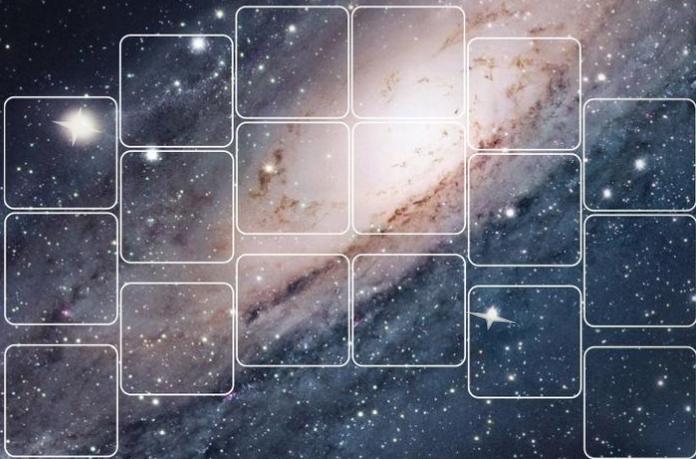




NANCY GRACE R.ÖMAN



SPACE TELESCOPE

RAPID Transient Science with the Roman Space Telescope

Ryan Lau (IPAC, RAPID Coordination Scientist)
4th TDAMM Workshop, Oct 27, 2025
Huntsville, Alabama



The Nancy Grace Roman Space Telescope

NASA next flagship observatory - Field of View >100 times that of Hubble

Primary Instrument - Wide-Field Instrument (WFI)

- Wavelength coverage: 0.48 – 2.30 μm
- Eighteen H4RG-10 Detectors (300 Mpix), 0.28 deg² FoV
- Prism and grism for full-field, slitless spectroscopy from 0.75 – 1.93 μm

Launch by May 2027 and a 5+5 year nominal/extended mission

3 Core Community Surveys (CCS) + General Astrophysics Survey (GAS) + Coronagraph Survey



The Nancy Grace Roman Space Telescope

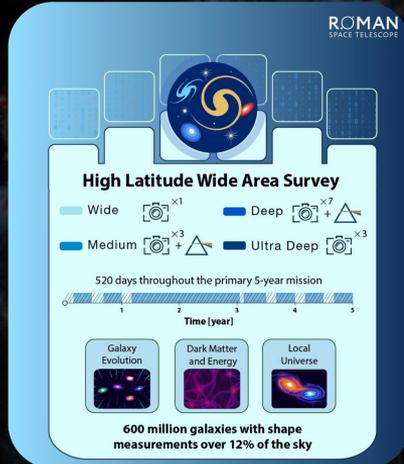
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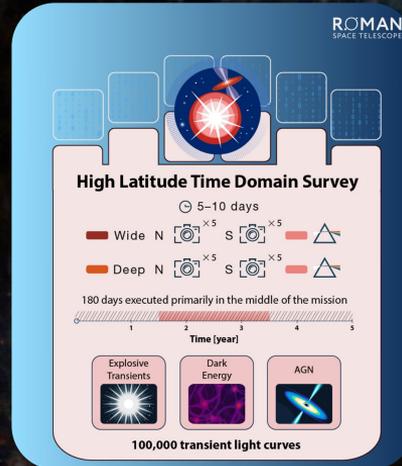
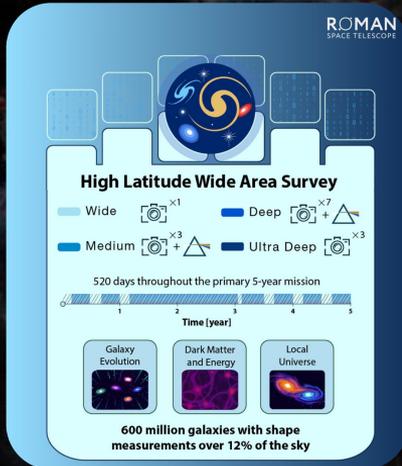
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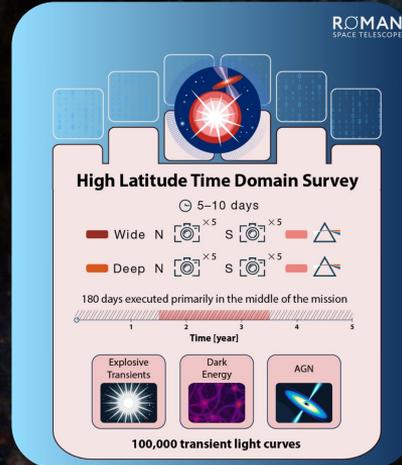
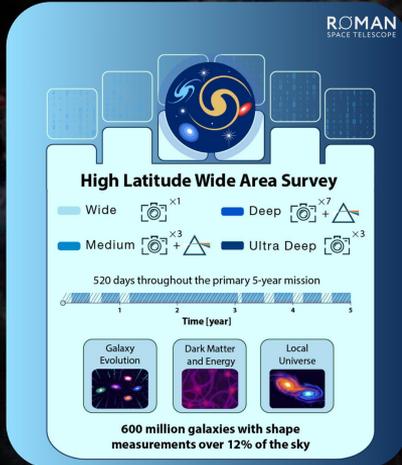
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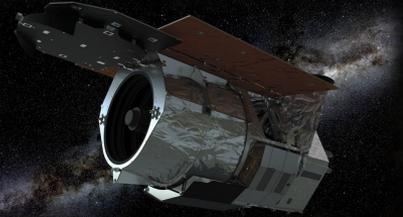
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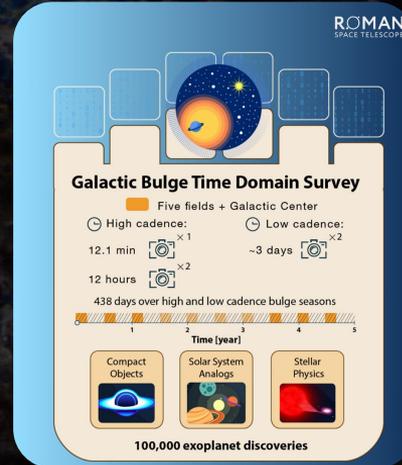
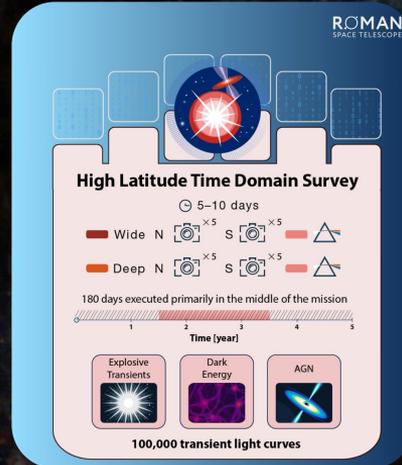
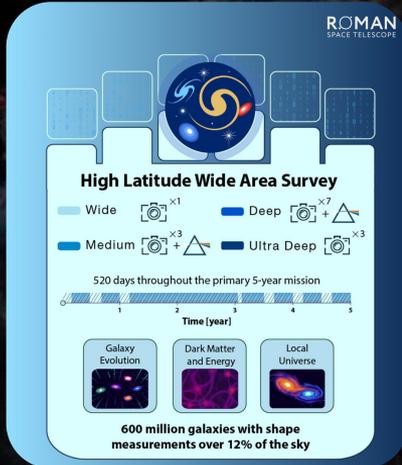
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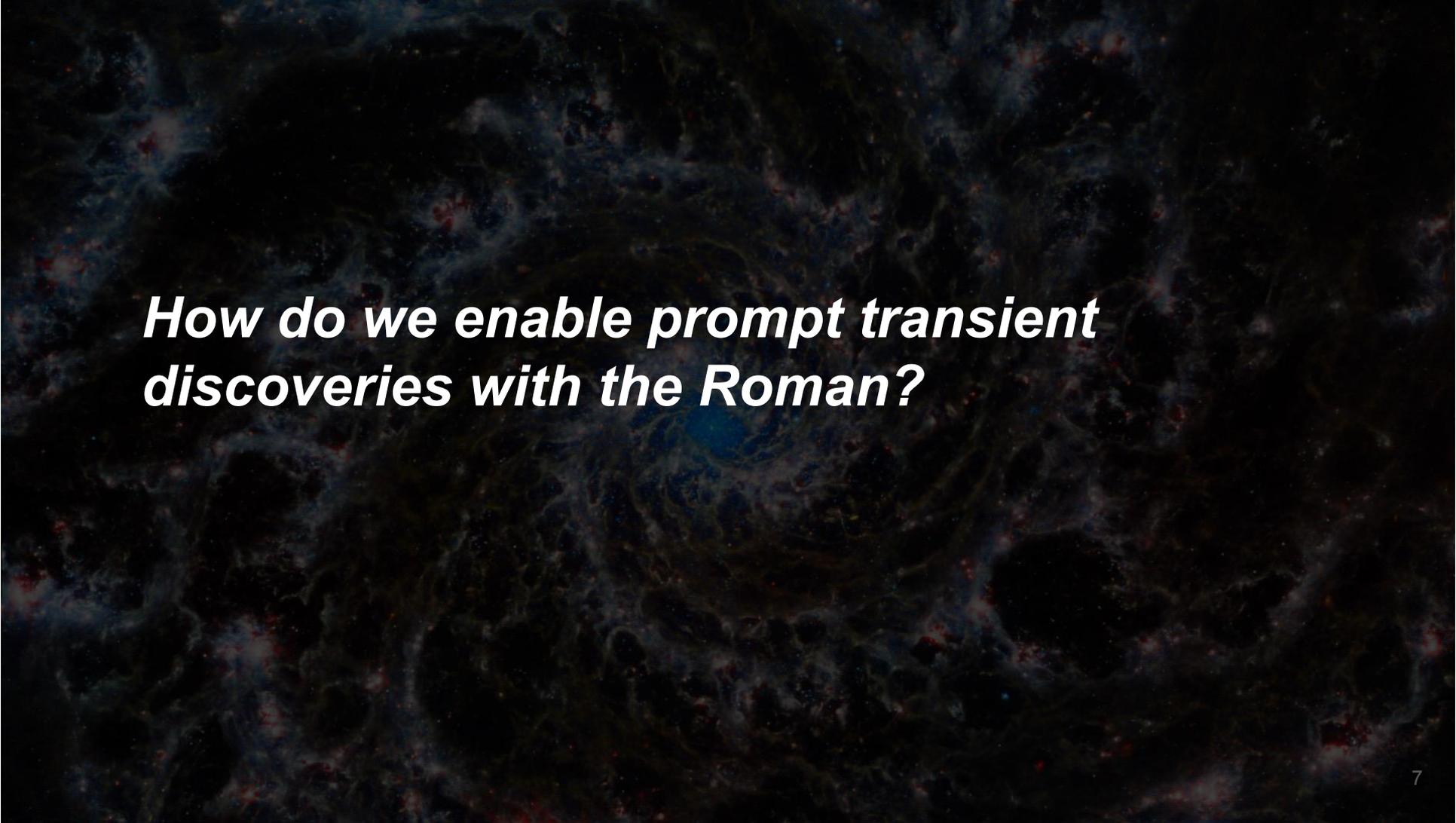


