A Tool for Rapid Object Vetting and Examination

(TROVE)

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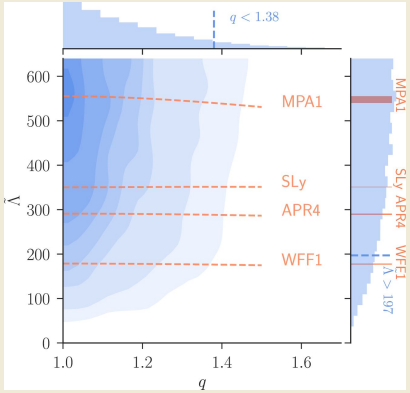
University of Arizona

TDAMM 2025
Huntsville, AL

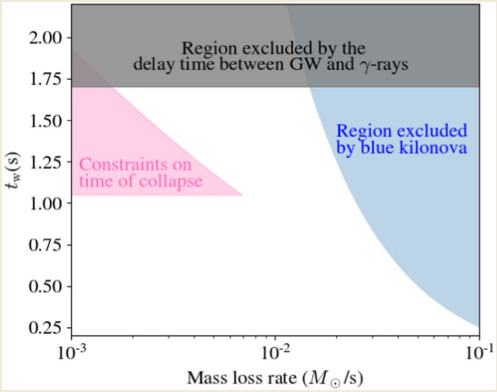


NS Constraints

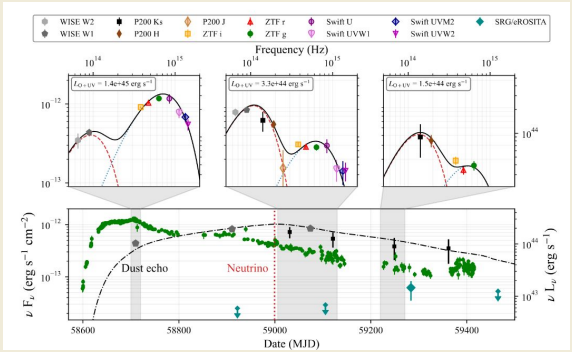
(e.g, Coughlin+18)

SGRB/Jet Constraints

(e.g., Murguia-Berthier+17)



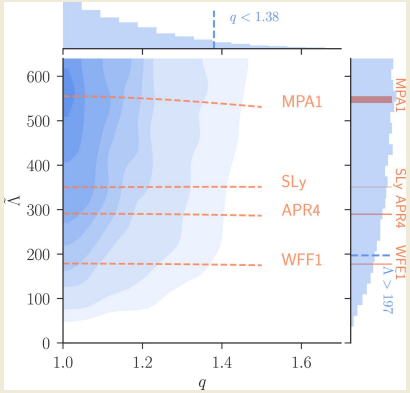
EM counterparts to MMA events provide a wealth of information…



Extragalactic Neutrino Sources

(e.g., Reusch+22)

And many other topics, pioneered by many people in this room!



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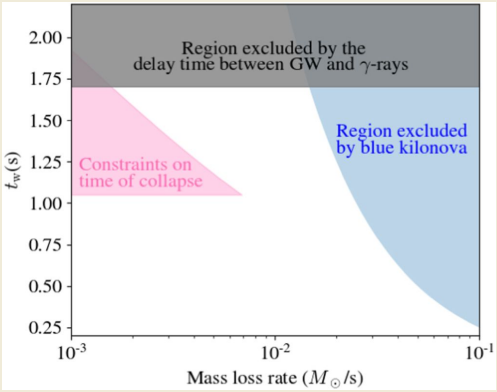
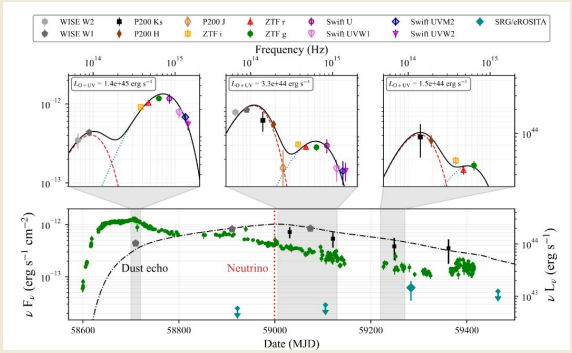


...but they are hard to find!



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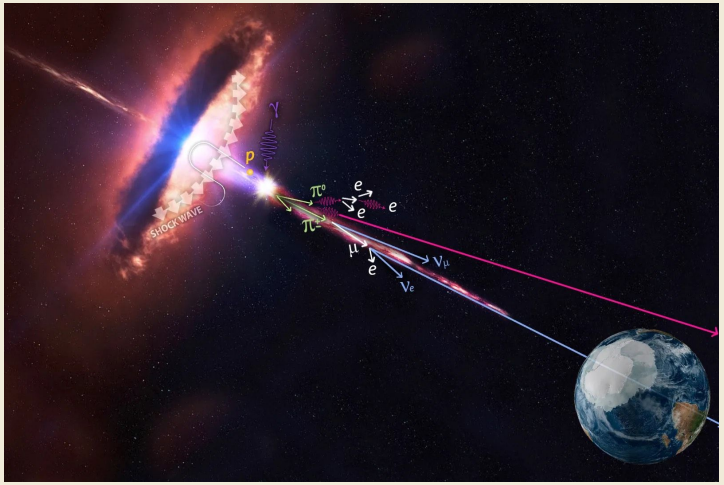
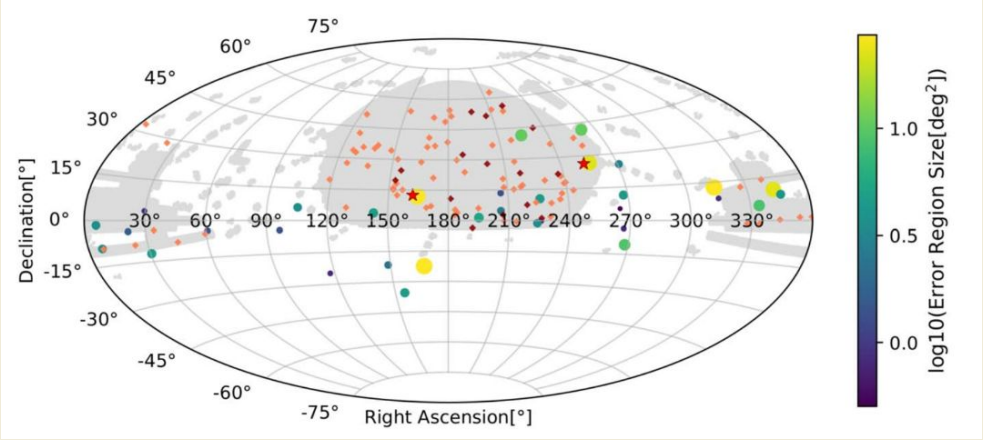
In MMA we have many poorly localized events

