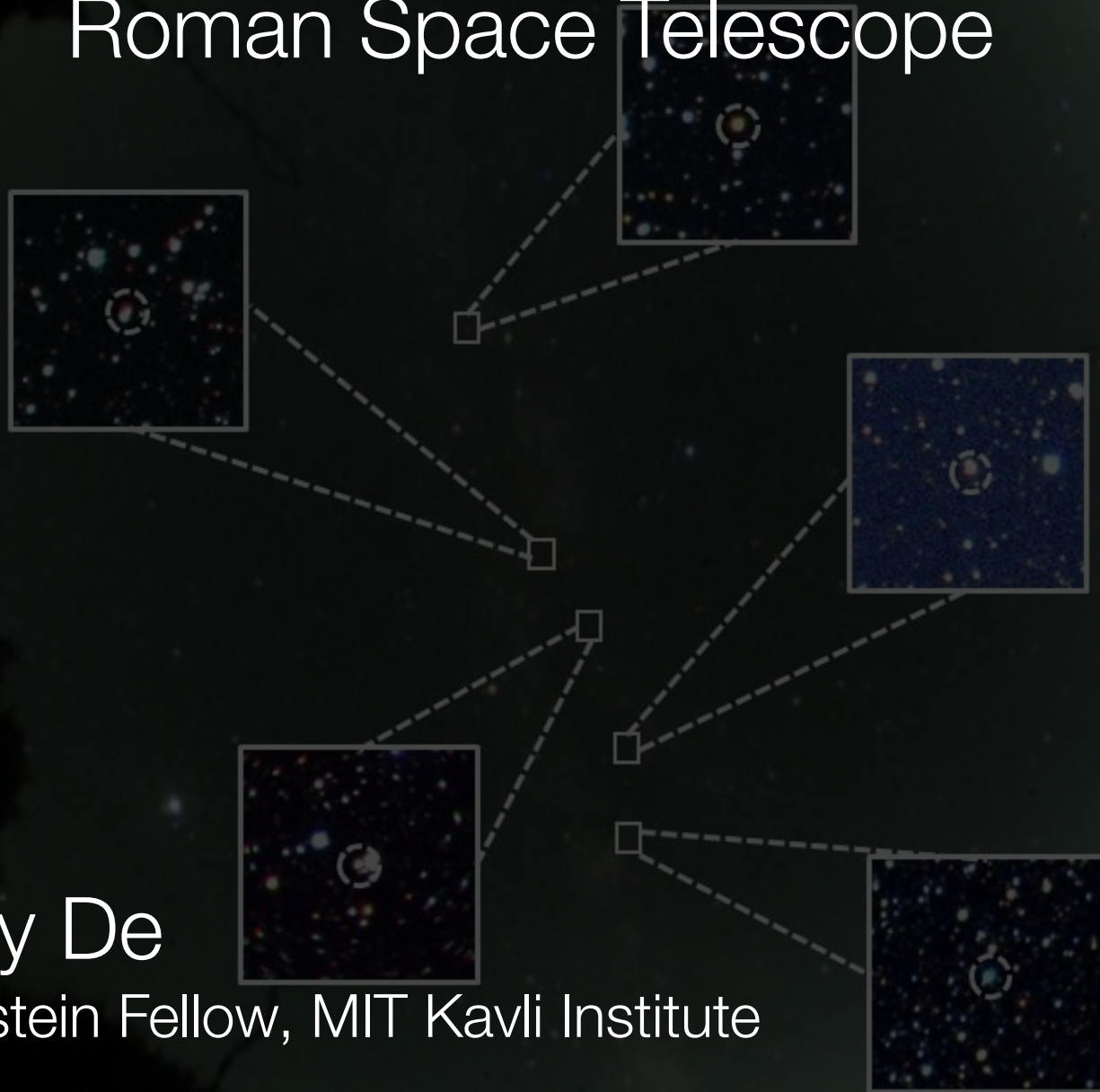


The Dynamic Galactic Plane viewed with the Roman Space Telescope



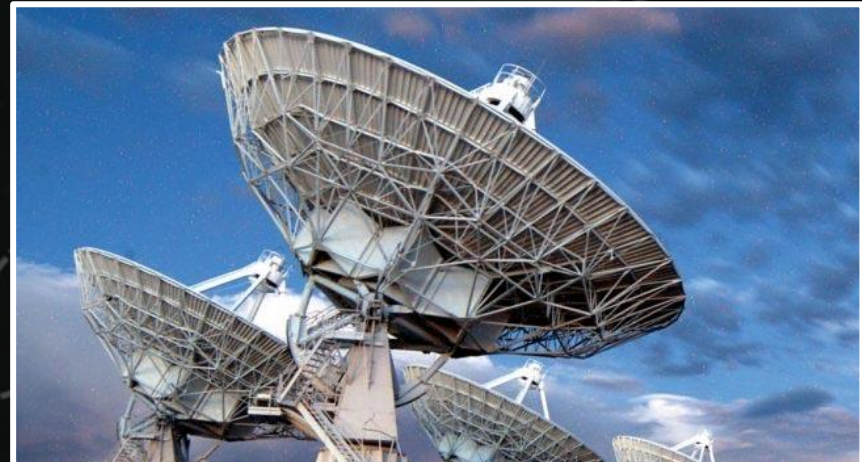
Kishalay De

NASA Einstein Fellow, MIT Kavli Institute

The decade of time domain surveys



eROSITA + ART-XC

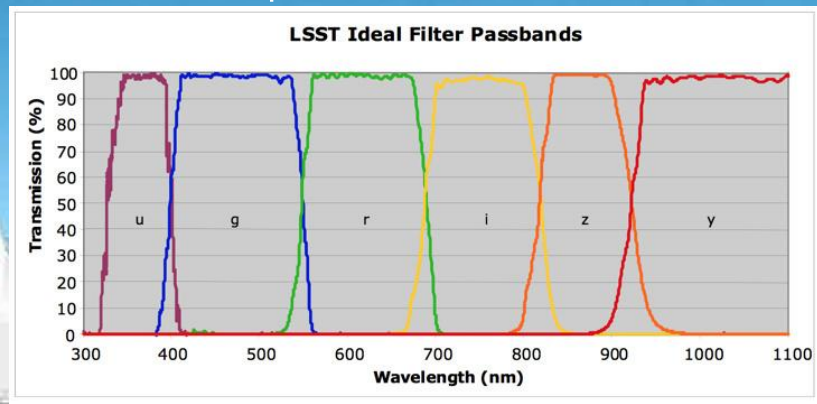


VLA Sky Survey



Rubin Observatory

Single epoch depth ~ 24 mag
Comparable to Roman



ESA/Gaia/DPAC

Optical

Near-Infrared
(NIR)

Credit: ESO

Fast forward to Roman Surveys

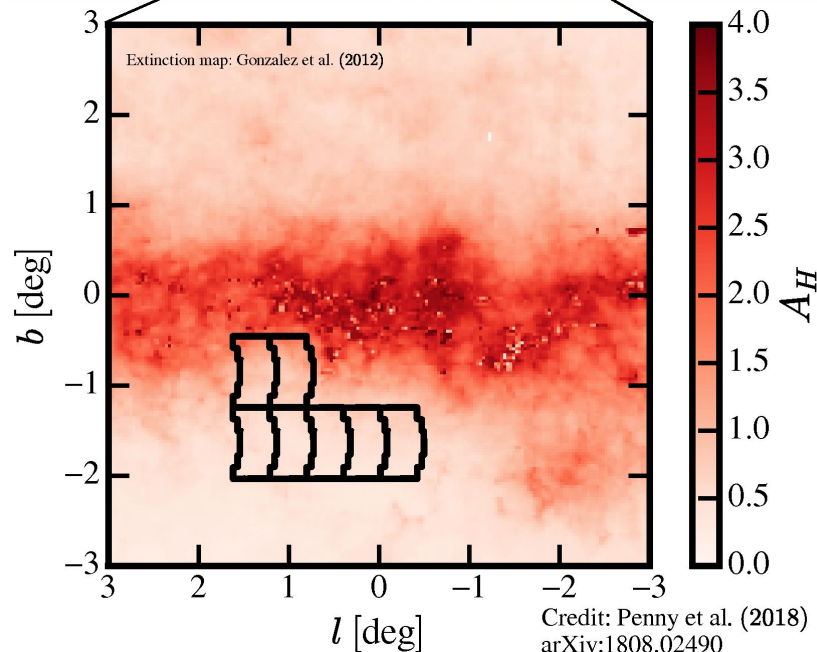
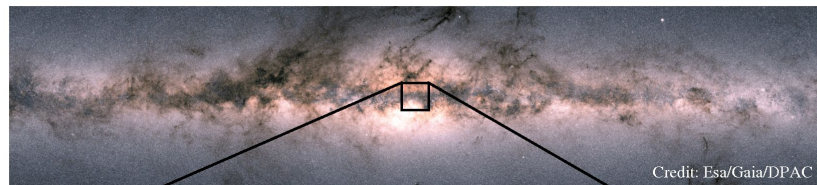
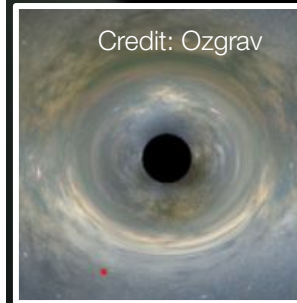
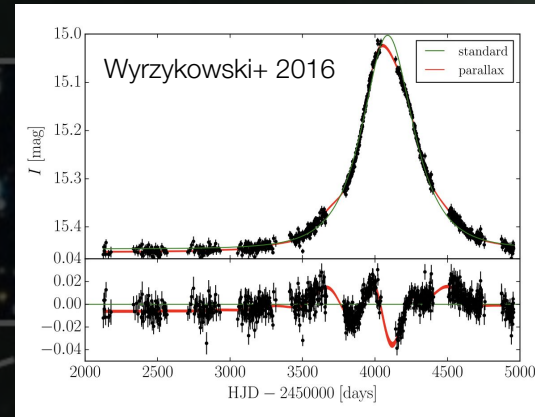


Table 2
The *WFIRST* Microlensing Survey at a Glance

| | |
|-------------------|-------------------------|
| Area | 1.96 deg ² |
| Baseline | 4.5 yr |
| Seasons | 6 × 72 days |
| W149 Exposures | ~41,000 per field |
| W149 Cadence | 15 min |
| W149 Saturation | ~14.8 |
| Phot. Precision | 0.01 mag @ W149 ~ 21.15 |
| Z087 Exposures | ~860 per field |
| Z087 Saturation | ~13.9 |
| Z087 Cadence | ≲ 12 hr |
| Stars (W149 < 15) | ~0.3 × 10 ⁶ |
| Stars (W149 < 17) | ~1.4 × 10 ⁶ |
| Stars (W149 < 19) | ~5.8 × 10 ⁶ |
| Stars (W149 < 21) | ~38 × 10 ⁶ |
| Stars (W149 < 23) | ~110 × 10 ⁶ |
| Stars (W149 < 25) | ~240 × 10 ⁶ |

NIR 5σ depth of ~ 24 AB mag
per exposure, out to ~ 2 μm

The Dynamic Galactic Plane

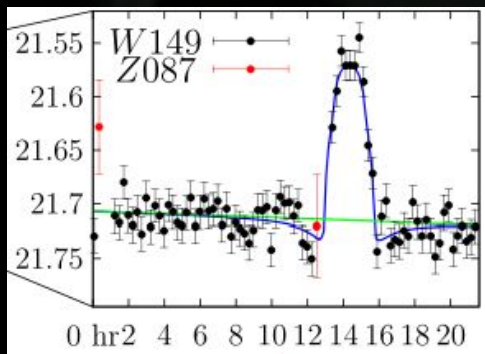


Timescale

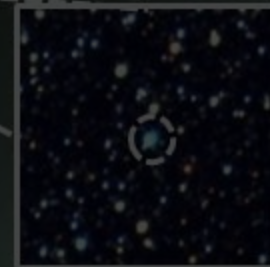
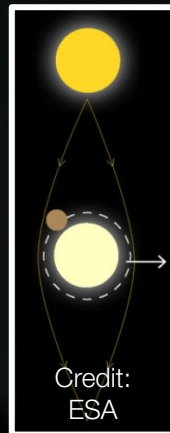
~ Minutes

~ Weeks

~ Years



Penny+ 2019



The Dynamic Galactic Plane

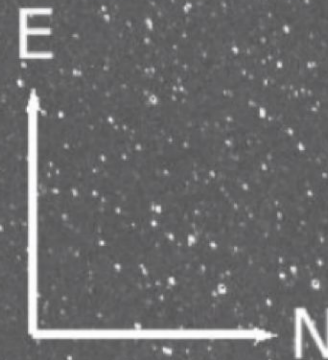


Pathfinder to Galactic transient science with Roman in the NIR?