*Galactic Plane Survey is an early-definition GAS, other GAS programs (~25% of total time) will be selected via peer-reviewed proposal process



Galactic Plane Survey*

- ★ Includes time-domain science element (19 deg², 130 hrs) of six fields in seven filters
- ★ Repeat observations with cadences from ~11 minutes to weeks
- ★ [Survey Definition report](#) now available!



How do we enable prompt transient discoveries with the Roman?

How do we enable prompt transient discoveries with the Roman?



Mansi Kasliwal (PI; Caltech)

Ben Rusholme (Pipeline Development Lead; IPAC)

Schuyler Van Dyk (Science Definition Lead; IPAC)

Roberta Paladini (Galactic transients, Inclusion Lead; IPAC)

Lin Yan (Testing and Validation Lead; Caltech)

Ashish Mahabal (Machine Learning Lead; Caltech)

Joe Masiero (Solar System Objects Lead; IPAC)

Russ Laher (Applications Developer; IPAC)

Jacob Jencson (Testing and Validation Scientist; IPAC)

Amalia Rivera (Database Administrator; IPAC)

Ryan Lau (Coordination Scientist; IPAC)

What is RAPID? (Roman Alerts Promptly from Image Differencing)

What is  **RAPID**? (Roman Alerts Promptly from Image Differencing)

 **RAPID** is...

...a Project Infrastructure Team for the Roman Space Telescope

What is RAPID?

 RAPID is...

...a ***Project Infrastructure Team*** for the Roman Space Telescope

Role of Project Infrastructure Teams

Provide comprehensive and sustained support to Roman and the science community for research areas that require long-term scientific infrastructure development.

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Role of Project Infrastructure Teams

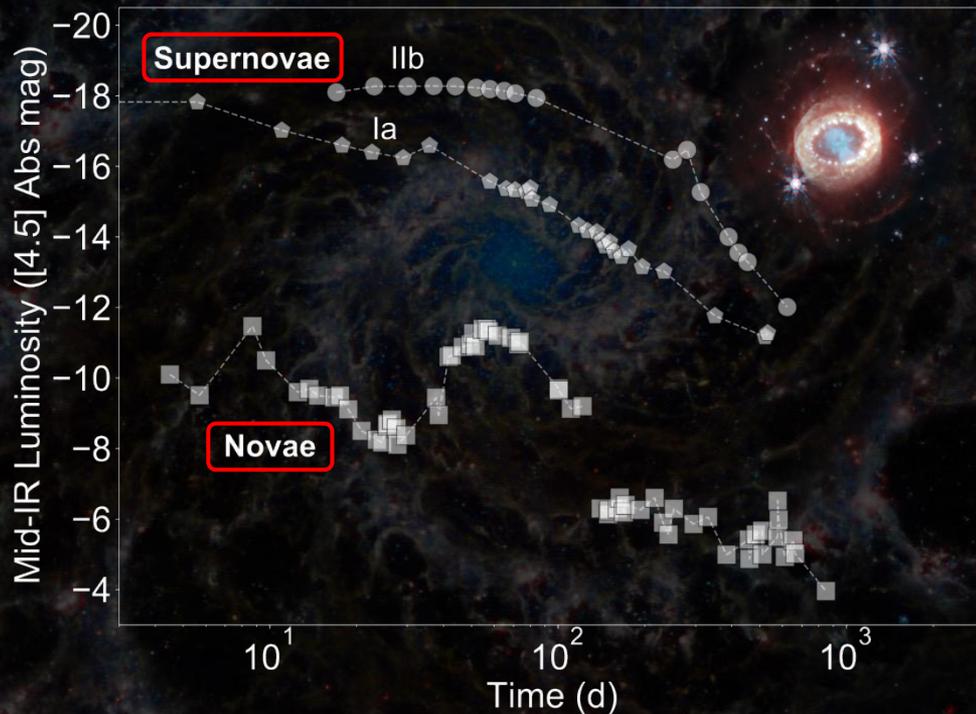
Provide comprehensive and sustained support to Roman and the science community for research areas that require long-term scientific infrastructure development.

 RAPID will deliver...