Neutrinos



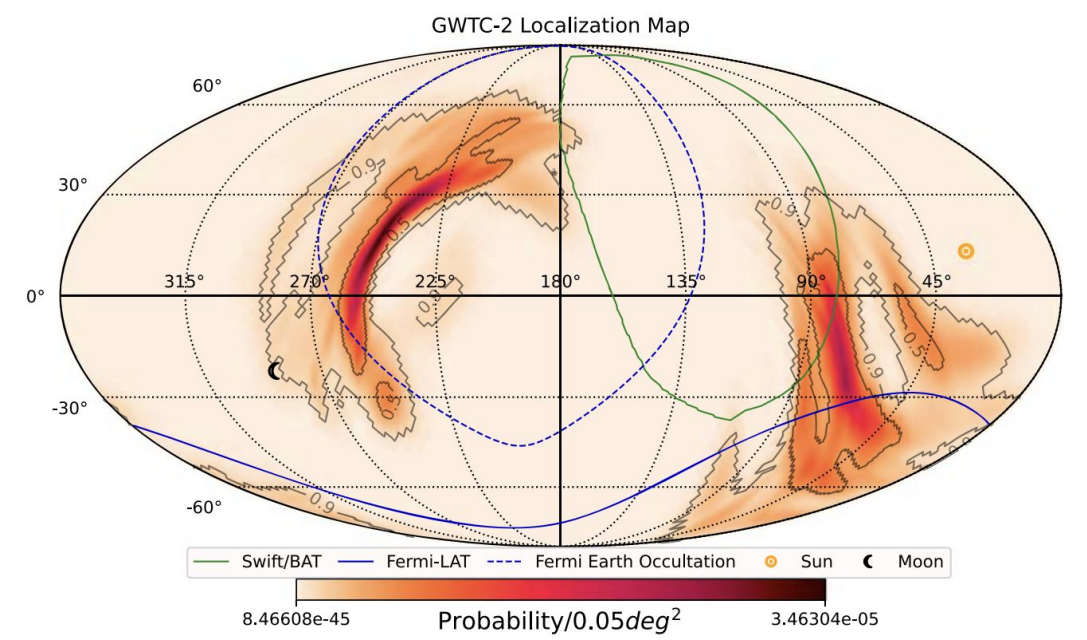


← Jiang+23

In MMA we have many poorly localized events

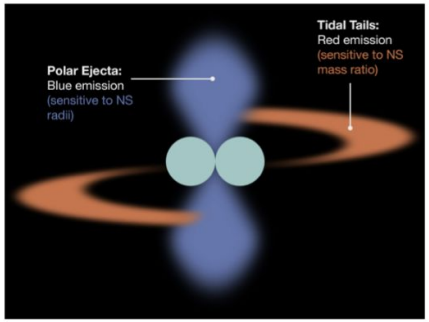
GW Events

GW190425: BNS with 90% localization of ~8900 deg^2. D=160 Mpc.

