1e50) erg/s for an assumed redshift of z=0.5 (2.0). The Neil Gehrels Swift Observatory and Neutron star Interior Composition ExploreR discovered a fading X-ray counterpart lasting for 5 d (observer frame), which showed a long-lived (4 d) plateau-like emission before an extremely sharp powerlaw decline. The plateau emission was in excess of 1e46 (1e47) erg/s at z=0.5 (2.0). Deep optical and radio observations resulted in non-detections of the transient. Our observations with Gemini South revealed a faint potential host galaxy near the edge of the X-ray localization. The faint candidate host, and lack of other potential hosts to deep limits, implies a higher redshift origin, which produces extreme X-ray properties that are inconsistent with many known extragalactic transient classes. In particular, the lack of a bright gamma-ray counterpart, as constrained by GECam-B and Konus-Wind, conflicts with known gamma-ray bursts (GRBs) of similar X-ray luminosities. We therefore favor a jetted tidal disruption event (TDE) as the progenitor of EP240408a at high-z, possibly caused by the disruption of a white dwarf by an intermediate mass black hole. The alternative is that EP240408a may represent a new, previously unknown class of transient.

Christos Panagiotou (Massachusetts Institute of Technology)

Identifying mid-IR nuclear transients and their connection to neutrino sources

While nuclear transients associated with flares from accreting supermassive black holes are nowadays regularly detected in optical and X-ray surveys of the sky, there’s increasing evidence that mid-IR detected flares may provide a more complete picture of the underlying population. Interestingly, accretion flares with strong mid-IR emission have recently been argued to emit high-energy neutrinos, potentially accounting for a considerable fraction of the observed neutrinos. To further explore this, we performed a systematic search of the NEOWISE archive in order to detect nuclear flares in the nearby Universe. In this talk, I will outline our ongoing efforts to categorize mid-IR nuclear transients, presenting the identification and analysis of the closest detected TDE, and I will demonstrate the lack of connection between neutrino sources and a complete sample of mid-IR accretion flares, which challenges past claims. I will discuss potential explanations for this disagreement and will conclude with our plans for future work.

Daniel Perley (Liverpool John Moores University)

Ultraviolet Spectroscopy of a Luminous Fast Blue Optical Transient

The rare and mysterious class of event sometimes known as luminous fast blue optical transients, typefied by the event AT2018cow, has provided a steady stream of surprises over the past five years: they are extremely radio-luminous, highly X-ray variable, and at least in some cases they produce ultra-fast optical flares for months and leave behind a hot remnant. While the emission from these transients peaks in the UV at all epochs, the only UV spectrum obtained before now has been a low-S/N UVOT grism observation of AT2018cow. I will pretent the first HST spectrum of a LFBOT, using COS and STIS to provide simultaneous coverage over the entire FUV/NUV range, with <1 Angstrom resolution blueward of 2000 Angstroms. Surprisingly, the spectrum is almost a pure single-temperature blackbody with no strong transitions beyond ISM absorption features from the Milky Way and host galaxy. The lack of strong features calls into question most supernova-like models, pointing towards models in which virtually all material from the progenitor system remains bound in a hot and dense plasma surrounding the central engine.

Vincenzo Petrecca (Istituto Nazionale di Astrofisica)

Synergies between Euclid and ground-based surveys for time-domain astronomy

Time-domain astronomy is living in a golden era thanks to next generation facilities, including revolutionary ground-based surveys such as the LSST, and advanced space telescopes like Euclid and Roman. Enhanced synergies between these facilities can significantly improve both the detection and characterization of a wide range of transient sources. In fact, near-infrared (NIR) photometry from space telescopes enables the identification of both high redshift transients and heavily obscured sources, typically missed from optical surveys. However, fully characterizing these transients requires complementary photometric coverage from ground-based surveys. With a pilot search in the Euclid Self-calibration field (SelfCal), we found ~700 Supernova candidates over just ~3 square degrees and a few months of observations. These numbers confirm Euclid capabilities as a transient detection machine, and will dramatically increase when considering observations over all the Euclid Deep Fields (~50 square degrees) and the entire survey duration. Detections may include many super-luminous SNe, as well as transients never observed, like Pair Instability or Electron Capture SNe, expected to be more numerous at high redshift. While the Euclid key project DR1-KP-SNT-1, of which I am co-coordinator, continues the transients search in the SelfCal field, we initiated a project to enhance synergies between Euclid and ground-based surveys and get extensive monitoring of dedicated fields. For this purpose, in October 2024 we started a campaign of weekly observations with the VST of 4 square degrees in the Euclid Deep Field South, complementing Euclid observations and in preparation for LSST. We will present preliminary results from these joint observations, showing how combining NIR data from space with optical photometry from the ground allows for a more comprehensive transient characterization. This synergy between Euclid and VST also set a foundation for future transient studies with Roman and LSST, advancing our understanding of the transient Universe on unprecedented scales.

Chris Reynolds (University of Maryland)

TDAMM in the Era of the Axis Probe Mission

Coming soon!

Sam Rose (California Institute of Technology)

Confirmation of the first low-metallicity highly dust producing Wolf-Rayet system with JWST/NIRSpec

Recent results from JWST have shown that significant quantities of dust are formed early in cosmic history, even within 600 Myr of the Big Bang. While in the local universe significant quantities of dust are formed in the winds of low-mass AGB stars, these stars may evolve too slowly to explain the bulk of early universe dust formation. Supernovae from more massive stars have also been shown to be capable of producing dust, predominantly oxygen rich silicate dust. Another potentially significant contributor to dust production by massive stars, especially carbon-rich dust production and dust production at low metallicity, which has been previously overlooked are carbon-rich Wolf Rayet (WC star) colliding wind binaries. These systems can form large amounts of dust where carbon-rich winds from a WC star collide with the winds of an O/B star companion. In this talk I will present recent observations with JWST/NIRSpec IFU of a candidate low-metallically (half-solar) dust producing WC colliding wind binary located in the nearby galaxy NGC 2403. Our JWST observations confirm the association of the luminous dust producing transient SPIRITS 19q, discovered by the Spitzer space telescope, with a late type WC star. I will discuss the implications of this association for the contribution of WC colliding wind binaries to the cosmic dust budget and the formation of dust at sub-solar metallicities.

Arkaprabha Sarangi (Indian Institute of Astrophysics)

Dust formation in massive stars, before and after supernova explosion

Core-collapse supernovae are recognized as significant contributors to dust formation in both local and high-redshift galaxies. Supernova environments are characterized by exotic phenomena such as shocks, radioactivity, non-equilibrium chemical processes, and rapid cooling. In my presentation, I will provide an overview of the current state-of-the-art in modeling dust formation in supernovae, drawing on the physics and chemistry of these environments. I will discuss the nature and mechanisms of dust production in (a) the pre-supernova progenitors, (b) the ejecta post-explosion, and (c) the interaction region of the forward shock, reverse shock, and the circumstellar medium. This talk will address all the properties of supernova dust, observed in the last two years with JWST, as well as its connection with Spitzer observations over the past few decades. A similar formalism is applicable to many stellar transients, dominated by heavy or sporadic mass-loss episodes, explosions, binary interactions or colliding winds.

Norbert Schartel (European Space Agency)

XMM-Newton: Scientific Policy and Target of Opportunities

XMM-Newton is one of the most successful science missions of ESA to date, with over 400 refereed papers published annually. The presentation outlines the evolution of the scientific policy. Despite the inherent limitations of XMM-Newton in detecting novel, bright transient phenomena, follow-up Target of Opportunity observations have constituted a significant proportion of the observing programme in recent years. In conclusion, the presentation will address the findings of Target of Opportunity observations.

Steve Schulze (Northwestern University)

The tale of two PISN candidates and the implications of finding them at high redshift

Pair-instability supernovae (PISNe) are purportedly produced by the thermonuclear runaway of metal-poor stars with zero-age-main-sequence masses of 140-260 solar masses. During the explosion, up to 40 solar masses of radioactive nickel are produced, giving rise to luminous, long-lived transients. Simulations suggest that the James Webb, Euclid and Roman Space Telescopes could detect PISNe at intermediate and high redshift. However, owing to the vast distances, data on these PISN candidates will be scarce. In this talk, I will present the properties of SN 2018ibb - the best PISN candidate today - and a new candidate discovered in 2023. In particular, I will highlight observational challenges and open questions for PISN models. These findings are critical for studying the fate of the most massive stars in the early Universe and developing search strategies for PISNe at high redshift.

Kendall Shepherd
(Scuola Internazionale Superiore di Studi Avanzati)

Stellar Winds & the Fate of Very Massive Stars: Impacts on Evolution, Supernova Types, and Remnants

Very massive stars (VMS) play a crucial role in astrophysics, by injecting energy and new chemical species into the environment through their winds and powerful supernovae. Since they may evolve close to the Eddington limit, stellar winds play a pivotal role in shaping their evolution via mass loss, and as a result, directly affect the supernova type and remnant masses.

In this work I study how the evolution and final fate depends on several different stellar wind prescriptions applied during the evolution. I present newly implemented wind mass loss recipes recently published in the literature within the PARSEC code, of very massive stars mass (Mi > 100 M$_{\odot}$ to 400) at LMC metallicity.

The different mass-loss recipes lead to significantly different stellar evolutionary paths and consequently, to distinct advanced phases. Depending on the mass loss recipe used, stars end their evolution either as red supergiants or Wolf Rayet, resulting in different SN types. The new mass loss recipe better reproduces both observations of massive stars and the observed BH mass distribution.

Their location in the HR diagram and contribution to the ISM enrichment will be used to observationally constrain current uncertainties in stellar evolution models, in particular concerning the mass-loss rate phenomenon. Moreover, these results may contribute to explain future data from next-generation observations to aid in our understanding of pre-supernova evolution and the remnants left behind from massive stars.

Manisha Shrestha (University of Arizona)

A gold sample of young and nearby transients from the UV to the NIR

Massive stars and their spectacular end-of-life explosion have far-reaching implications for a broad range of astrophysics such as the evolution of the ambient medium, galaxy evolution, the formation of compact objects that produce gravitational waves, and rapid neutron capture (r-process) elements such as gold and platinum. Despite decades of research, our understanding of the final moments of the lives of massive stars is very limited. Interestingly, the circumstellar material created by this mass loss can have a major impact on the early spectra and light curves of supernovae. We are in a golden era of time-domain astronomy with a wide variety of surveys deploying different approaches to finding young and interesting supernovae. The Distance Less Than 40 Mpc (DLT40) supernova survey focuses on obtaining multi-wavelength observations mere hours after the explosion on only the closest objects and maintaining follow-up in the days and months afterward. For unprecedented multi-wavelength data from the X-ray to the NIR, we employ space-based telescopes like Swift, HST, and TESS, and ground-based telescopes like MMT, Gemini, and LBT, along with our dedicated survey telescopes. In this talk, I will present the results of recent exciting transients such as a fast blue optical transient, and nearby supernovae 2024ggi and 2024bch. I will discuss the importance of simultaneous UV and optical observations to improve our understanding of these transients and their connection to the progenitor and the usefulness of high-resolution spectra particularly in the first few weeks after the explosion. This high-quality early data from DLT40 is crucial in determining the need for a late-time follow-up using space-based telescopes.

Matthew Siebert (Space Telescope Science Institute)

Discovery of a Relativistic Stripped Envelope Type Ic-BL Supernova at z = 2.83 with JWST

The combined depth and wavelength coverage of JWST is beginning to enable a new era of transient discovery at redshifts z>2. During Cycles 1 and 2, the JADES program obtained multiple epochs of the same field, allowing for one of the first searches for transients in deep images (~30 AB mag) over a relatively wide area (27 arcmin^2). One of the transient candidates discovered (SN 2023adta), has a light-curve and host galaxy spectroscopic redshift consistent with a Type Ic-BL supernova (SN Ic-BL) at z = 2.83, making it the most distant stripped-envelope SN (SESN) discovered to date. Its light curve matches well with other SESNe and the broad absorption features in its spectrum are consistent with other SNe Ic-BL 1-3 weeks after peak brightness. We measure a Ca II NIR triplet expansion velocity of 29,000 km s^-1. The host galaxy of this SN is irregular, and modeling of its SED indicate a metallicity of Z = 0.35 Zsol. Given the rarity of SNe Ic-BL in the local universe, the detection of a SN Ic-BL at z=2.83 could indicate that their rates are enhanced at high redshift.

Leo Singer (NASA Goddard Space Flight Center)

Gravitational-Wave Follow-Up Strategy for the UltraViolet EXplorer (UVEX) Mission

The UltraViolet EXplorer (UVEX) is a Medium-Class Explorer (MIDEX) mission selected by NASA for launch in 2030. UVEX will conduct an unprecedented all-sky time-domain survey in two UV filters. UVEX will follow up GW binary neutron star mergers as targets of opportunity, rapidly scanning across their localization regions to search for their kilonova counterparts. Early-time multiband ultraviolet light curves of kilonovae are key to explaining the interplay between jet and ejecta in binary neutron star mergers. Owing to high Galactic extinction in the ultraviolet and UVEX's large field of view, variation in sensitivity across the GW region of interest is an important consideration for observation planning. We present a strategy for GW follow-up with UVEX in which exposure time is adjusted for each field individual to maximize the overall probability of detection. We have implemented this strategy in an open source astronomical scheduling toolkit called M4OPT (Multi-Mission Multi-Messenger Observation Planning Toolkit), on GitHub at https://github.com/m4opt/m4opt.

