

HLIS



roman-hlis-cosmology.caltech.edu



github.com/Roman-HLIS-Cosmology-PIT



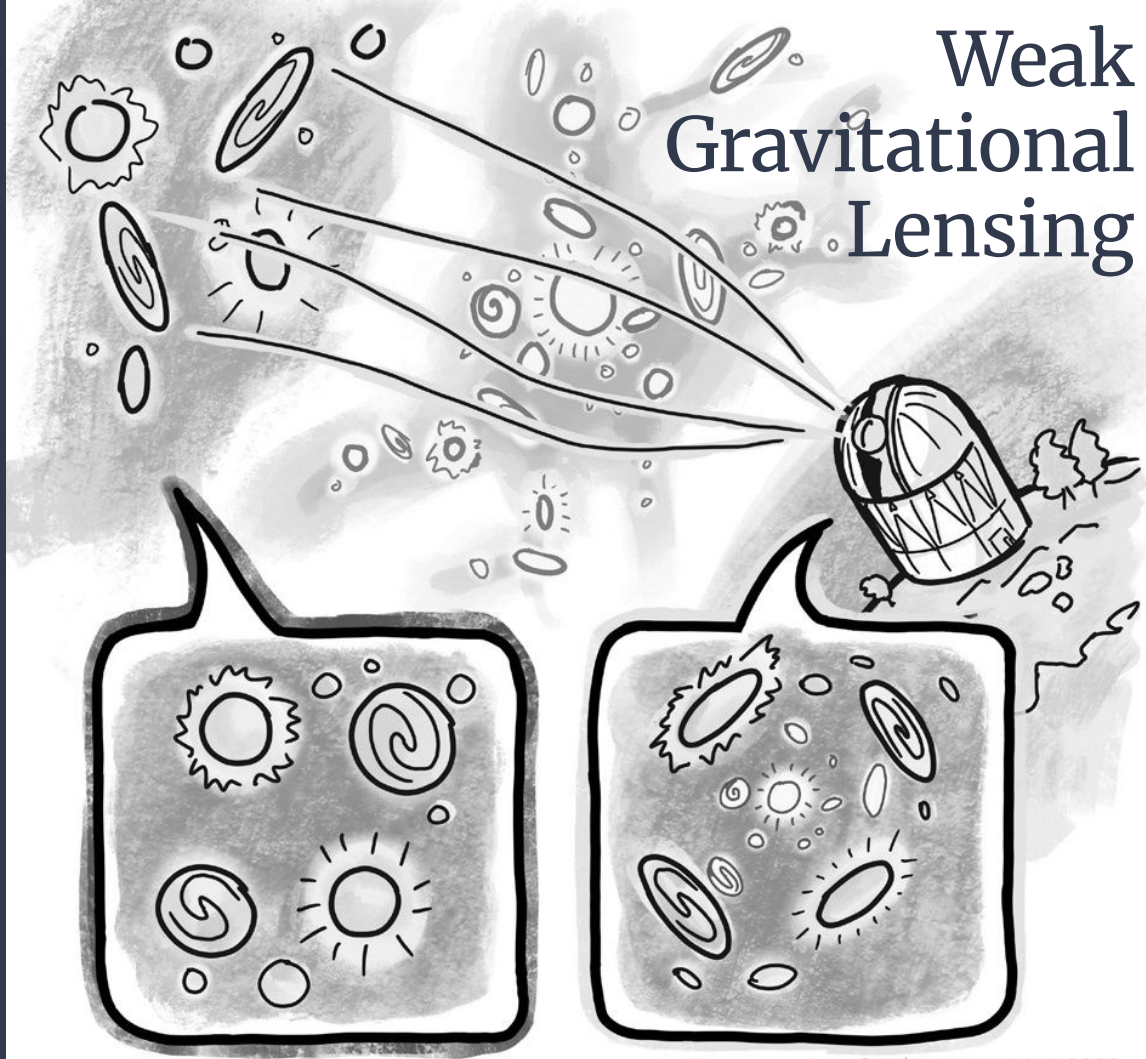
Hot-wiring the Roman Sky: Resolving the Undersampling Crisis with Fast IMCOM for Real-Time Discovery

Presenter: Kaili Cao (The Ohio State University → University of Michigan)

RAPID Response: Hot-wiring the Next Generation of Time-Domain Science, March 25, 2026

