



JSI JOINT SPACE-SCIENCE INSTITUTE



Rubin and DSA-2000: A winning synergy to unveil populations of elusive transients

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Neil Gehrels Fellow



= *I am talking about radio*

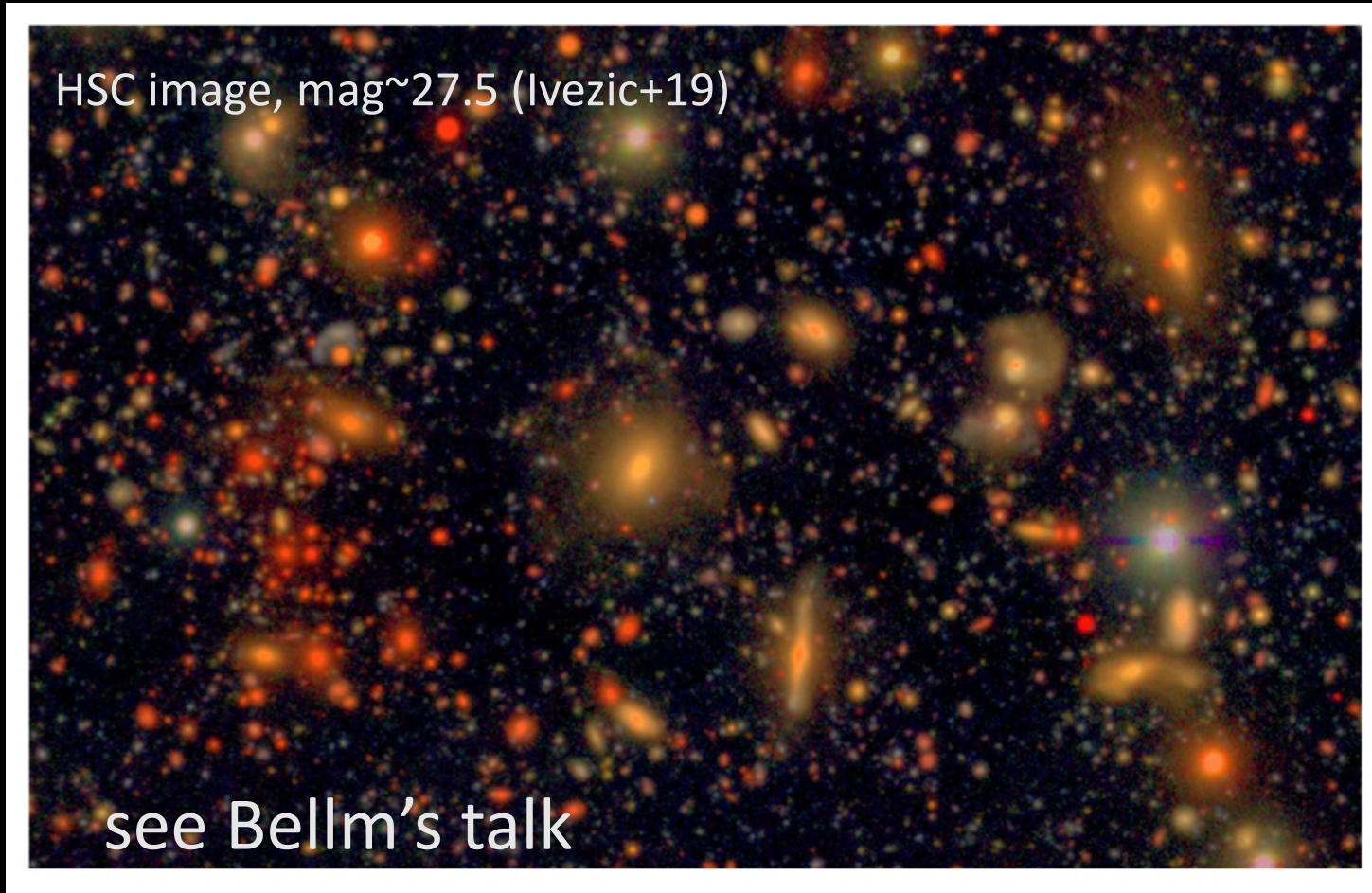


= *I am talking about optical*



The Transient and Variable Universe