Bhagya Subrayan (Steward Observatory, University of Arizona)

Probing Shock Breakout and Cooling Emission of SN2024uwq with Early Swift UV Observations

We present an early, high-cadence multi-wavelength dataset of SN 2024uwq, a nearby Type IIb stripped-envelope supernova exhibiting a distinctive double-peaked light curve following shock breakout. Using a combination of space-based Swift UV data and ground-based optical photometry, we capture the initial days after the explosion, providing an in-depth view of rapid shock cooling in the progenitor's stripped envelope. We model the earliest phases of shock cooling emission using theoretical analytical models placing strong constraints on its progenitor properties, including radius, envelope mass, ejecta mass, and explosion energy. In this talk, I will also compare SN 2024uwq's photometric and spectroscopic data with well-studied Type IIb supernovae exhibiting shock cooling, including SN 1993J, SN 2011dh, SN 2013df, and SN 2016gkg, highlighting key similarities and differences in progenitor systems. This work highlights the critical role of Swift in capturing early UV light curves and emphasises the transformative potential of upcoming missions like UVEX and ULTRASAT. These high-cadence UV observatories are set to revolutionise early-time supernova studies, providing crucial insights into the last stages of massive stars and the diverse pathways that lead to core-collapse supernovae.

Kirsty Taggart (University of California, Santa Cruz)

SN2023fyq: The first Type Ibn Supernova with a Detected Progenitor System & Silicate Dust Formation

We present JWST and HST observations of SN 2023fyq, the closest (~18.2 Mpc) Type Ibn supernova (SN Ibn). SNe Ibn are rare yet astrophysically significant explosions of highly stripped stars whose ejecta interact with a close-in, H-poor/He-rich circumstellar medium (CSM) created shortly before their terminal explosion. We identified a blue (B-V = 0.2) and luminous (M = -9 mag) progenitor candidate for SN 2023fyq in HST imaging taken a decade prior to the explosion. Remarkably, the progenitor steadily increased in luminosity for at least three years, reaching M = -12 mag, then began to brighten rapidly before exploding. During this brightening and only 3 weeks before explosion, the progenitor was serendipitously imaged by JWST/MIRI, revealing a significant reservoir of cold carbonaceous dust (T ~ 120 K). This finding suggests that extreme mass loss at the end of a progenitor star's life plays a crucial role in pre-explosion dust formation. An extensive observing campaign followed SN 2023fyq, including a JWST DDT program one year after the explosion. These data revealed warm amorphous silicate dust (T ~ 300 K, M = 2.5 × 10^-3 M⨀), marking the first definitive detection of silicate dust in a supernova at +1 year, likely formed after the explosion. While astronomers have taken advantage of interacting SNe to characterise the final moments of the progenitor's evolution. SN 2023fyq provides a unique opportunity to connect these observations to a directly observed, highly stripped progenitor star. We will discuss SN 2023fyq in the context of its progenitor system, mass loss, and dust properties.

Jason Tumlison (Space Telescope Science Institute)

Transient Science with HabWorlds Observatory
Coming soon!

Christian Vassallo (University of Turku)

Relation Between Core-Collapse Supernova Rates and Star Formation Rates Using JADES Data

Core-collapse supernova (CCSN) rates across the redshifts holds important information on how galaxies and their star formation have evolved over cosmic time. Our work aims at shedding light on the connection between CCSNe and star formation rates (SFR) by using new high-redshift CCSN rates from the JWST Advanced Deep Extragalactic Survey (JADES). For this, the observed CCSN rates are compared with the expected rates based on the cosmic star formation history using both chi-square and Markov Chain Monte Carlo (MCMC) analysis. Effects of dust obscuration, metallicity (fallback into a blackhole), binary stellar populations and the initial mass function (IMF) are investigated. We find that correcting the observed CCSN rates for dust obscuration and taking fallback into account becomes especially important at redshifts higher than z ~ 0.5. Using the The Binary Population and Spectral Synthesis code (BPASS) we find that including effects of binary systems has only a small impact on matching the observed and theoretical CCSN rates. Our findings show no significant variation in the results when using the Salpeter, Kroupa, or Chabrier IMFs.

Charlotte Ward (Princeton University)

Strongly lensed supernovae in focus: joint analysis of gLSNe in ground and space-based imaging

The Euclid and Roman surveys coincide with an exciting new era for supernova (SN) cosmology, where time-domain surveys such as the Legacy Survey of Space and Time at Rubin Observatory (LSST; beginning 2025) will enable the detection of 100,000 - 1 million SNe per year, including ~100-200 gravitationally lensed SNe (gLSNe) per year. Given the substantial overlap between the Euclid and Rubin wide and deep fields, and potential for Rubin overlap with the Roman High Latitude Wide Area Survey, we will discover hundreds of lensed supernovae with comprehensive ground and space-based datasets, expanding the populations of lensed SNe Ia for time delay cosmography. In addition, Euclid and Roman will enable large-scale population analyses of SN host galaxies and SN dust reddening, essential to calibrating SNIa distance measurements. Supernova cosmology experiments with overlapping Euclid/Roman and LSST imaging will suffer from a number of key technical challenges: the majority of lensed supernovae discovered by LSST will be unresolved or marginally resolved in ground-based imaging; at the depths of LSST half of galaxies will also be blended with background galaxies; and combining SN photometry from multiple surveys must be possible when a SN-free reference image is unavailable, or when reference image epochs are mismatched. I will discuss how we can address these challenges with multi-resolution image forward modeling methods that jointly analyze multi-epoch ground-based imaging and higher resolution space-based imaging, using a new software package Scarlet2. These methods leverage the resolutions offered by Euclid and Roman to model gravitational lenses that are marginally resolved in LSST -- without background galaxy contamination -- and extract high quality photometry across all available imaging data.

Haojing Yan (University of Missouri - Columbia)

Transient Discoveries in the JWST Era

JWST has opened a new window for time-domain science in infrared. The experiences over the past two years show that JWST's discovery of transients is a norm: all repeated NIRCam observations on the same field have revealed transients. The JWST GTO program "Prime Extragalactic Areas for Reionization and Lensing Science" (PEARLS) had a built-in component for time-domain science, which observed two fields in multiple epochs at different cadences using NIRCam: three epochs on the lensing cluster MACS J0416.1-2403 (M0416) separated by ~86 and ~42 days, and three epochs on the Spitzer IRAC Dark Field (IDF) separated by ~6 months in between. The observations in the M0416 field were mainly aimed at discovering new, highly-magnified stars in two caustic-straddling background galaxies previously known, while those in the IDF were to test the strategies in monitoring a blank field in JWST's northern continuous viewing zone (CVZ). Both sets of observations were highly successful: (1) in M0416, we found not only new caustic-crossing stars as expected but also supernovae unexpectedly; (2) in the IDF, we found supernovae and at least one hostless transient. This talk will present these results.

Emmanouil Zapartas (IA/FORTH Greece)

The population of binary companions next to stripped-envelope core-collapse supernovae

Stripped-envelope supernovae (Type Ib, Ic, IIb, etc) comprise one of the main types of core-collapse events, marking the death of massive stars that lost their hydrogen-rich envelope before exploding. Although very massive stars are not excluded from being their progenitors, the majority of them are believed to get stripped during a mass transfer towards a stellar companion in a close binary system. Various deep searches with the Hubble Space Telescope in post-supernova images to identify a remaining stellar source in nearby supernova sites and in older supernova remnants have led to detections or strong constraints to the existence of a possible binary companion. I will present the observational sample so far of companions next to nearby stripped-envelope supernovae which provides valuable independent information about the supernova progenitor systems. This compilation of observed companions allows us to do the first statistical study of them as a whole, comparing it with the predicted population properties derived from binary population synthesis codes, either based on detailed binary models, such as POSYDON, as well as other parametric ones. We find that in most stripped-envelope supernovae a fairly unevolved companion star is expected next to the exploding star, being the cause of its stripping and increasing its probability of exploding. The possible discrepancy of the observed narrow luminosity (and mass) distribution of the companions compared to the broader expected one may provide critical insights about uncertain phases of binary evolution of these progenitor systems.

Erez Zimmerman (Weizmann Institute of Science)

Ultraviolet observations of infant Supernovae

Observing Supernovae (SNe) shortly after they explode is key to probing their progenitor properties and the physics behind the explosion shock-breakout. As SNe are hot in their early stages, peaking in the ultraviolet (UV), space observations are critical to resolve these properties.

In this talk, I will present results from recent studies based on UV observations of infant SNe, only accessible from space. These results include probing the circumstellar material around the exploding progenitors through early UV photometry and spectroscopy (notably of the decadal SN2023ixf), SN wind shock-breakout, fitting early SN lightcurves to shock-cooling models, and probing SN galaxy host extinction using UV observations.

Posters & Poster Pop Talks

Gautham Adamane Pallathadka (Johns Hopkins University)

Double white dwarf binary population from SDSS-V

Binaries of two white dwarfs (WDs) are of vital importance to modern astrophysics. If the period is less than 10 hours they can merge due to gravitational wave emission. Merging binaries more massive than the Chandrasekhar mass is theorized to lead to Type-Ia supernovae. Being the final stages of stellar binary evolution, WD binaries help us study and model the binary evolutionary channels. We systematically looked for double WD (DWD) binaries in the upcoming fifth generation of Sloan Digital Sky Survey (SDSS-V). SDSS-V includes the first large-scale spectroscopic survey of WDs in the era of Gaia parallaxes. We present a search for DWD binaries in this rich dataset. We quantify radial velocity (RV) variations between sub-exposures to identify binary candidates, look for overlap with literature, and measure the orbital period for a subset of DWD binary candidates. We find about 100 DWD binary candidates. For about 10 WDs, we obtain a tentative period purely based on the SDSS-V data. The observing cadence of SDSS suggests that a fraction of these candidates are likely to be short-period binaries that will lead to transients within Hubble time and as such are used to infer the DWD population characteristics. Short-period DWDs emit gravitational waves that are detectable through the upcoming space-based gravitational wave detector LISA, and transients from the WD binaries are detectable through the upcoming Rubin Observatory. This DWD binary catalog has a wide variety of WDs ranging from single-lined WD binaries, double-lined WD binaries, binaries of different species of WDs, etc, and forms a rich collection of objects that unveil to us the secrets of stellar binary evolution and the transients they lead to.

Salama Alhinaaia (Sultan Qaboos University)

A Comprehensive Study of Lensed Gamma-Ray Bursts

Gamma-ray bursts (GRBs) are transit events found at cosmological distances. Hence, the gravitational lensing of GRBs can be observed occasionally. Lensed gamma-ray bursts are considered a unique cosmological probe of the universe, offering valuable understandings into matter distribution, dark energy's nature, and galaxies' formation and evolution. In principle, the lensed GRBs prompt emission in which the source-lens-observer geometry produces duplicating pulses with similar light curves and spectra but differing fluxes and time-shifted. Several temporal and spectral analyses must be conducted to evaluate the impact of gravitational lensing on a gamma-ray burst signal for both pulses. In this study, we searched for lensed GRBs among swift BAT 2004- 2023 data, performing four gravitational lensing tests: an autocorrelation test, a hardness ratio similarity test, a time-resolved spectral test, and a time-integrated spectral test. The results show several substantial lensed GRB candidates, providing a robust foundation for further research. Our work includes a comprehensive study of all published lensing of gamma-ray bursts that follow the same technique we used in our search for lensed GRBs. Results reveal the spatial distribution, the density per solid angle, event rate, lensed mass, time delay, and redshift distributions for all lensing gamma-ray bursts in our study.

Cristina Andrade (University of Minnesota)

The Effect of Vera C. Rubin Observatory Cadence Selections on Kilonova Detectability

The discovery of the optical/infra-red counterpart (AT2017gfo) to the neutron-star binary merger gravitational wave detection (GW170817), which was followed by a short gamma-ray burst (GRB170817), marked a groundbreaking moment in multi-messenger astronomy. To date, it remains the only confirmed joint detection of its kind. However, many experiments are actively searching for similar fast-fading electromagnetic counterparts, known as kilonovae. Fortunately, the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST) provides excellent prospects for identifying kilonova candidates either from, or independent of, gravitational-wave and gamma-ray burst triggers. Cadence choices for LSST surveys are especially important for maximising kilonovae detections. In this work, we explore the possibility of optimizing the Rubin Observatory's ability to detect kilonovae by implementing a fast transient metric shown to be successful with the Zwicky Transient Facility (ZTF) and studying existing prospective LSST cadences, how detection rates are affected by filter selections, the return timescales for visits of the same area in the sky, and other relevant factors. Through our analysis, we have found that employing baseline cadences and utilizing triplet families like presto_gap produced the highest likelihood of kilonova detection.

Wasundara Athukoralalage (Harvard University)

Exploring Double-Peaked Long Duration Type IIn Supernova

Type IIn supernovae (SNe IIn) are hydrogen-rich stellar explosions classified by the presence of “narrow'' Balmer-series emission lines in their spectra, powered by the shock interaction between the explosion ejecta and the dense circumstellar material (CSM) shed by the progenitor star prior to explosion. As a result, they exhibit a broad range of luminosities and timescales that depend on the diverse combination of CSM and explosion properties indicative of a range of progenitor types and mass loss mechanisms. SNe IIn with multi-peaked light curves suggest complex CSM structures and eruptive mass loss. Therefore, studying such events provides an opportunity to understand mass-loss activity of complex progenitor systems and their environments. We present a unique sample of five SN IIn with double-peak long duration light curves and use detailed optical photometry and spectroscopy to comprehensively characterize their complex mass loss history. These spectra are dominated by Balmer lines with a complex morphology, including narrow emission and P Cygni components. Coupling the spectra and the luminosity and velocity evolution, we can analytically model mass-loss histories. Observations of this rare subtype of SNe IIn and their host galaxies with space-based telescopes will be key for independent constraints on the CSM density and detailed studies of their birth environments.