- **Rapid image-differencing** of every new Roman image
- A **prompt public alert stream** of all transient and variable candidates in difference images
- Source match-files recording **candidate light curves**
- **Forced photometry tool** to investigate a precise photometric history

Science Enabled by RAPID

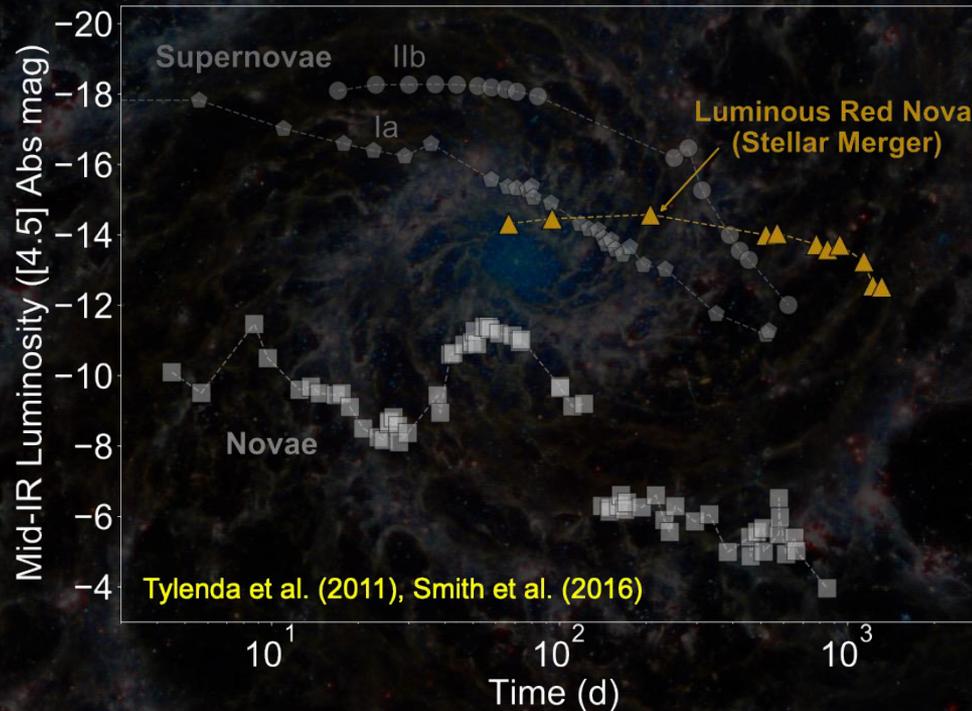
Stellar Explosions: Novae and Supernovae