Gattini-IR at Palomar observatory

First light in September 2018

0.5 degrees



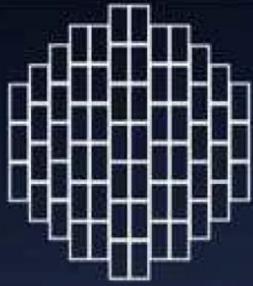
30 cm

J ba

De et al. 2



VISTA



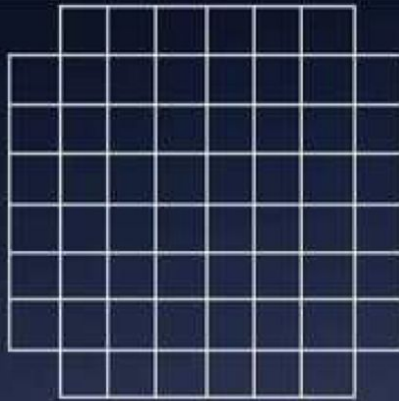
DES,
2.5 deg²



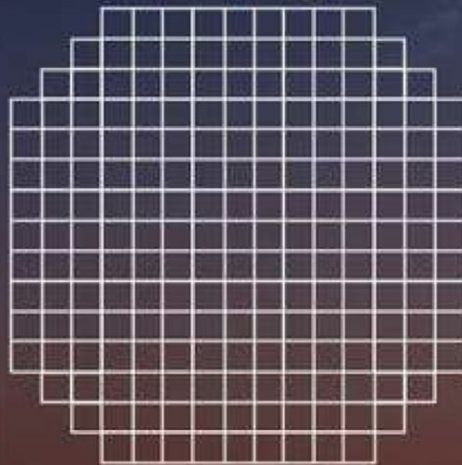
SDSS,
3 deg²



PTF/IPTF, 7.3 deg²



PS1, 7 deg²



LSST, 9.6 deg²



ZTF, 47 deg²

Gattini-IR FOV

1 deg

Adapted from Laher 2017

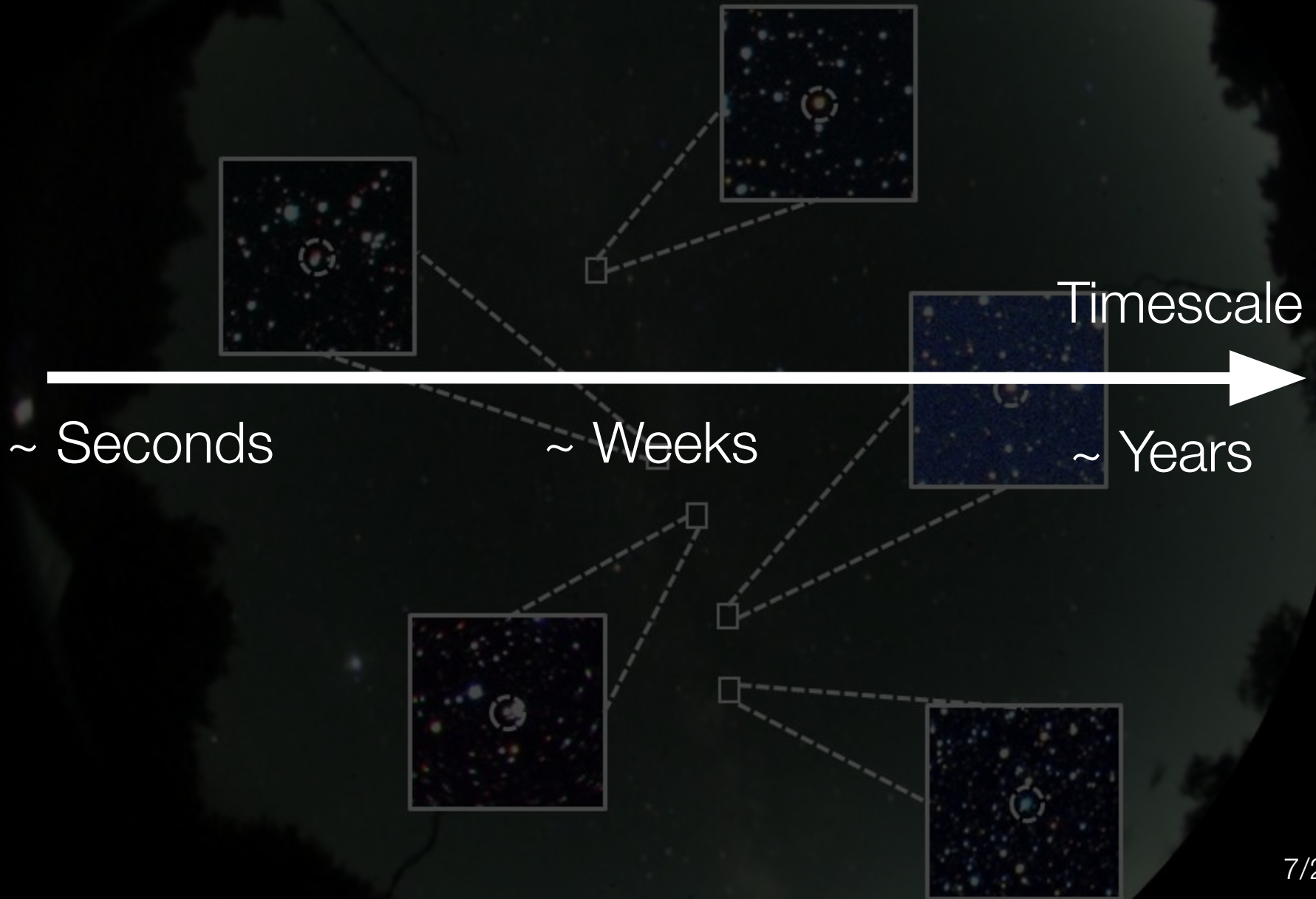
Palomar Gattini-IR (PGIR) field of view is 40 times larger than any other near-infrared instrument

Robotic eyes on the infrared sky

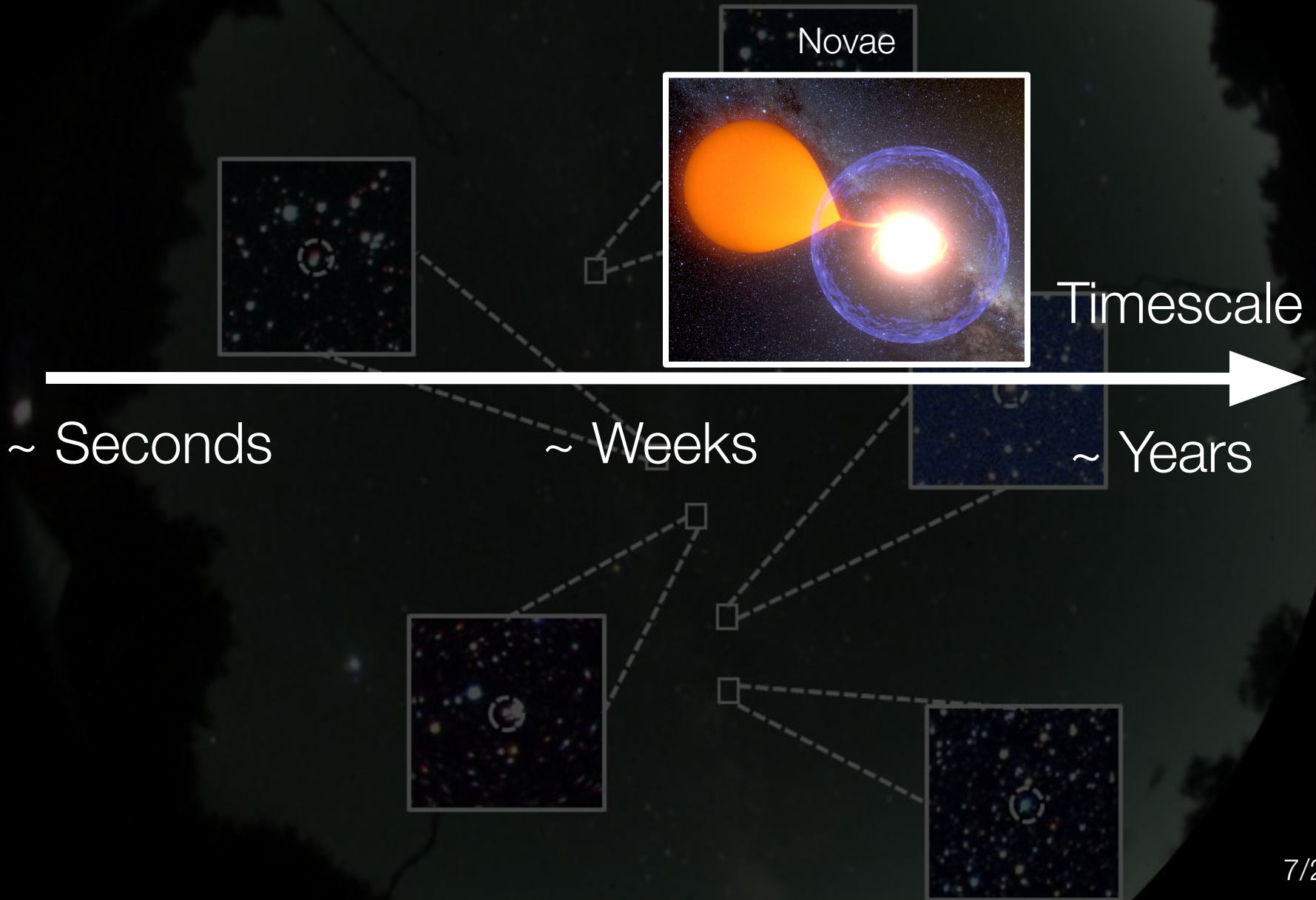
Covers 15,000 sq. deg. at 2 night cadence to J=15.7 AB mag

“Quarter of 2MASS Every Night”