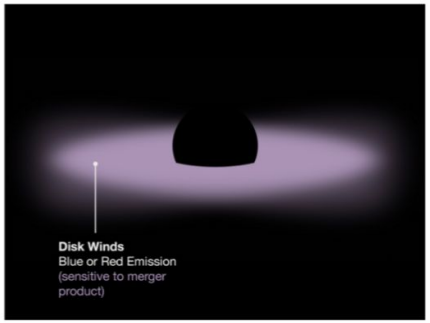


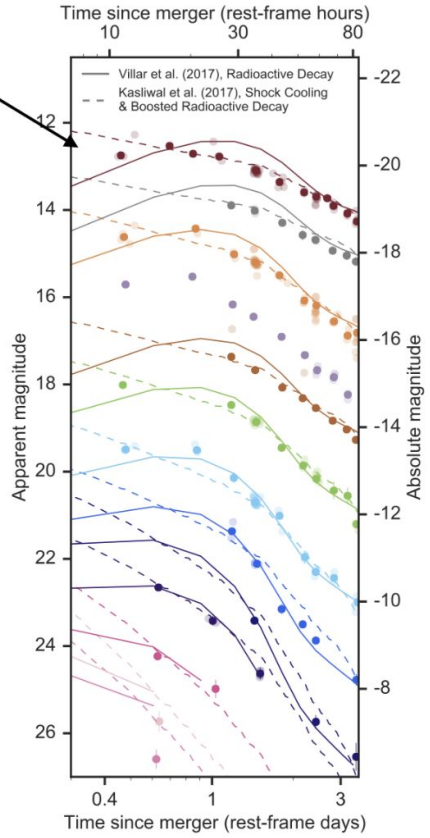
GW Counterparts are faint and fast

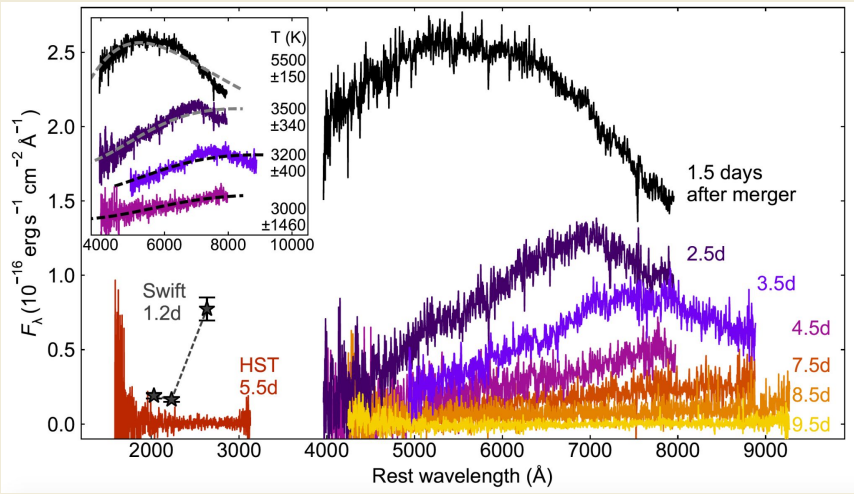
Early data can distinguish models.



Possible kilonova emission mechanisms







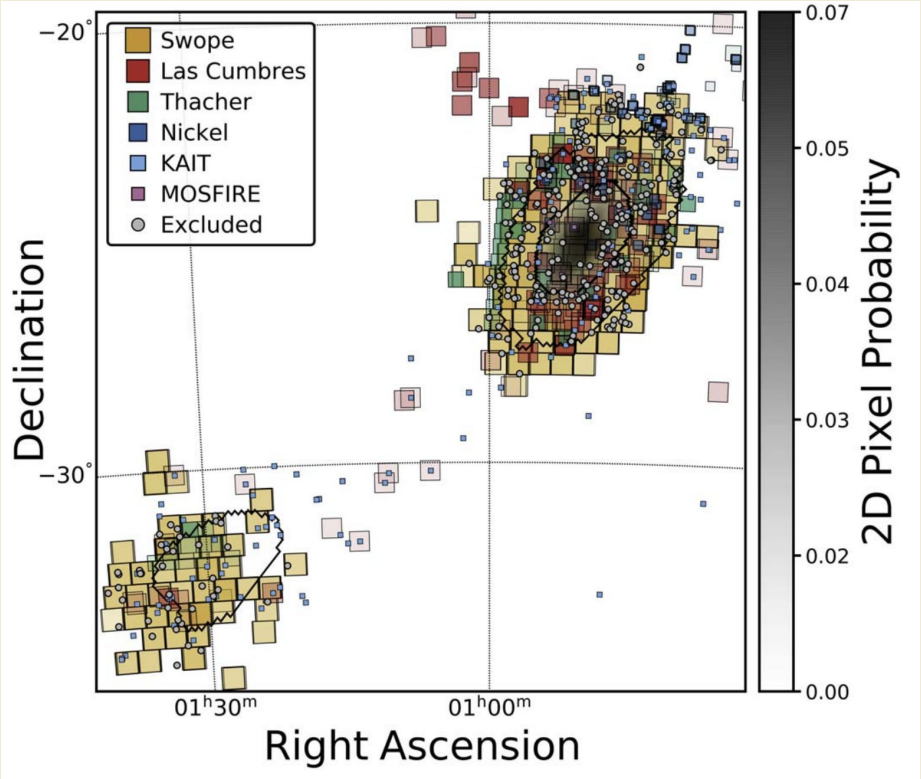
Science cases: r-process, neutron star equation of state, Hubble constant, explosion physics, etc etc.