Raphael Baer-Way (University of Virginia)

X-Ray diversity in type IIn supernovae revealing different progenitors seen through SN 2020ywx

Hydrogen-rich interacting supernovae (type IIn SNe) generate powerful X-ray emission due to their strongly shocked dense circumstellar material (CSM). While SNe IIn have comparable X-ray luminosities and timescales, their detailed X-ray evolution varies due to their different CSM and progenitors. We present an X-ray view of the type IIn supernova 2020ywx from Chandra and Swift combined with observations in the optical, NIR and radio, and place it in context with other X-ray bright type IIn supernovae such as SN 2010jl and SN 2006jd. By modeling the emission in the X-rays and across wavelengths, we constrain the mass-loss history of 2020ywx. We find from the magnitude and duration of mass-loss that 2020ywx likely originates from a binary progenitor channel. Through the X-ray comparison with other IIn's, we emphasize that IIn's are coming from different progenitors given the vastly different CSM configurations derived. We demonstrate how X-ray observations, combined with other multi-wavelength observations, resolve degeneracies between model parameters and allow for the most confident assessment of the mass-loss rate. Furthermore, we also investigate the infrared evolution of this object in comparison to other IIn's. Through a comparison of the X-ray to infrared luminosity and the dust temperatures measured, we begin to understand the type of dust this supernova is forming and where it is forming (in the ejecta vs the dense shell between the shocks); an understanding which will have implications for future potential observations with JWST.

Solen Balman (Istanbul University)

State transitions in Cataclysmic Variables and the Dwarf Nova Z Cha in Quiescence and Outburst

We present X-ray spectroscopy of the SU UMa-type dwarf nova (DN) Z Cha using the EPIC and RGS instruments onboard the XMM-Newton Observatory. The quiescent system can be modeled by collisional equilibrium or nonequilibrium plasma models, yielding a kT of 8.2-13.0 keV at a luminosity of (5.0-6.0) E30 erg/s. The spectra yield significantly better fits using partial covering absorbers of cold and photoionized nature. The ionized absorber has an equivalent N H=(3.4-5.9)E22 cm^-2 and a log(ξ)=3.5-3.7. We detect for the first time Fe XXVI absorption line in an accreting CV. The line diagnosis in quiescence shows no resonance lines with only detected forbidden lines of Ne, Mg, Si. The H-like C, O, Ne, and Mg are detected. The strongest line is O VIII with (2.7-4.6)E−14 erg/s/cm^2. The quiescent X-ray emission is not collisional and not in ionization equilibrium which is consistent with hot ADAF-like accretion flows. The line diagnosis in outburst shows He-like O and Ne with intercombination lines being the strongest along with weaker resonance lines. This indicates the plasma is more collisional and denser, but yet not in a collisional equilibrium with ionization timescales of (0.97-1.4)E11 s cm^-3. The R-ratios in outburst yield electron densities of (7-90)E11 cm^-3 and the G-ratios yield electron temperatures of (2-3)E6 K. The outburst luminosity is lower (1.4-2.5)E30 erg/s. All detected lines are narrow with widths limited by the resolution of RGS yielding Keplerian rotational velocities <1000 km/s. This is too low for boundary layers, consistent with the nature of ADAF-like hot flows. CVs and DNe closely relate to other compact object binaries, even to young stellar objects, active galactic nuclei, quasars and supernova remnants. X-ray emission from Z Cha shows ADAF-like advective hot flow characteristics in quiescence and outburst. Our results have implications on all state transitions and disk outbursts together with accretion physics in accreting WDs. This work help to improve theoretical studies of disk modeling, MHD formalism and shock formation and outflows adding to the general understanding of radiatively inefficient hot flows in accretion disks in X-ray binaries and AGNs as it comprises a non-relativistic limit at lower temperatures with hard surface and low-to-no magnetic field of the accretor.

Tyler Barna (University of Minnesota – Twin Cities)

IIb or not IIb: Identifying Kilonova Imposters Through Photometric Analysis

Kilonovae (KNe) are a class of fast astrophysical electromagnetic transients associated with several other signals, including gamma–ray bursts (GRBs), their associated afterglows, and gravitational waves (GWs). Thus far, there has been a single Kne that has been definitively associated with a GW signal as well as a GRB afterglow – AT2017gfo, GW170817, and GRB170817 respectively. Kne are challenging to observe given their rapid rise and fade, usually peaking in the optical/infrared within a day of the initial binary merger and fading from view on the order of a week. In addition to this, there are many other classes of transient that can initially behave in a manner similar to Kne, including several classes of supernovae (Sne). Due to the aforementioned properties of Kne, one must usually allot limited spectroscopic resources towards assessing whether a candidate is indeed a KN. This project analyzes a number of imposter candidates observed by the Zwicky Transient Facility (ZTF) dating back to 2018. We compare these imposters against a grid of modeled KN lightcurves to evaluate if there are any metrics one can derive from photometric data in order to exclude the imposters from consideration without having to take spectroscopy.

Judhajeet Basu (Indian Institute of Astrophysics

Observing Nova from Space: UV and X-Ray Studies of Novae in M31 and LMC with AstroSat and Swift

Novae are explosive thermonuclear runaway events occurring on the surfaces of white dwarfs accreting matter from a companion star. These events are marked by dramatic increases in brightness—up to several orders of magnitude across the UVOIR spectrum—followed by a gradual decline unique to each nova. Thanks to its size, visibility, and orientation, the Andromeda Galaxy (M31) hosts a more significant number of observed novae than our own Milky Way, offering an exceptional field for study.

Here, we present a comprehensive nova catalog derived from archival AstroSat/UVIT observations of M31 (Basu et al. 2024a), in which 42 novae have been detected, either in quiescence or outburst. We will share findings on FUV magnitudes, light curves, and UV SEDs for several of these notable novae, focusing on recent outbursts observed by both AstroSat and Swift. Particular emphasis will be placed on M31N 2008-12a, a recurrent nova with a period of one year, distinguished by its robust jet signatures. Observations from AstroSat's SXT and UVIT, in conjunction with Swift's XRT and UVOT, have illuminated the nova's flux and temperature evolution, offering insights into the UV-X-ray flux relationship and its broader implications.

The presentation will also cover white dwarf properties and the supersoft source timescale derived from Swift and AstroSat, underscoring M31N 2008-12a as a promising single-degenerate pathway candidate for a type Ia supernova progenitor (Basu et al. 2024b). These findings, along with a few more novae in M31 and LMC with Astrosat data, will be discussed in detail, including their broader implications for nova evolution and type Ia SN progenitor studies. Additionally, we will present the FUV spectroscopy of SN 2023ixf, the first-ever supernova spectrum captured in FUV bands using AstroSat UVIT. This spectrum, obtained at a very young phase, is among the few FUV spectra recorded for supernovae, offering unique insights into their initial stages.

William Benoit (University of Minnesota)

Software tools to power machine learning development for gravitational wave physics

Intermediate Luminosity Red Transients (ILRTs) are Gap Transients produced by super-AGB stars embedded in dusty cocoons, and are valid candidates as Electron Capture Supernovae.Their progenitors are not detected in the optical or near infrared domains, but are bright in the mid infrared (MIR) as detected by the Spitzer Space Telescope. In this talk, I will present the results, recently published in Valerin et al. 2024, of the analysis of infrared data from space telescopes of two among the best studied ILRTs: NGC300-OT2008 and AT 2019abn in M51. From WISE data of NGC300-OT2008 in all of its 4 filters (up to 22 μm), we determined the mass of the newly-formed cold dust. Then, from Spitzer images taken in 2019, we confirm the transient has disappeared even in the MIR, supporting the scenario of ILRTs being terminal events. AT 2019abn was observed by JWST twice (in 2023 and 2024) with both NIRCam and MIRI. From the well-sampled spectral energy distribution, thanks to images taken with multiple bands from 2 to 21 μm, we are able to infer the chemical composition of the dust, likely made of silicates, and even the possible presence of PAH. Finally, we established that AT 2019abn has also faded below the progenitor level at 4.5 μm.

Peter Brown (Texas A&M University)

20 Years of Supernova Observations

The Swift spacecraft has observed supernovae for nearly 20 years. These include large samples of major types and examples of most subtypes. We will show some highlights of the observations and science done and synergies with other space-based observatories past, present and future. We will reflect on the lessons learned and give suggestions for those observing with Swift in the next 20 years.

Seo-Won Chang (Seoul National University)

Rapid Optical Followup of Gravitational Wave Events with KMTNet during the LVK O4 Observing Run

We present the current status of our optical follow-up program utilizing KMTNet facilities for gravitational wave (GW) events during the LVK O4 observing run. Our primary goal is to rapidly identify and characterize optical counterparts to GW triggers on timescales ranging from hours to weeks after the merger. The KMTNet Synoptic Survey of the Southern Sky (KS4) provides deep, multi-band reference images, which are essential for real-time transient searches and rapid differential image analysis. Currently, the KS4 survey covers over 6,600 square degrees for declinations below -30°, with co-added images reaching 5-sigma limiting magnitudes of 22-23 across the BVRI bands. To effectively filter out contamination from known variable sources, we cross-match transient candidates with the full KS4 source catalog and external photometric catalogs (e.g. DELVE, GAIA, LS). Additionally, we have developed a new real/bogus classifier tailored for KMTNet data based on a convolutional neural network architecture to further automate transient vetting. In this poster, we highlight several compelling followup case studies from O4a, including GRB230307A, a long gamma-ray burst with an accompanying kilonova, and S230518h, a potential neutron star-black hole merger event. We also discuss our most recent activities from the O4b run, focusing on the GW triggers S240422ed and S240915b.

Adrian Crawford (University of Virginia)

Peaky Finders: The Search for Double-Peaked SNe IIb in Large-scale Surveys and the Follow-up Race

In the imminent deluge of transient alerts that the Rubin Legacy Survey of Space and Time (Rubin LSST) will bring forth, we must be able to describe our targets of interest well enough and fast enough to identify them among the haystack in order to coordinate space-based follow-up observations. Our targets of interest—Type IIb supernovae (SNe IIb)—are partially stripped, core-collapse supernovae whose light curves can produce an additional preceding peak, powered by shock-cooling emission (SCE), which contains unique tracers of progenitor characteristics. Studying these information-rich objects leads to better understanding of massive star evolution and core-collapse supernova progenitors. The most valuable photometric progenitor information in the SCE peak emits mostly in the UV and thus requires fast triggering and coordination to acquire space-based follow-up UV observations (e.g. with Swift, UVEX, and ULTRASAT). To this end, we present the largest photometric population of double-peaked SNe IIb and the first-ever early-time population statistics of these interesting objects. We find that SNe IIb spend an average of just 5 days above half-maximum light during their SCE and that the SCE-peak-rise evolves 25x faster (in the g-band) than the rise to nickel-peak. Thus, if we want to study SCE, particularly in the UV, we must identify, coordinate, trigger, and observe all within days of discovery. To aid this follow-up race and better coordinate vital multiband light curve coverage, we develop a preliminary alert filter, using the ANTARES broker, to translate these population statistics into simple and effective filters for use on large-scale survey alert streams, like the imminent Rubin LSST.

Geza Csornyei (European Southern Observatory)

Classifying beyond the classes: identifying twin supernovae through multi-epoch spectral matching

With the advent of multiple all-sky surveys, such as the Zwicky Transient Facility (ZTF), the ATLAS survey, or the PAN-STARRS survey for transients (not to mention the upcoming Rubin Observatory survey) and the related spectroscopical follow-up programmes, transient astronomy has finally reached the era of Big Data science. This, however, poses a difficulty to a field where objects are often analyzed on an object-to-object basis: the constant need to re-analyze and model every new transient separately poses an enormous challenge owing to the heap of incoming new transient observations. This calls for improving the efficiency of spectral analysis, where improving the identification of "spectral look-alike" or "twin" supernovae, which exhibit very similar evolutions, can be a way forward.

While supernovae exhibit a significant range of features in their spectra when classes are compared against each other, they can also be highly similar when cross-checked on a supernova-by-supernova basis. This fact is well-known for Type Ia supernovae, however, it also holds for Type II supernovae: with the range of parameters being limited, given a sufficient number of observations, one can find objects that look like twins, exhibiting very similar spectral evolutions. Assuming that matching spectral evolution implies similar initial conditions and processes, one may analyze a 'new' supernova using the results from the 'older' twin, if it exists, which often speeds up the modeling. For this to be accurate, however, one must find objects that behave similarly across all epochs. In this context, template matching algorithms, such as SNID and GELATO are insufficient, as they do not consider the temporal information available on the spectra, providing mostly tentative comparisons.

In this work, I would present an improved way of classifying transients, which allows for identifying objects that not only look similarly at given epochs but consistently evolve similarly and produce suitable matches across the whole spectral time series. The method is based on a feature-to-feature comparison such as SNID, however, it is extended by the Gaussian Process-based interpolation of the spectral time series, allowing for the comparison of the full spectral evolutions in a chosen temporal range. I demonstrate the method on the early spectral evolution of Type IIP/L supernovae, which exhibits a wide diversity, yet, through this method, one can easily find pairs or trios of similarly evolving supernovae. This will not only assist in analyzing larger batches of supernovae through the results of previous analysis but will also yield insights into the properties of supernovae where data is incomplete or not as detailed as past objects, such as high-redshift transients observed by JWST.