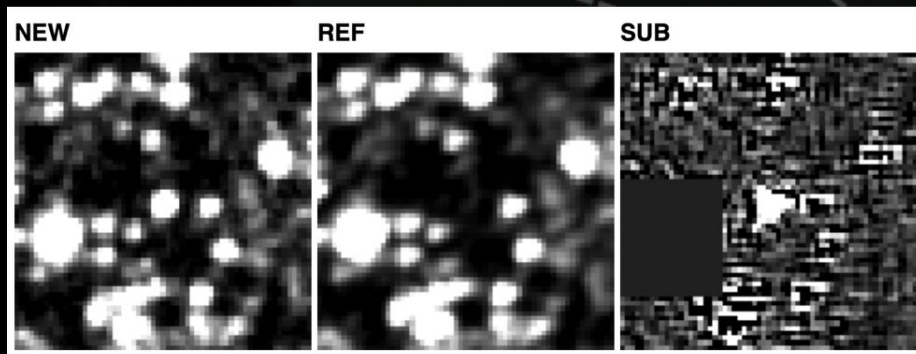
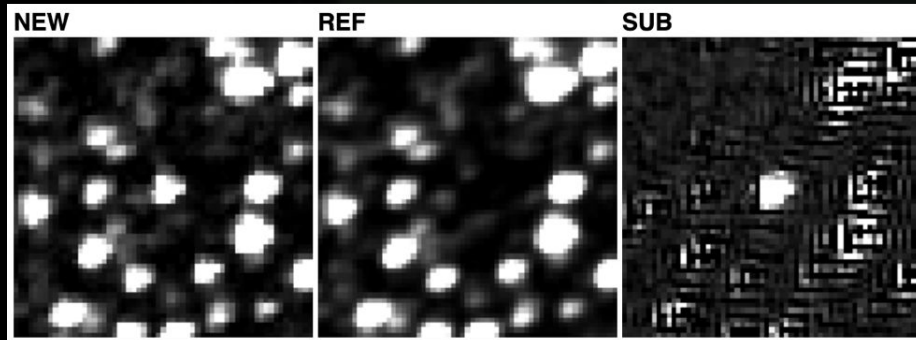
The Dynamic Galactic Plane



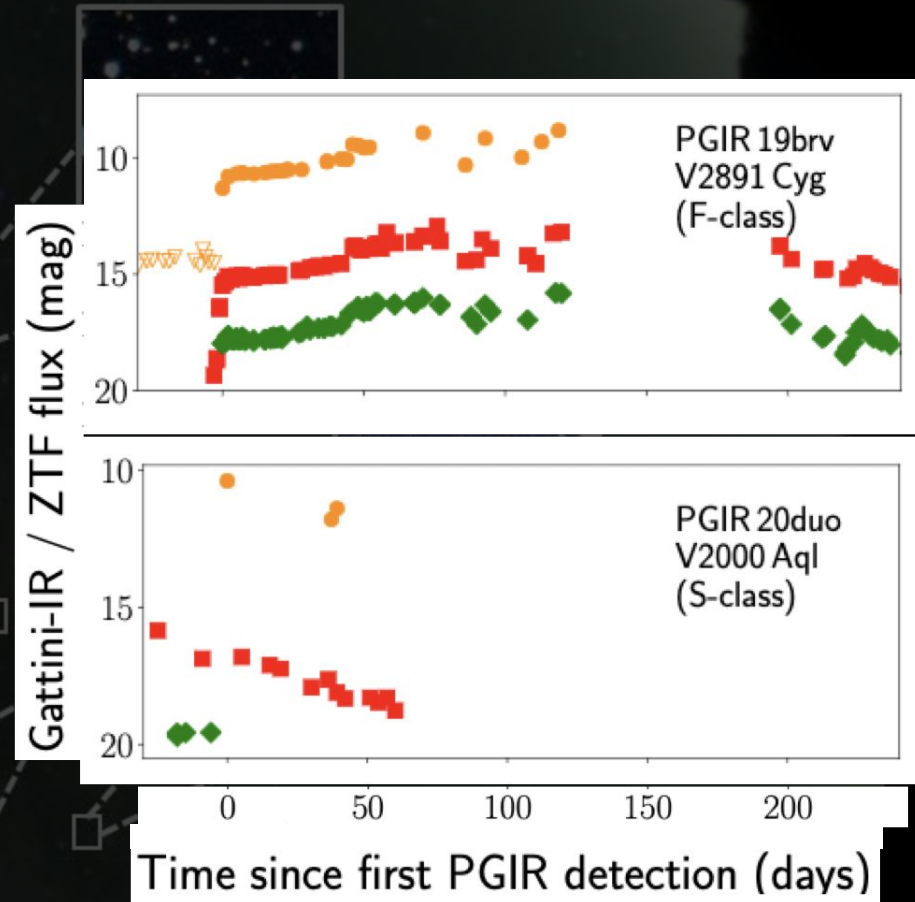
The Dynamic Galactic Plane



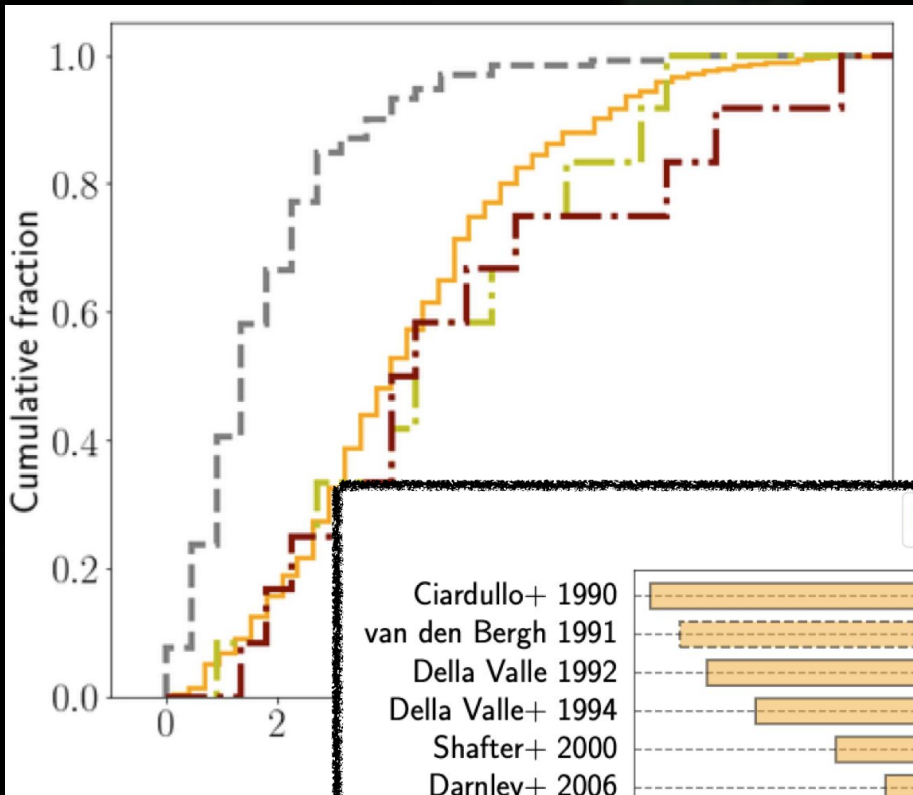
An optically missed population of novae



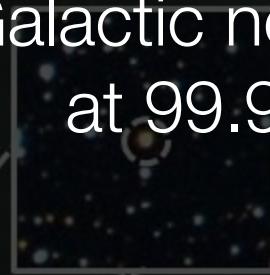
De+ 2021b



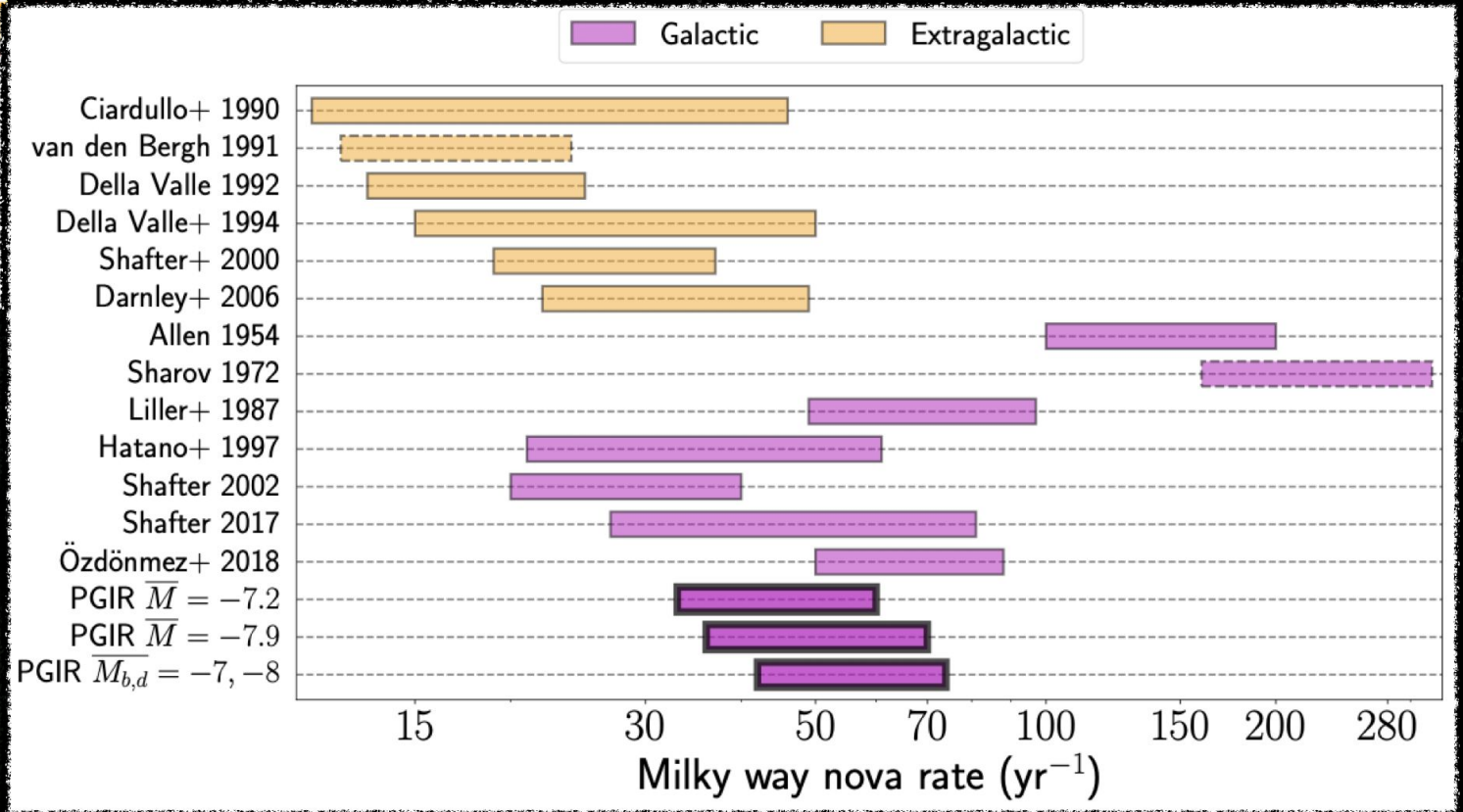
PGIR has doubled the discovery rate of novae in its observing footprint