Many viable candidates, but only one counterpart

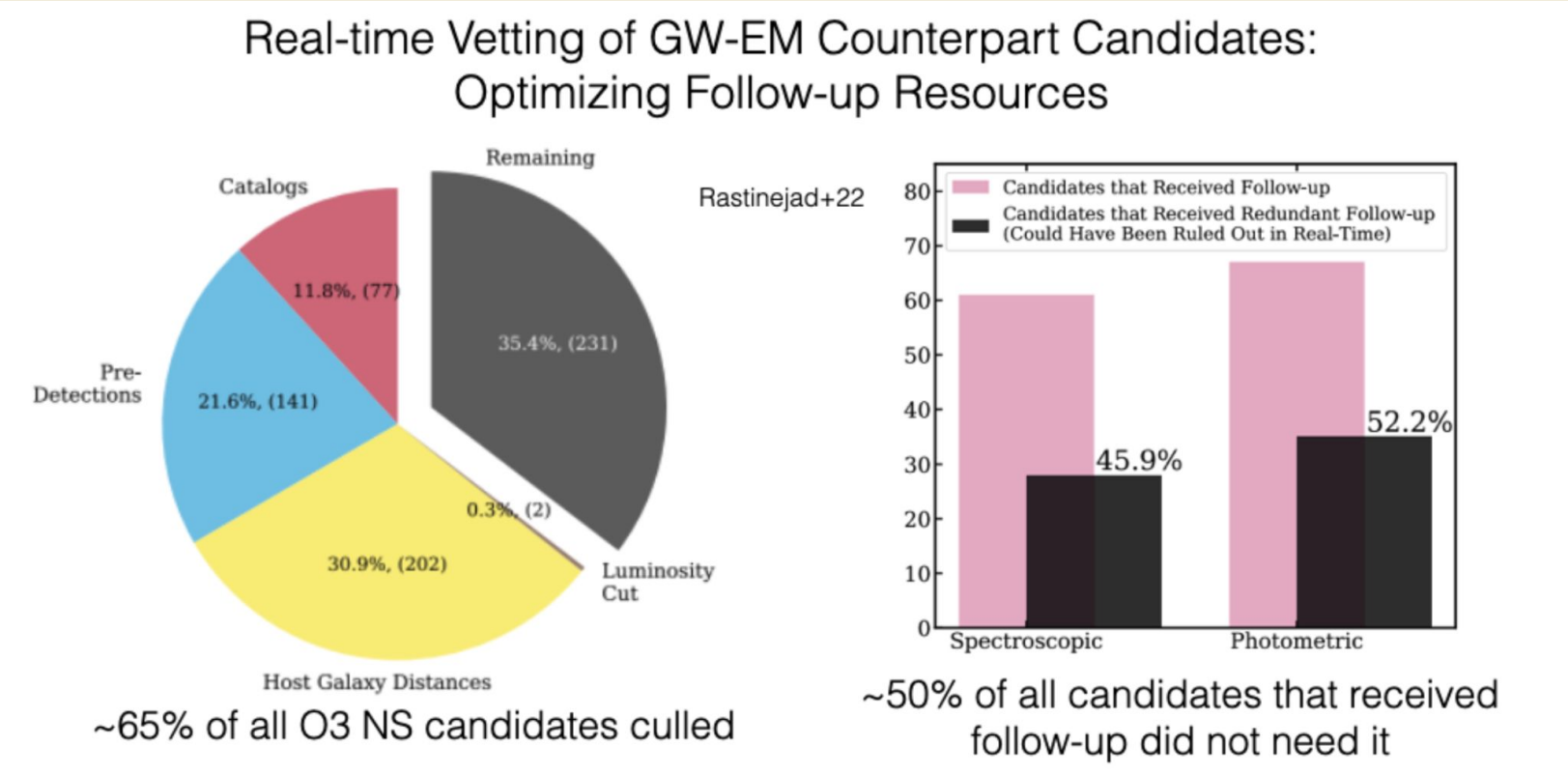
GW190814:

- NSBH merger
- 51 deg^2 localization

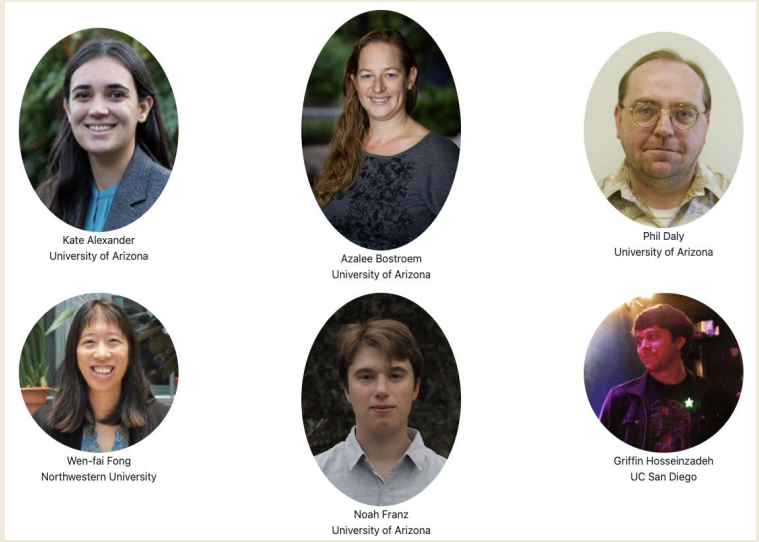
189 transients in that localization
(e.g. Kilpatrick+21)