Kyle Davis (University of California, Santa Cruz)

Boom and Dust: Insights from JWST Observations of Dust in the Nearby Type Ibn/Icn Supernova 2023xgo

We present late-time JWST imaging and spectroscopy of the nearby Type Ibn/Icn Supernova 2023xgo. SNe Icn are an exceptionally rare and only recently discovered class of extremely stripped SNe hallmarked by interaction between the SN shock and dense, C/O-rich circumstellar medium (CSM). Previous hydrogen/helium-interacting SNe (IIn/Ibn) observed by Spitzer and now JWST have significantly more dust than non-interacting SNe, and SNe Icn, with their dense and comparatively dense C/O-rich CSM should be the ideal sites for SN dust. Ground-based and HST observations of SN 2023xgo revealed a dense, C-rich CSM and strong dust emission only 72 days post-explosion -- suggesting that the SN is condensing dust extremely rapidly, or hosts substantial reservoirs of pre-existing dust in its CSM. With JWST imaging and spectroscopy from 1.7--23 micron to be executed between November 2024 and February 2025 (~400 days post-explosion), we will robustly characterize the mass, composition, and origin of dust in SN 2023xgo. These data will provide insights into the yet unknown SN Icn progenitors. Additionally, this test of dust production and growth in the ideal cosmic dust factory will constrain dust growth models, which, in turn, will determine if SNe alone can balance the early universe dust budget.

Steven Dillman (Stanford University)

Detecting Transients in High-Energy Catalogs with Representation Learning

Recent serendipitous discoveries in X-ray astronomy such as extragalactic fast X-ray transients as counterparts to gravitational wave signals from binary neutron star mergers highlight the importance of a systematic search for such events in X-ray archives. We present the first representation learning based anomaly detection approach for the discovery of high-energy transients. Variable-length time series data in form of X-ray event files present a challenge for the identification of characteristic features of these time-domain anomalies with machine learning methods. We introduce novel equal-length event file representations capturing both time and energy information. Applying our unsupervised X-ray transient detection pipeline to these event files representations enables the efficient identification of new transients. This involves extracting features from the representations using autoencoders followed by dimensionality reduction and clustering. By associating these clusters with previously identified transients and performing nearest-neighbor searches, we create a catalog of X-ray transient candidates. The catalog lists over 3500 galactic and extragalactic flare candidates including one intriguing new giant magnetar flare candidate in the Large Magellanic Cloud.

Tzvetelina Dimitrova (Arizona State University School of Earth and Space Exploration Astrophysics PhD)

Orphan Afterglows in Connection to sGRB-Binary Merger Event Rates in the Roman Space Telescope Era

There is strong tension between the rate of short-duration Gamma-ray Bursts (sGRBs) detected by Swift and Fermi, and rate estimates for their likely progenitors - binary neutron star (BNS) events. In Dimitrova et al. 2023 we calculate the observed Swift sGRB rate and make predictions for the number of sGRB/gravitational wave (GW) associations in the aLIGO O4 volume, assuming all sGRBs are due to compact object merger events. We find that these numbers strongly depend on sGRB beaming, and that estimates are thus fundamentally limited by a scarcity of jetting angle constraints. The lack of BNS events and joint sGRB observations in aLIGO O4 especially highlight the need for more challenging constraints and emphasize beaming as a key factor in understanding sGRB-GW association. To better constrain sGRB jetting effects, measurements or limits of orphan afterglow rates are needed from the Roman Space Telescope and Rubin Observatory. Beaming angle parameters can be inferred from the number of orphan afterglows found by such near-IR and optical facilities, and can be applied to GRB luminosity models (such as those used in Dimitrova et al. 2023) to update estimates of off-axis sGRB events and therefore further probe the relation between sGRBs and merger events.

Ryne Dingler (Texas A&M University)

Optical RMS-flux relation of Southern TESS Blazars

Blazar flares represent a frequent occurrence of multiwavelength astrophysical transients, stemming from intricate astroparticle physics that cannot be explored through other methods. These flares epitomize the extreme manifestations of the accretion and jet-launching process, which currently elude complete comprehension. Our thorough analysis of TESS light curves of blazars has unveiled unexpected behaviors within a new parameter space. One notable observation is the absence of a linear relationship between the brightness of a light curve segment and its overall variability, known as the rms-flux relation, which was previously believed to be universal. To assess the rms-flux relation on intra-day time scales in relation to the properties of the flux distribution, we leverage simulated light curves with globally identical variability properties to enhance statistical significance, akin to methods employed for power spectral analyses. Our findings indicate that although linear rms-flux relations may manifest in individual realizations, such correlations may be speculative, as we discover more intricate relationships or no correlation in these simulated light curves, in contrast to the commonly observed linear relation in x-ray light curves. Furthermore, our research suggests that these (non-)relations may stem from additive contributions to the flux distribution, as opposed to prior findings indicating multiplicative contributions. These results may imply non-stationarity in the optical emission or the presence of multiple, non-interacting optical emission mechanisms, of which only a portion exhibits the rms-flux relation.

Erin Eastep (University of Auckland)

BPASS Predictions of Compact Remnant Binary Populations Within the Milky Way

We present a study using the Binary Population and Spectral Synthesis code (BPASS) that predicts the Galactic population of binaries that contain a black hole or neutron star. By incorporating the stellar evolution models from the BPASS suite with a Milky Way analogue galaxy from the Feedback in Realistic Environment (FIRE) simulation suite, we can generate a theoretical population of quiescent compact remnant binaries as well as x-ray binaries within our Galaxy. We split the population into quiescent systems before and after their binary interactions, to investigate how such systems evolve and to further understand their role as supernovae remnants. Furthermore, we explore the code's output of x-ray binaries with a focus on how they can be studied as transients for systems that appear to be quiescent. We predict the distribution of masses and orbital periods for these systems and compare these to the current observed distributions within our Galaxy, including the recently discovered Gaia Black Hole systems. The remnant masses produced by the code for the pre-interaction systems serve to give us the most accurate measurement of the masses for compact remnants that form from supernovae. We find that the agreement in general is reasonable but there are strong indications that we need to include new physical processes within BPASS to be able to accurately reproduce the observed compact remnant distributions. These being ablation of white dwarfs by pulsars and the supernova kick prescription.

Michael Eracleous (Pennsylvania State University)

Preparing for LISA: What Might We Find Inside Pandora's Error Box?

The gravitational wave (GW) signals detected by the upcoming Laser Interferometer Space Antenna (LISA) will contain redshift information, which makes the uncertain location of the source a 3-D error box. Furthermore, since the GW signal is time-variable and the size of the error box changes with time, we must consider this a 4-D error box. For a typical merging massive black hole binary (MBHB, e.g., M_tot=10^6 M_⦿ at z=1) the volume of the 3-D error box is > 10^5 Mpc^3 at 1 hour before the merger and shrinks to ~10^3 Mpc^3 after the merger. We will present the first results of a systematic effort to anticipate the contents of such an error box. This is the stepping stone towards developing search strategies for the electromagnetic (EM) counterpart of the GW source. Our efforts proceed in two different directions. First, using existing surveys and cosmological simulations, we ask how many galaxies we may find in a typical error box that have the right mass to be considered good candidates to host the merging MBHB. The preliminary answer, assuming the above parameters, is ~10^8 candidate hosts at 1 hour before the merger and ~10^6 candidate hosts after the merger. Attempting to find the EM counterpart, then, resembles opening Pandora's box. However, the number of candidates drops sharply at lower redshifts. Second, we ask if an unrelated transient or periodic EM source (an "imposter") might appear in the error box when we try to identify the counterpart of the GW source. Our preliminary estimate is that a few imposters (dominated by supernovae) may be present in the error box at 1 hour before the merger and imposters are unlikely after the merger. Large redshift catalogs are critical for removing potential imposters that reside outside the 3-D error box of the MBHB. Without redshifts for detected transients and/or periodic EM sources, the number of imposters can increase by a factor of 100. The above challenges notwithstanding, at the bottom of the box there is hope that we will be able to identify the EM counterpart of the GW source, even before the MBHB merges by using more specific selection criteria for the EM counterparts, such as the color and variability properties of the EM source.

Alex Filippenko (University of California, Berkeley)

A Snapshot Survey of Nearby Supernovae with the Hubble Space Telescope

Over recent decades, robotic (or highly automated) searches for supernovae (SNe) have discovered several thousand events, many of them in quite nearby galaxies (distances < 30 Mpc). Most of these SNe, including some of the best-studied events to date, were found before maximum brightness and have associated with them extensive follow-up photometry and spectroscopy. Some of these discoveries are so-called SN impostors, thought to be superoutbursts of luminous blue variable stars, although possibly a new, weak class of massive-star explosions. We conducted a Snapshot program with the Hubble Space Telescope(HST) and obtained images of the sites of 31 SNe and four impostors, to acquire late-time photometry through two filters. The primary aim of this project was to reveal the origin of any lingering energy for each event, whether it is the result of radioactive decay or, in some cases, ongoing late-time interaction of the SN shock with pre-existing circumstellar matter, or the presence of a light echo. Alternatively, lingering faint light at the SN position may arise from an underlying stellar population (e.g., a host star cluster, companion star, or a chance alignment). The results from this study complement and extend those from Snapshot programs by various investigators in previous HST cycles.

Jared Goldberg (Flatiron Institute Center for Computational Astrophysics)

Big Stars have Buddies: Stellar Companions modulating Dusty Circumstellar Material Explains the LSP

About 30% of pulsating cool supergiant stars exhibit Long Secondary Periods (LSPs) in their light-curves, many with associated signals in their radial velocities (RVs). These LSPs are substantially longer than the stars' slowest (fundamental mode) radial pulsation, implying an extrinsic source for the variability. A favored explanation for these periodic signals is that they are a result of a lower-mass companion in orbit around the star, modulating the dusty environment and causing fluctuations in the star's observed brightness. I will discuss this scenario in the context of Betelgeuse, our Red Supergiant neighbor in the shoulder of Orion, which itself exhibits an LSP with a 2170-day periodicity ~5 times longer than the star's 416 day fundamental radial pulsation mode. By considering the lightcurve fluctuations and RVs together, we predict the existence of α~Ori~B, a low-mass companion orbiting Betelgeuse with a mass of Msin i ~ 1 Msun at an orbital separation of ~8.4 AU. I will describe features of the companion as constrained by the fundamental parameters of Betelgeuse and its orbital system, and what additional measurements might can shed light on the nature of the companion's interaction with the stellar environment. I will also detail the progress of our efforts to confirm or refute its existence observationally during the putative companion's Limb passage in early December. Finally, I will discuss our expectations for induced asymmetries in the circumstellar structure, and the likely impact on early Supernova emission, with implications for events such as the recent Supernovae 2023ixf and 2024ggi.

Mariusz Gromadzki
(Astronomical Observatory, University of Warsaw)

A Decade of Gaia Science Alerts and their follow-up with BHTOM.

The European Space Agency's Gaia mission, launched in 2014 and set to continue until 2025, is dedicated to surveying the entire sky with unprecedented astrometric precision. In addition to its primary objectives, Gaia has been providing hundreds of millions of photometric observations down to G=20 mag, covering approximately 1000 square degrees every day. These data have been analyzed to identify new or variable sources with the Gaia Science Alerts system, run at the University of Cambridge, UK. Over the past decade, Gaia has reported more than 25,000 unbiased detections of a wide range of transient events across extragalactic and galactic environments. These include supernovae, super-luminous supernovae, tidal disruption events, flares in quasars, cataclysmic variables, young stellar object flares, Be-type stars, and microlensing events.
To complement Gaia's discoveries, a coordinated network of ground-based telescopes has been developed, now forming a global time-domain observatory for transient and variable sources. The BHTOM.space system collects data from 120 telescopes and processes it automatically to produce rapid, science-ready photometric light curves. This talk will present the Gaia Science Alerts discoveries, showcase the capabilities of BHTOM for time-domain targets, and extend an invitation for additional telescopes to join this collaborative network for the forthcoming era of the Rubin/LSST.

Soumya Gupta (Bhabha Atomic Research Centre)

Investigating GRB 171227A Prompt Phase under the Relativistically Expanding Fireball Scenario

The emission process of the prompt phase of the Gamma-Ray Bursts (GRB) is still an open question. GRB spectrum is often well fitted by an empirical smooth broken power-law function term as the Band function. However, observations from the GLAST Burst Monitor (GBM) onboard the Fermi Gamma-Ray space telescope suggest the presence of a thermal component along with the non-thermal, whose origin is unintelligible. We perform a detailed study of the relativistically expanding fireball model with its temperature evolving as a function of its radius. In this work, we addressed the effect of high optical depth and its dependence on the density profile between the wind and the observer, resulting in the nontrivial shape of the photospheric radius. Further, the effect of the light travel time integrated with the time-averaged spectrum results in a much broader spectrum compared to the Planck function. A numerical code developed under this scenario is employed to reproduce the time-averaged and time-resolved spectrum of one of the bright GRB 171227A. We investigated the details of the prompt phase of GRB 171227A using GBM data. The spectral fitting is performed by coupling this numerical model with the statistical fitting package XSpec.