Science Enabled by **RAPID**

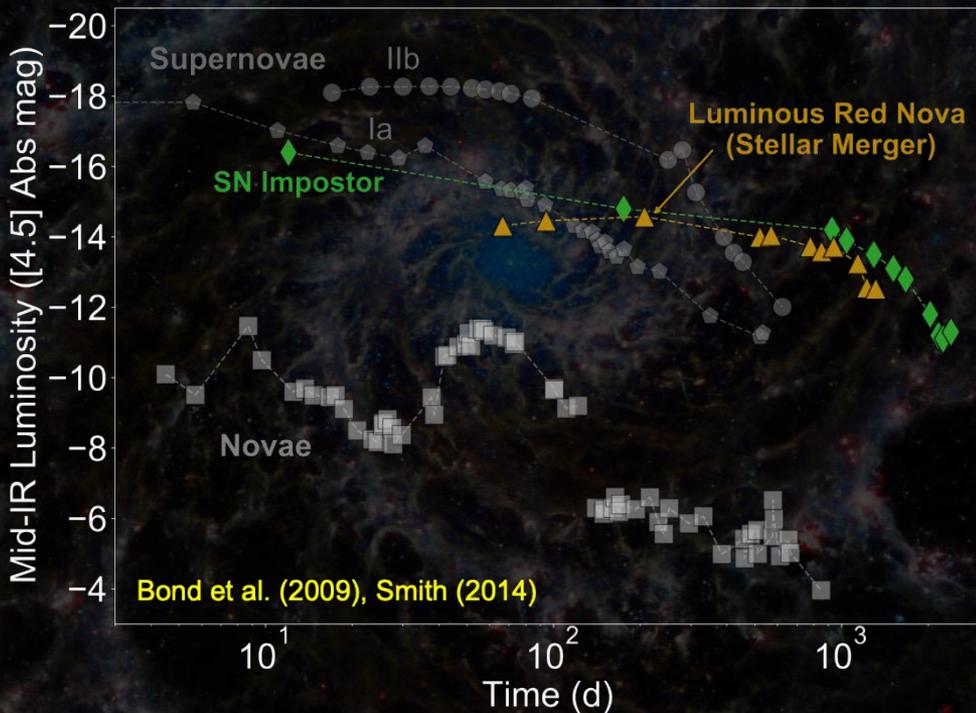


Emerging Classes of IR-Luminous Transients



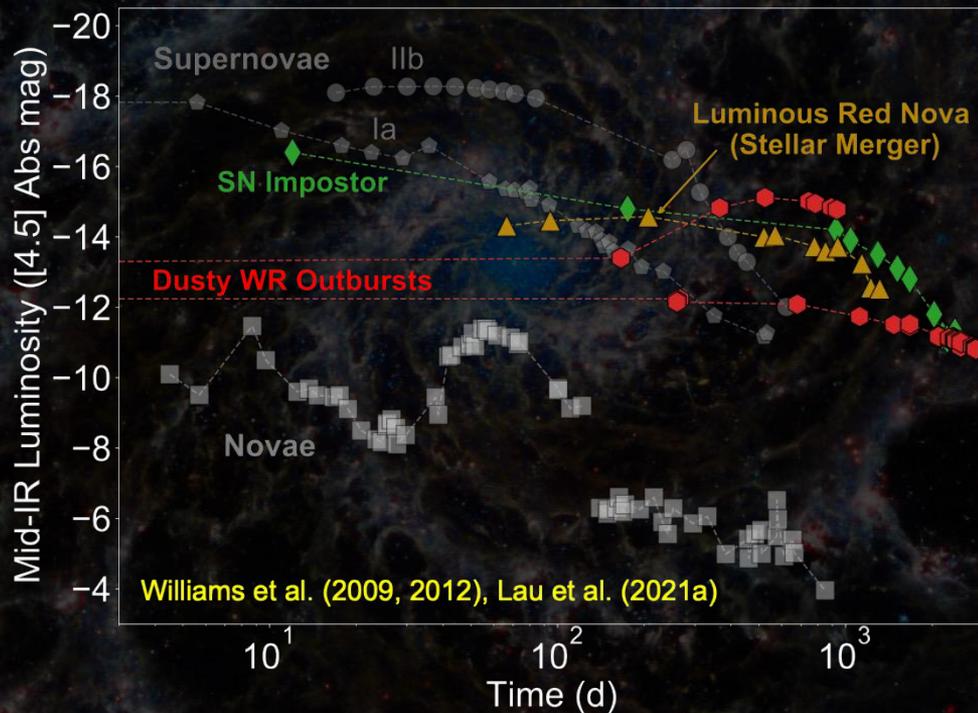
Science Enabled by **RAPID**

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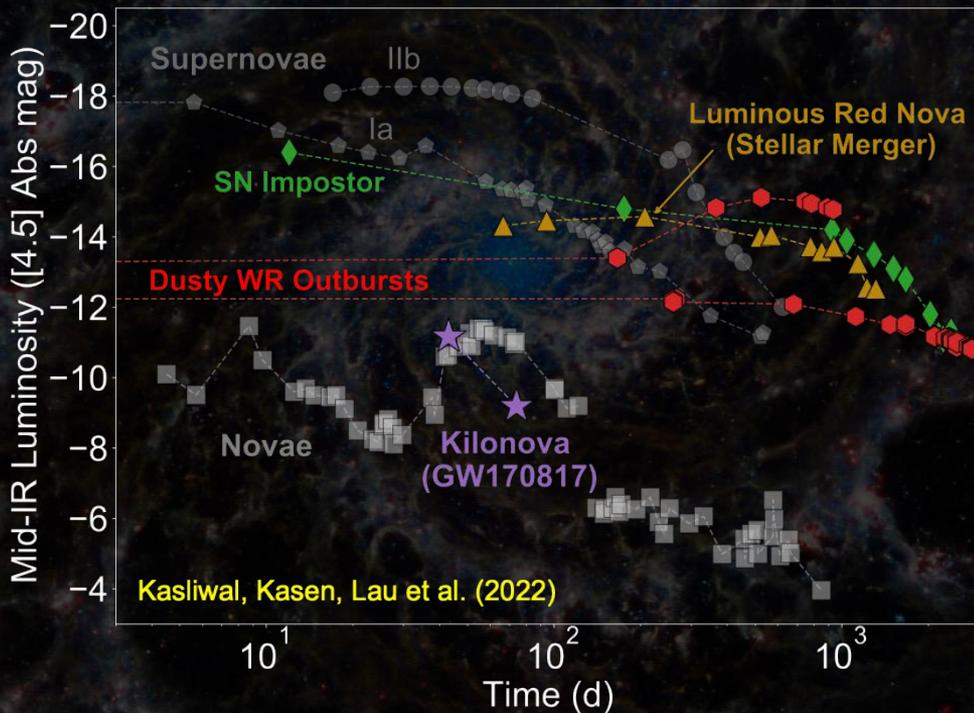
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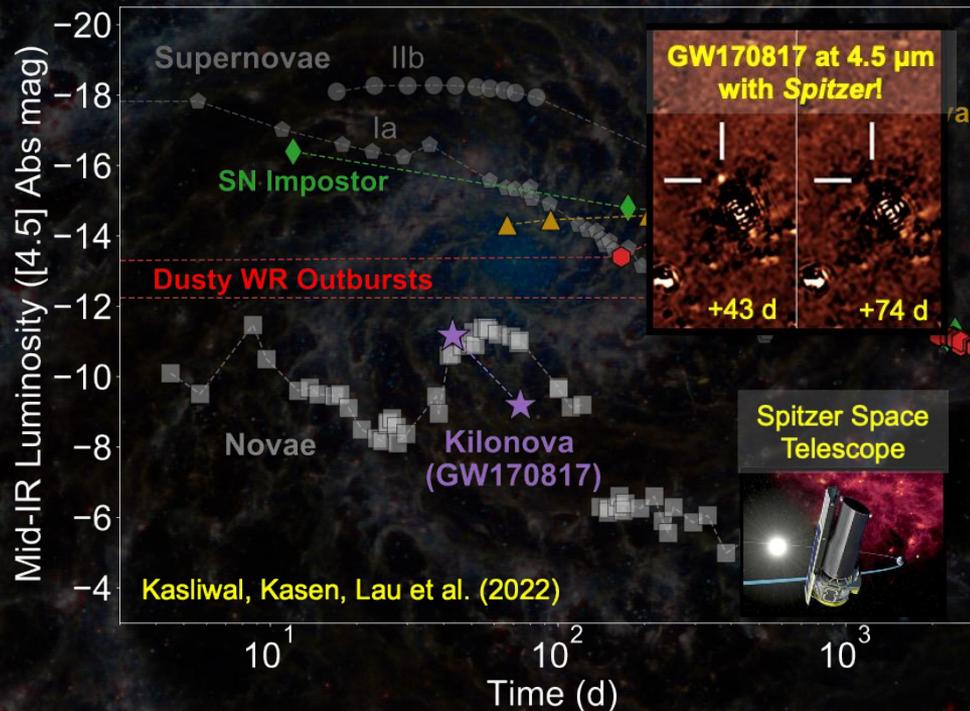
Science Enabled by **RAPID**

Emerging Classes of **IR-Luminous** Transients



Science Enabled by RAPID

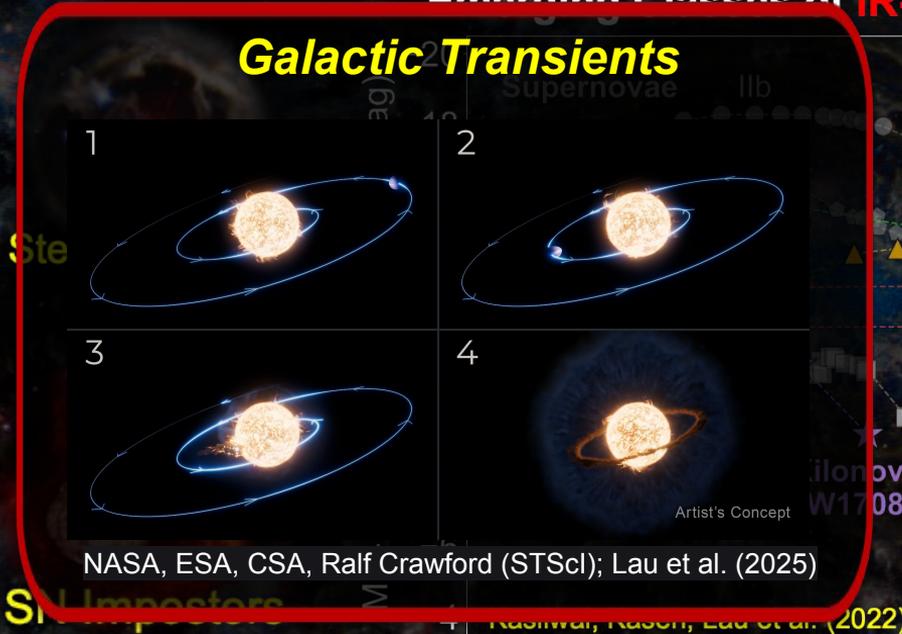
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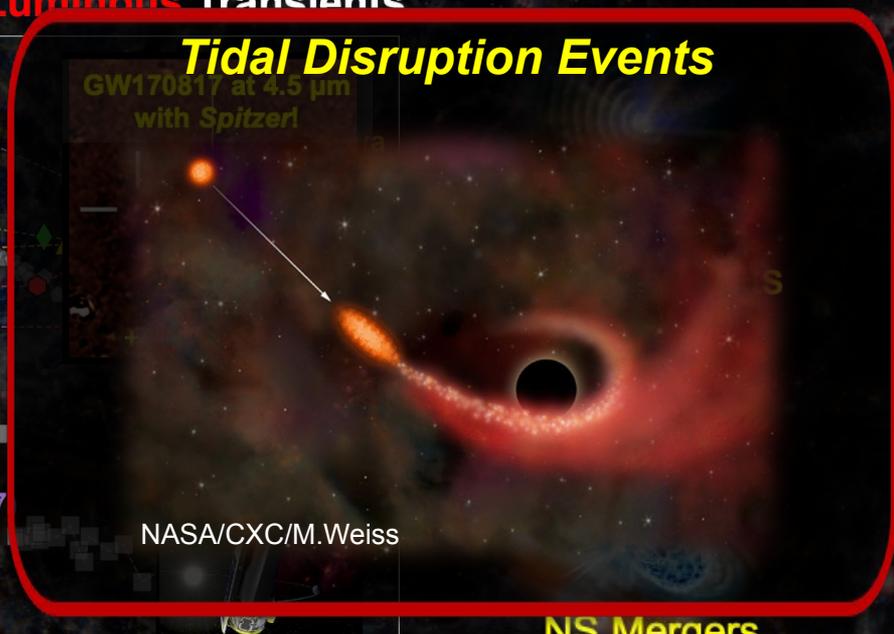
Science Enabled by RAPID

Emerging Classes of IR-Luminous Transients

Galactic Transients



Tidal Disruption Events



SN Imposters
(LBV eruption)

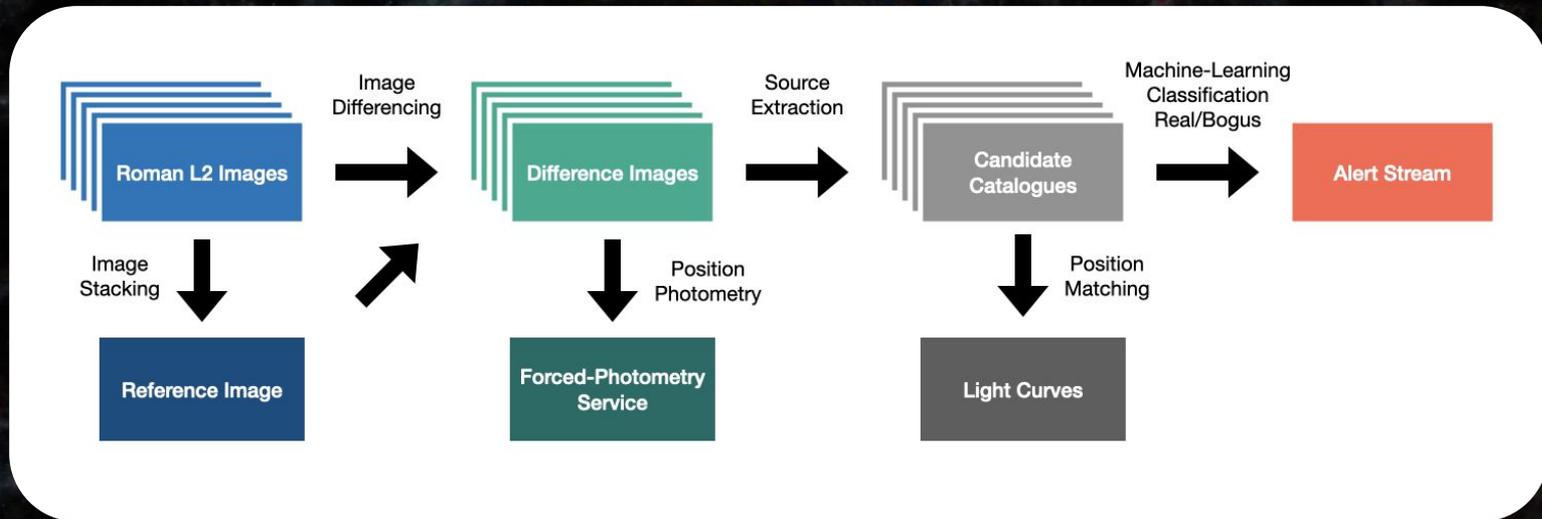
Rashtwar, Kasen, Luu et al. (2022)