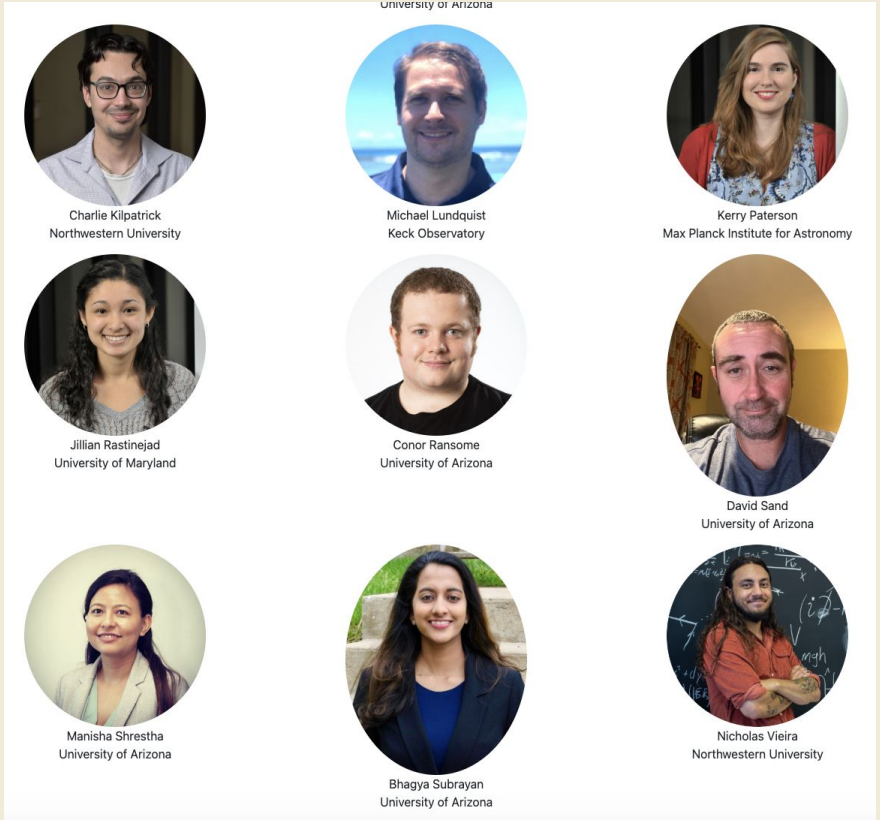


Many candidates can be ruled out before follow-up



One Solution? TROVE





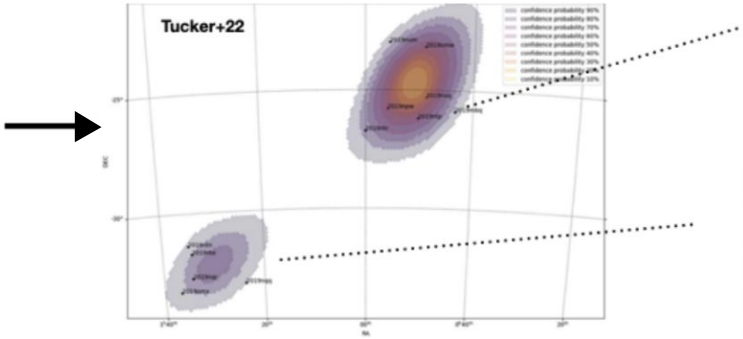
A result of the 2nd TDAMM!

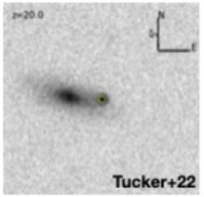
TROVE Overview

GW Candidate Follow-up & Vetting

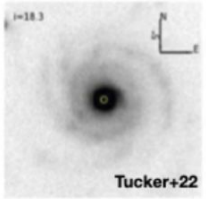
GW Alert and Localization

Many Viable Transients Within Localization

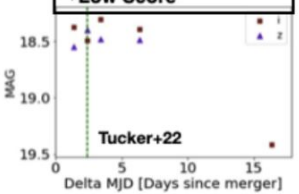




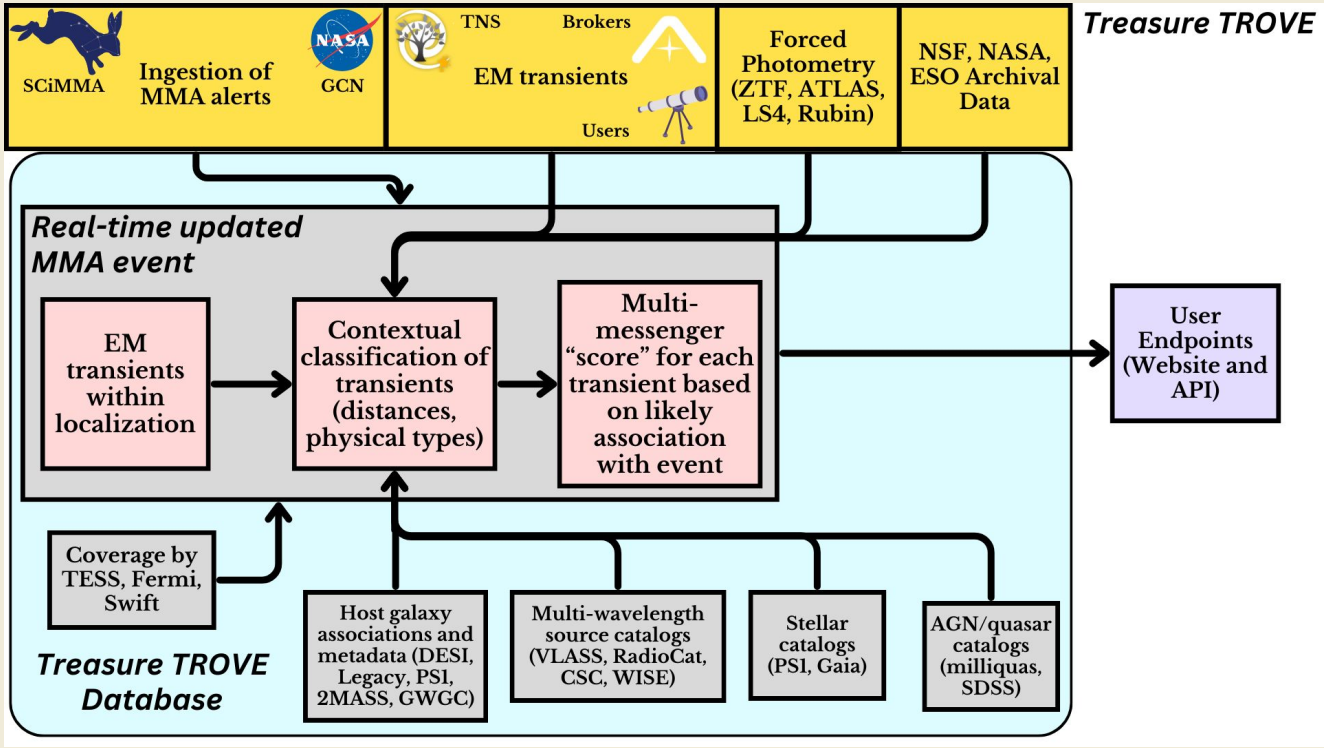
-Host at right distance
-No detection prior to merger
↳High Score



-Transient consistent with AGN position (NS merger)
-Detection prior to merger
↳Low Score



