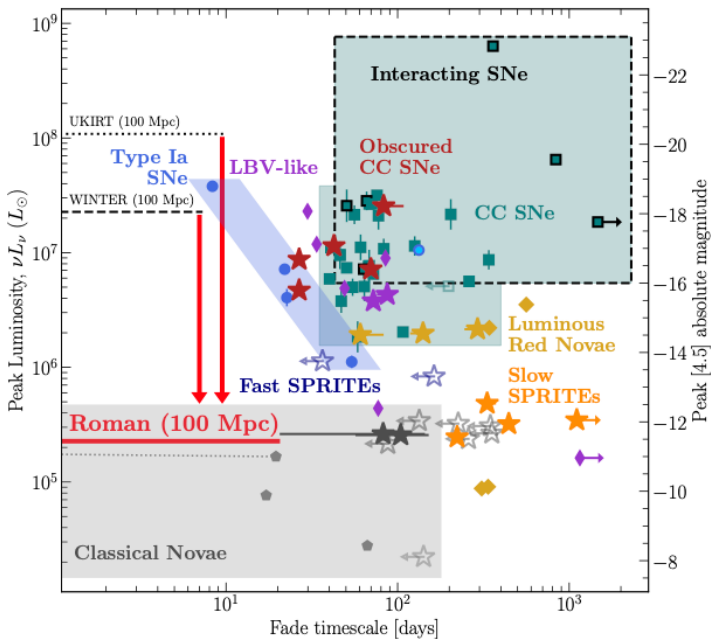


(Roman Alerts Promptly from Image Differencing)

A Roman Space Telescope Project Infrastructure Team (PIT)

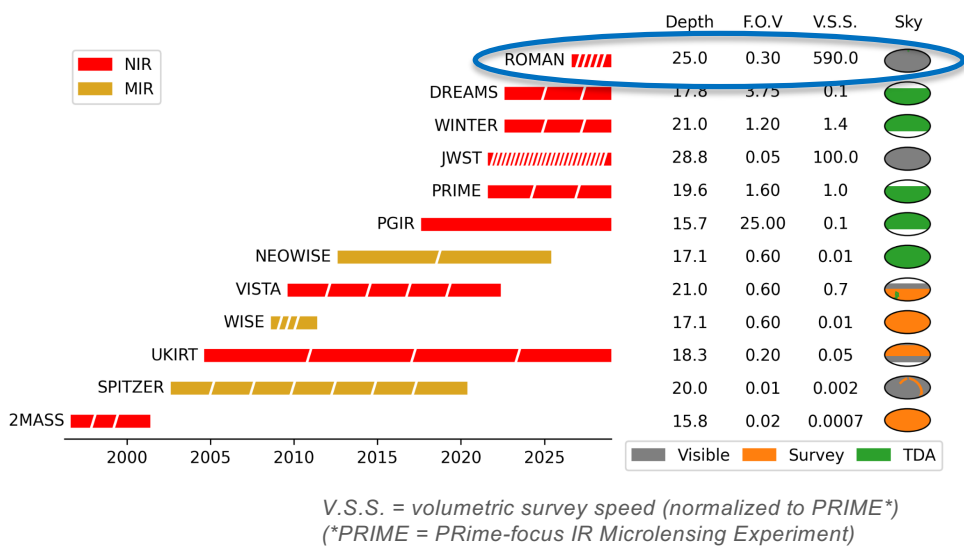
Mansi Kasliwal (PI; Caltech), Ben Rusholme (Caltech/IPAC), **Schuyler Van Dyk** (Caltech/IPAC), Jacob Jencson (Caltech/ IPAC), Russ Laher (Caltech/IPAC), Ashish Mahabal (Caltech), Joe Masiero (Caltech/IPAC), Siddharth Mohite (Caltech/IPAC), Roberta Paladini (Caltech/IPAC), Amalia Rivera (Caltech/IPAC), Lin Yan (Caltech)