Vera Rubin Observatory: wide field of view + depth + resolution

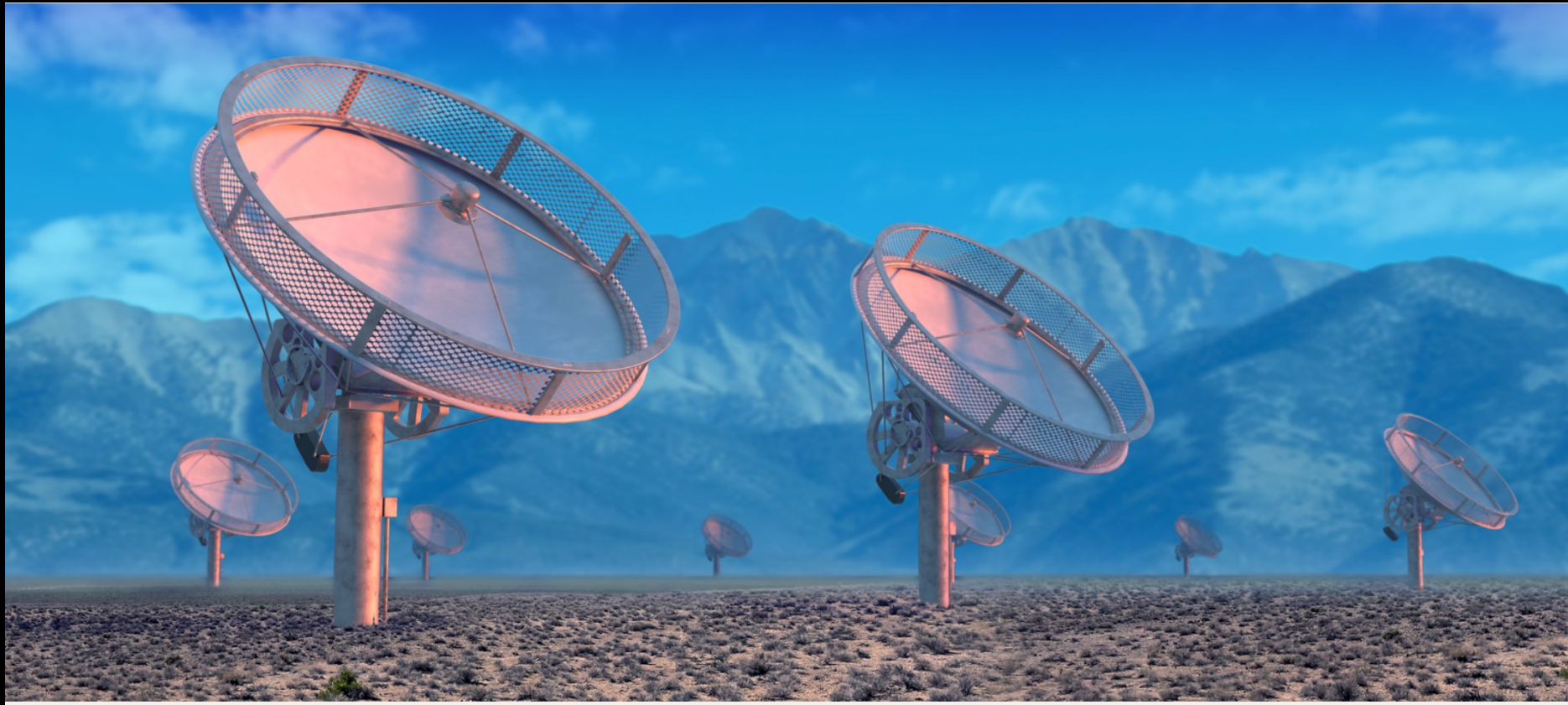


9.6 deg² field of view

u-g-r-i-z-y filters

0.2 arcsec/pixel

DSA-2000



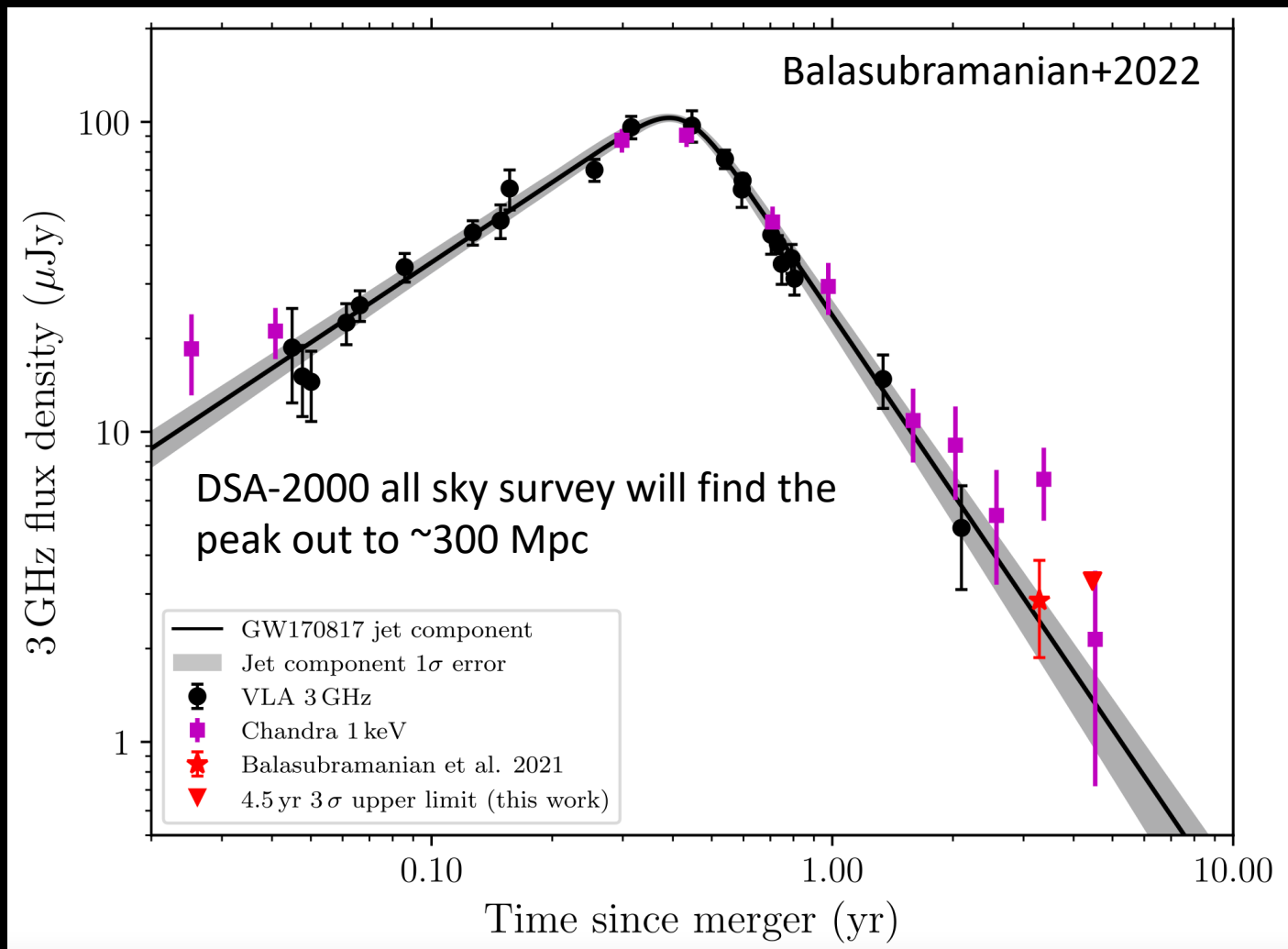
10.6 deg² field of view

0.7 – 2 GHz frequency range

3.5 arcsec resolution

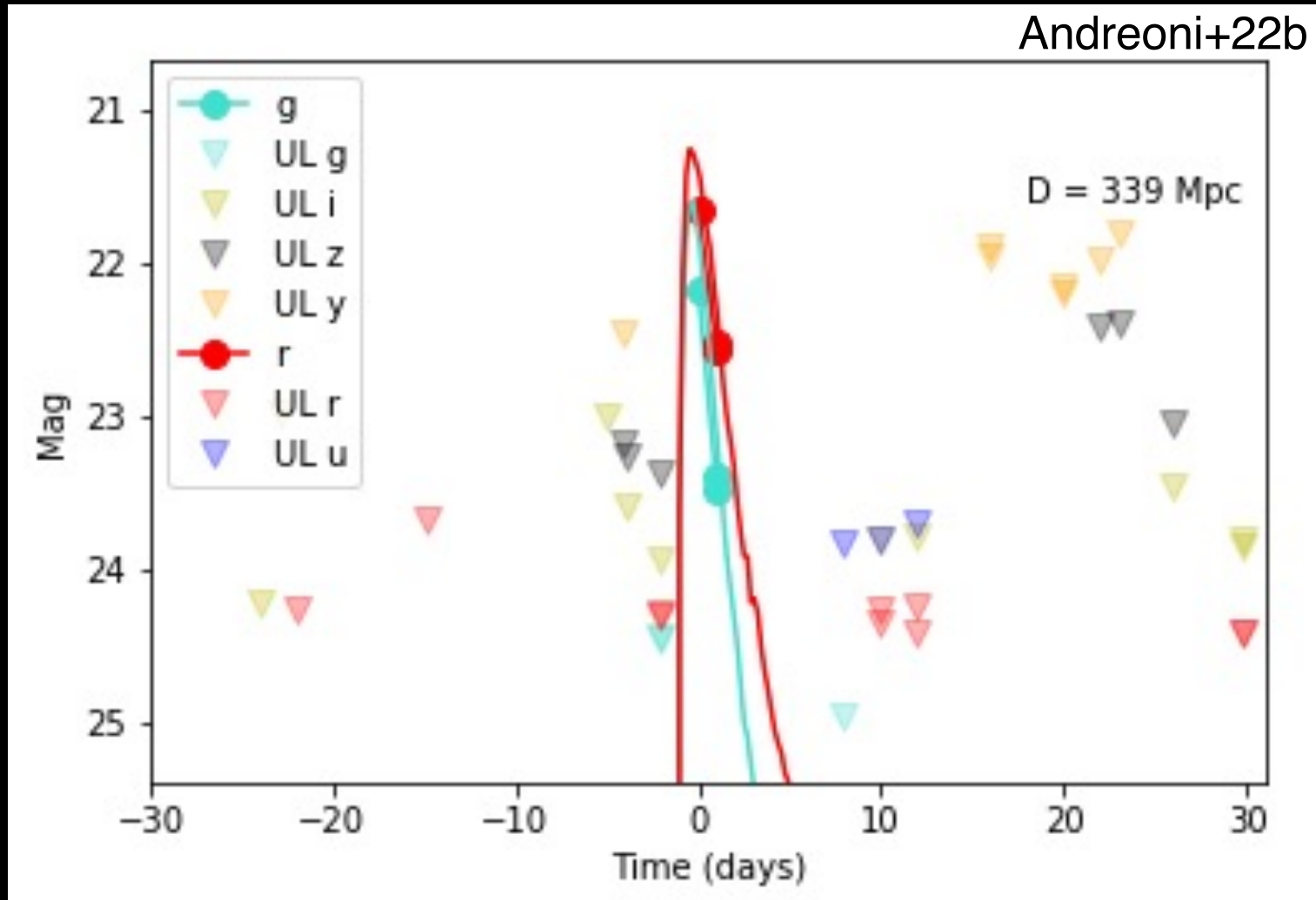
Survey ~30,000 deg² repeatedly over 16 epochs in 5 years