Sarah Healy (Virginia Tech)

Mapping Evolutionary Pathways: Dust Production in Red Supergiants and Supernovae

Supernovae (SN) are among the most energic phenomena in the universe, resulting in significant dust formation and production of chemical elements. While massive stars have been directly linked to Core-Collapse (CC) SNe, particularly red supergiants (RSGs) to type II-P/L, the mapping between mass ranges of stars and types of SN, which initially seemed to be one-to-one, has been shown to be more complex as large-scale surveys of SNe increase. A significant barrier comes from how dust is accounted for, not only for SN but also RSGs which represent the phase where most mass loss of massive stars occurs. To fill the gap between these stages of stellar evolution, the effect of dust on both populations of RSGs and CCSNe, as well as our methods for estimating luminosity and mass, need to be studied. Using the rise of large-scale infrared surveys and recent work to fully map the red supergiant (RSG) population of the Local Group, we examine how the current assumption of dust behavior affects the estimates of stellar characteristics and dust production methods. We studied how the luminosity of RSGs changes as they evolve and cool to determine at what phase the explosion occurs and what specific stars represent the progenitors of type II SNe. We then built a sample of RSGs that recreated the ages and metallicities of pre-explosion detected SN progenitors to interpret how dust affects our luminosity estimates and their connection to specific SNe. We then examine dust estimated from the early light observations of CCSNe and the stellar energy distributions of progenitor populations to understand better the possible enhanced mass loss that is expected to occur right before the collapse. Together, they provide useful insight into the current methods used to characterize RSGs and how mass loss rates change towards explosion and influence the resulting SN.

Assaf Horesh (The Hebrew University of Jerusalem)

Deciphering the Origins of Delayed Flares in Tidal Disruption Events: New Observations and Theories

Tidal disruption events (TDEs) occur when a star is torn apart by the immense tidal forces emanating from a supermassive black hole (SMBH). These events serve as dynamic laboratories for studying dormant SMBHs, their environments, and the physical processes associated with SMBHs, including the formation of accretion flows. Among the numerous enigmatic phenomena associated with TDEs, a relatively recent discovery is the occurrence of delayed X-ray and radio flares. Numerous events have been observed exhibiting sudden X-ray and radio emission at exceptionally late times, spanning from hundreds of days to several years after the initial tidal disruption. Notably, optical flaring has not been consistently associated with these flares. The origin of these delayed flares remains elusive, but several hypotheses have been proposed, including transitions in accretion states, the presence of large viewing angle off-axis jets, and recurring disruptions. The temporal and spectral characteristics of these delayed flares exhibit remarkable diversity, suggesting that they may be driven by a diverse range of processes. In my presentation, I will review several such flares that we recently observed concurrently with the Swift (X-ray) and AMI (radio) telescopes. Our initial findings, indicate a strong correlation between X-ray and radio emission in some of these events, implying a potential common mechanism.

Christopher Irwin
(Research Center for the Early Universe)/University of Tokyo)

Exploring the Landscape of Shock Breakout Spectra

The first light that escapes from a supernova explosion is the shock breakout emission, which produces a bright flash of UV or X-rays. Standard theory predicts that the shock breakout spectrum will be a blackbody if the gas and radiation are in thermal equilibrium, and a Comptonized free-free spectrum if not. Using recent results which suggest that thermalization takes place faster than previously thought, we show that another breakout scenario is possible in which the gas and radiation are initially out of equilibrium, but the time to reach equilibrium is shorter than the light-crossing time of the system. In this case, the observed spectrum differs significantly from the standard expectation, as light travel time effects smear the spectrum into a multi-temperature blend of blackbody and free-free components. Including this regime enables a complete categorization of possible shock breakout spectra into five distinct types; we explore the necessary conditions to obtain each type, and study the resulting spectral evolution. The scenario with coexisting free-free and blackbody components may be relevant for blue supergiants, or for fast shocks ($v \approx 0.1c$) in extended envelopes or circumstellar media. We consider possible applications of this novel breakout scenario to the low-luminosity gamma-ray burst GRB 060218, as well as the mysterious SN-associated X-ray transient EP 240414a recently reported by the Einstein Probe.

Luca Izzo (Istituto Nazionale di Astrofisica)

First results from the search of supernova events in the Euclid Self-Cal field

In this talk, I will present and discuss about first results obtained from a dedicated search of supernova candidates in the Euclid Self-Cal field. The Self-Cal field is a relatively small dedicated area of the sky that Euclid is observing with a monthly cadence for instrument calibration and data quality purposes. This makes the Self-Cal field an ideal source of astrophysical transients detected by Euclid. I will first describe the methodologies adopted for the data reduction and analysis of repeated epochs, and finally, I will present some of the preliminary results obtained from over a year of Euclid's observations in this field.

Mankeun Jeong (Seoul National University)

Host Galaxy Properties of Gamma-ray Bursts from Neutron Star Mergers: Implications for GW Follow-up

The formation channels and occurrence rates of transients are closely correlated with the properties of their host galaxies. For gravitational wave (GW) events, which are challenging to localize precisely, this environmental analysis can provide an effective framework for setting location priors or estimating redshifts. Our comparison of the host galaxy properties of 40 short gamma-ray bursts with those of COSMOS field galaxies at z < 0.5 suggests that binary neutron star (BNS) merger rate can be better estimated by the relation log(n_{BNS}/Gyr) = 0.86*log(M/M_{sun}) + 0.44*log(sSFR/yr) + 0.857, rather than by direct proportionality to stellar mass alone. To validate our prediction, we utilize historic GW events that reportedly coincide with neutrino detections in both time and location. By analyzing galaxies within the credible volume of coincidence, we assess the feasibility of GW follow-up strategies based on host galaxy predictions and discuss the astrophysical significance of such events.

Allison Keen (University of Minnesota)

Modeling the Stellar Populations of Strongly Lensed Galaxies

Strong gravitational lensing by galaxy clusters highly magnifies distant galaxies. Galaxies that straddle the cluster caustic appear as extended arcs, whose high magnification areas enable the study of regions tens of parsecs in size, such as star forming regions. Even individual stars at z~1-2 near the caustic can be detectable as transients. Recent discoveries of highly magnified stars are found in these arcs, some of which have boosted magnification from microlensing. The number and type of lensed stars constrain the star formation history (SFH) of the galaxy as well as the high mass end of the initial mass function (IMF). Through comparing simulations of lensed galaxy star populations to observations, we constrain the IMF and qualitative properties of stellar populations near cosmic noon.

Robert Kirshner (Thirty Meter Telescope International Observatory)

The Thirty Meter Telescope-- Adaptive Optics makes it like being in space!

We have all seen the revolutionary effect of 3X higher resolution imaging in the transition from HST to JWST. Adaptive Optics at the Thirty Meter Telescope will provide images at its diffraction limit--over 4 times sharper than JWST. Combined with 20 times the collecting area and a powerful suite of spectroscopic instruments, TMT will be a revolutionary new tool for time domain science. The telescope has been designed with nimble response in mind-- instrument changes are rapid and the telescope and enclosure can slew and settle promptly in response to transient events. I will describe the adaptive optics system and illustrate its application to the science of transient objects as elaborated in the 2024 Detailed Science Case for TMT (https://www.tmt.org/download/Document/10/original). TMT is the only extremely large telescope planned for the northern hemisphere and will play an essential role that is complementary to the coming array of all-sky space-based telescopes.

Mitsuru Kokubo (National Astronomical Observatory of Japan)

Challenging the AGN scenario for JWST broad Hα emitters in light of non-detection of variability

JWST has uncovered a substantial population of high-z (z>4) galaxies exhibiting broad Hα emission line with a Full Width at Half Maximum exceeding 1,000 km/s. This population includes a subset known as 'Little Red Dots', characterized by their compact morphology and extremely red rest-frame optical colors. If all of these broad Hα emitters were attributed to type 1-1.9 Active Galactic Nuclei (AGNs), it would imply a significantly higher number density of low-luminosity AGNs than extrapolated from that of more luminous AGNs. Here, we have examined the rest-frame ultraviolet (UV)-optical flux variability of five JWST broad Hα emitters using multi-epoch, multi-band JWST/NIRCam imaging data. The rest-frame temporal sampling interval of the NIRCam data (~400-500 days/(1+z)) is comparable to typical variability timescales of AGNs with black hole (BH) masses of M_BH~10^7 M_sun; thus, the flux variations should be detectable if AGNs were present. However, no measurable flux variation over the rest-frame wavelength range of λ_rest ~ 1,500 - 9,000 Ang has been detected, placing stringent upper limits on the variability amplitudes. This result, combined with the X-ray faintness confirmed by the ultra-deep Chandra data, indicates that, under the AGN scenario, we need to postulate peculiar Compton-thick broad-line AGNs with either (a) an intrinsically non-variable AGN disk continuum, (b) a host galaxy-dominated continuum, or (c) scattering-dominated AGN emission. Alternatively, (d) they could be non-AGNs where the broad-line emission originates from unusually fast and dense/low-metallicity star-formation-driven outflows or inelastic Raman scattering of stellar UV continua by neutral hydrogen atoms.

Conor Larison (Rutgers University)

Improved Photometry and Stronger Evidence for Microlensing of the Strongly Lensed SN Ia, SN Zwicky

Strongly lensed supernovae (SNe) are a rare class of transient that can offer tight cosmological constraints that are complementary to methods from other astronomical events. We present a follow-up study of one recently-discovered strongly lensed SN, the quadruply-imaged Type Ia SN 2022qmx (aka, "SN Zwicky") at z = 0.3544. We measure updated, template-subtracted photometry for SN Zwicky and derive improved time delays and magnifications. We measure point spread function (PSF) photometry for all four images of SN Zwicky in three Hubble Space Telescope WFC3/UVIS passbands (F475W, F625W, F814W) and one WFC3/IR passband (F160W), with template images taken ~ 11 months after the epoch in which the SN images appear. We find consistency to within 2σ between lens model predicted time delays ($\lesssim$ 1 day), and measured time delays with HST colors ($\lesssim$ 2 days), including the uncertainty from chromatic microlensing that may arise from stars in the lensing galaxy. We estimate absolute magnifications for the four images, with images A and C being elevated in magnification compared to lens model predictions by about 6σ and 3σ respectively, confirming previous work. We show that millilensing or differential dust extinction is unable to explain these discrepancies and find evidence for the existence of microlensing in images A, C, and potentially D, that may contribute to the anomalous magnification.

Davide Lazzati (Oregon State University)

Fast and Furious Delayed Emission from Transients in Black Hole Binary Systems

The progenitors and physical origin of Fast Luminous Blue Optical Transients (FLBOTs) is still to be established. To add challenges to any models, some events display luminous, fast flares with timescale of minutes with delays of months to years after the primary event. AT2022tsd is the most striking case. We propose a model in which the delayed flares are indirectly caused by the primary event but are due to a BH in close orbit with the FLBOT progenitor star. We discuss the energetics and timescales of this new phenomenon, including the effect of radiation transfer through the expanding ejecta. We compare the model predictions with current FLBOT observations and elaborate on what potential signatures could be observed from similar system at smaller and bigger orbital separations.

Chang Liu (Northwestern University)

HostSubGP: Subtracting the Host Galaxy for Robust Supernova Spectroscopy from the Ground and Space

JWST is revolutionizing the study of supernovae (SNe) with late-time spectroscopy, making it more imperative that we rigorously estimate the emission from the SN host galaxy in order to isolate the flux from the faint SN. In long-slit spectroscopy, traditional methods perform “aperture spectroscopy” on the 2D spectrum, i.e., the host flux contribution within the SN trace is estimated using an interpolation of the local flux outside the SN aperture, which can be highly biased where there is complex host structure in the vicinity of the SN (e.g., spiral arms and/or clumpy star forming regions). Here we present a new procedure and pipeline, HostSubGP, to model the host background in a novel, robust, and efficient way, which generally applies to both ground-based and space-based spectroscopic observations (e.g., Keck and JWST). HostSubGP models the host galaxy continuum in the 2D spectrum as a Gaussian process (GP), allowing the pipeline to incorporate (i) prior knowledge of the galaxy structure from multi-band acquisition and/or archival images; and (ii) the differing scales on which the flux varies along both the spatial and spectral directions, i.e., the PSF size and the spectral resolution. The Python-based pipeline benefits from jax, which enables efficient optimization for GP hyperparameters. On archival Keck and JWST observations of SNe in nearby galaxies, our pipeline behaves consistently better than the traditional “aperture” approach. In building samples of nebular-phase SNe from both the ground and space, HostSubGP offers a useful toolkit in recovering weak emission features contaminated by their host galaxies.

Jing Lu (Michigan State University)

Physics-driven Explosions of Stripped High-Mass Stars: Synthetic Light Curves and Spectra of Strippe

Stripped-envelope supernovae (SESNe) represent a significant fraction of core-collapse supernovae, arising from massive stars that have shed their hydrogen and, in some cases, helium envelopes. The origins and explosion mechanisms of SESNe remain a topic of active investigation. In this talk, I will present the synthetic light curves and spectra from radiative-transfer simulations of a set of explosions of single, solar-metallicity, massive Wolf-Rayet (WR) stars with ejecta masses ranging from 4 to 11 solar masses, that were computed from a turbulence-aided and neutrino-driven explosion mechanism. We analyze these synthetic observables to explore the impact of varying ejecta mass and helium content on observable features. We find that the light curve shape of these progenitors with high ejecta masses is consistent with observed SESNe with broad light curves but not the peak luminosities. The commonly used analytic formula based on rising bolometric light curves overestimates the ejecta mass of these high-initial-mass progenitor explosions by a factor up to 2.6. In contrast, the calibrated method by Haynie et al., which relies on late-time decay tails, reduces uncertainties to an average of 20% within the calibrated ejecta mass range. Spectroscopically, the He I 1.083 um line remains prominent even in models with as little as 0.02 solar mass of helium. However, the strength of the optical He I lines is not directly proportional to the helium mass but instead depends on a complex interplay of factors such as 56Ni distribution, composition, and radiation field. Thus, producing realistic helium features requires detailed radiative transfer simulations for each new hydrodynamic model.