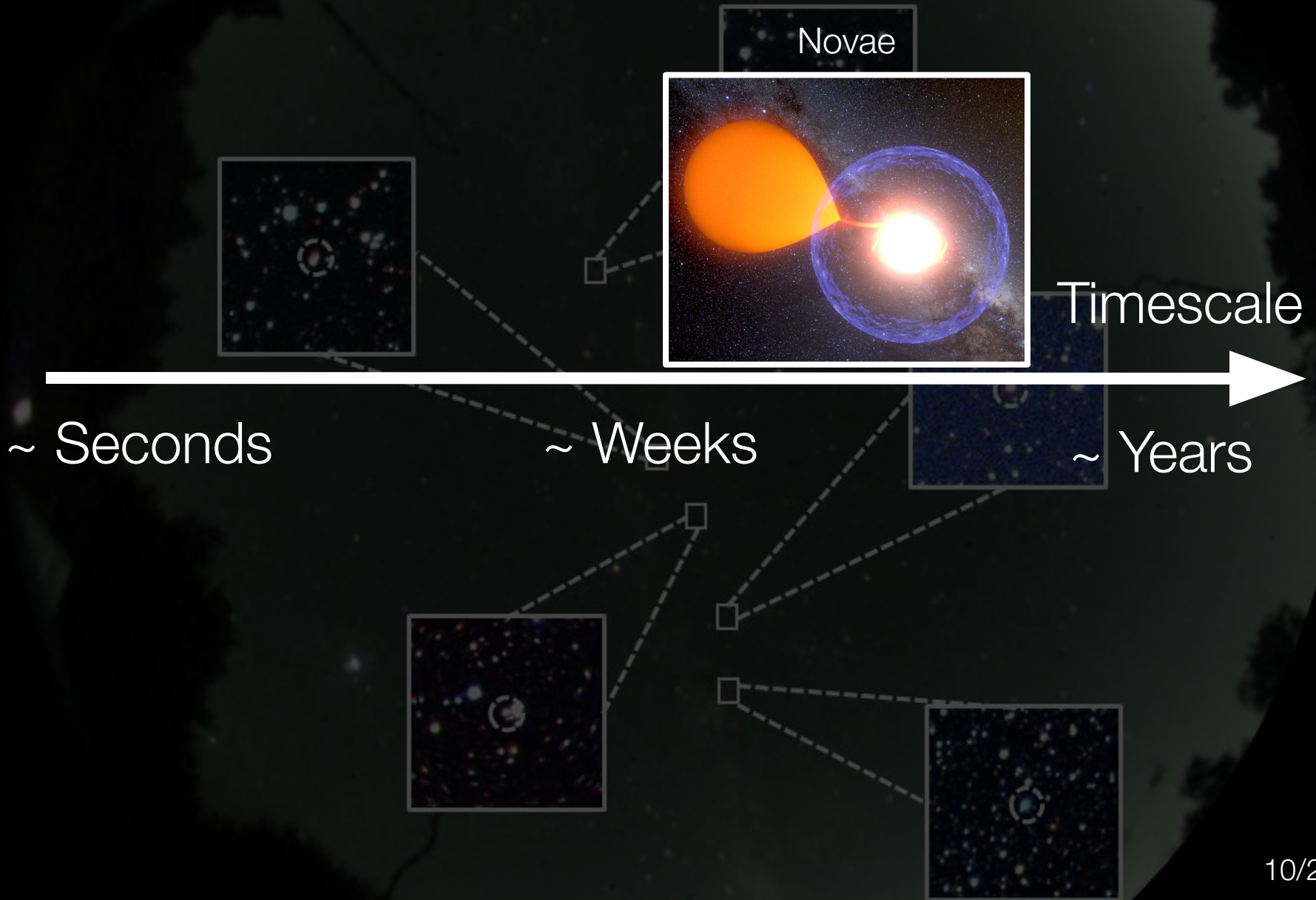
Optical searches miss most Galactic novae, inconsistent at 99.9% confidence



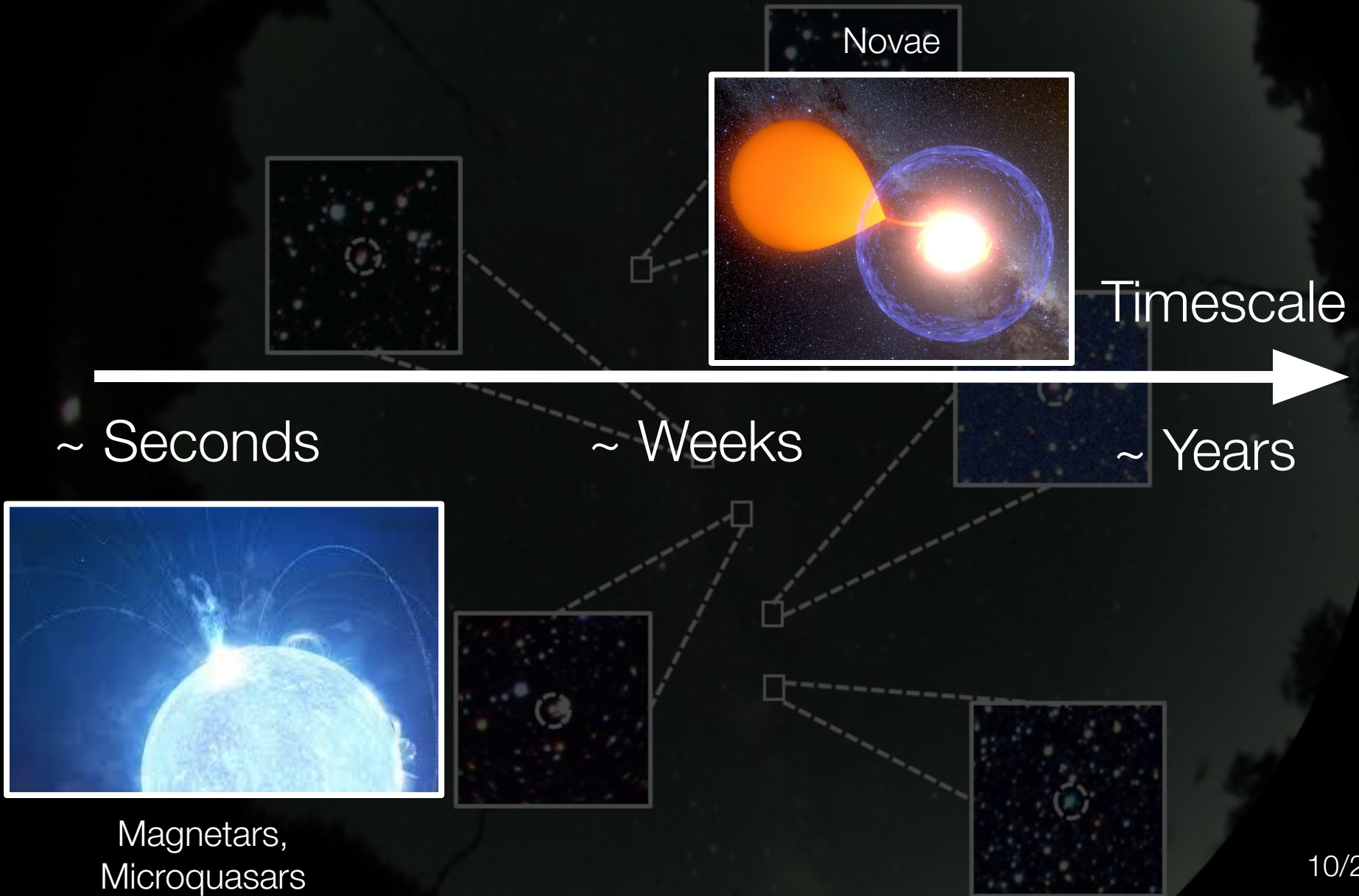
De+ 2021b



The Dynamic Galactic Plane

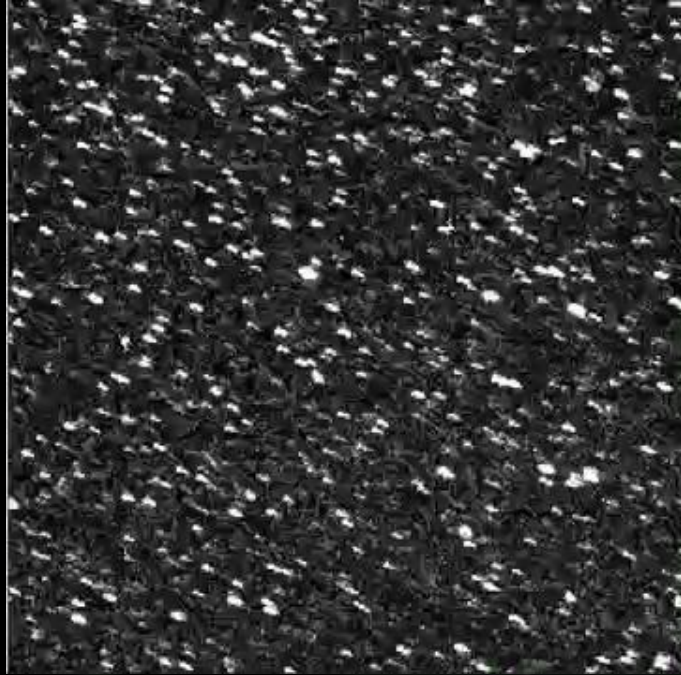


The Dynamic Galactic Plane

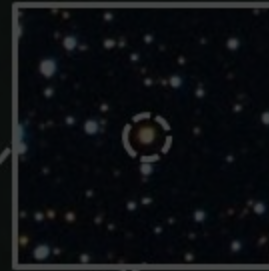
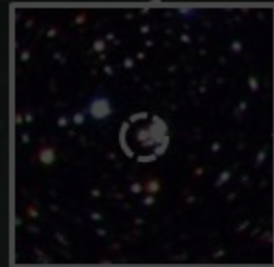