Un-triggered kilonova searches



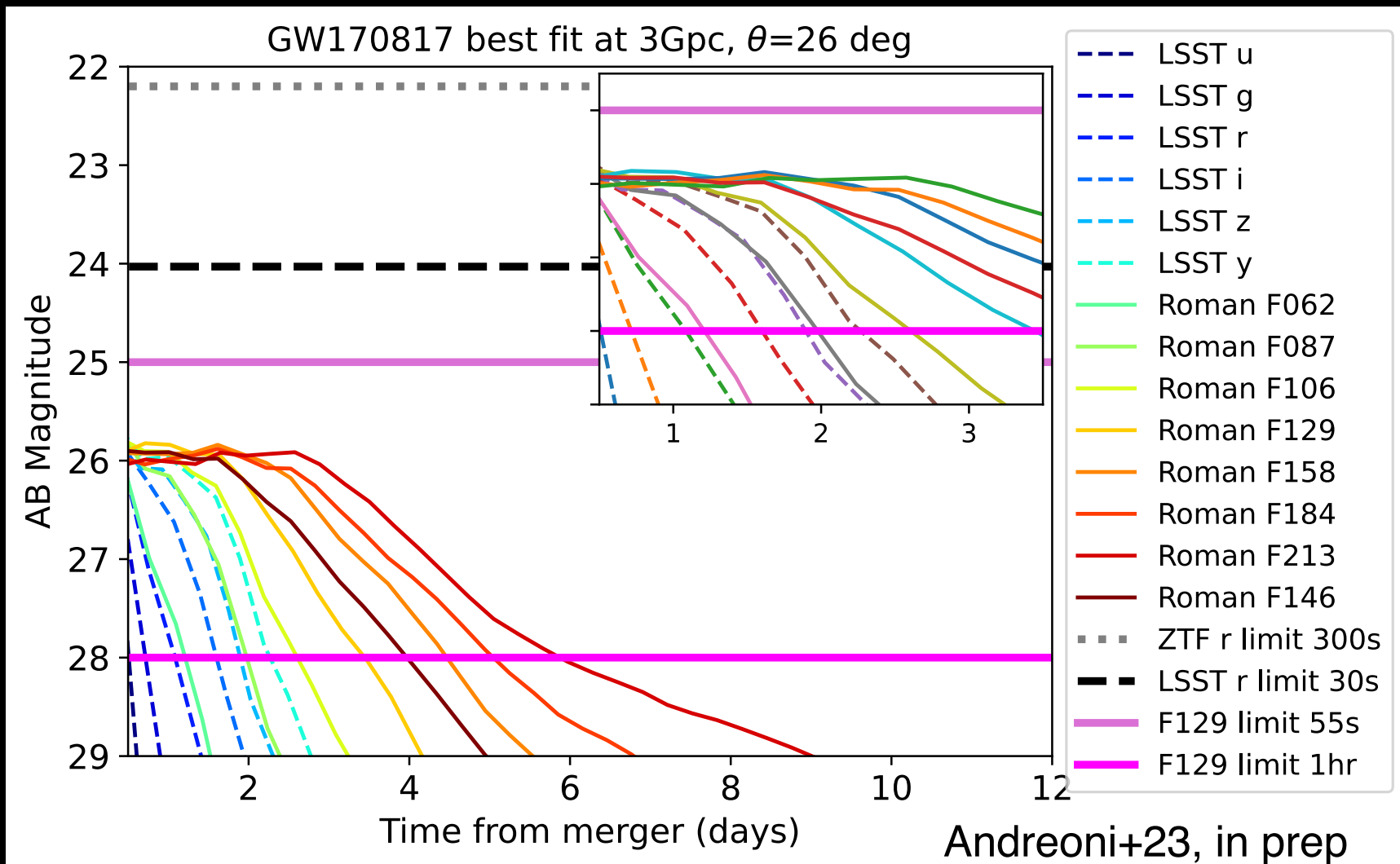
GW170817 multi-wavelength light curve

Un-triggered kilonova searches



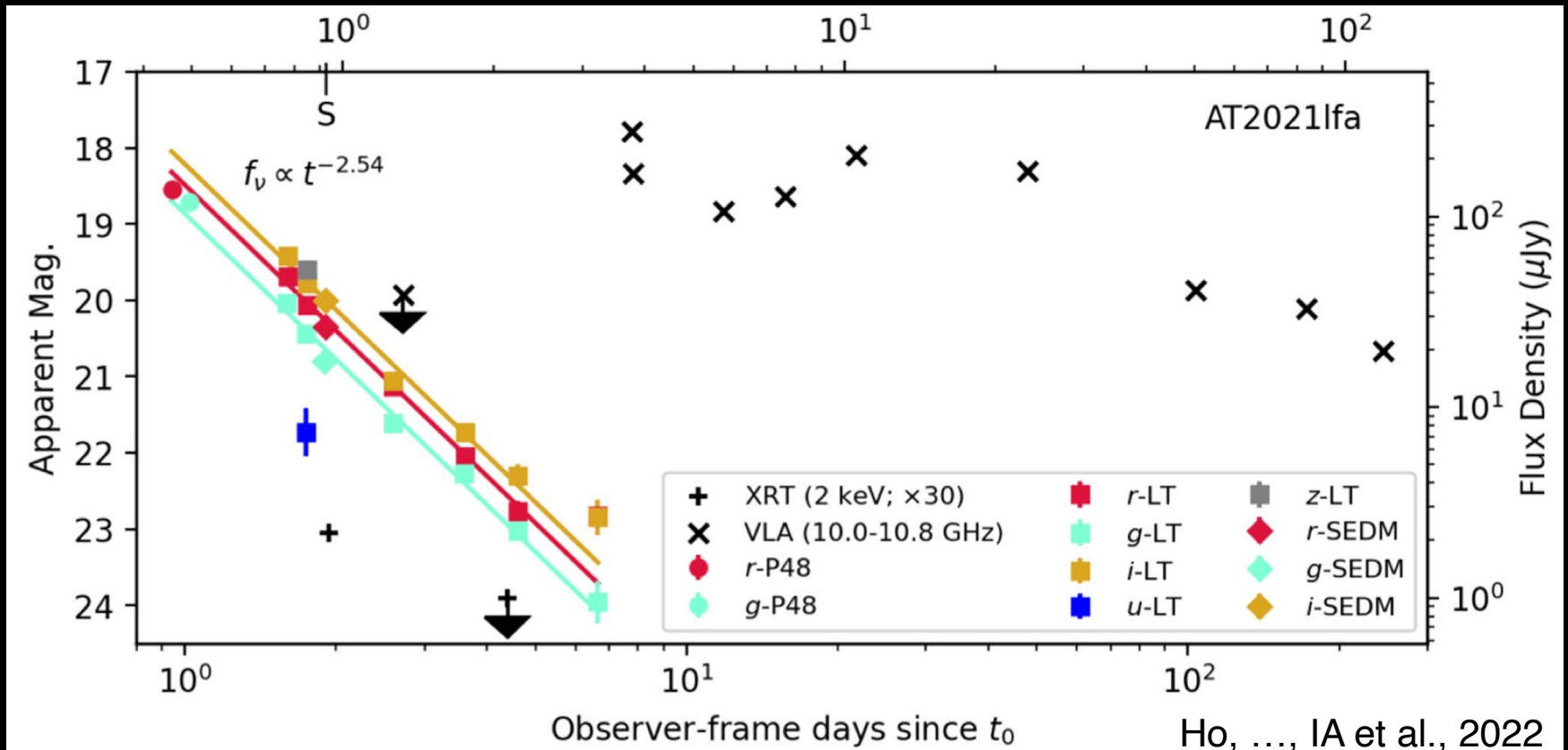
Simulated distant kilonova in **Rubin/LSST** data