Kilonova
GW170817

NS Mergers
(Kilonovae)



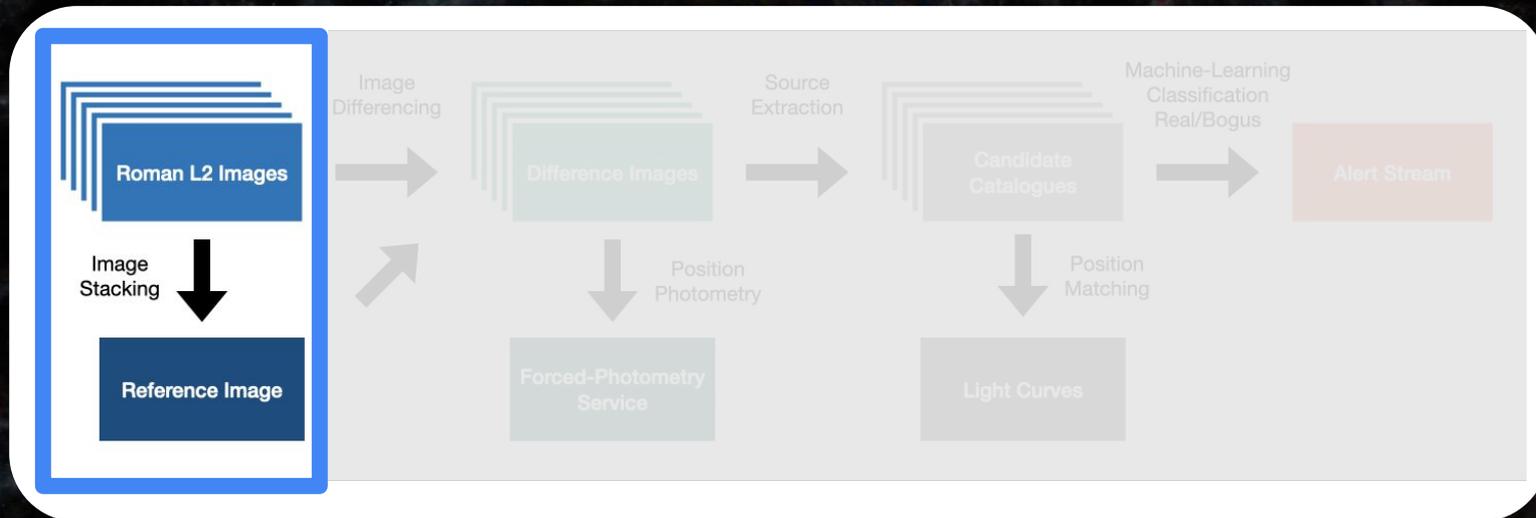
A Quick Tour of the **RAPID** pipeline



On-going development – feedback is welcome!

A Quick Tour of the **RAPID** pipeline

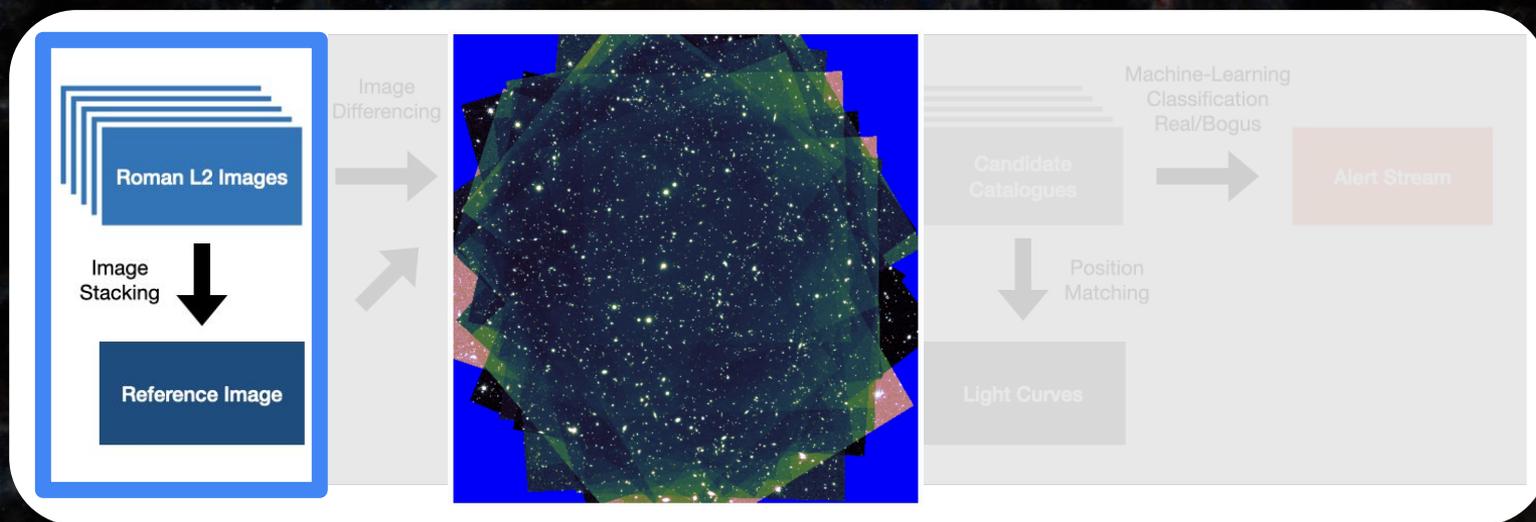
Roman Images and Reference Building



A Quick Tour of the **RAPID** pipeline

Roman Images and Reference Building

RAPID pipeline will run on every new Roman/WFI Image!

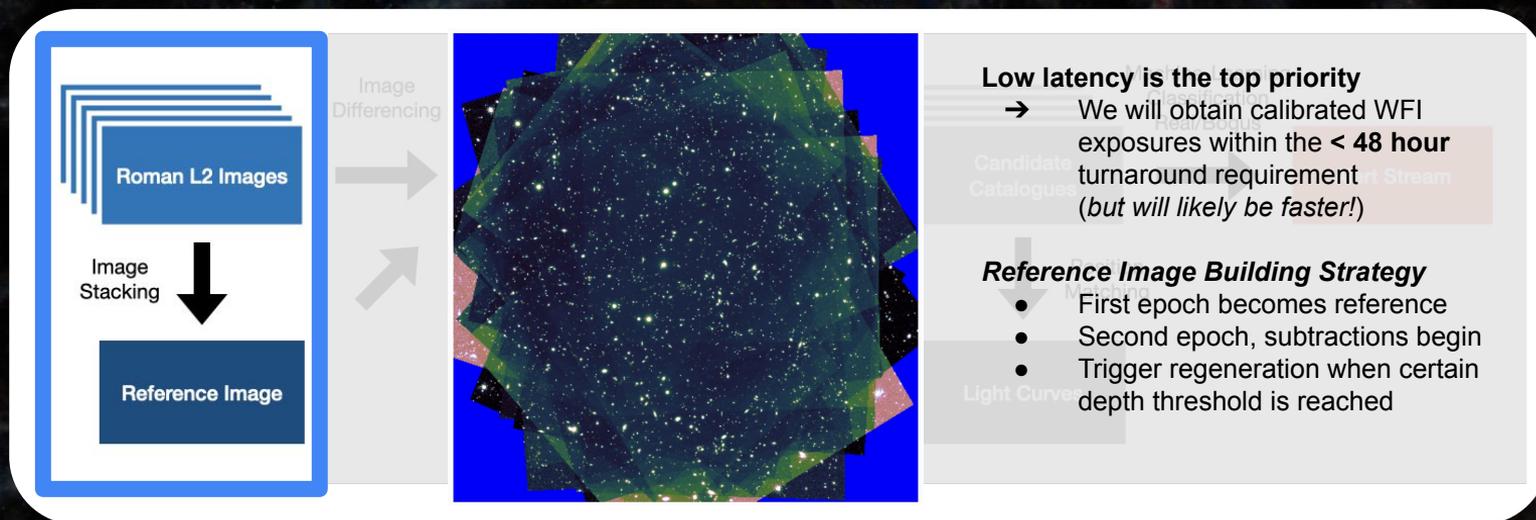


Simulated reference mosaic of 100 frames
(Roman sims from [OpenUniverse2024](#))