Motivation



Explore the phase space of IR transients with Roman

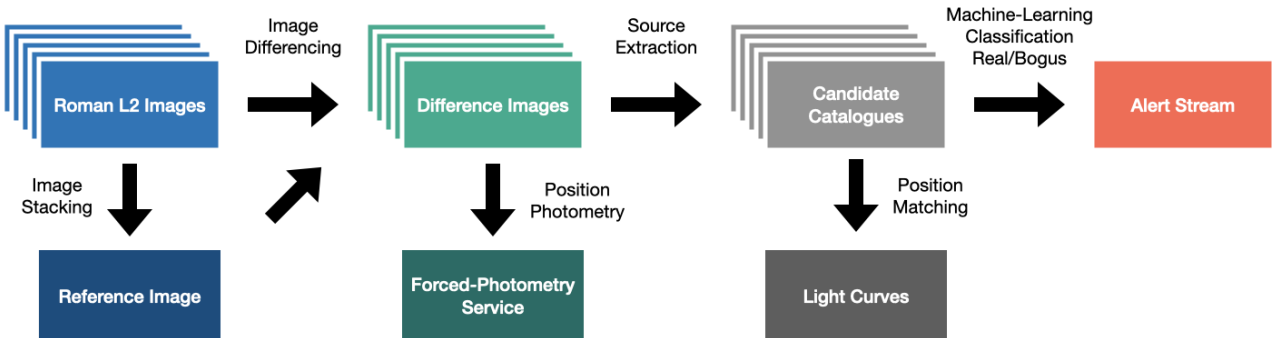
Motivation



RAPID Will Enable Roman Time Domain

Roman will be very efficient for time domain discovery

RAPID high-level overview



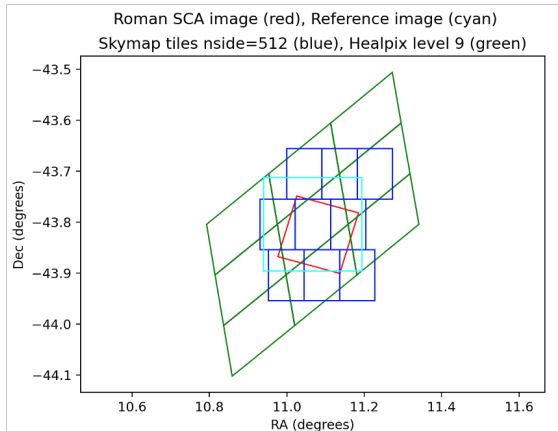
Our goal is to provide four services to the Roman community:

- Rapid image-differencing of *every* new Roman image from a reference image
- 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

Low latency is *the* High Priority for RAPID

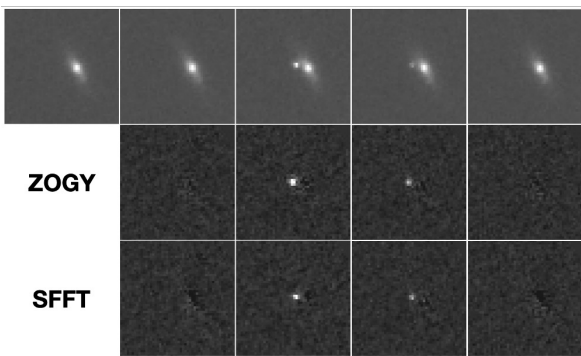
- Pull calibrated Level-2 WFI data from the SOC staging location and stack (< 48 hour turnaround)
- Execute fully-automated image differencing and prompt public alert broadcasting (< 1 hour)
 - Includes initial source classification via machine learning
- Offer forced photometry on difference images
- Append and release light curve history of sources
- Archive public alerts via STScI MAST; Final photometry via SOC

Reference image tiling scheme



Reference images built pre-survey or on-the-fly (single Level-2 SCA or mosaic stack)