Un-triggered kilonova searches



Simulated distant kilonova in **Roman Space Telescope** data

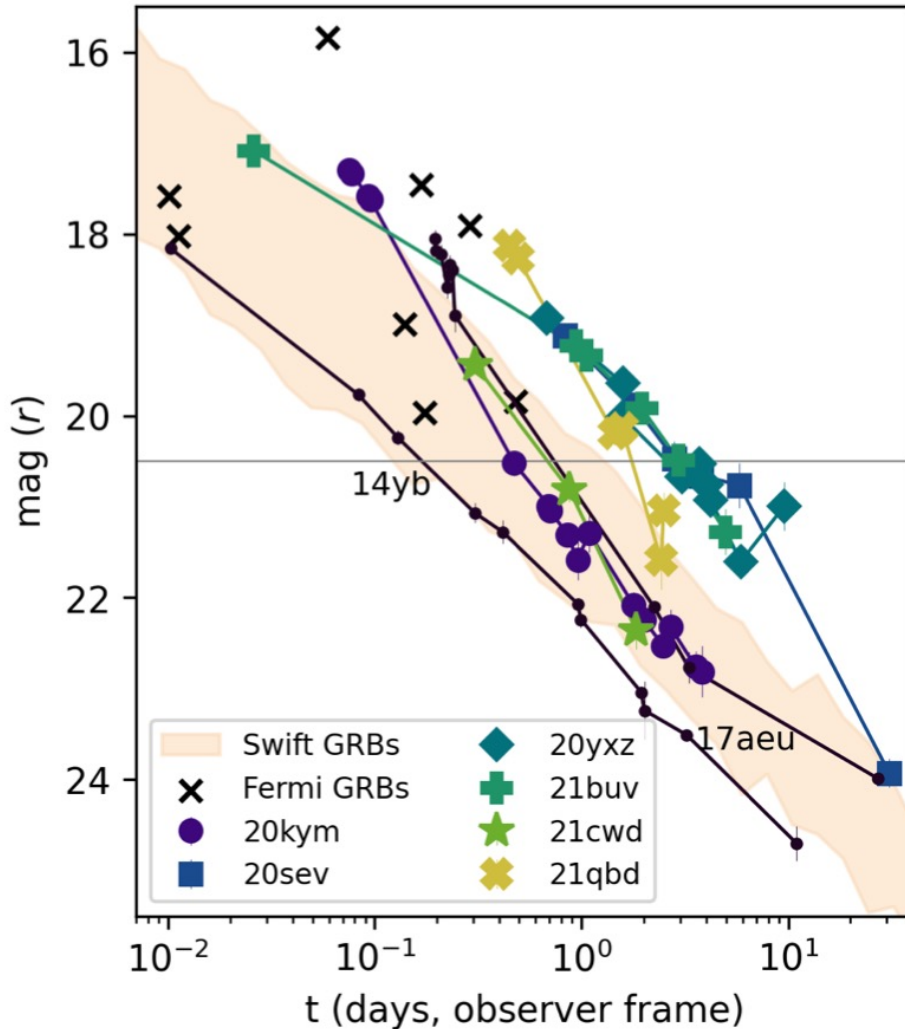
“Orphan” GRB afterglow



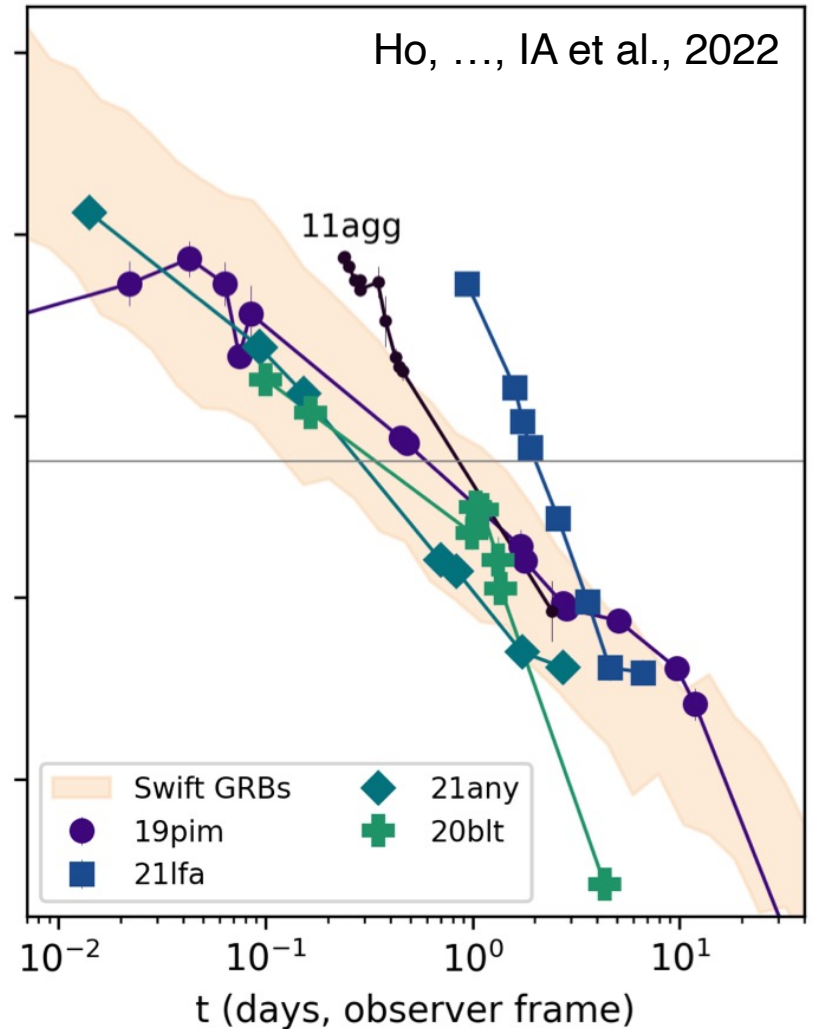
“Orphan” GRB afterglow



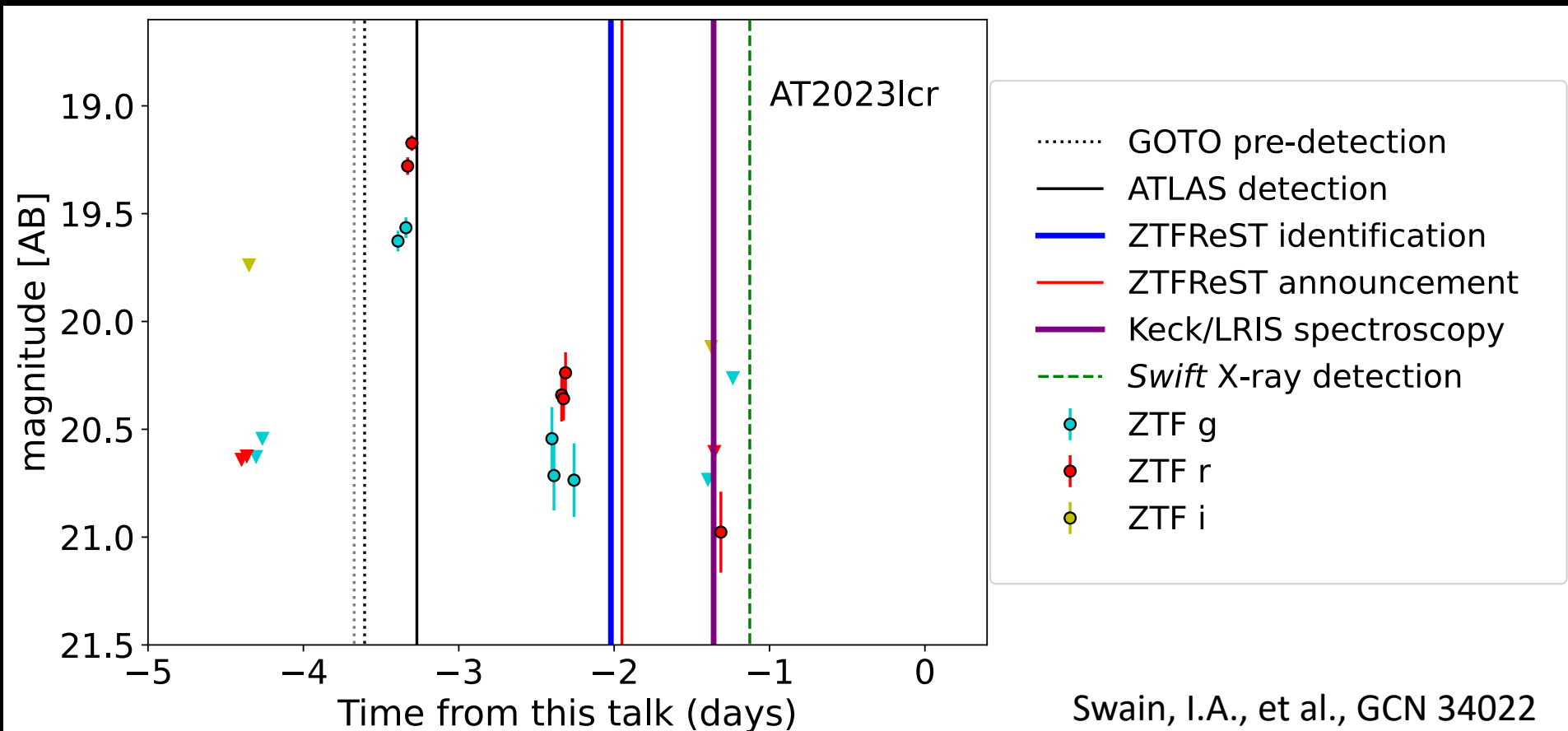
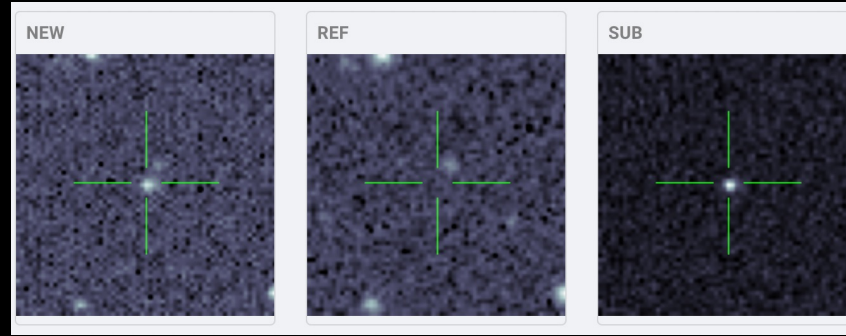
GRB Associations



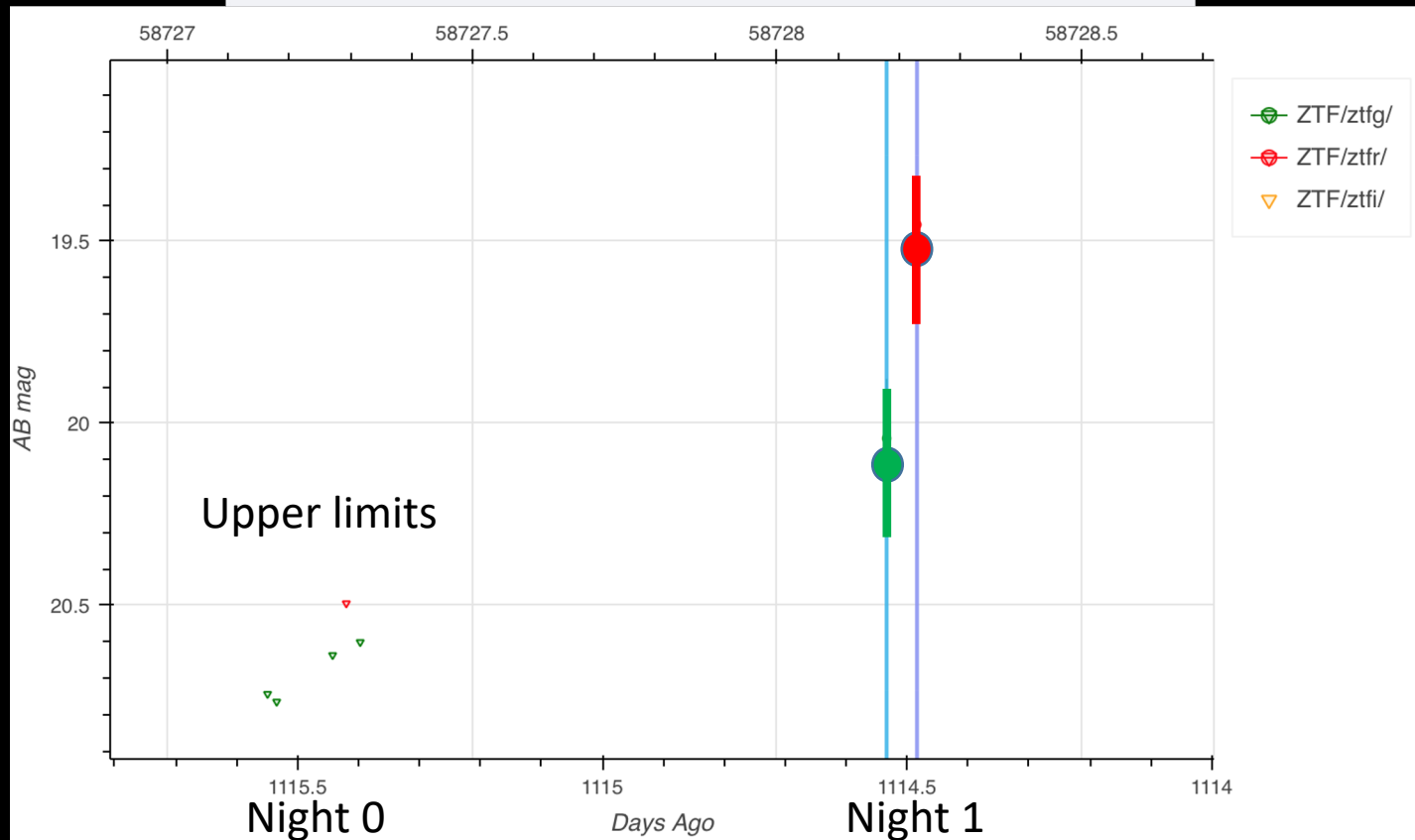
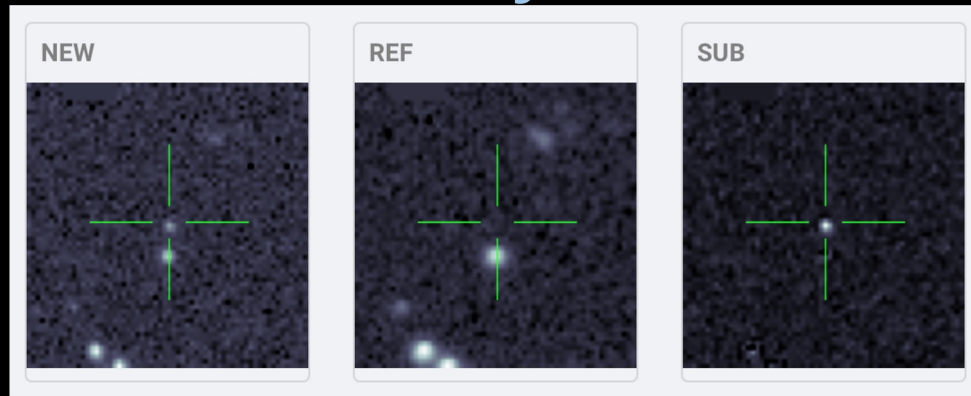
No Associated Detected GRB