Eileen Meyer (University of Maryland, Baltimore County)

A late-time radio outburst in changing-look AGN 1ES 1927+654

The formerly type-II radio-quiet AGN 1ES~1927+654 is widely considered one of the most unusual and extreme CL-AGN yet discovered, exhibiting an extreme 4 magnitude flare in the optical in late 2017 concurrent with the first-ever appearance of broad emission lines. Multi-wavelength monitoring since the event has shown strong variability in the soft X-rays corresponding to the twice-repeated destruction and reappearance of the X-ray corona. Ongoing X-ray monitoring now shows that the soft X-ray flux is again rising while VLBA observations since April 2023 show an unprecedented 50x increase in the VLBA radio flux, making the source officially radio-loud for the first time. This observation triggered perhaps the most intense radio-wavelength campaign on a changing-look AGN to date, including data from the VLBA, EVN, VLA, e-Merlin, and AMI. VLBI imaging now shows a resolved bipolar radio outflow which is likely mildly relativistic. I will present the latest observations of this extreme source, which probe the enigmatic connection between the sub-pc scale compact radio emission and the origin of the X-ray corona in AGN.

Divya Mishra (Texas A&M University)

From Ground to Space: A detailed study of the high velocity Type Ia Supernova SN2022hrs

We present the first ultraviolet spectroscopic time-series of a high velocity type Ia supernova -- SN2022hrs. Ground-based spectroscopy and space-based Swift photometry were used to identify the target and confirm an appropriate brightness level to trigger ultraviolet spectroscopy with the Hubble Space Telescope. Ground and space-based observations are used to characterize the spectral and photometric evolution. We examine the velocity and spectral evolution of key features, including the Ca II NIR triplet, Ca II H&K, and Si II lines. We investigate reddening derived from Na I D absorption features in the host galaxy and the Milky Way as a color-independent means to estimate reddening and compare with values determined from fitting the photometric colors. We also show how SN2022hrs fits compared to the other supernovae observed in the ultraviolet, and how the synergy of multiple space and ground-based observations optimizes the scientific output.

Kunal Mooley (IIT Kanpur; California Institute of Technology)

Measuring the speeds and geometries of off-axis jets leveraging precision astrometry

GW170817 confirmed the link between binary neutron star mergers and short gamma-ray bursts, thanks to the measurement of superluminal motion via precision astrometry with the Hubble Space Telescope and radio very long baseline interferometry. GW170817 gave the first direct imaging constraint on the speed of an ultra-relativistic GRB jet. I will present the results from GW170817 and how precision astrometry, with the HST and the JWST, can help constrain the speeds and geometries of off-axis jets, like in neutron star mergers and jetted tidal disruption events.

Takashi Moriya (National Astronomical Observatory of Japan)

Properties of high-redshift Type II supernovae discovered by the JADES transient survey

We estimated the explosion and progenitor properties of six Type II supernovae at $0.675 < z < 3.61$ discovered by the JWST Advanced Deep Extragalactic Survey (JADES) transient survey by modeling their light curves. This is the first sample of Type II supernovae in this redshift range, allowing us to compare the low-redshift Type II supernovae to their high-redshift counterparts. Two Type II supernovae are found to have high explosion energies of 3e51 erg, while the other four Type II supernovae are estimated to have typical explosion energies found in the local Universe [(0.5-2)e51 erg]. The fraction of Type II supernovae with high explosion energies might be higher at high redshifts because of, e.g., lower metallicity, but it is still difficult to draw a firm conclusion because of the small sample size and potential observational biases. We found it difficult to constrain the progenitor masses for Type II supernovae in our sample because of the sparse light-curve data. We found two Type II supernova light curves can be better reproduced by introducing a confined dense circumstellar matter. Thus, the confined dense circumstellar matter frequently observed in nearby Type II supernovae can also exist in Type II supernovae at high redshifts. Two Type II supernovae are estimated to have high host galaxy extinctions, showing the ability of JWST to discover dust-obscured supernovae at high redshifts. More high-redshift Type II supernovae are required to investigate the differences in the properties of Type II supernovae near and far.

Geoffrey Mo (Massachusetts Institute of Technology)

An overlooked population of SNe Ia exhibiting mid-infrared signatures of delayed CSM interaction

It is well understood that Type Ia supernovae arise from the thermonuclear explosions of white dwarfs in binaries, but the nature of the companion remains unclear. A rare sub-class of SNe Ia exhibit signatures of interaction with circumstellar material (CSM), allowing for direct constraints on companion material. While most known events show evidence for dense nearby CSM identified via peak-light spectroscopy (as SNe Ia-CSM), targeted late-time searches have revealed a handful of cases exhibiting delayed CSM interaction with detached shells. Using mid-infrared data from the NEOWISE space telescope, we report evidence for late-time CSM interaction in six previously overlooked events spanning multiple SNe Ia sub-types. Our systematic search doubles the known sample, and suggests that $\gtrsim 0.1\%$ of SNe Ia exhibit mid-infrared signatures of delayed CSM interaction, often accompanied by new dust formation. These results highlight that CSM interaction is more prevalent than previously estimated from optical and ultraviolet searches. Current and future space telescopes with IR capabilities such as JWST, SPHEREx, Roman, and NEO Surveyor will yield further insight into delayed interaction, which may be commonplace at very late phases.

Tanner O'Dwyer (Johns Hopkins University)

From Choked to Ultra-Relativistic Jets: Assessing Jet Contributions in Type Ic-BL Supernovae

The connection between stripped-envelope core-collapse supernovae with broad lines (type Ic-BL) and long gamma-ray bursts (GRBs, i.e. on-axis successful relativistic jets) is unknown. While all supernovae associated with long GRBs are of type Ic-BL, what fraction of non-gamma-ray triggered Ic-BL supernovae is able to power jets remains an open question. Observations from radio to X-ray can help answer this question by probing the presence of fast ejecta for a variety of observing geometries (on-axis versus off-axis jets), and ejecta speeds (ranging from choked jets with speeds of 0.1-0.5c to successful ultra-relativistic jets), hence providing a key test to stellar explosion models. Here, we present the latest results from a radio-to-X-ray observing campaign of nearby Ic-BL supernovae aimed at hunting for fast ejecta. Our sample provides an initial estimate of the fraction of choked jets that may be powering Ic-BL supernovae, which remained largely unconstrained in previous studies targeting faster jets (GRB980425/SN1998bw-like ejecta). Our study also contributes to building a sample of nearby Ic-BL supernovae that can aid future multi-messenger searches for sources of high-energy neutrinos.

Anna O’Grady (Carnegie Mellon University)

Identifying YSG Binaries in the Magellanic Clouds: Towards a Population of Partially Stripped Supern

Hydrogen-poor, partially-stripped envelope supernovae (SNe) comprise 10-15% of observed core collapse SNe, yet the precise nature of their progenitor systems is still uncertain. Pre-explosion images at the locations of partially-stripped envelope SNe have revealed, surprisingly, yellow supergiant (YSG) progenitors. The favoured explanation for these observations are YSGs being stripped of their envelopes from binary interaction with a main sequence (MS) companion, likely a B-type star, and subsequently exploding in the Hertzsprung Gap. As theoretical models of these systems rely on assumptions for many physical processes, observational constraints are crucial. However, no local examples of interacting, partially stripped YSG+MS binaries are known. To fill this gap, we identify YSG+MS binary candidates in the Magellanic Clouds by searching for YSGs with excess blue/UV flux, a method previously used to successfully identify red supergiant binaries. In this talk we describe the method used to identity YSG binaries, present the results of our initial search for YSG binaries, show preliminary spectroscopic results, and discuss plans to characterize the properties of these systems, constrain the binary fraction of YSGs in the Clouds, and identify what fraction of the binary population have partially stripped envelopes.

Yang I. Pachankis (Scientific Global Limited)

How to Define the Relativistic Time Domain?

The evolvement on the concept of time from human activities went from the three-body motions of the earth-moon-sun system and the gravitational phenomena to the current SI unit definition of time with the doming of nuclear age. Two distinctive problems arise from the perspective of objective epistemology in the realm of time domain after relativistic physics going mainstream: 1. the improbabilities of a uniformed definition of time in the formal science contributed by Gödel's Incompleteness Theorems; and 2. can inconsistency be the objective epistemology of the universe and the concept of time that is constructive to relativistic physics? The two problems lead to the two question: 1. is a uniformed definition of time necessary for astrophysics and cosmology; and 2. should the consistency of the Big Bang theory and its derivations be regarded as the only acceptable academic and scientific formalism and authority? The seemingly easy questions' concerns go far beyond the natural sciences.

The current solutions with the SI definition of time are based on the basics of integration and incremental adjustments from the advancements of particle physics with time dilation. It is a pragmatic and human-centric set of solutions except for when it comes to the mysteries of the origins of life, how lives are predestined to proliferation and death, and if there are forms of lives other than these on earth, etc. The alternative proposition being raised here is not being justified for any novelty for the numeration of the limitations of the current consensuses, and it is only put forth to discuss the possibilities with the ready-mades. With the space-based telescopes, informatics, and data combined with relativistic physics, it is probable to prolong the definition of the SI unit of time to the dimensions larger than life as we know it, and study the local dynamics from the relativistic data and data points by the concept of time borrowed from the relative celestial motions of many bodies. The sets of cleaned data, the local hidden variables in Einstein's words, may be further adjusted and reveal one thing or two on the mechanics of celestial dynamics within and beyond the degrees of freedom set by the speed of light.

The accumulation of empirical evidence has paved way for the consensus that black holes exist in the center of every galaxy, only that no determination has yet been reached on each and every one's mass and mass center, nor the potential force(s) that has been keeping the galaxies distinct within the observed and observable universe. I managed to process the monochrome data of the Kerr-Newman black hole in NGC 3034 from the multi-wavelength space-based telescopes and produced the direct evidence for the adjacent structure with the white hole. In theory, the oscillations differ from black hole types, or in other words, the diversity of nuclear dynamics in the oscillations determines the black hole types, and further studies may have to involve the pions and the annihilation between the quark and the antiquark with minimalist interference of gravitational force that can affect the spin positions. The proposition thereon goes back to the starting point that if the large structure of the universe can only be plausibly and empirically studied by the derivations of the Big Bang theory combined with particle physics.

The transition to a relatively more objective epistemic paradigm, however, is possible from here with a developmental heuristics to the concept of time. The consistency on the evolution of the universe is dictated by the inseparable continuum of spacetime and the linearized concept of time according to the individual life spans that are universally unidirectional, apart from the observational vantage point originated from the earth. The broadly defined light technologies such as informatics and information science complementary with quantum technologies may not alter the linearity of logical formalism, even with doxastic logic's amendments to first-order logic, but can change the methodologies of scientific modeling to a higher degree of precision, if and only if the possible decay paths during traveling to our detections are tolerable to our comprehension. For example, the unit of lightyear in the quantum realm is defined by length in space, but the quanta of the length is not quantified in terms of time for the infinitely divisible decadal path with the non-perturbative solution. Thereby, the numerical and set theoretical methods can be applied that led to the before-mentioned evidence from the data of NGC 3034.

Gregory Paek
(University of Hawai'i at Manoa, Institute for Astronomy)

Bridging Space and Ground: The 7-Dimensional Telescope in Multi-Messenger Astronomy

The detection of GW170817 marked a new era in multi-messenger astronomy, yet identifying electromagnetic (EM) counterparts to gravitational wave (GW) events, especially kilonovae, remains challenging due to their rapidly evolving nature, limited GW localization, and numerous confounding transients. In this talk, we introduce the 7-Dimensional Telescope (7DT) and its comprehensive approach to follow-up and transient search, focusing on its capabilities in identifying early kilonovae (KN) in optical wavelengths. 7DT is a ground-based system of 20 wide-field 0.5m telescopes located in Chile, equipped with 40 medium-band filters spanning 400-900nm, allowing for low-resolution spectroscopy over a wide field of view (~1.2 deg^2). To enhance early detection, 7DT uses a machine learning-based transient classifier, capable of distinguishing transients such as kilonovae from other events using single-epoch photometric SEDs, supporting efficient and rapid classification. Not only that, 7DT offers dedicated, high-cadence monitoring to capture detailed time-series low-resolution spectral data, facilitating a comprehensive understanding of these events over time. We expect 7DT's unique capabilities to enhance synergies with space-based missions by enabling rapid follow-up of high-energy (Swift, Fermi) and optical/UV (TESS, ULTRASAT) detections while providing early classification and detection to guide deeper observations by HST, JWST, Euclid, and Roman.

Paarmita Pandey (The Ohio State University)

Analyzing the Luminous Ambiguous Nuclear Transient AT2020adpi

Ambiguous nuclear transients (ANTs) are a new and growing class of transient events. These events are characterized by hot blackbody-like UV and optical spectral energy distributions (SEDs), smooth photometric evolution, and hard power law-like X-ray emission. These events may be associated with either tidal disruption events (TDE) or flares originating in active galactic nuclei (AGNs). In some rare instances, they might also be associated with superluminous supernovae. We analyze the ANT AT2020adpi (ZTF20acvfraq) which is located at a redshift of 0.26. We present the optical, UV light curve and find a luminous mid-Infrared dust echo. Due to the presence of strong MgII lines, this ANT is most likely associated with an AGN flare.