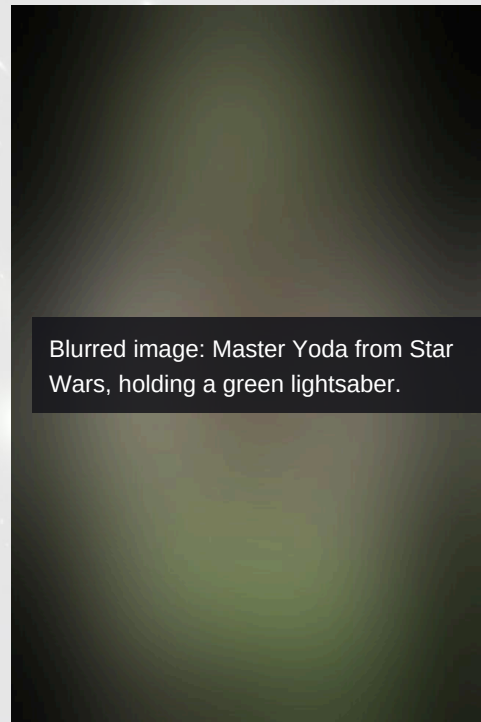
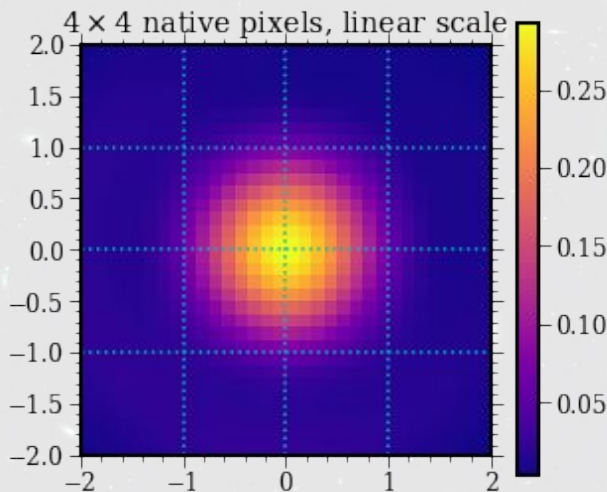
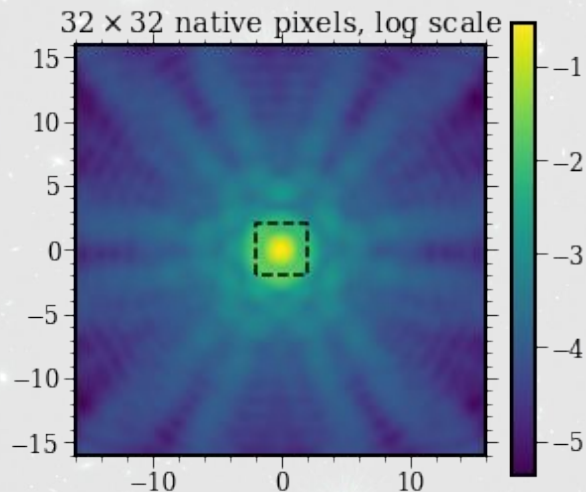
Our Project
Infrastructure
Team:
Maximizing
Cosmological
Science with the
Roman High
Latitude
Imaging Survey

Weak
Gravitational
Lensing



Why do we coadd images? – “Oversample, we must!”