Searching for second timescale flares

Fast Readout: 0.9 s

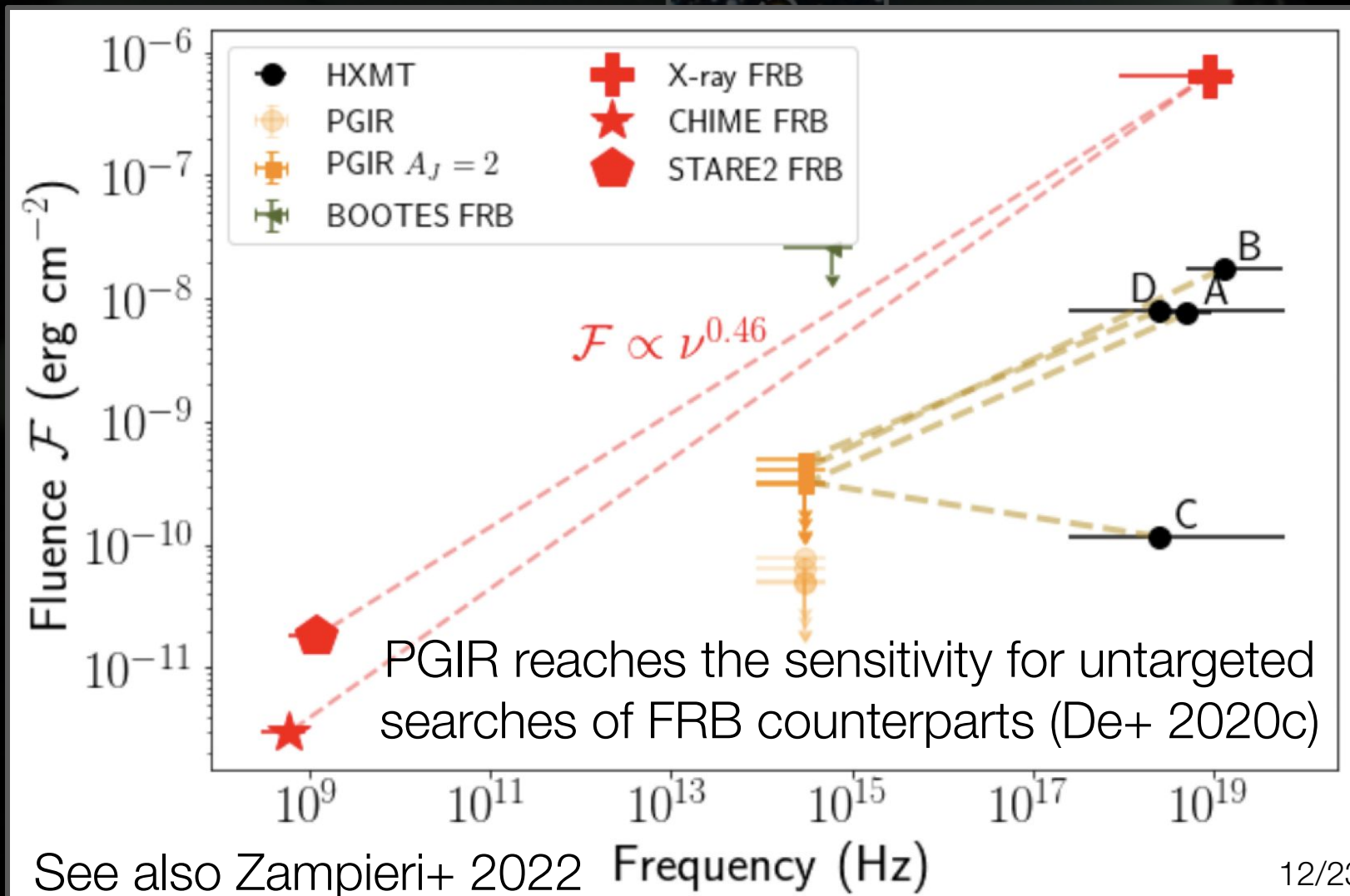
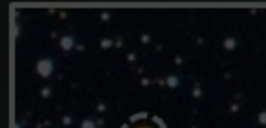