TROVE Overview



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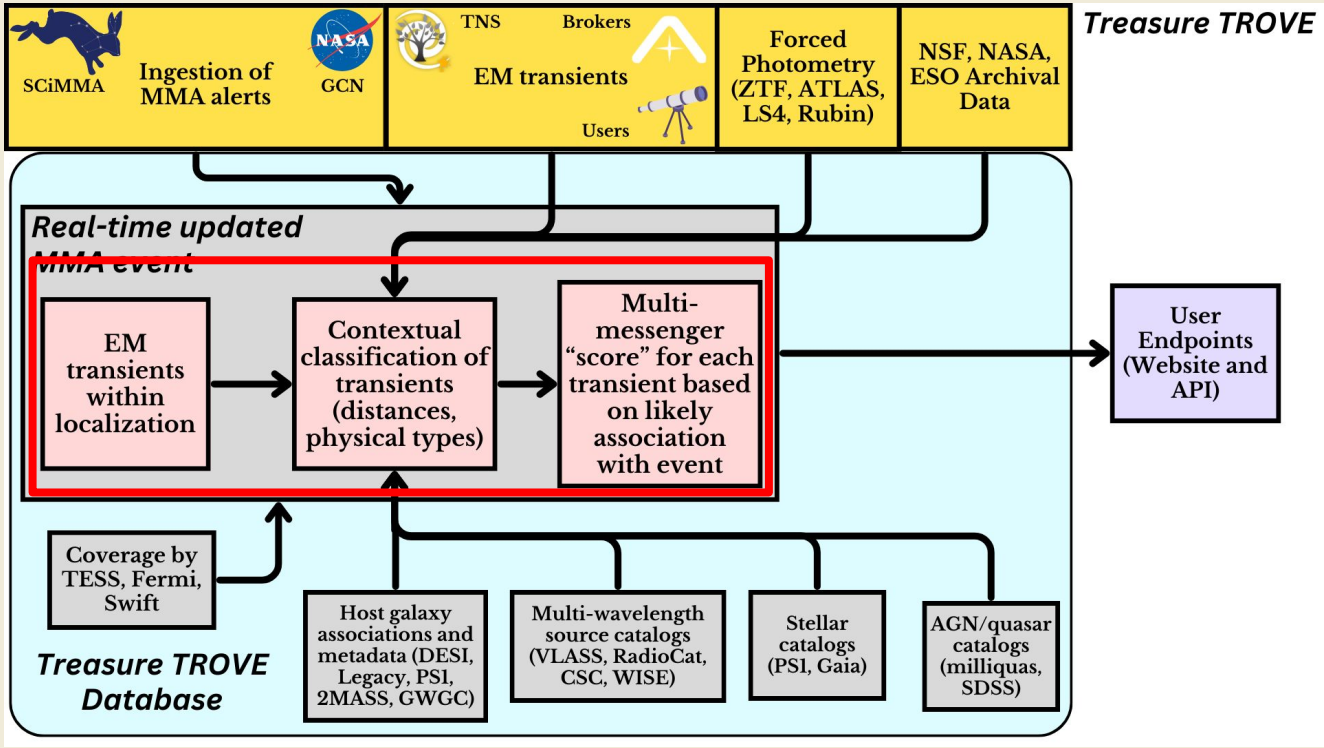