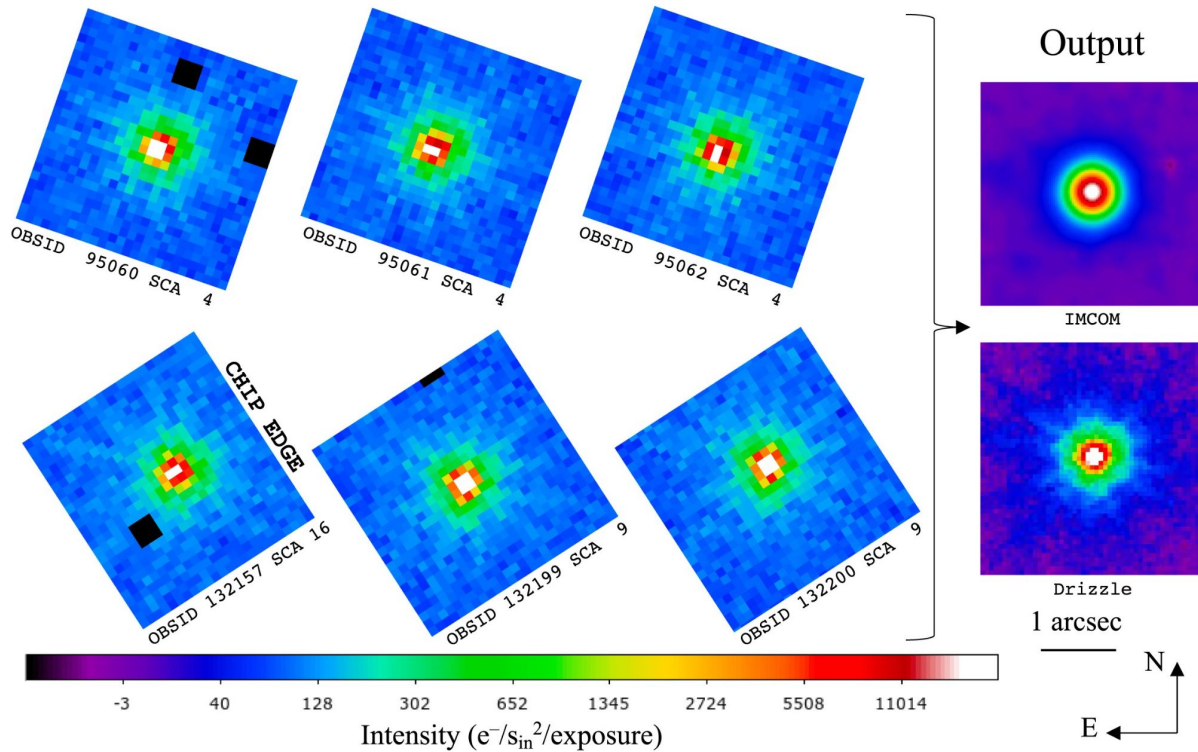
- Roman point spread functions (PSFs)
 - = Airy disk ($\sim \lambda/D$) + linear obscuration + diffraction spikes + detector effects
 - An example in **Y106** band shown below



Blurred image: Master Yoda from Star Wars, holding a green lightsaber.

Image credits: Lucasfilm Ltd., Janson_G

IMCOM (B. Rowe et al. 2011): Image Coaddition with Control over Output Point Spread Function



←: 3 dithers × 2 passes
(typical for Medium and
Wide Tiers of HLWAS)

↗: IMCOM (IMage
COMbination) – **optimal**
image coaddition

↘: Drizzle – **efficient**
image coaddition

*Credit: Figure 9 from
C. Hirata et al. 2024*

One day

Time to reconstruct a Roman WFI image $[(7.5 \text{ arcmin})^2]$
with a single CPU core using IMCOM.