A Quick Tour of the RAPID pipeline

Roman Images and Reference Building

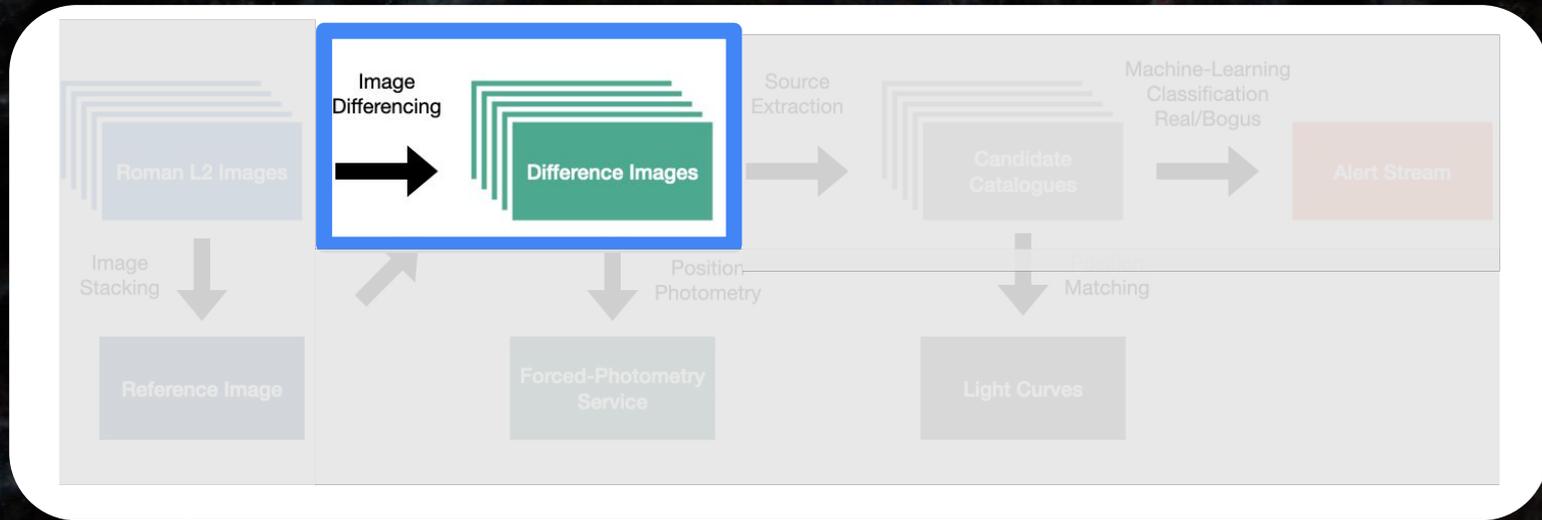
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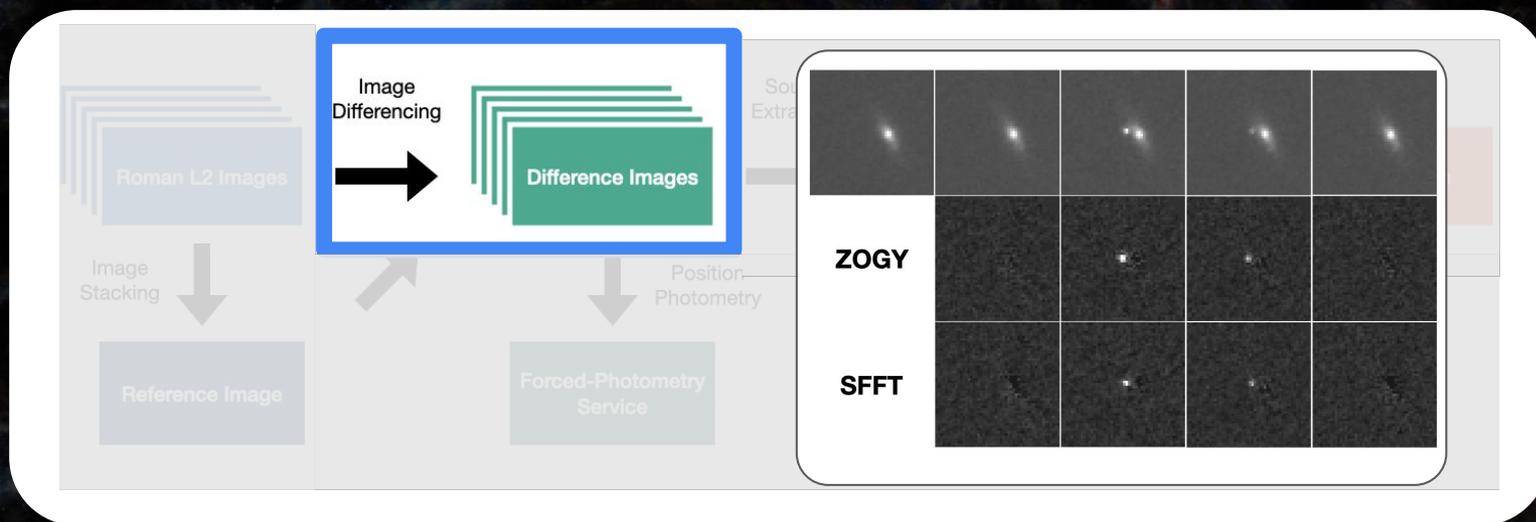
Image Differencing



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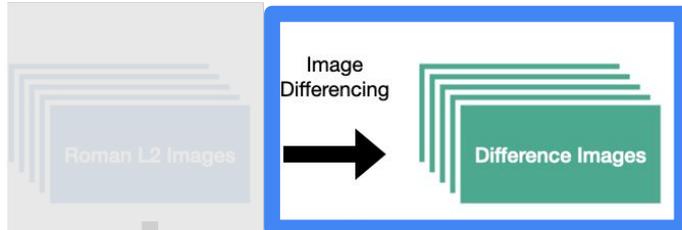
Image differencing tests on simulated data