Galactic FRB source
SGR 1935+2154

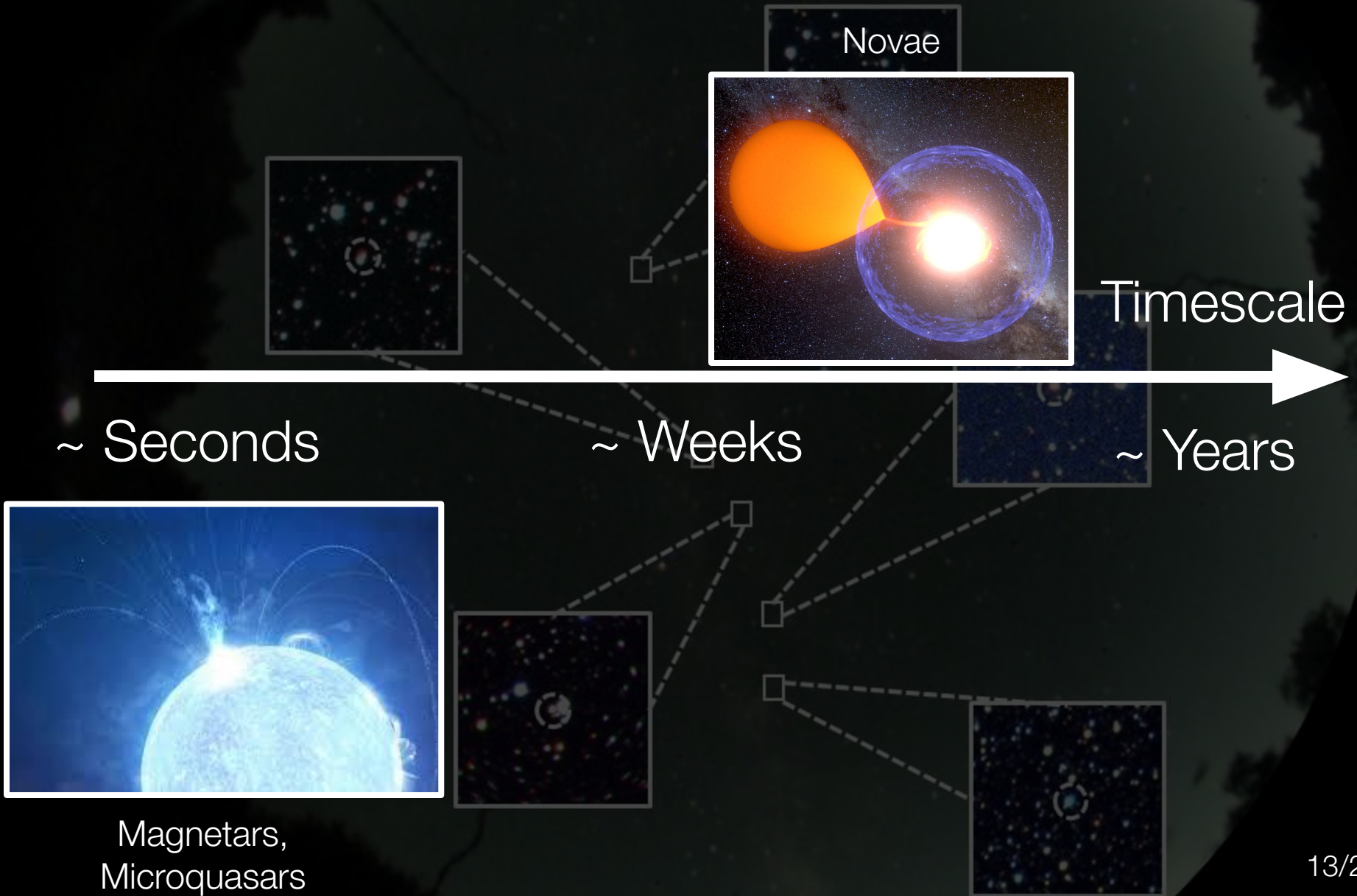


NIR constraints on X-ray flares of SGR 1935+2154

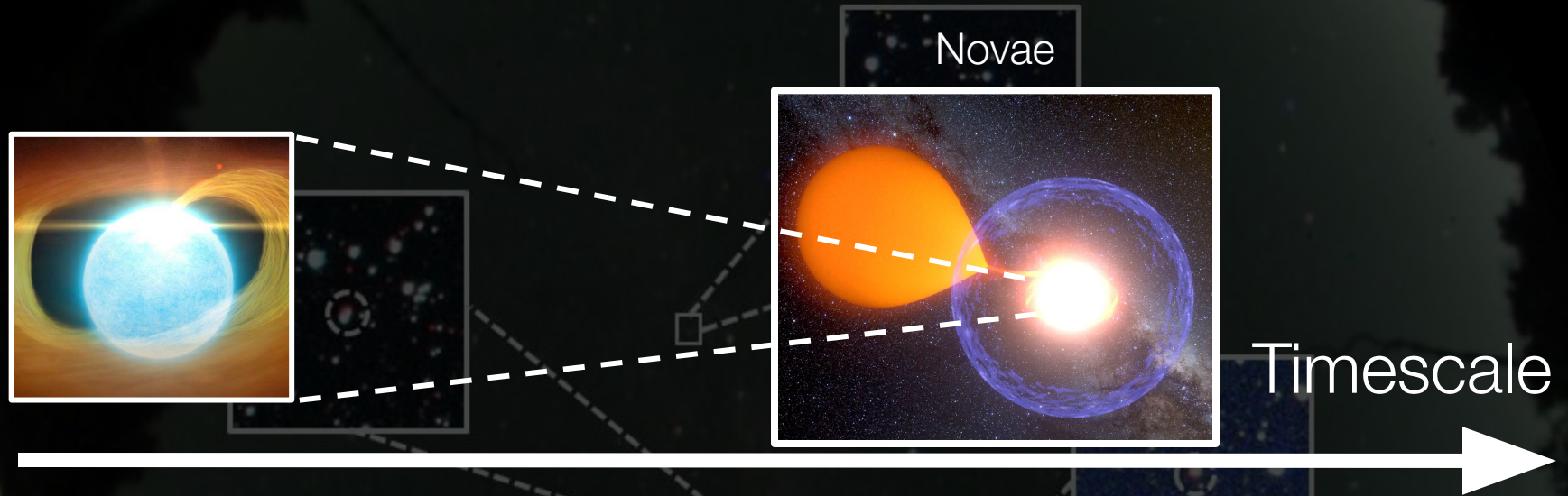
Fast Readout: 0.9 s



The Dynamic Galactic Plane



The Dynamic Galactic Plane



~ Seconds

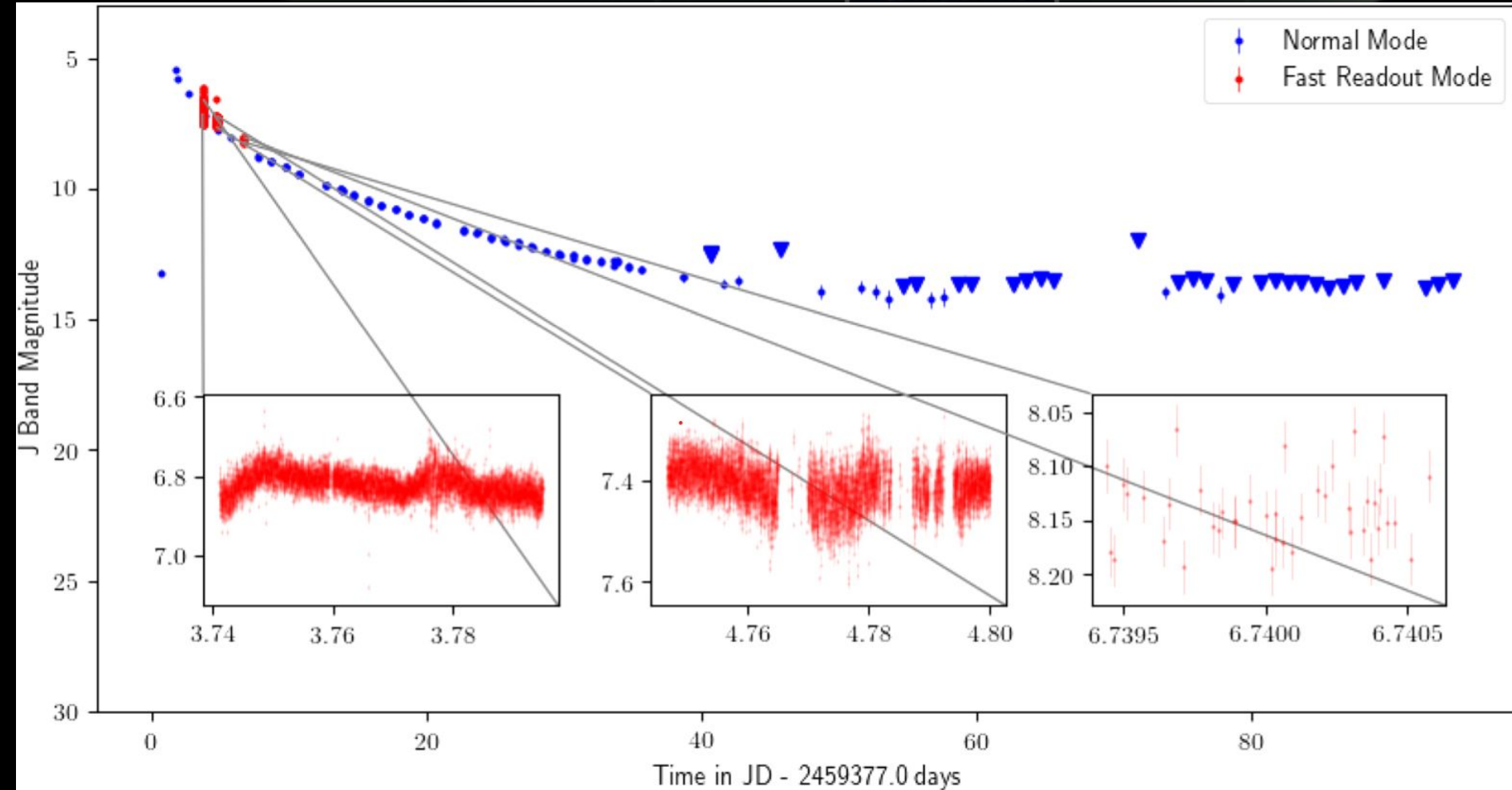
~ Weeks

~ Years

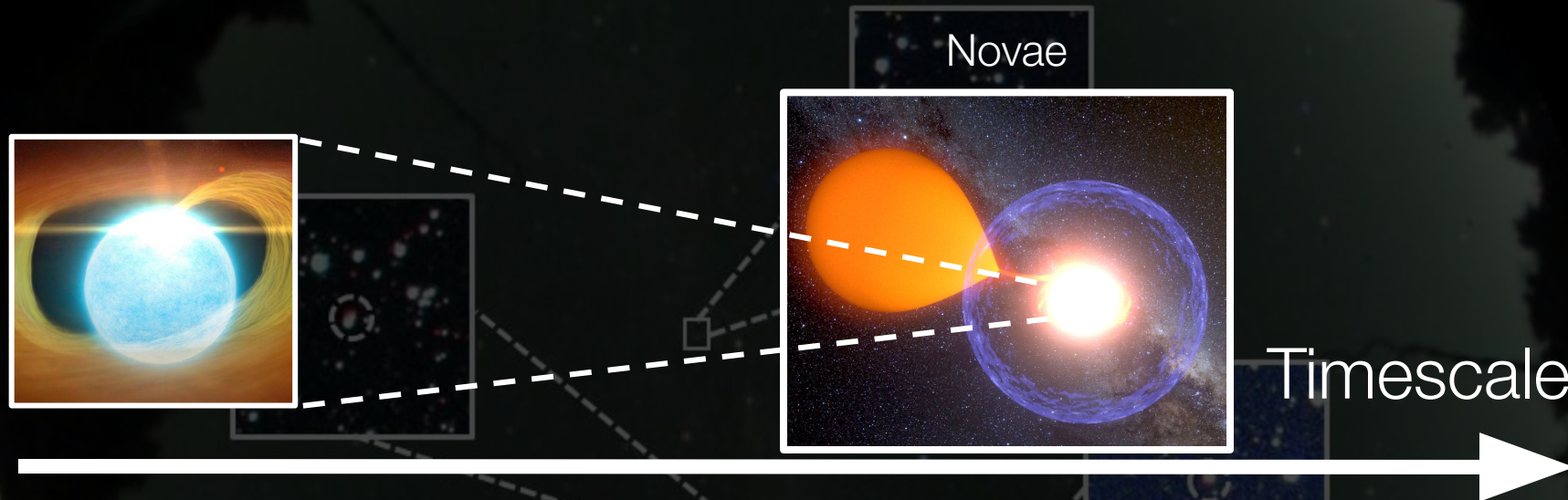


Magnetars,
Microquasars

Second timescale photometry of Nova V1674 Her



The Dynamic Galactic Plane



~ Seconds

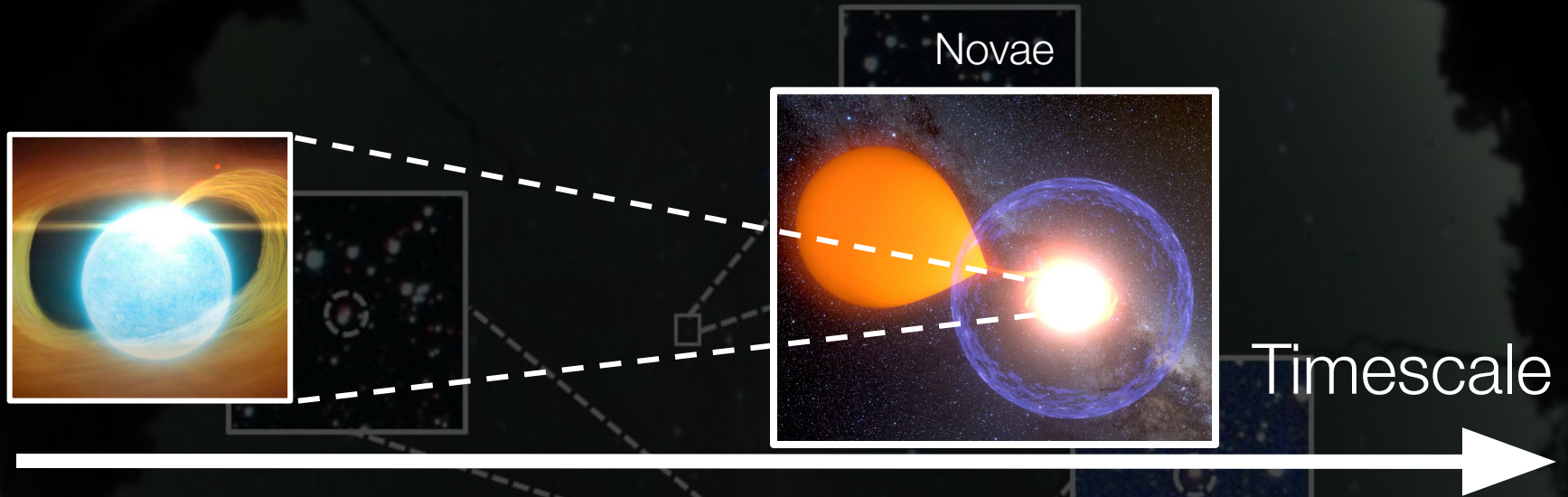
~ Weeks

~ Years



Magnetars,
Microquasars

The Dynamic Galactic Plane



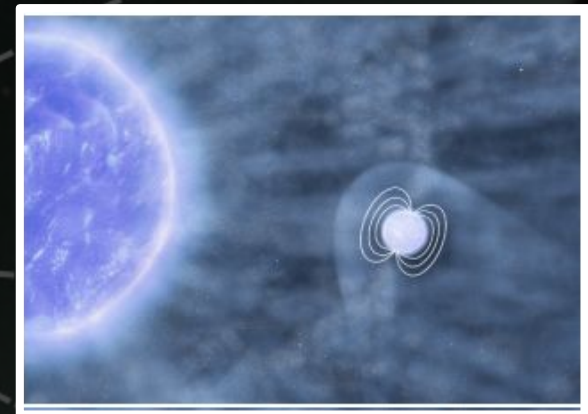
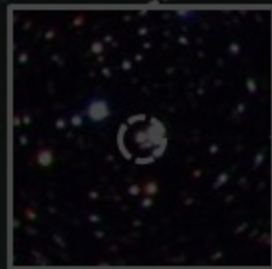
~ Seconds

~ Weeks

~ Years

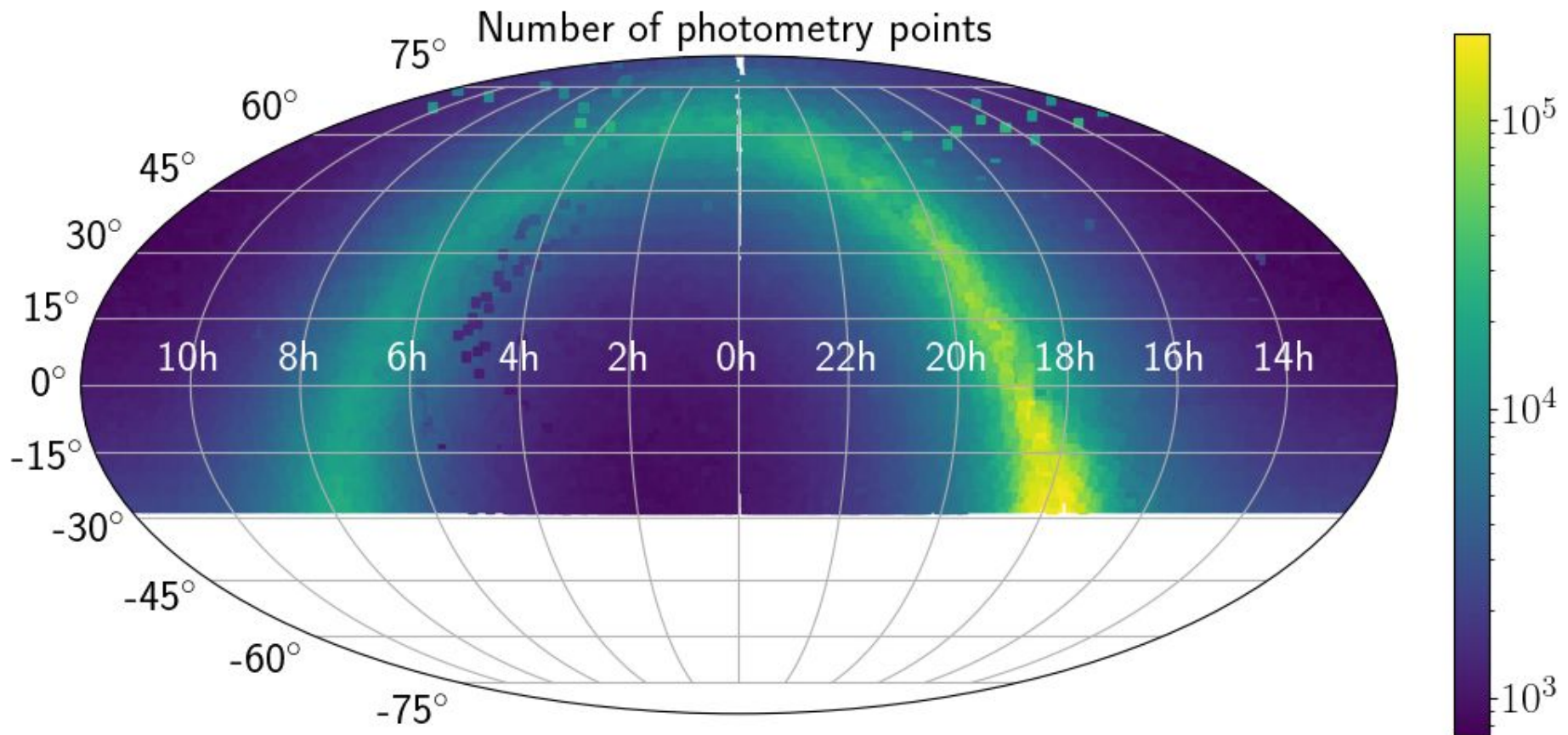


Magnetars,
Microquasars



Accreting binaries,
Dusty variables 15/23

~25 Billion Photometry Points Over ~2 years



Watch any 2MASS source change with time!