Jose Parra (Florida International University)

Quasars as strong standard candles candidates

This work presents a resolution to Einstein's General Theory about radiation propagation, aligning closely with a previously documented solution from a relativistic quantum perspective. In this condition, the radiation progressively diminishes in energy as it traverses intergalactic distances. Integrating this dynamic light redshift with the static redshift created by intense gravitational fields, such as those seen in quasars, enhances our comprehension of quasar characteristics. This finding reinforces the idea that quasars may function as trusted cosmic distance indicators. The intensity transience of signals from quasars may provide the additional information required to utilize quasars as cosmic distance ladders.

Dheeraj Pasham (Massachusetts Institute of Technology)

Mysterious Quasi-Periodic Signals from Centers of External galaxies

In the last five years, a mysterious new class of astrophysical transients have been uncovered using X-ray space telescopes. These sources are spatially coincident with centers of galaxies and show X-ray variations that repeat with quasi–periodicities on timescales of minutes to ~ a month. One of the prevailing ideas for these Repeating Extragalactic Nuclear Transients (RENTs) is that they are triggered by interactions of a gravitationally bound (smaller) object with the accretion disk of a supermassive black hole (SMBH). If that is indeed the case, then some of these extreme mass ratio binaries could also be detectable with future space-based gravitational wave detectors like LISA and Taiji, and have the potential to transform our understanding of supermassive black hole growth, probe dark energy, and put fundamental constraints on gravity. I will present an observational overview of RENTs, their connection to stellar tidal disruption events and also present some state-of-the-art general relativistic hydrodynamic simulations of objects embedded in SMBH disks and argue that, in some cases, these repeating transients could be double compact object binaries with direct implications for multi-messenger astrophysics. I will end by highlighting the exciting prospects of discovering more such systems with synergy between the Rubin/LSST observatory and various space-based X-ray and UV telescopes.

Haille Perkins (University of Illinois Urbana - Champaign)

Searching for Neutron Star Mergers in the Absence of Gravitational Waves

GW170817 was the first confirmed binary neutron star merger (NSM) with an associated kilonova. Observations of this event was revolutionary as kilonovae and NSMs are excellent laboratories for studying {\em r}-process nucleosynthesis, multi-messenger astronomy, cosmology, the equation of state of neutron stars, and more. Its discovery was made possible by the LIGO-Virgo-KAGRA (LVK) gravitational wave network; however, based on recent predictions for Observing runs 4 and 5, there will only be a handful of EM counterparts will be detectable for LVK-detected NSMs. As a result, we cannot wholly rely on gravitational wave detections to do kilonova science. Given the faint nature of kilonovae, we propose leveraging bright short gamma ray burst afterglows to identify candidate NSM events in large scale optical surveys like Legacy Survey of Space and Time (LSST). By overlaying existing afterglow and kilonova models, we find the afterglow can enhance the UV/optical emission such that it remains visible for an additional three days relative to the kilonova alone. This enhancement can enable a study of NSM hosts and their environments by expanding the possible search volume and time window to find these events. Additionally, the afterglow emission is not dominant at redder wavelengths, allowing for infrared follow-up to study the kilonova. All of which demonstrate how critical multi-wavelength observations are for these rare events, especially without gravitational wave information.

Conor Ransome (Harvard & Smithsonian Center for Astrophysics)

The Enigmatic Type IIn Supernovae: Progenitor Inferences from Modeling and Prospects for Roman

The highly heterogeneous type IIn supernovae (SNeIIn) challenge our understanding of massive stars and stellar evolution, particularly what happens in the last few decades of a star's life. SNeIIn are characterized by interaction signatures with a pre-existing dense and slow circumstellar medium (CSM). The progenitor must have lost incredible amounts of mass in a relatively short amount of time. The mechanisms for such mass loss are uncertain. Direct progenitor detections seem to suggest that the progenitors of SNeIIn are luminous blue variables, but this is in tension with the environments as SNeIIn do not generally occur in the same environments of massive stars. In this talk, I will present the results of the largest systematic light curve modeling study. I will then demonstrate how these models can be used to infer progenitor paths. Furthermore, SNeIIn are effective dust factories and mass-loss rates can be inferred from the surrounding dust. As such, I will discuss the future prospects of SNIIn study with the Nancy Grace Roman Telescope.

Jakub Ripa (Masaryk University)

GRB-detecting nanosatellites GRBAlpha and VZLUSAT-2

Results from GRBAlpha and VZLUSAT-2 nanosatellites, which carry gamma-ray detectors on board for monitoring transients will be presented. GRBAlpha is a 1U CubeSat launched in March 2021 and it has operated on a 550-460 km altitude sun-synchronous polar orbit (SSO) for more than three years. VZLUSAT-2 is a 3U CubeSat launched in January 2022 and it operates also on SSO at a similar altitude for more than two years. So far both missions have detected about 300 gamma-ray transients including over 100 long and short gamma-ray bursts (GRBs), soft-gamma repeaters and solar flares, including the most intense GRB ever recorded GRB 221009A and exceptionally bright GRB 230307A. The onboard gamma-ray detectors are based on CsI(Tl) scintillator readout by silicon photomultipliers (SiPMs). SiPMs are known to be prone to radiation damage. With the increasing popularity of SiPMs among new spaceborne missions, especially on CubeSats, it is of paramount importance to characterize their performance in the space environment. Therefore, we will also report the in-orbit aging of SiPMs at SSO over three years, which in duration is unique. We have demonstrated that SiPMs can be used in the low Earth environment on a scientific mission lasting beyond three years and gamma-ray detectors on nanosatellites can routinely detect GRBs.

Stuart Ryder (Macquarie University, Australia)

Hunting for the most distant Fast Radio Bursts with HST and JWST

Fast Radio Bursts (FRBs) are millisecond-timescale luminous transients, with no optical counterparts. Much like Type Ia supernovae, FRBs are proving to be powerful tools for cosmology even though their origins are not fully understood. An FRB's signal contains an imprint of all the ionized baryons traversed, enabling the cosmic baryon density to be mapped provided the distance to the FRB can be determined. More than 100 FRBs have now been pinpointed to their host galaxies, out to redshifts of 1 and beyond, which is pushing the limits for ground-based follow-up. In this talk I will discuss results from our recent HST and JWST observations of the host galaxies of the most distant FRBs, and look ahead to the SKA era.

Ana Sainz de Murieta (University of Portsmouth)

Searching for lensed transients from space

Strong gravitationally lensed supernovae (glSNe) are a powerful tool for cosmology and astrophysics. By measuring the time delays between the multiple images of a lensed supernova, we can derive the Hubble constant—provided we have an accurate model of the lensing galaxy's gravitational potential. The presence of a lensed host galaxy is crucial for accurately modelling this potential. In this talk I will discuss the connection between discoverable lensed transients and their host galaxies. I will demonstrate that glSN systems occurring in detectable lenses tend to exhibit longer time delays, making them ideal candidates for time-delay cosmography. I will also show that LSST will discover 20 glSNe per year in systems that could have been identified by Euclid as galaxy-galaxy lenses prior to the glSN discovery. This underscores that monitoring galaxy-scale lenses discovered with space-based facilities is a promising strategy to search for lensed supernovae. Additionally, I will discuss some of the limitations of this search method and highlight other advantages that space-based surveys offer for lensed supernova astrophysics.

Huei Sears (Rutgers University)

Meet Me In the Afterglow: Late-time HST and JWST Observations of GRB 221009A

GRB 221009A is one of the brightest transients ever observed with the highest peak gamma-ray flux ever for a gamma-ray burst (GRB). Previous studies have made claims for a jet break at $t < 0.03$ days, others at 1 day, and even others not finding one at all. A Type Ic-BL supernova (SN), SN 2022xiw, was detected in late-time ($t = 195$ days, observer-frame) JWST spectroscopy, however other studies have found conflicting flux scaling ranging from 10-70% the flux of the canonical GRB-SN, SN 1998bw. In this talk, I present late-time HST/WFC3 and JWST/NIRCam imaging of GRB 221009A out to $t = 345$ days (observer-frame) post-trigger. The joint ground, HST, and JWST light curve shows strong support for a jet break at $t = 50 +/- 10$ days, and a supernova at 1.4 +/- 0.4 x the flux of SN 1998bw. The light curve and joint HST/JWST SED also show support for the late-time emergence of a blue component in addition to the fading afterglow and SN. We find consistency with the interpretation of this source as an optical scattered light echo of the afterglow, however an underlying star cluster or dwarf satellite galaxy are also possible.

Melissa Shahbandeh (Space Telescope Science Institute)

Simulation Tools to Prepare for Transient Science with the Roman Space Telescope

The Nancy Grace Roman Space Telescope (Roman), launching in 2026, will transform astrophysics with its vast field of view—100 times larger than Hubble's—enabling studies of a billion galaxies, direct imaging of exoplanets, and critical investigations into dark energy. To support the astronomical community, the Science Operations Center (SOC) at STScI has developed a comprehensive suite of simulation tools for Roman's Wide Field Instrument (WFI). Ranging from accessible Python notebooks to advanced simulations, these tools model Roman's point-spread function, exposure times, and complex astronomical scenes, with specialized capabilities for transient science. Researchers can use these simulations to inject transient sources, optimize observational strategies, and explore cross-mission synergies. Aligned with the Decadal Survey's prioritization of Time Domain Astronomy and NASA's TDAMM initiatives, this presentation will showcase Roman's simulation tools, highlighting applications in transient science, infrared observations, and multi-mission collaboration. By integrating these tools into workflows, the community can prepare for Roman's groundbreaking contributions to time-domain and transient astronomy.

Sagiv Shiber (Louisiana State University)

Lightcurves and Spectra from a Mergerburst of a Massive Binary

We investigate the lightcurves and spectra as a result of a merger event between a 16 solar mass star, on its way to becoming a red supergiant, and a 4 solar mass main-sequence companion. Our study import the results from three-dimensional hydrodynamic simulations to the radiative transfer code SuperNu. Our findings reveal that the ejection of approximately 0.6 of solar mass produce a transient with a peak luminosity of 10^40 ergs/sec and an average duration of 100 days. Following a fast decline there is another peak due to recombination effects. As the mergeburst is asymmetric and somewhat bipolar we explore its geometrical effects on the lightcurve in 2d and 3d.

Dimitriois Skiathas (SURA/ NASA GSFC /University of Patras)

Electromagnetic outflows from binary neutron star mergers

The magnetospheres of merging neutron stars interact strongly during their inspiral motion, continuously reshaping their magnetic field line structure. Emissions, fueled by this dynamic interaction, being produced prior to the merger, could serve as precursor signals to gravitational wave events from binary neutron star mergers.

To better understand these pre-merger emissions, we conducted near-force-free numerical simulations to thoroughly explore the multidimensional parameter space. This exploration involves the relative strengths and orientations of the stars' magnetic dipole moments as well as their orientation relative to the orbital axis. The resulting Poynting flux patterns are calculated as the system evolves, revealing diverse, non-uniform, and non-symmetric distributions. Our analysis shows how the Poynting flux depends on the increasing over time orbital angular frequency. Additionally, we investigate the gamma-ray emission patterns generated by particles accelerated through the strong electric field components present in these environments. In particular, gamma-ray skymaps and spectral properties, assuming curvature radiation, will be discussed.

Noam Soker (Technion, Israel)

The universal role of jets in gravitationally-powered bright transients

I will argue that one of the most crucial future observational tasks is the search for jets in powerful transients. The finding of jets will answer many questions and solve old puzzles, like the explosion mechanism of core-collapse supernovae (CCSNe) and the onset of the common envelope evolution. New results from 2024 show point-symmetric morphology in many CCSN remnants, morphologies that only pairs of jets can explain, suggesting that CCSNe are exploded by jittering jets. I will present very new results that show that jets power CCSNe, the pre-explosion outbursts of CCSNe, intermediate luminosity optical transients (which include LBV major eruptions, luminous red novae, the formation of common envelope evolution, and more), and peculiar transients like fast blue optical transients (FBOTs, e.g., AT2018cow). The evidence includes bumps in light curves, polarization, point-symmetric CCSN remnants, high energies unreachable to other explosion mechanisms, and nucleosynthesis of elements.

Jenny Su (University of Toronto)

Progenitor and Companion Constraints of the Stripped-Envelope Supernova SN2017gax

Stripped-envelope supernovae (SESNe) originate from stars that have lost their hydrogen envelope. The progenitor can be a single massive star (e.g. a Wolf-Rayet star) that had lost its envelope through stellar winds or a star that lost its envelope during binary interactions. It has been theorized that most SESNe are in binary systems, but direct observational constraints remain limited. In this talk, I will present a detailed analysis of Hubble Space Telescope (HST) images of the explosion site of SN2017gax, one of the few SESNe with deep pre- and post-explosion imaging. Applying spectral models, we placed constraints (e.g. on temperature and luminosity) on the progenitor using pre-explosion data. Likewise, with post-explosion data, we placed constraints on any surviving companion. Using binary population synthesis models, I will discuss possible evolutionary histories of the SN2017gax system with our current constraints. These results provide new insights into the binary evolution pathways of SESNe.