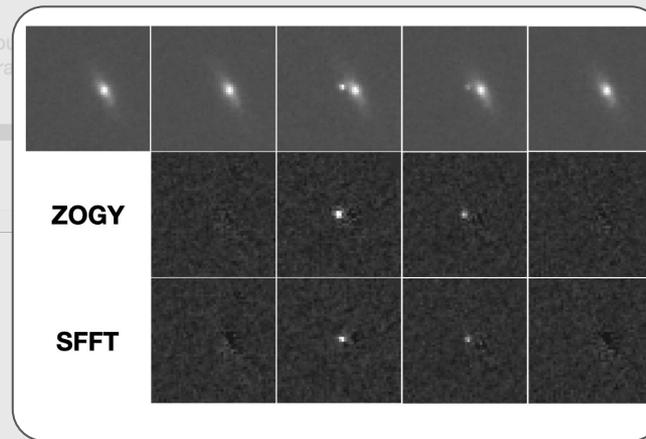
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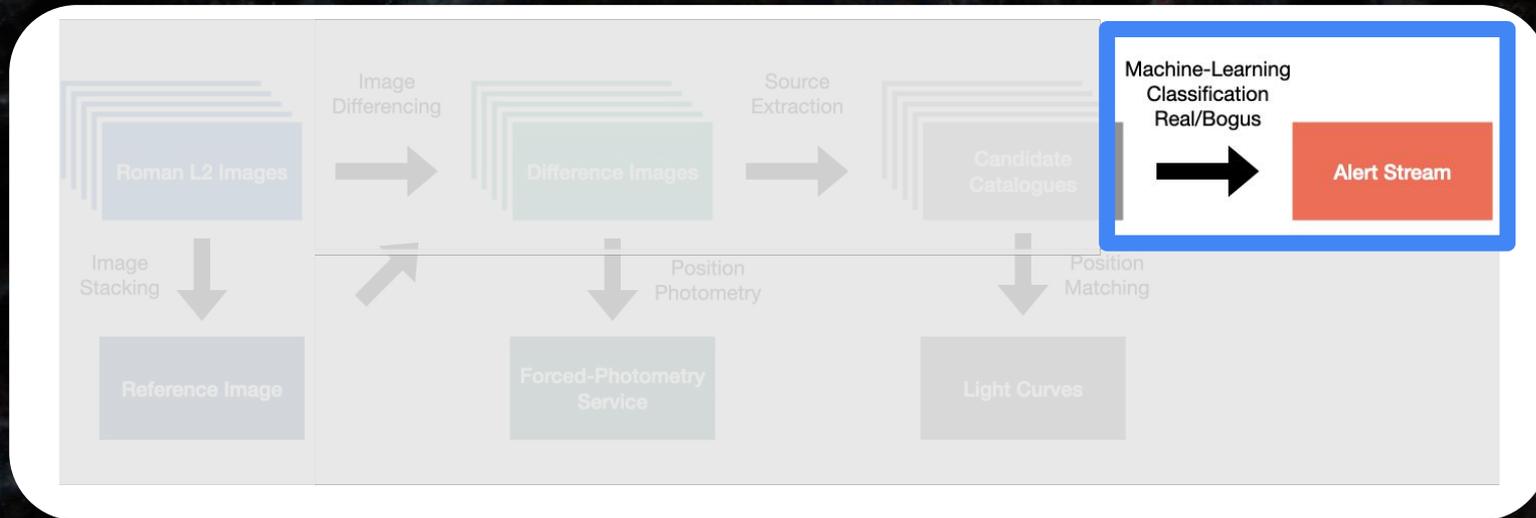


- Considering **ZOGY** (Zackay, Ofek & Gal-Yam 2016) and **SFFT** (Hu+ 2022), or hybrid model (e.g., Hu+2024)
- Able to recover injected sources with both ZOGY and SFFT in sparse fields
- Both algorithms performing similarly well (and better than naive A-B)



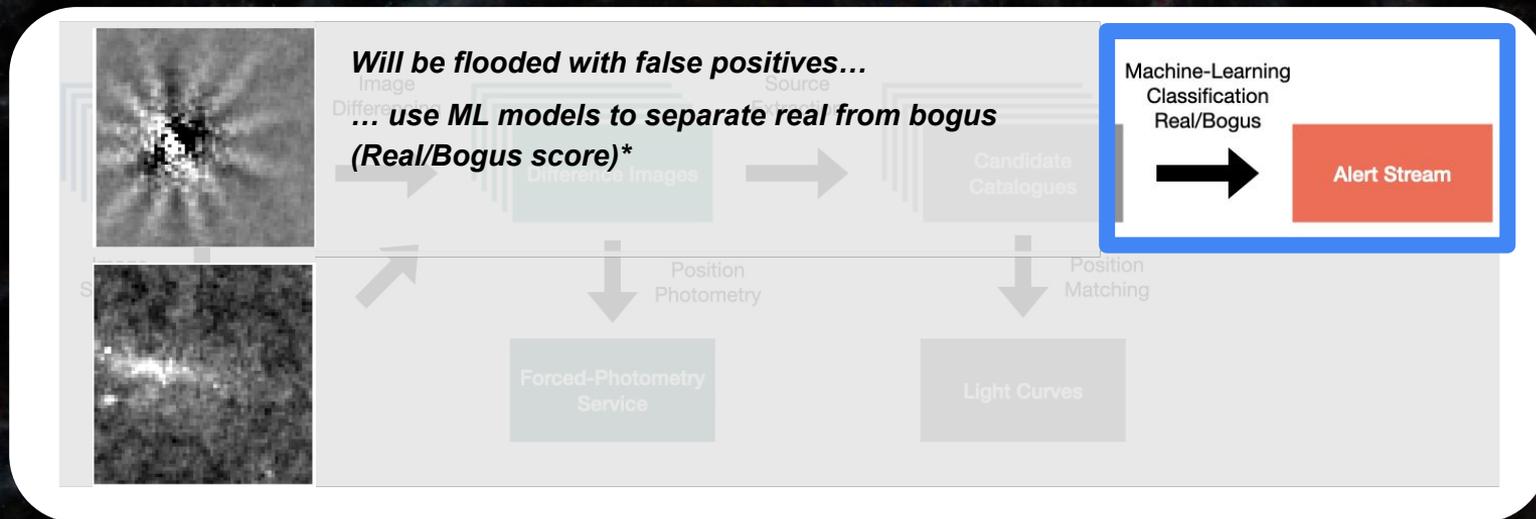
A Quick Tour of the **RAPID** pipeline

Alerts and Machine Learning



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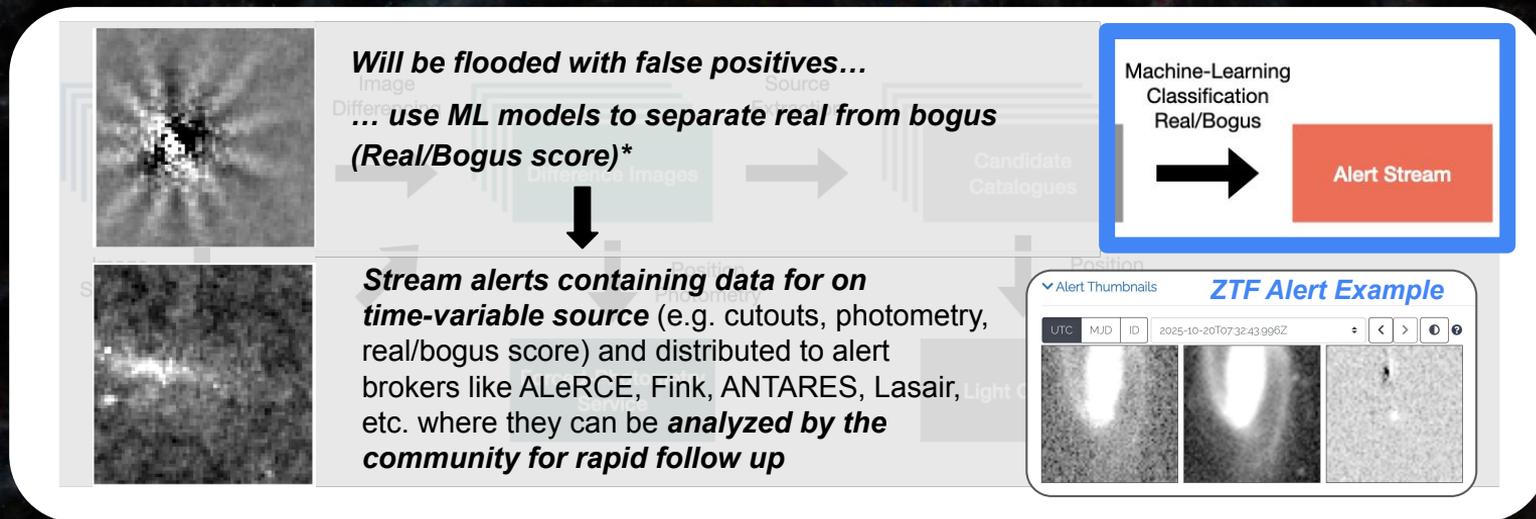
Alerts and Machine Learning