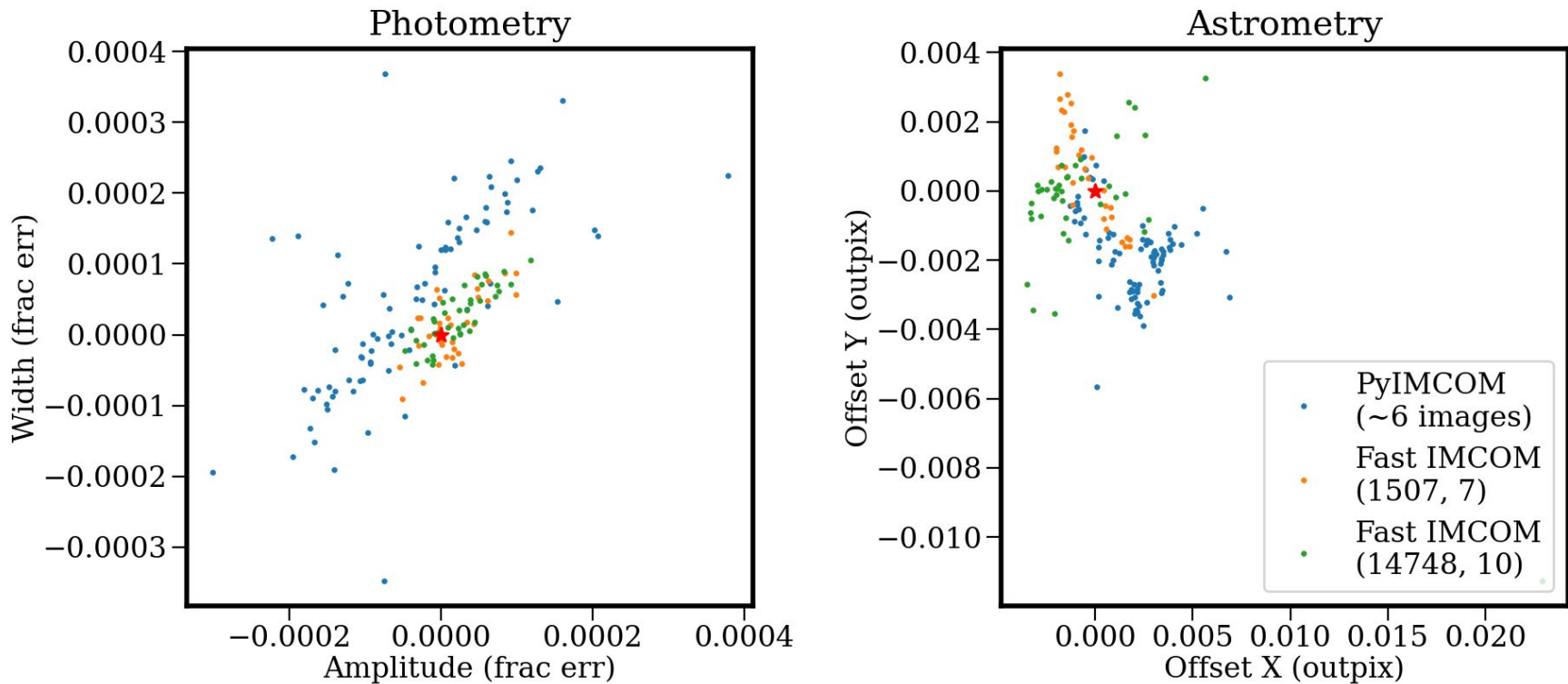
One day →
Half an hour

Time to reconstruct a Roman WFI image $[(7.5 \text{ arcmin})^2]$
with a single CPU core using IMCOM → Fast IMCOM.

Foreseeable Future: Efficient Optimal Image Reconstruction with Fast IMCOM (Cao 2026*)

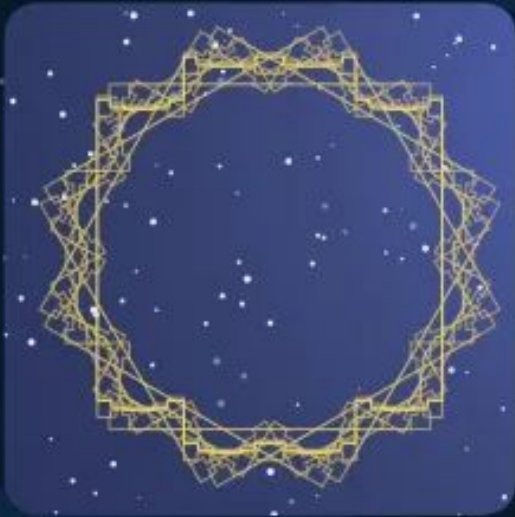


Measurements with Fast IMCOM (Cao 2026*)



For noiseless point sources. The output pixel scale is currently ~ 46.3 mas.