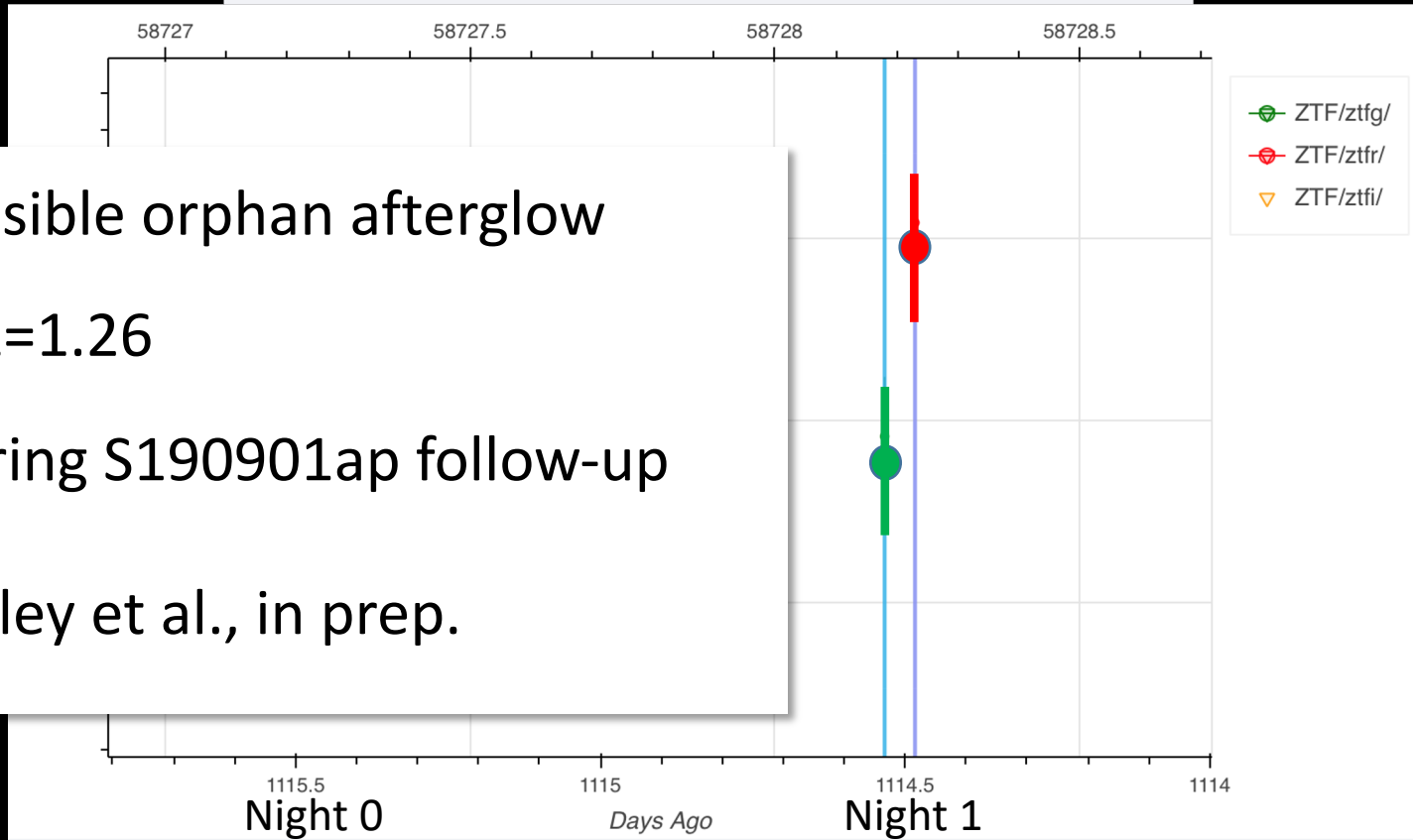
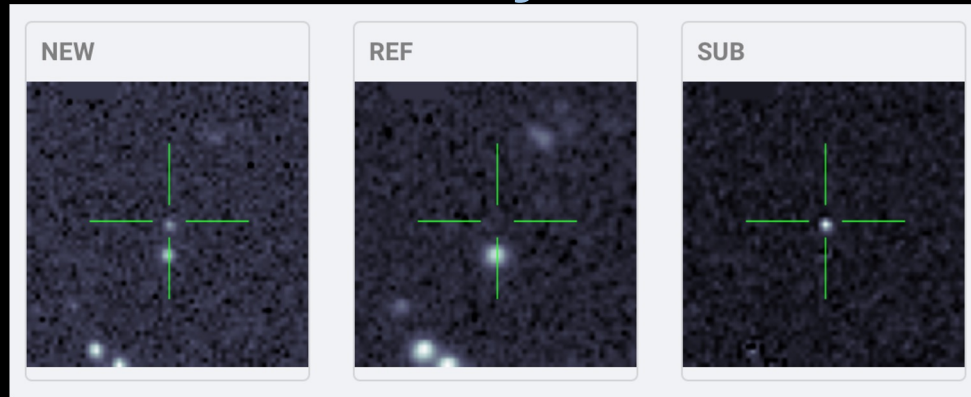
What do they look like?



What do they look like?



What do they look like?



Possible orphan afterglow

at $z=1.26$

During S190901ap follow-up

Perley et al., in prep.