Optimized image differencing



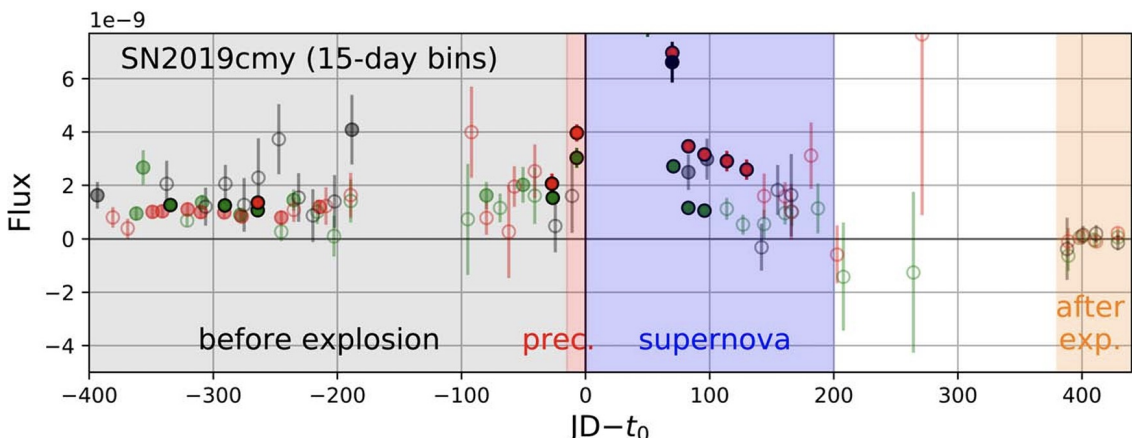
Subtraction Algorithm Comparison for Down-Select (Many thanks to the NASA OpenUniverse simulations team)

Alert stream offered to brokers

rapid.alert
- candidate
- prv_candidate
- fp_hist
- cutout

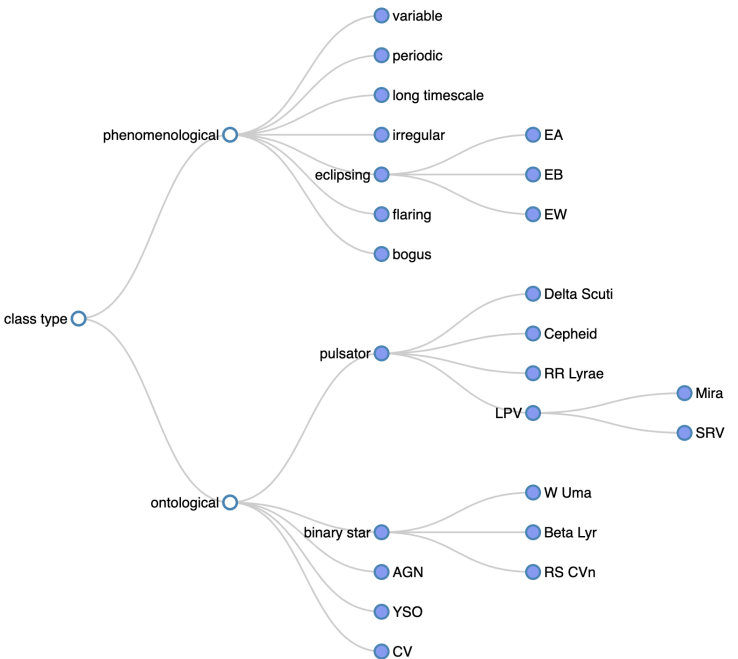
Identical structure to Rubin alerts
Majority of schema fields are matches to external catalogs
Draft alert schema on GitHub: [public announcement soon!](#)

Forced photometry and light curves



Complete ZTF light curve of SN 2019cmy – upper limits (open circles) and detections (solid circles) via forced photometry (from Strotjohann et al. 2021).

Source classification via machine learning



Data products and deliverables

Product	Format	Distribution	Access
Simulated Images	ASDF	S3/MAST	Public
Reference Images	ASDF	S3/MAST	Public
Difference Images	ASDF	S3/MAST	Public
Alert Stream	Avro	Kafka	Public
Alert Archive	Avro/tarball	MAST	Public
Light Curves	Parquet	S3/MAST	Public

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