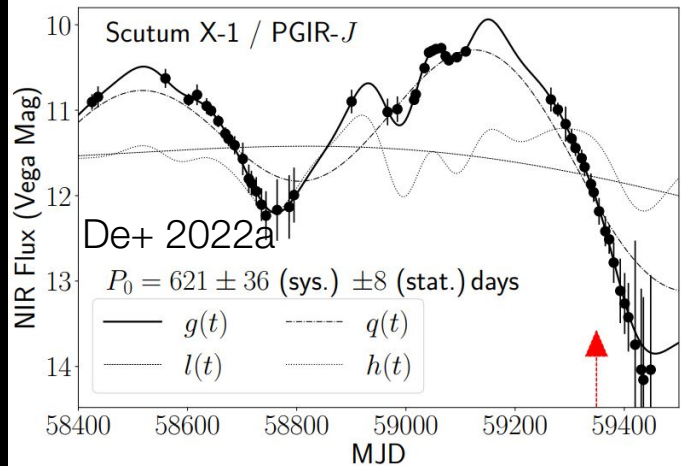
The X-ray Sky Revolution

eROSITA (Predehl et al. 2021)

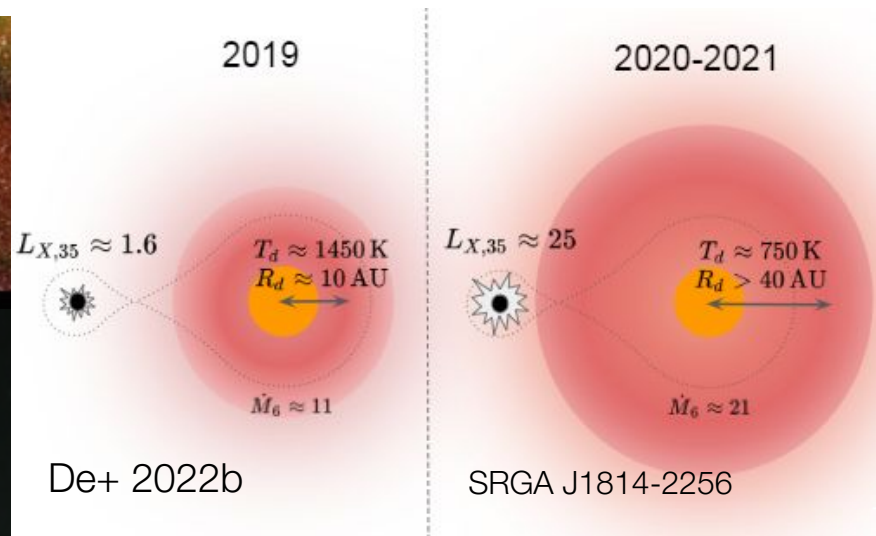
PanSTARRS

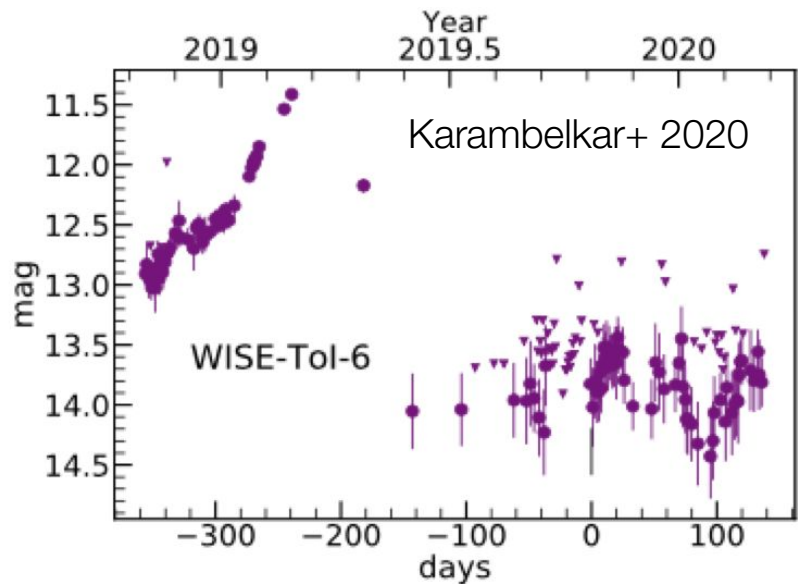
2MASS

Evolutionary state, age, binary separation, supernova kicks..