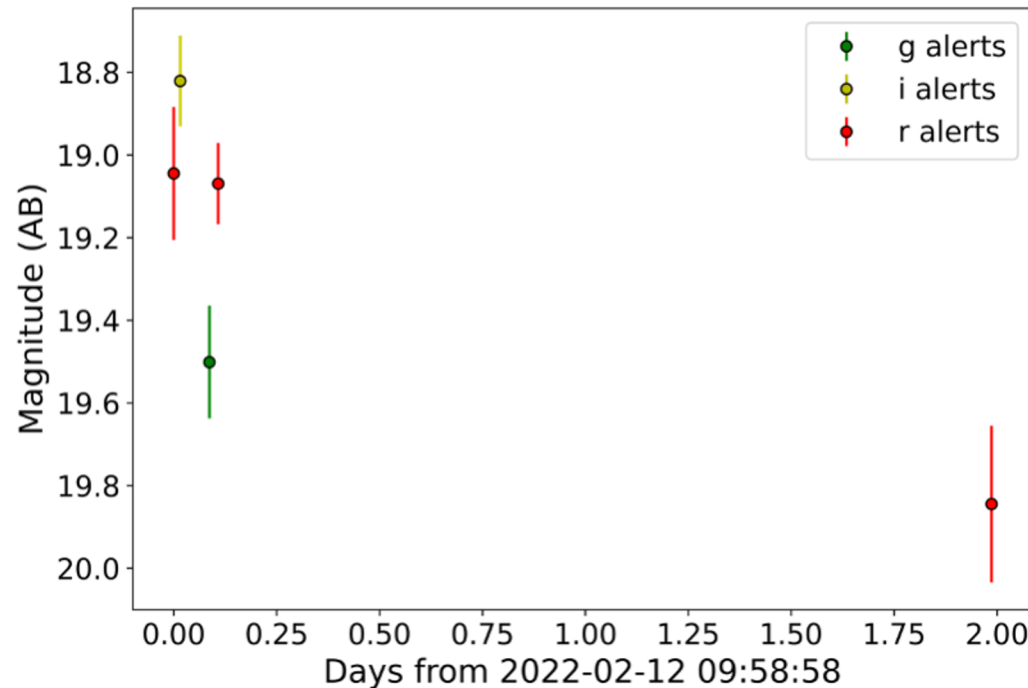
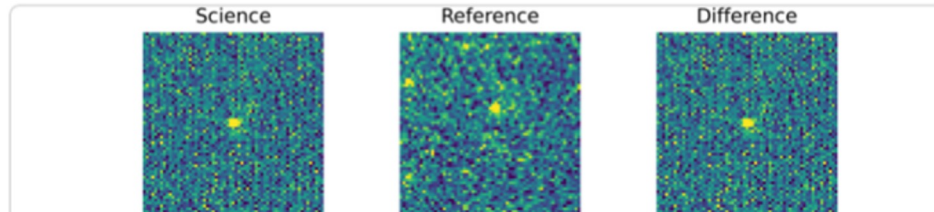
Would you trigger on this?



Extinction: $E(B-V) = 0.01$

Galactic latitude: $b_{\text{Gal}} = 78.85$

triplet ZTF22aaajecp ▾



ZTFReST:
ZTF Realtime Searching
and Triggering



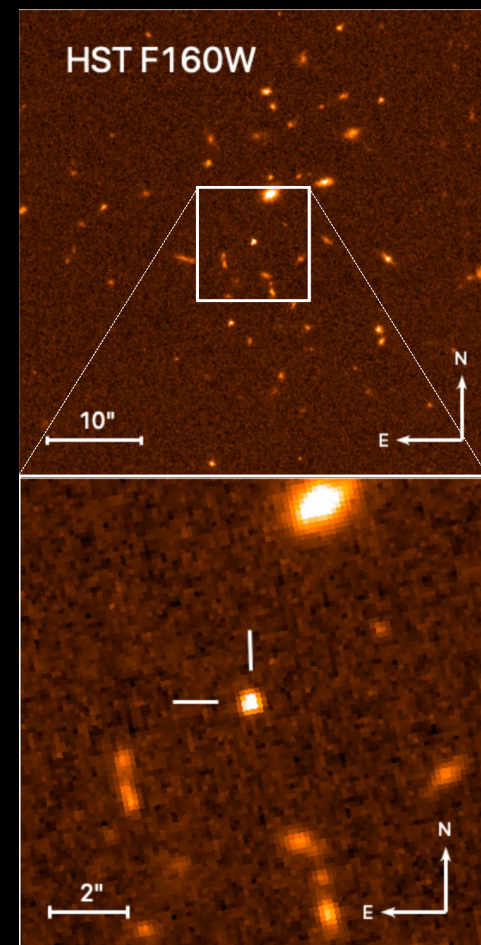
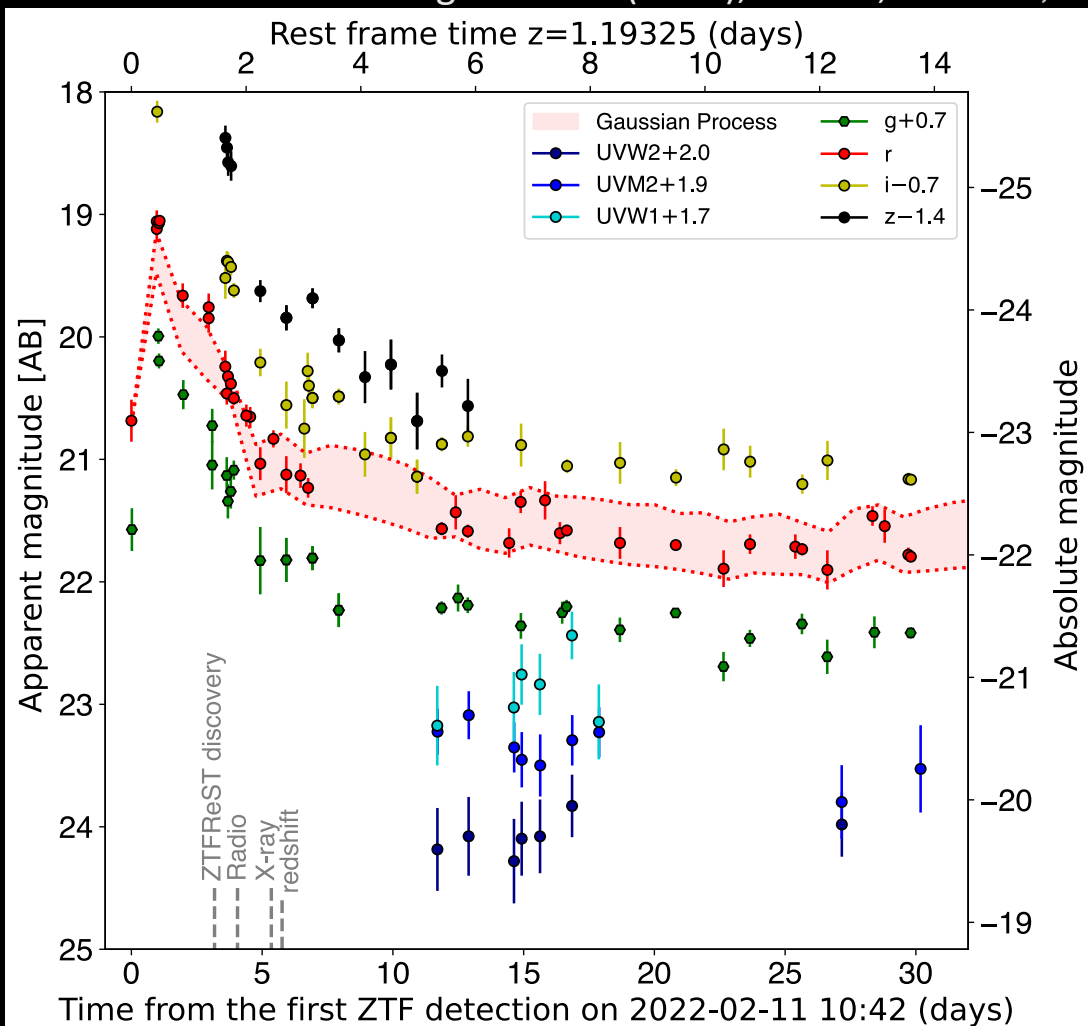
[growth-astro/ztfrest](https://github.com/growth-astro/ztfrest)

Andreoni & Coughlin et al. (2021)

AT2022cmc: The first optically-discovered jetted TDE ($z \sim 1.2$)



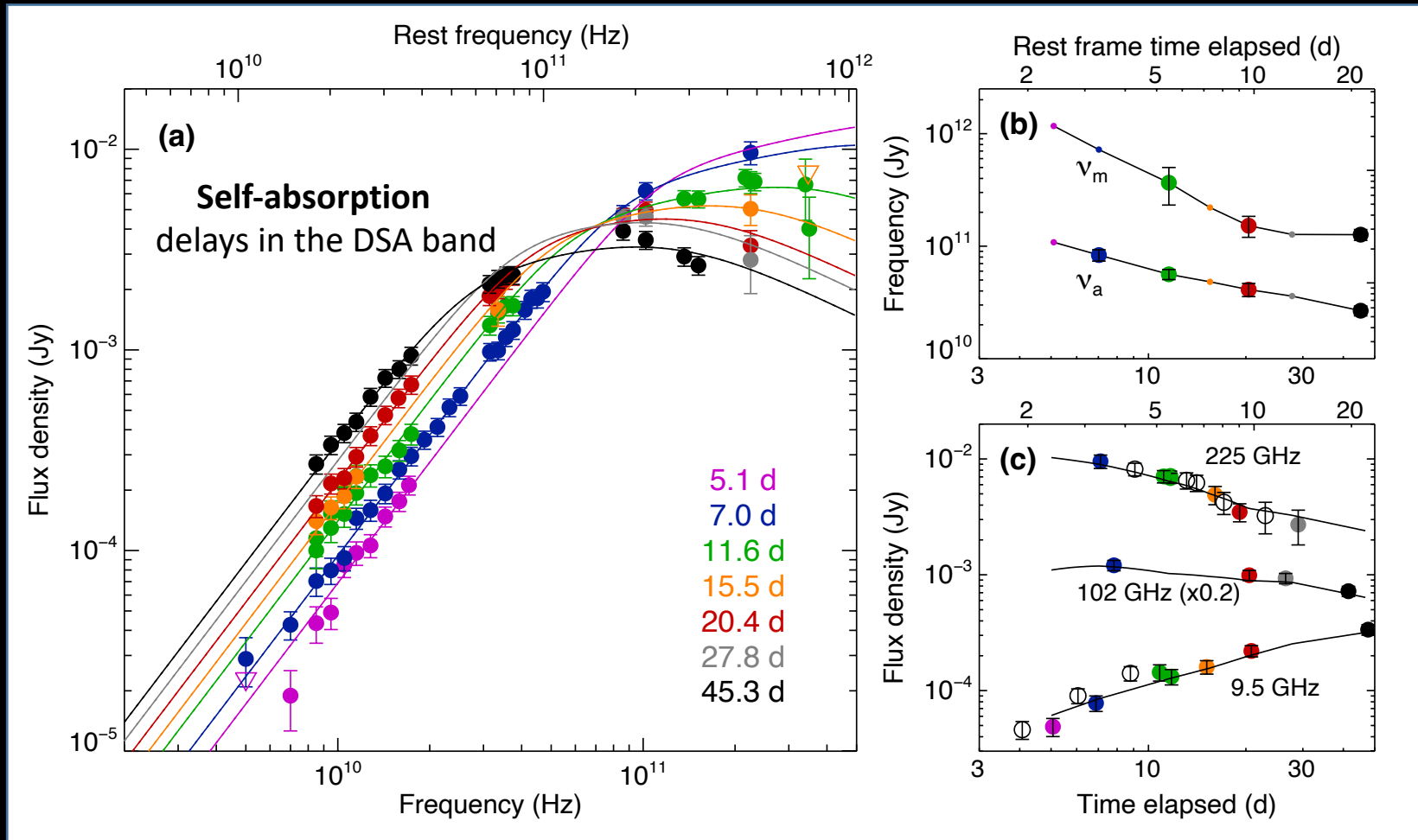
Andreoni & Coughlin et al. (2022), Nature, Vol 612, 7940, p.430-434