Aswin Suresh (Northwestern University)

Exotic Stars and How to Find Them: Extragalactic Red Supergiants from JWST

Red supergiants (RSGs) are evolved, helium-fusing massive stars with a ZAMS mass of at least ~8 $M_\odot$. As the largest massive stars, with high luminosities and massive hydrogen envelopes, over a dozen have been observed as the progenitors of Type-IIP supernovae. Studying them is therefore crucial to understanding the end stages of massive star evolution, mass loss, and modes of massive star variability.
Utilizing the exquisite spatial resolution and depth offered by JWST, we present a framework to generate a high-precision photometric catalog from Near Infrared Camera (NIRCam) imaging and identify extragalactic RSGs from color-magnitude space using only photometry. The peak of the spectral energy distribution of RSGs falls in the NIR, making JWST ideally suited to study them in extragalactic fields. Using archival imaging of 12 nearby (< ~20 Mpc) galaxies, we use reduced NIRCam images to generate a photometric catalog using the stellar photometry code DOLPHOT. This extragalactic sample of RSGs can be used to perform archival searches for future supernovae, while also serving as the largest, homogeneous sample of known RSGs for direct comparison to supernova progenitor stars. En route to this catalog, we present general-purpose tools of use to the JWST community for image registration, within the JWST detector frame and to the Gaia frame, and multiple filter image coaddition, using drizzled and PSF-matched single-filter mosaics generated using the JWST pipeline, improving source-detection capabilities and depth.

Tea Temim (Princeton University)

New Insights into the Structure and Origin of the Crab Nebula

The Crab Nebula (SN 1054 AD) is the first astronomical object identified as having resulted from a supernova explosion, and since its re-discovery nearly 300 years ago, it has been one of the most studied objects in the sky. It has served as a benchmark for understanding pulsars and supernova explosions, yet many fundamental questions about its structure and origin remain. The nature of the explosion that produced the Crab Nebula is still under debate, and we continue to untangle the influences of the explosion itself, the surrounding circumstellar environment, and the evolution of the pulsar wind on the remnant's ejecta structure. I will present new insights into these questions, including from recent JWST observations that have revealed the Crab Nebula in unprecedented detail.

Wei Leong Tee (University of Arizona)

Variability-selected Low-luminosity AGN in the era of HST+JWST

Variability is a fundamental signature for AGN accretion activity, and serve as an unbiased indicator for rapid activity happened near the center supermassive black hole. Studies on AGN variability suggests that variability is a powerful probe to identify low-mass, low-luminosity AGN, which appears to be redshift independent and scales with bolometric luminosity and BH mass. The launch of JWST has opened a new era in finding the high-redshift galaxies (z~4-10) hosting moderate BH (>10^6 M_sun), in which 1-2 um (rest-frame UV) variability can be measured to determine the existence of active accreting BH. We construct a sample of 17 V-shaped SED galaxies (also known as little red dots), with HST and JWST data (MUV<-18). Taking advantages of close pair filters in HST and JWST, the variability significance is calculated with flux variation strength, in both photometry and imaging difference analysis. Given 6-11 years time difference between HST and JWST observation, the mean magnitude difference is about 0.11-0.14$+-0.20 mag, in overall <3sigma variability significance, while the predicted magnitude change estimated from local SDSS AGNs is in order of 0.3 mag. We derived their predicted variability amplitude and compared with observation, we are able to provide an upper limit constrain of about ~30% AGN contribution to the observed total UV light. We also constructed a variability-selected faint high-redshift AGN candidates with high completeness and low contamination at z=4.7. These sample will provide an independent measurement of the faint end of the AGN luminosity function, characterize the evolution of SMBH accretion activity by studying the redshift dependence of variability, and uncover the relationship between AGN activities and their host galaxies in the early Universe.

Andrew Toivonen (University of Minnesota)

EM-bright or not? Kilonova ejecta mass and light curve predictions for gravitational-wave candidate

Efficient multi-messenger observations of gravitational-wave candidates from compact binary coalescence (CBC) candidate events rely on data products reported in low-latency by the International Gravitational-wave Network (IGWN). As an extension of existing EM-bright data products such as HasNS, the probability of at least one neutron star, and HasRemnant, the probability of remnant matter forming after merger, we present proposed data products for direct kilonova observables. By marginalizing over our uncertainty in our understanding of the neutron star equation of state (EoS) and using measurements of the source properties of the merger, we predict the amount of mass ejected as well as the light curves produced for a given candidate neutron star event capable of producing a kilonova. We are developing these data products, amongst others, in the context of the IGWN low-latency alert infrastructure, and will be advocating for their use and release for future detections.

Schuyler Van Dyk (California Institute of Technology/IPAC)

Roman Alerts Promptly from Image Differencing (RAPID)

RAPID is a Nancy Grace Roman Space Telescope Project Infrastructure Team, based entirely at Caltech. The Astro2020 Decadal Survey identified time-domain and multi-messenger science as a high priority. RAPID will enable a wide suite of dynamic-sky science for Roman. The RAPID team has experience providing services to the global time-domain community and is leveraging previous work on other projects, particularly the Zwicky Transient Facility. Our goal is to provide four services to the Roman community: rapid, low-latency image-differencing of every new Roman image from a reference image; a prompt public alert stream of all Roman transient and variable candidates; source-matched light curve files for every identified Roman candidate; and, a forced-photometry service for the photometric history at any observed sky location. RAPID can be found at https://rapid.ipac.caltech.edu.

Margaret Verrico (University of Illinois Urbana – Champaign)

Star Formation Histories of Changing-Look AGN Host Galaxies

Changing-look active galactic nuclei, or CL-AGN, are AGN which appear to transition between Seyfert Type 1 and 2 over periods of months to years. Several mechanisms to trigger these transitions have been proposed, but we have yet to conclusively determine their cause. Like other nuclear transients (e.g. tidal disruption events and quasi-periodic eruptions), recent studies suggest CL-AGN are hosted primarily in galaxies which are shutting down star formation (Dodd et al. 2021, Liu et al. 2022, Wang et al. 2023}, which may indicate a link between galaxy quenching and changing look events. We use Prospector Stellar Population Synthesis software (Leja et al. 2017, Johnson & Leja 2017, Johnson et al. 2021) to model non-parametric star formation histories for ~50 CL-AGN host galaxies. In this work, we find evidence that CL-AGN hosts are more likely to be in the Green Valley than other AGN host galaxies, suggesting CL-AGN may be a distinct population from other AGN. We do not find evidence for significant recent starbursts in most CL-AGN hosts, suggesting that CL-AGN reside in distinct host galaxies from other nuclear transients. Future spectroscopic surveys like Roman will be necessary to increase the number of detected CL-AGN and provide futher insights into their origins.

Jozsef Vinko (HUN-REN CSFK Konkoly Observatory)

SN 2023adsy -- a normal, but highly reddened Type Ia supernova at z=2.9, discovered by JWST

SN 2023adsy, discovered by the JWST JADES program recently, was classified as a Type Ia SN at z=2.9 (Pierel et al., 2024). The NIRCam light curves, fitted by SALT3-NIR templates, suggested a very red, very low luminosity Ia that surprisingly showed quite normal light curve decline rate. We re-analyzed the NIRCam photometry by adding the possibility for host-galaxy extinction, which was not taken into account in the original paper. We show that SN 2023adsy may be a normal luminosity SN Ia that suffered significant extinction (E(B-V) ~ 0.5 - 0.7 mag). Its photometric properties are consistent with being a normal SN Ia at z=2.9.

Lingzhi Wang
(Chinese Academy of Sciences
South American Center for Astronomy)

Newly formed dust of SNIa-CSM 2018evt

Dust associated with various stellar sources in galaxies at all cosmic epochs remains a controversial topic, particularly whether supernovae play an important role in dust production. We report evidence of dust formation in the cold, dense shell behind the ejecta–circumstellar medium (CSM) interaction in the Type Ia-CSM supernova (SN) 2018evt three years after the explosion, characterized by a rise in mid-infrared emission accompanied by an accelerated decline in the optical radiation of the SN. Such a dust-formation picture is also corroborated by the concurrent evolution of the profiles of the Hα emission line. Our model suggests enhanced CSM dust concentration at increasing distances from the SN as compared to what can be expected from the density profile of the mass loss from a steady stellar wind. By the time of the last mid-infrared observations at day +1,041, a total amount of about 0.01 Msun of new dust has been formed by SN 2018evt, making SN 2018evt one of the most prolific dust factories among supernovae with evidence of dust formation. The unprecedented witness of the intense production procedure of dust may shed light on the perceptions of dust formation in cosmic history.

Amanda Wasserman (University of Illinois Urbana – Champaign)

Modular Metrics of the LSST Spectroscopic Recommendation System

The Legacy Survey of Space and Time (LSST) will observe over 10^6 transients per year, increasing the number of yearly discovered transients by a factor of 100. Spectroscopy is essential for probing supernova progenitor physics and accurately estimating cosmological parameters, among gaining information on many other open questions in astronomy. However, spectroscopic resources are scarce, an expected <1% will be followed up. Due to the incoming immense quantity of transient sources, we need an automated system to sort through the millions of Rubin SNe and prioritize the most scientifically interesting for followup. I present the LSST Spectroscopic Recommendation System to select the most useful supernovae based on a user specified metric. Anomaly Detection and Type Ia Cosmology are two of the metrics currently integrated into the RESSPECT pipeline, and I will illustrate how you can add your own custom metrics to find the objects you care most about. Recommendations from the pipeline can be submitted to the DESC Target and Observation Manager which will enable coordination with various spectroscopic telescopes.

Robbie Webbe (IRAP)

X-ray Transients in the Galactic Plane: Exploiting Big Data with STONKS

The combined archives of X-ray missions contain a wealth of information, and their exploitation can assist in the detection of new transient sources, potentially over timescales of decades. The Search for Transient Objects in New detections using Known Sources (STONKS) pipeline developed for XMM allows for users to efficiently detect new transient sources as new observations are processed. We present the results of a practical application of STONKS to an ongoing XMM survey programme looking at the Galactic Plane, which include a new magnetar candidate, and the detection of pulsations in a candidate gamma-Cas star. We also present the bright future for STONKS in X-ray astronomy including an ongoing project looking at extragalactic transients.

Ofer Yaron (Weizmann Institute of Science)

MAST – The Multi-Aperture Spectroscopic Telescope

We live in an era where wide-field robotic sky surveys discover thousands of clean, reliable extra-galactic transient candidates per year. As confirmed by e.g. the accumulated Transient Name Server statistics, over its 9 years of operation, the number of spectroscopically classified transients remains constantly on the 10% level, out of the total number of transients reported. Spectroscopic classification and followup is a major bottleneck, and we are constantly in need of more spectroscopic facilities at lower costs.

With emphasis on efficiency and cost-effectiveness, extending on the concept of constructing survey telescopes composed of multiple small-aperture (of-the-shelf) telescopes, MAST is a novel spectroscopic array consisting of twenty 24-Inch telescopes at the newly established Weizmann Astrophysical Observatory (WAO) in the southern Israeli desert. The light of a source gathered from multiple telescopes is injected via optical fibers into high-throughput spectrographs located in an isolated and controlled instruments room. The collective aperture is equivalent to a single 3m-class telescope, providing significant observational power at approximately a tenth of the cost of a similar-sized single telescope.

MAST is expected to serve as a valuable spectroscopic facility, serving the in-situ LAST survey telescope, the ULTRASAT UV space explorer and other feeding surveys, as well as to perform focused studies of galactic stellar sources, specifically white dwarfs.

Md Nageeb Bin Zaman (Louisiana State University)

Spectroscopic Modeling of Interacting Supernovae with Stripped Progenitors

Modern, unbiased search surveys unveil a very dynamic universe with a multitude of transient phenomena, many of which are driven by supernova (SNe) explosions. In some cases, supernovae are enshrouded by dense circumstellar matter (CSM) and the ensuing interaction of SNe ejecta and CSM can enhance their peak luminosities and give rise to some of the brightest astrophysical transients. Examples of such phenomena are Super Luminous Supernovae (SLSNe). While SLSNe powered by CSM interaction have been broadly modelled in the literature, the question of whether H-poor SLSNe (SLSN-I) can be powered by CSM interaction remains debated. In this project, I am investigating detailed Monte Carlo Radiation Transport (MCRT) models of SLSN-I spectra powered by CSM interaction by using the new MCRT code SuperLite. In specific I will present spectra resulting from the interaction of an envelope stripped supernova progenitor with a He-rich CSM envelope and explore the dependence of the emerging spectral features on different initial parameters such as density structure and composition. My study aims to constrain the properties of H-poor CSM interaction and explore its contribution to SLSN-I and other transients of interest.

Szanna Zsiros (University of Szeged)

Investigating the dust formation history in CCSNe using multiwavelength datasets

Core-collapse supernovae (CCSNe) have long been considered essential contributors to the formation of cosmic dust, particularly in explaining the observed dust content of high-redshift galaxies. However, only a few cases provide direct observational evidence for dust condensation in young extragalactic SNe, leaving several significant questions about the properties and origins of dust unanswered.

To trace dust grains, we can model the emerging infrared (IR) excess and the red-blue asymmetries in optical and near-IR emission-line profiles of SNe. By using both modeling approaches simultaneously, we can determine the location and properties of dust and effectively disentangle potential SN dust components.

While this approach has proven effective, it has only been applied to a small number of CCSNe. We aim to analyze various types of CCSNe with this method using high-quality data from the James Webb Space Telescope and large ground-based telescopes. With the most precise multiwavelength measurements available, we can investigate older SNe and compile more extensive datasets. Moreover, this comprehensive method will give us a deeper understanding of the timescales for dust formation in the environment of CCSNe.