**Please chat with Ashish Mahabal on RAPID ML!*

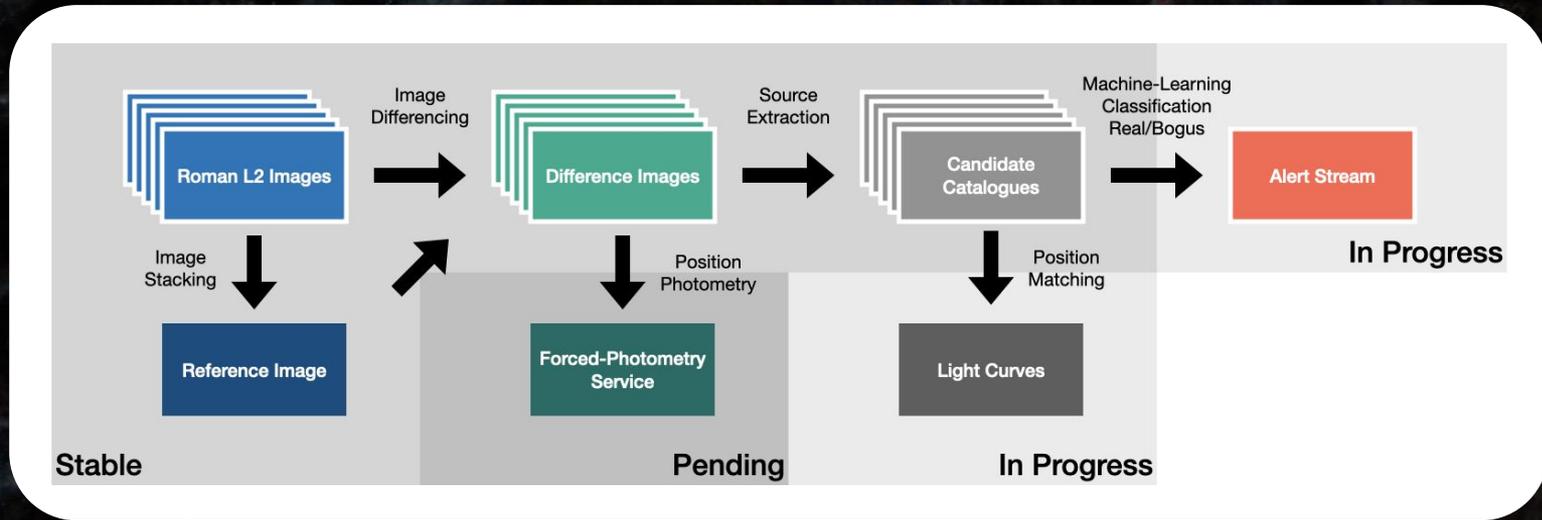
A Quick Tour of the pipeline

Alerts and Machine Learning



**Please chat with Ashish Mahabal on RAPID ML!*

Current status of RAPID pipeline



RAPID Github - <https://github.com/Caltech-IPAC/rapid>

RAPID Pipeline Docs - <https://caltech-ipac-rapid.readthedocs.io/en/latest/>

We're currently hiring an applications developer!

 **RAPID** *Community Engagement***AAS 247 Special Session**
*Preparing for Time Domain
Science with the Roman Space
Telescope*

Date: Thursday, Jan 8, 2026

Description:

90-min session to discuss RAPID services and products and engage with community

Speakers:

Jacob Jencson (IPAC)
Ashish Mahabal (Caltech)
Ori Fox (STScI)
Monika Soraisam (Gemini/NOIRLab)

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RAPID Response: Hot-wiring the Next Generation of Time-Domain Science

Dates: March 23 - 27, 2026

Website:

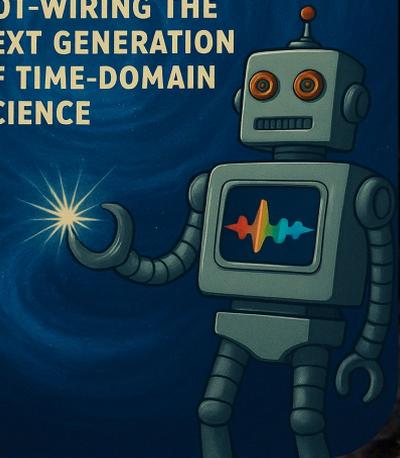
<https://conference.ipac.caltech.edu/rapid-hotwiring2026>

Location: Pasadena, CA (Caltech campus)

Engage in discussions on RAPID deliverables (and beyond!)

RAPID Response

**HOT-WIRING THE
NEXT GENERATION
OF TIME-DOMAIN
SCIENCE**



Summary and keeping up with



Roman will be launching soon and has tremendous potential for prompt Multi-messenger and Time-domain astronomy...

... and *RAPID* will fully realize this potential by delivering:



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- *Prompt public alert stream* of all Roman transient and variable candidates
- *Source-matched light curve* files for every identified Roman candidate
- *Forced-photometry service* for photometric history at any observed location



Summary and keeping up with



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Email Us!
rapid@ipac.c
altech.edu



Visit the
RAPID
Website!



Join the
RAPID
Slack!

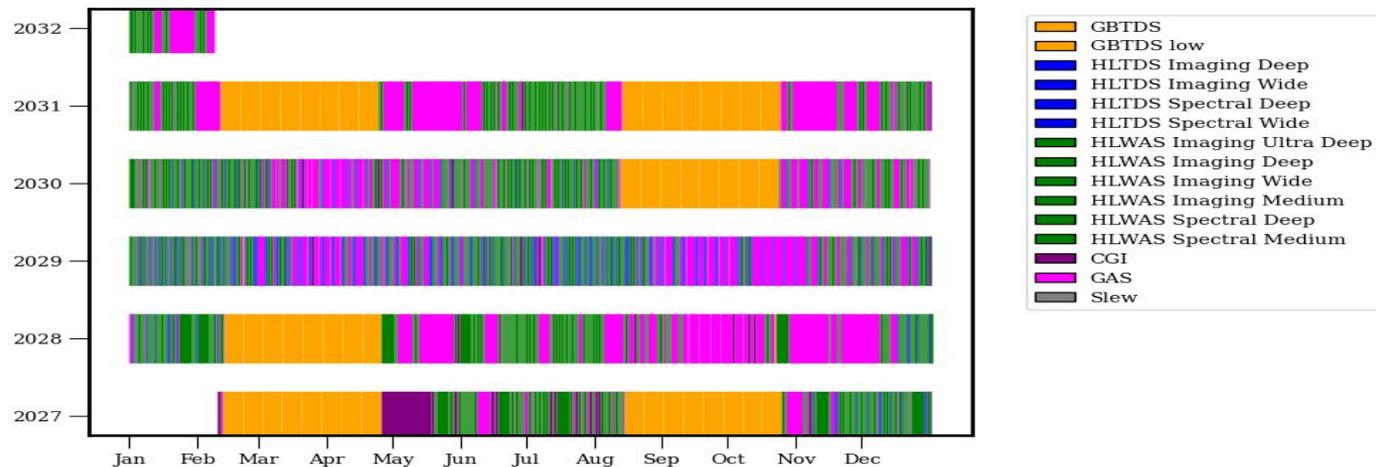


Sign up for a
Roman
Science
Collaboration!



Back-up slides

Roman's first 18 months



- **Observing programs that need to happen early**
 - Three Galactic Bulge Time Domain Seasons
 - 90 days of Coronagraph Instrument observations
 - 30 days of Galactic Plane Survey (some may be scheduled later than 18 months)
 - High Latitude Time Domain Pilot Survey
 - Euclid Deep Field South
 - ELAIS-N1
 - High Latitude Wide Area Survey deep/ultradeep tiers
 - Cosmos
 - XMM-LSS

Time available for additional General Astrophysics Surveys in this period is limited

The General Investigator Program

- **The Roman General Investigator Program is organized by IPAC on behalf of the Roman Project**
 - We expect the Roman Cycle 1 proposal call to be released in ~November, with a due date ~March 2026.
 - The primary resource distributed through this call is funding to support science investigations.

- **This call will support:**
 - Analysis of any data that will be collected by the Wide Field Instrument, this includes Core Community Surveys, predefined General Astrophysics Surveys (e.g. the Galactic Plane Survey), data from future to-be-defined surveys, calibration touchstone fields, WFI parallels during CGI observations
 - Analysis of ground-based data that directly ties to Roman science,
 - Theoretical investigations,
 - New Roman General Astrophysics Surveys,
 - Any combination of the above.

- **We anticipate multiple categories of proposal – for example, regular/large/key – with well differentiated funding caps.**