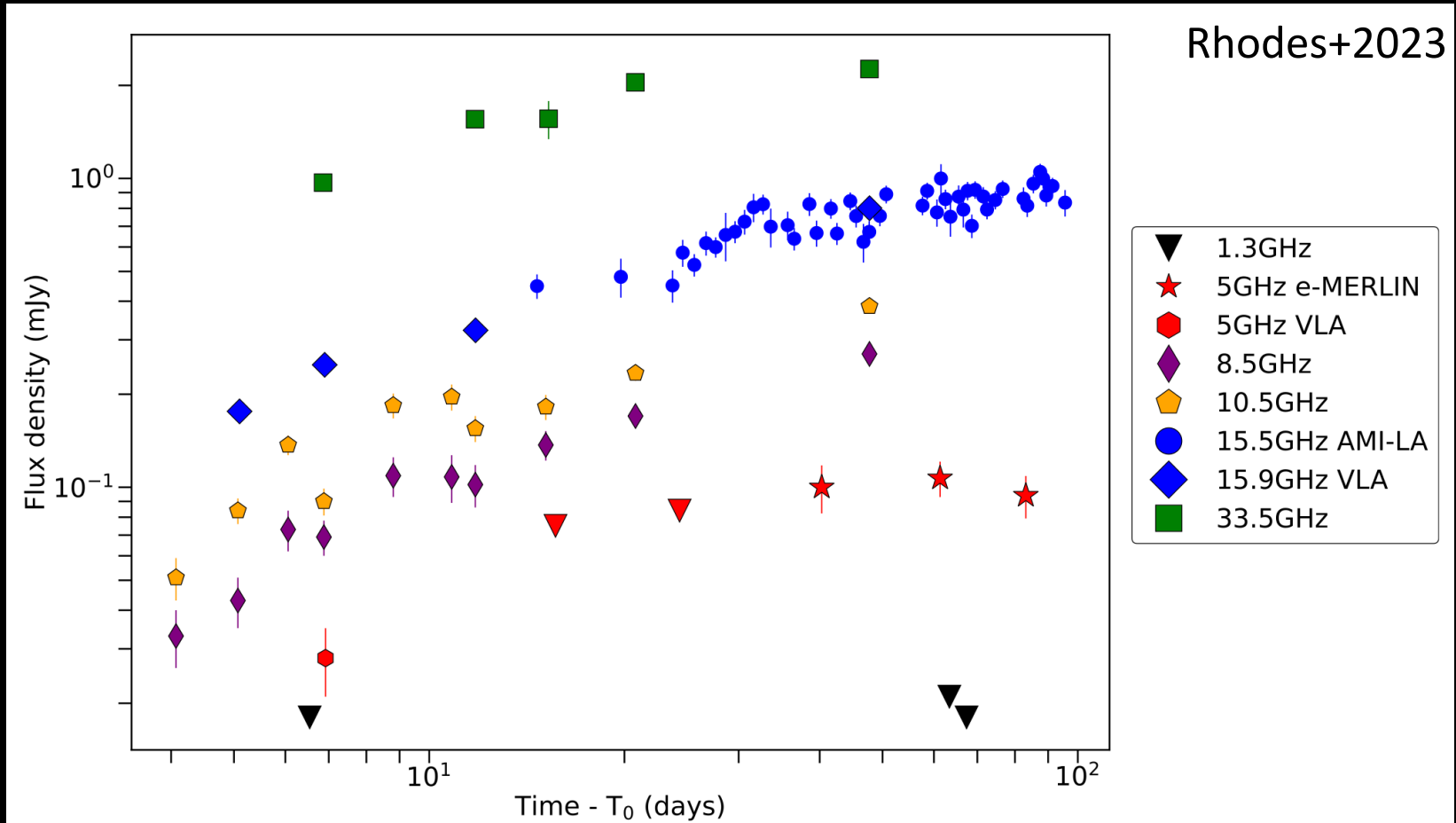
AT2022cmc: a luminous radio/sub-mm transient counterpart



Andreoni & Coughlin et al. (2022), Nature, Vol 612, 7940, p.430-434



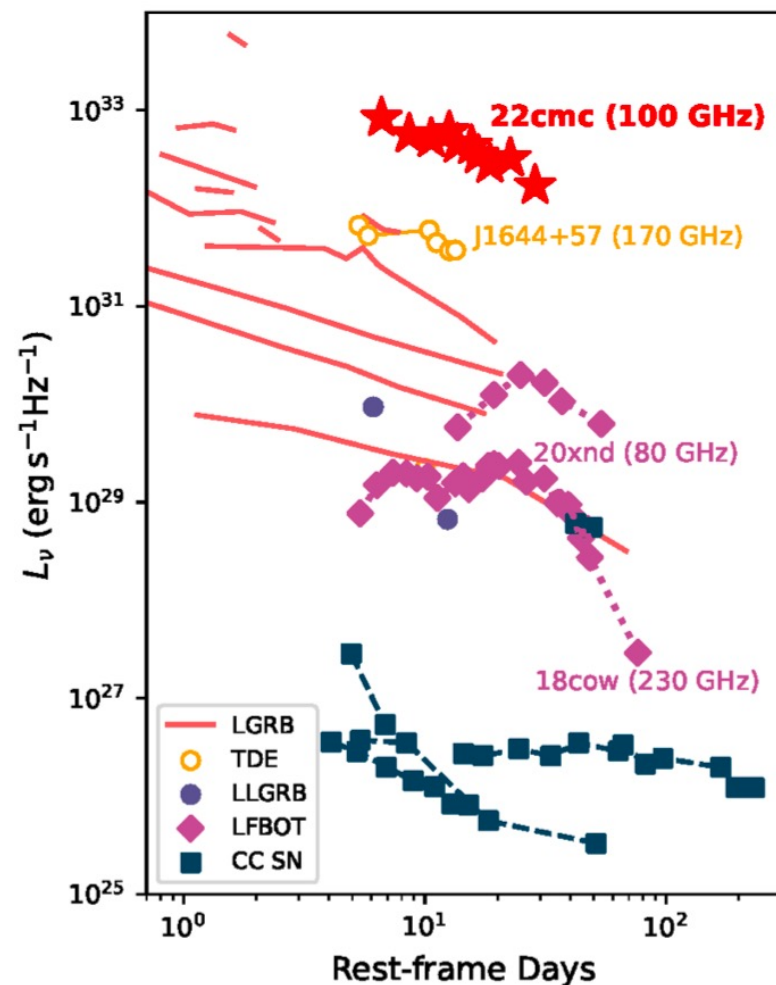
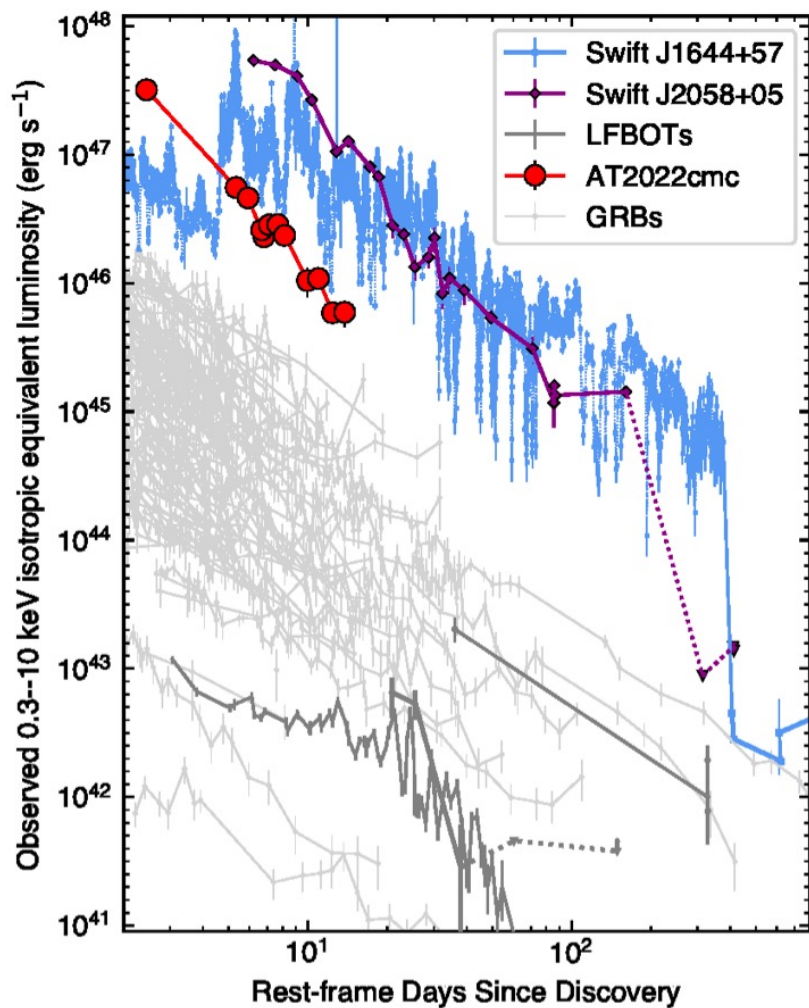
AT2022cmc: a luminous radio/sub-mm transient counterpart