The area of
90
full moons



HIGH-LATITUDE TIME-DOMAIN SURVEY



180 days, primarily in two years



30 hours every five days



18



Supernovae



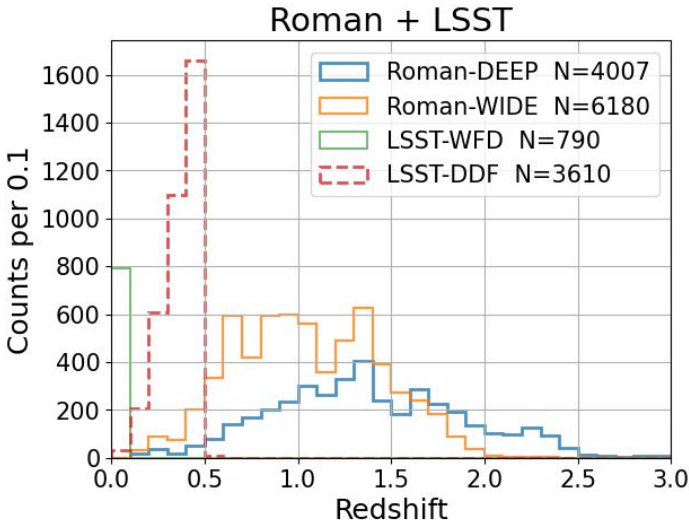
Transients



Galaxies



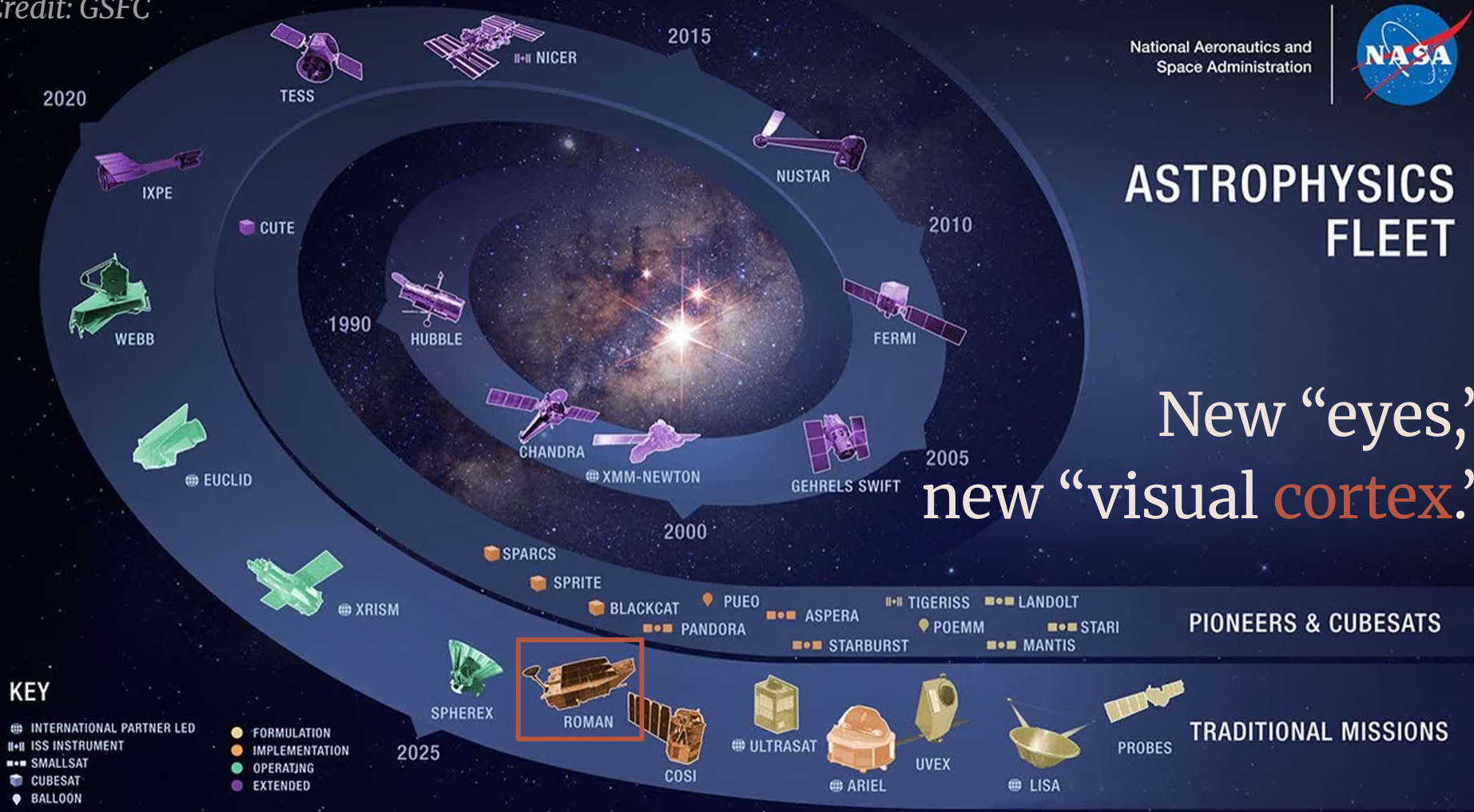
Dark Energy





ASTROPHYSICS FLEET

New “eyes,”
new “visual cortex.”



How do we optimize transient discovery with multi-wavelength and multi-messenger alert streams?

Is it worth projecting single-epoch images onto a common pixel grid and unifying the point spread functions?

Necessary inputs: calibrated single-epoch images (“Level-2”), world coordinate systems, point spread functions

Configurable outputs: pixel grid, point spread function

Formalism paper published in AJ; methods papers underway.

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