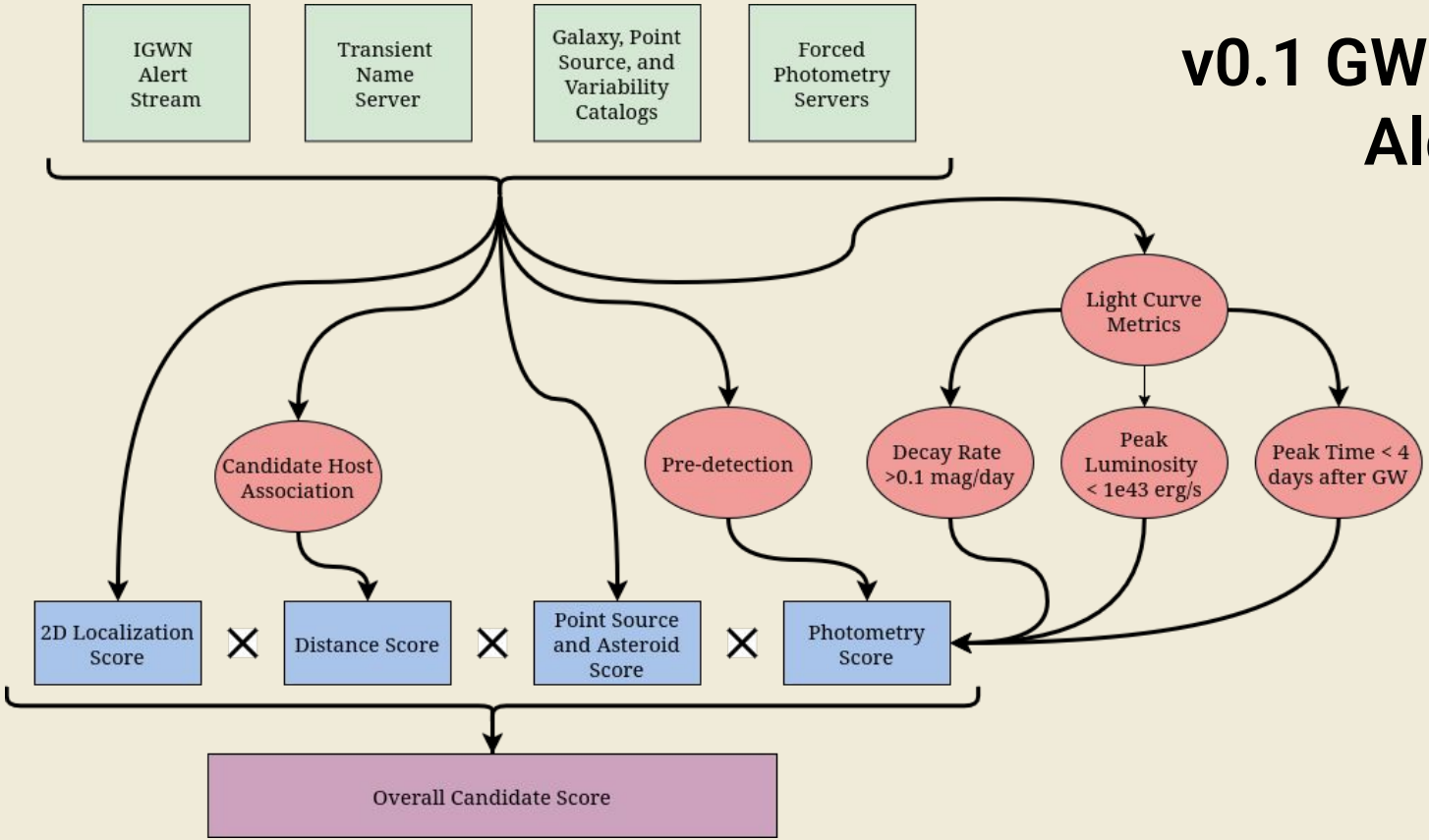
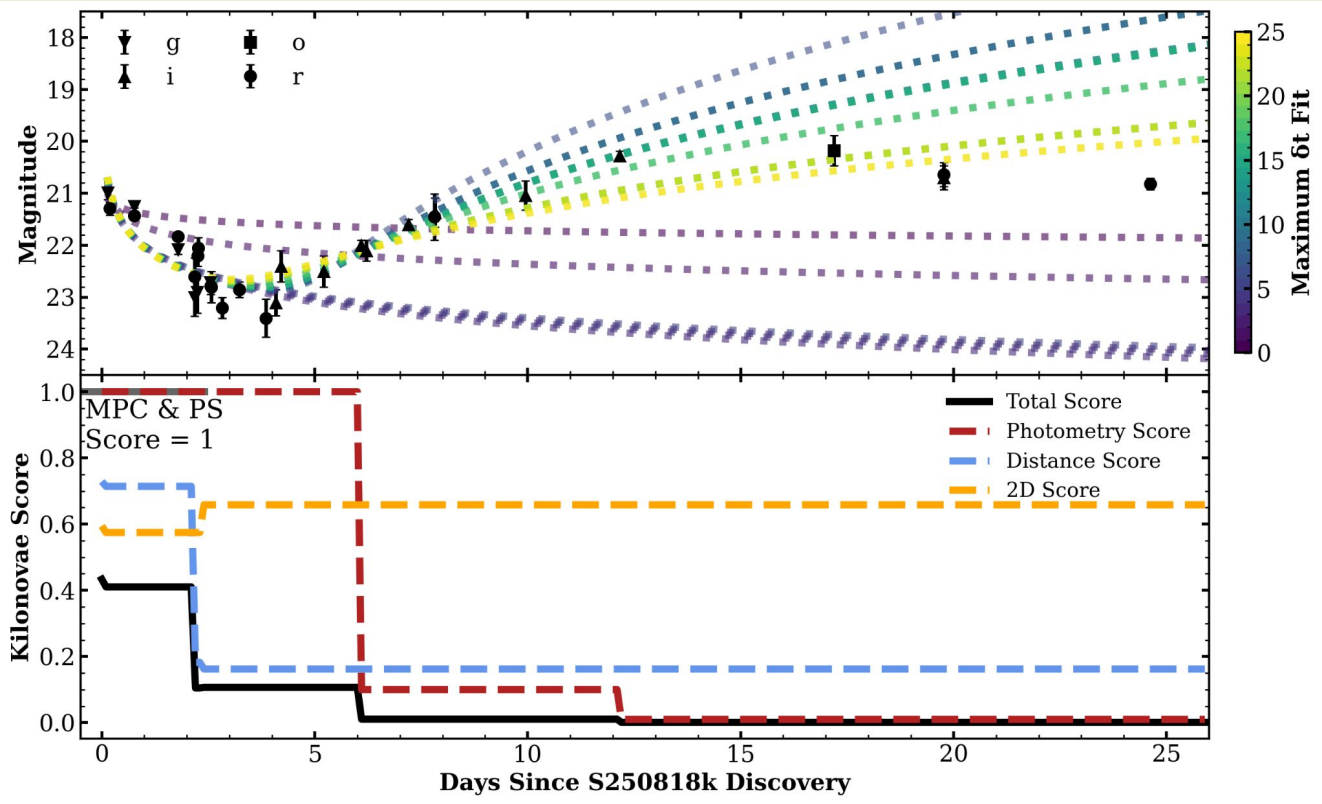