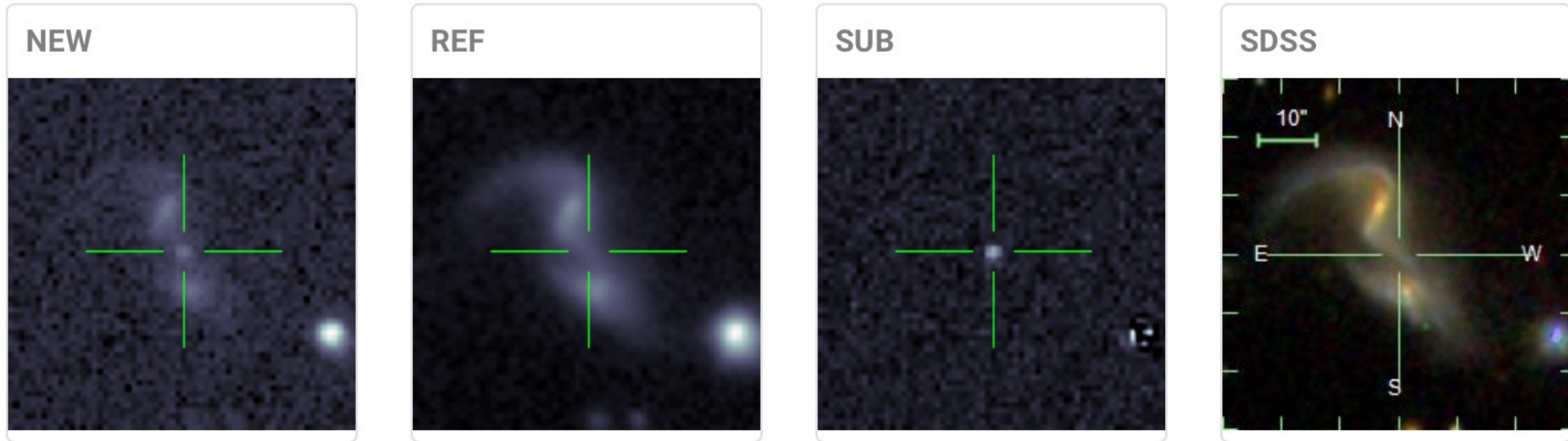
AT2022cmc: multi-wavelength data helped diagnose its nature



Andreoni & Coughlin et al. (2022) – see also Pasham et al. (2022)



Big data problem



Rubin will generate **up to 10 million Alerts per night**

DSA-2000 will find **~1 billion** sources

Some good news:

- ❖ cross-matching algorithm problems are **solved**
- ❖ Galaxy catalogs + Rubin photoz will help us know the **distance**

From overwhelming to manageable



Credit: Jakob Nordin

Brokers

AMPEL

Alerce

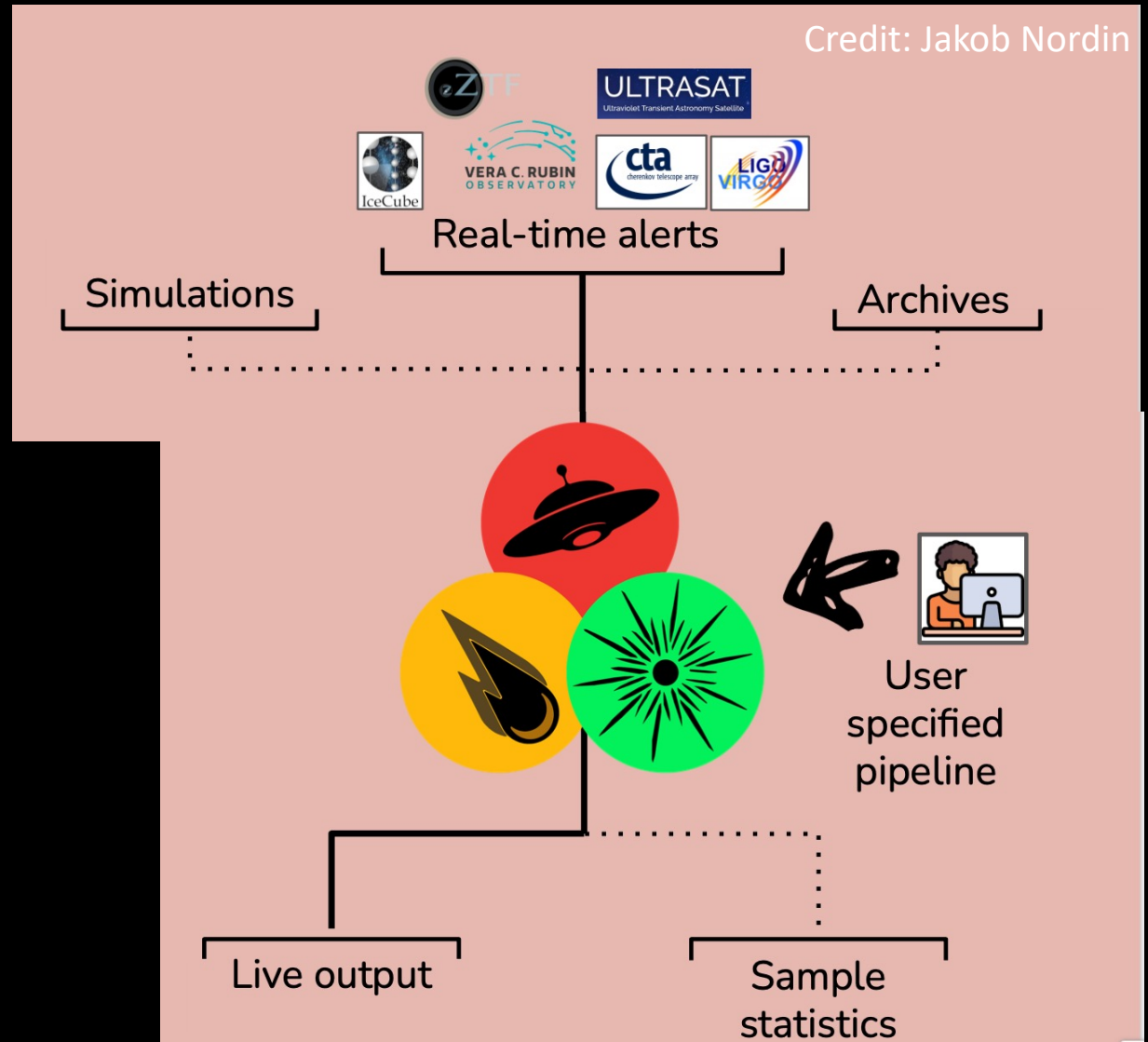
ANTARES

BABAMUL

Fink

Lasair

Pitt-Google



From overwhelming to manageable



Rubin Science Platform

Portal

Discover data in the browser



[Learn more about the portal.](#)

Notebooks

Process and analyze LSST data with Jupyter notebooks in the cloud



[Learn more about notebooks.](#)

APIs

Learn how to programmatically access data with Virtual Observatory interfaces



<https://data.lsst.cloud> or look up “Rubin Science Platform”

Rubin and DSA-2000: a winning synergy

Synergetic observations with Rubin and DSA-2000 will provide us with a large time window of **optical + radio cadenced observations**

Potential for discovering **populations of elusive transients**
(rare or difficult to recognize)

Tools exist to face **big data** problems

Possible item for discussion:
would it be useful to start thinking of a **multi-wavelength** survey
data exploration platform and/or building working groups?