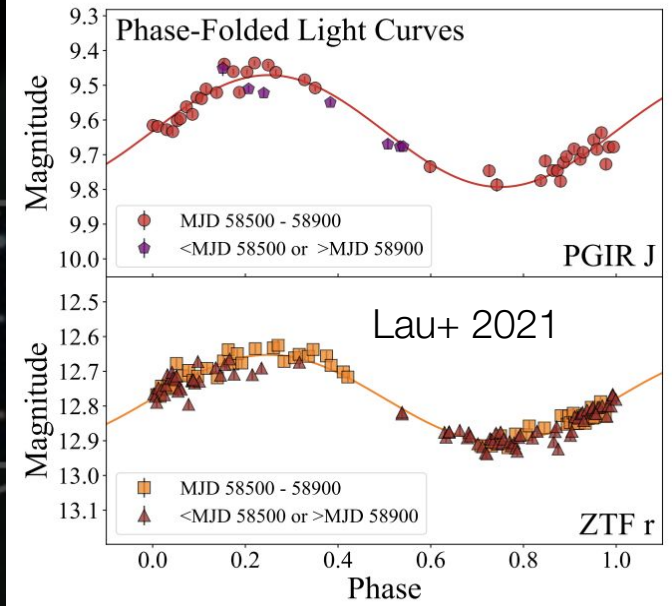


Relating donor variability to the dynamic X-ray behavior





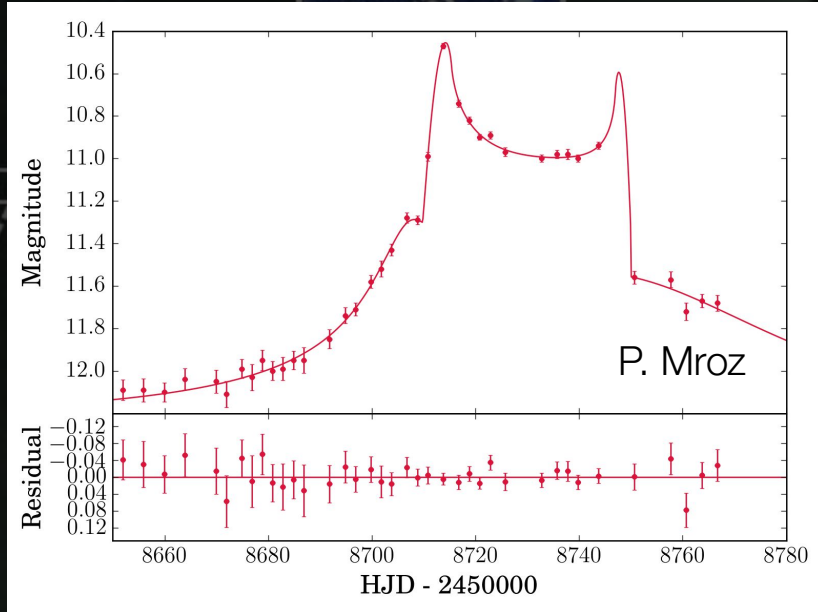
Dust forming R Cor Bor Variables



Dusty colliding wind binaries

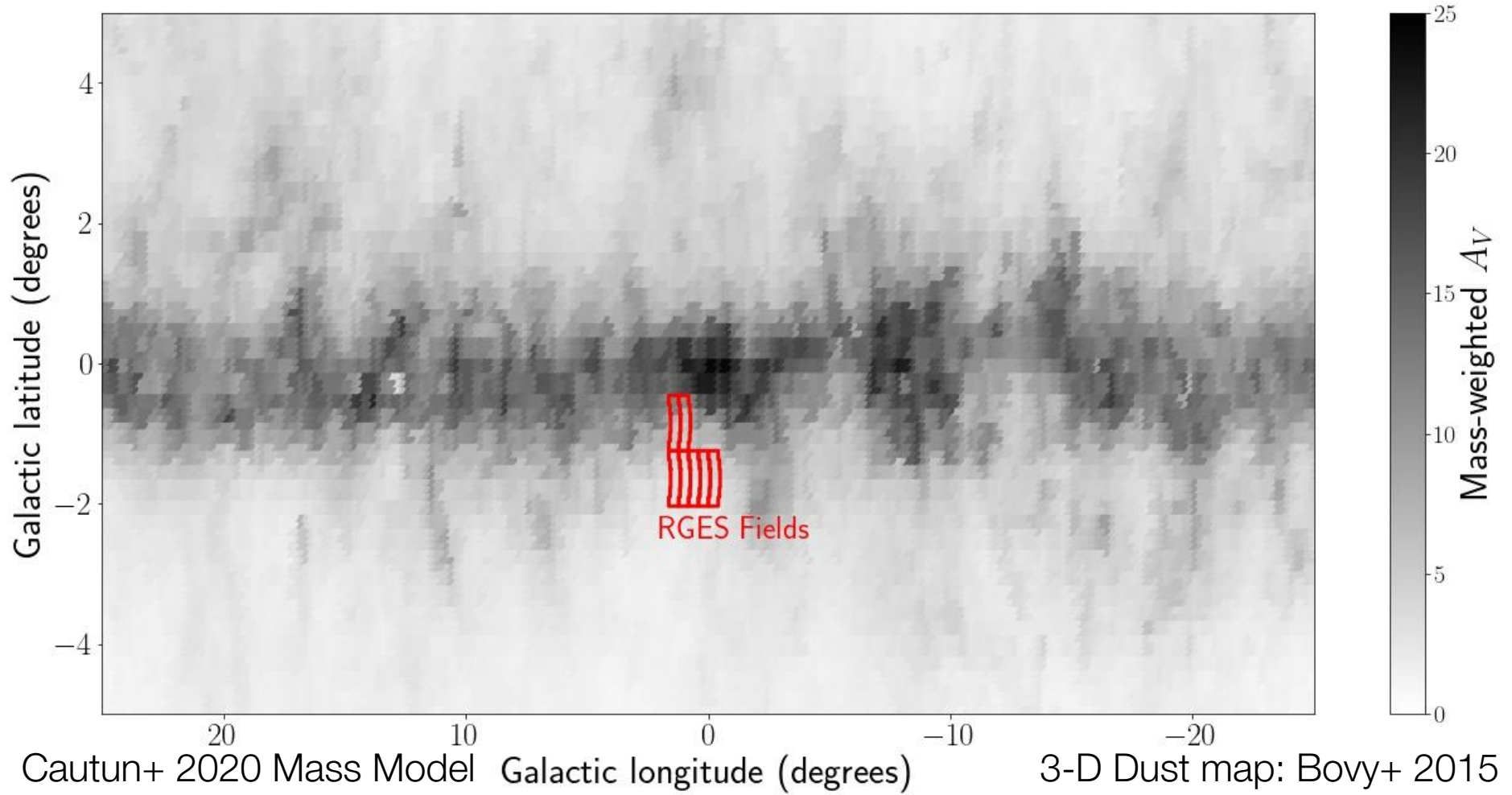


Obscured Young Star Outbursts

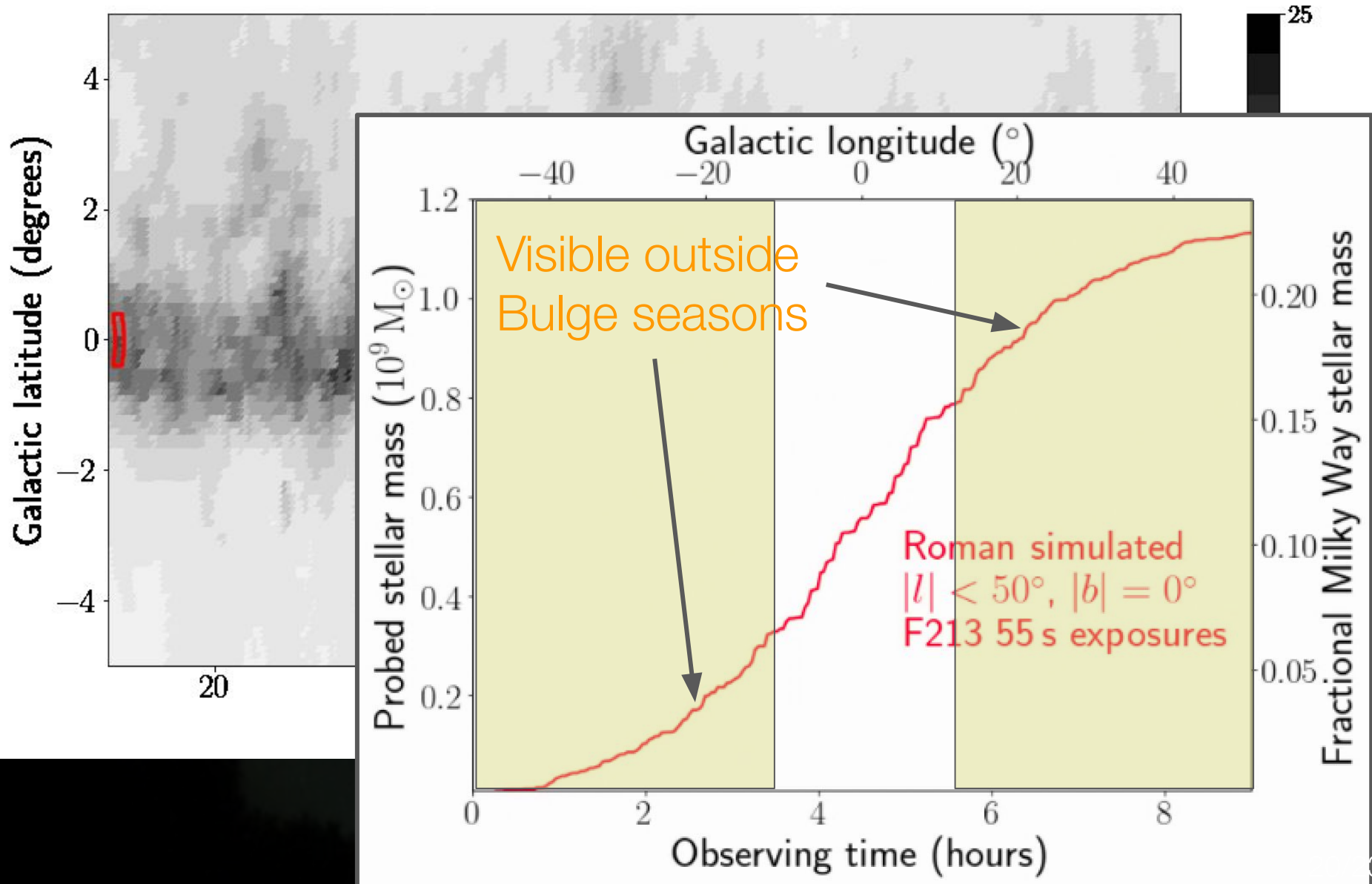


Reddened microlensing events 18/23

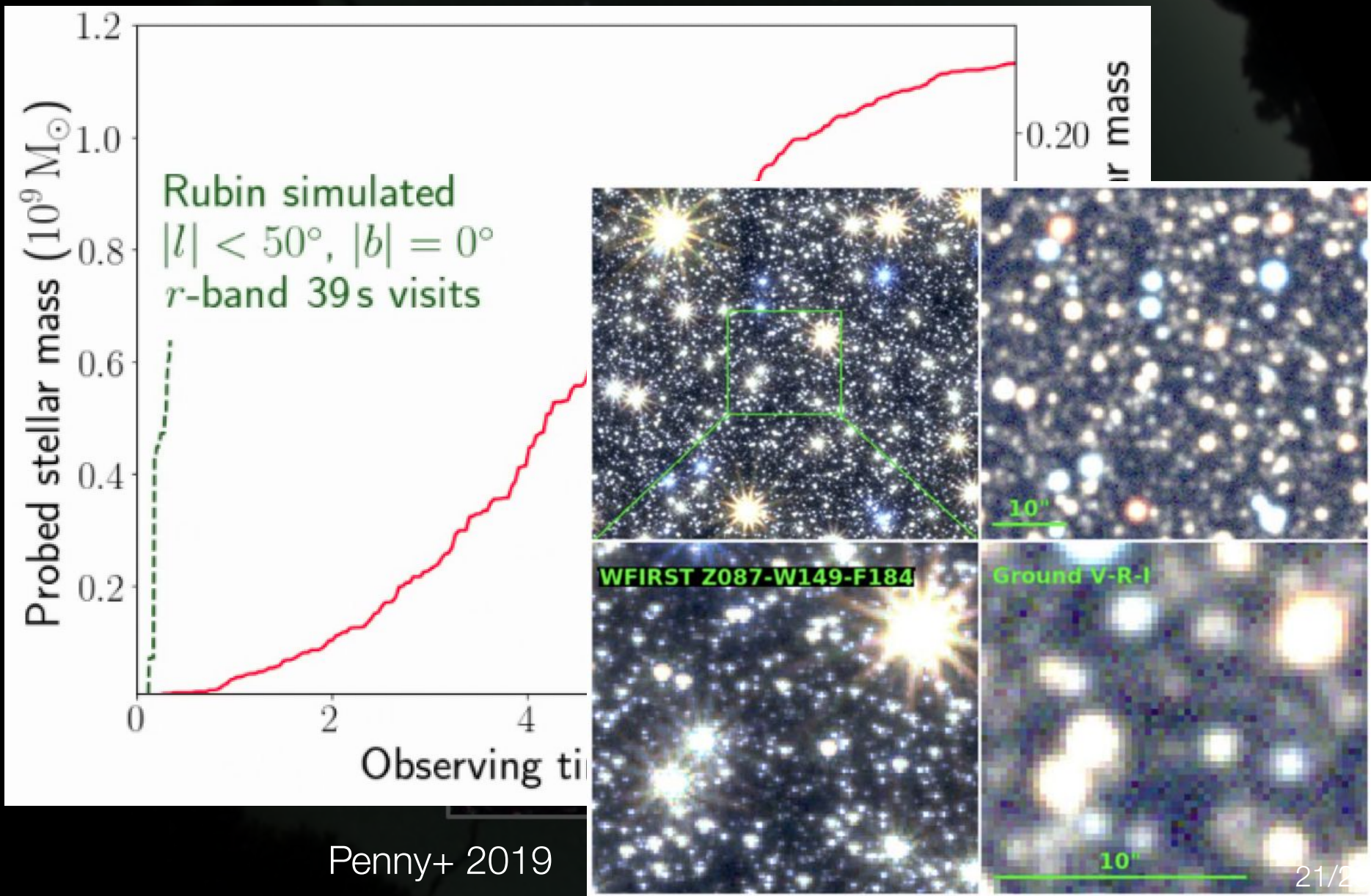
Looking ahead to Roman



Looking ahead to Roman



Quarter of the galaxy's stars in a night



Synergies with ground-based surveys

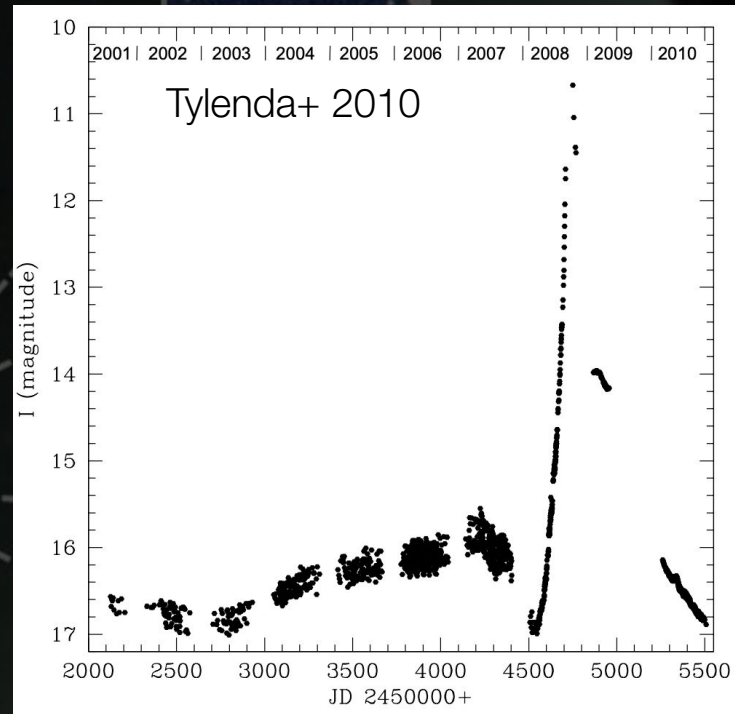
Roman can detect novae, accretion outbursts (cataclysmic variables, X-ray binaries, YSOs) across the Galaxy.

Roman will allow for the first time, routine identification and characterization their faint quiescent counterparts

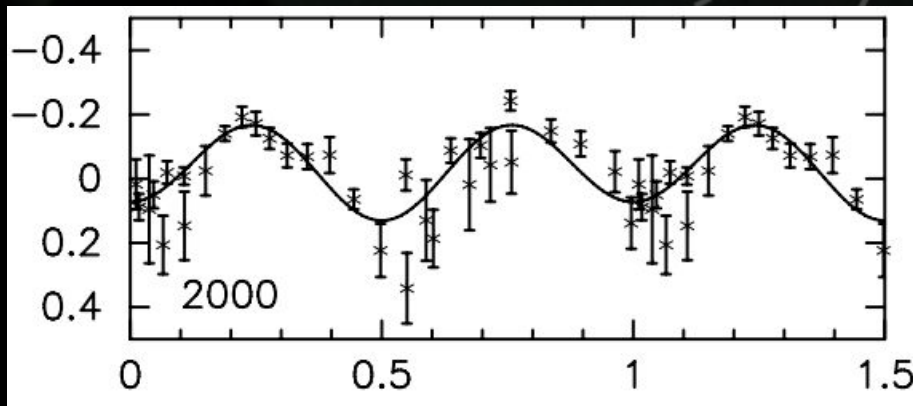
YSOs: Resolved outflows



Stellar mergers: Pre-eruption variability



Accreting binaries: Donor Type/Variability/Period



Ground-based pathfinders are setting the stage for Roman transient science in the obscured Galactic plane



Rubin = Outburst Discovery

PGIR, 7500 sq. deg./night
to J ~ 16 mag

Rubin, Optical,
Depth ~ 24 mag



WINTER, 400 sq. deg/night to
J ~ 19 mag (see Frostig poster)



Roman Launch