v0.1 GW Vetting Algorithm



Franz+25
(Accepted)

Application to 2025ulz



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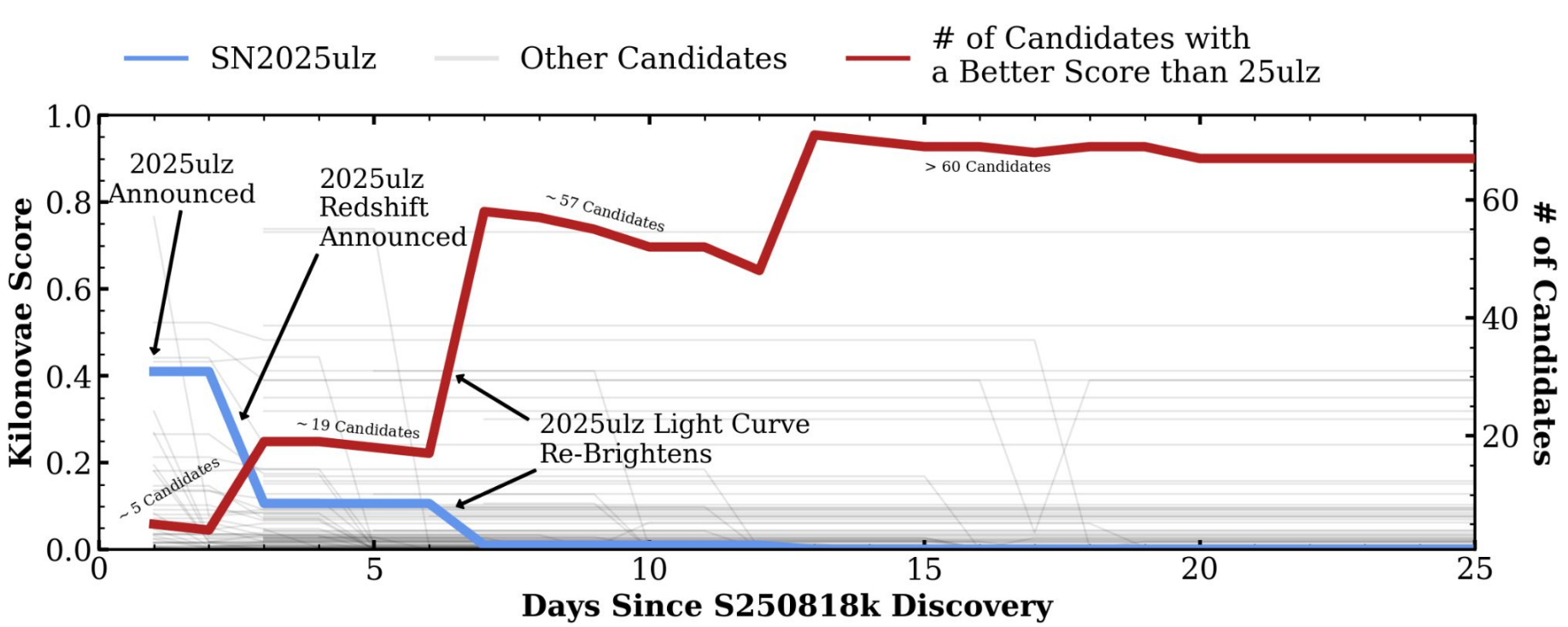


Franz+25 (Accepted)

v0.1 Web Interface

SN2025ulz

Classify | Edit | Share | Delete | Vet

Names	SN2025ulz	
	🔗S250818k	
Coords.	15:51:54.201	+30:54:08.67
	237.975838	30.902408
Galactic	49.509535	50.630027
Ecliptic	225.504783	49.514382

Score Details

S250818k

2D Localization Score: 0.66
Point Source Score (1 or 0): 1
3D Association Score: 0.17
Maximum Luminosity: 4.89 x 10^{41} erg/s
Time of Maximum Light Curve: 26.76 days
Light Curve Slope (positive is brightening): 3.01 mag/day

▸ Host Galaxies

▾ Photometry

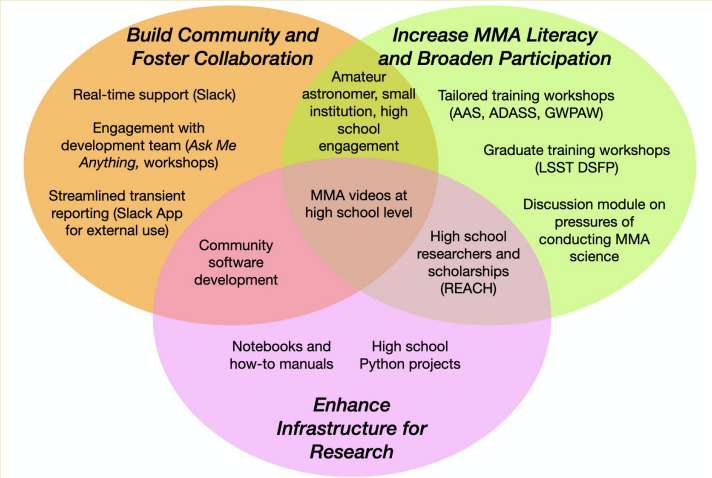
Summary

- TROVE is useful for KN searches
- We demonstrated the algorithm with 25ulz
- Neutrino scoring coming soon!

Checkout Franz+2025 (Which was just accepted!)

What to expect in the next year

- v1 of the web interface and API
  - *Tell us if you want to beta test!!*
- Tutorial notebooks and other documentation
- Tutorials at conferences
- Slack channel
- O3/O4 paper and neutrino paper



Extra Slides

TROVE Overview

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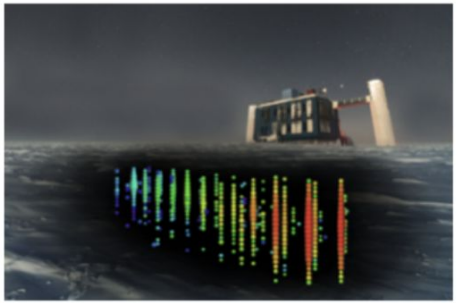
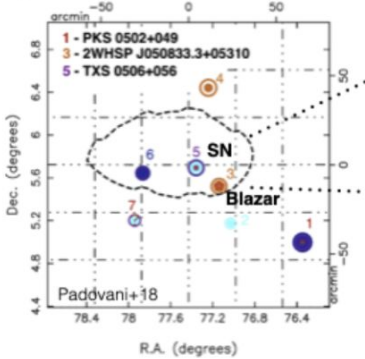
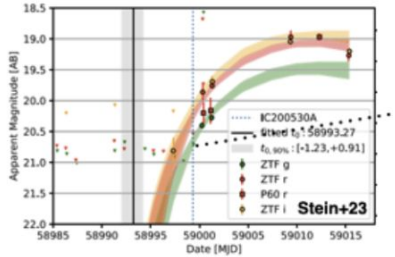
Neutrino Alert and Localization

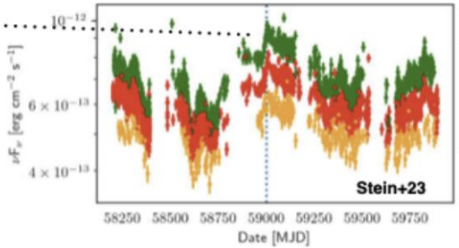


Transient & AGN within Localization: Are they associated with the neutrino?



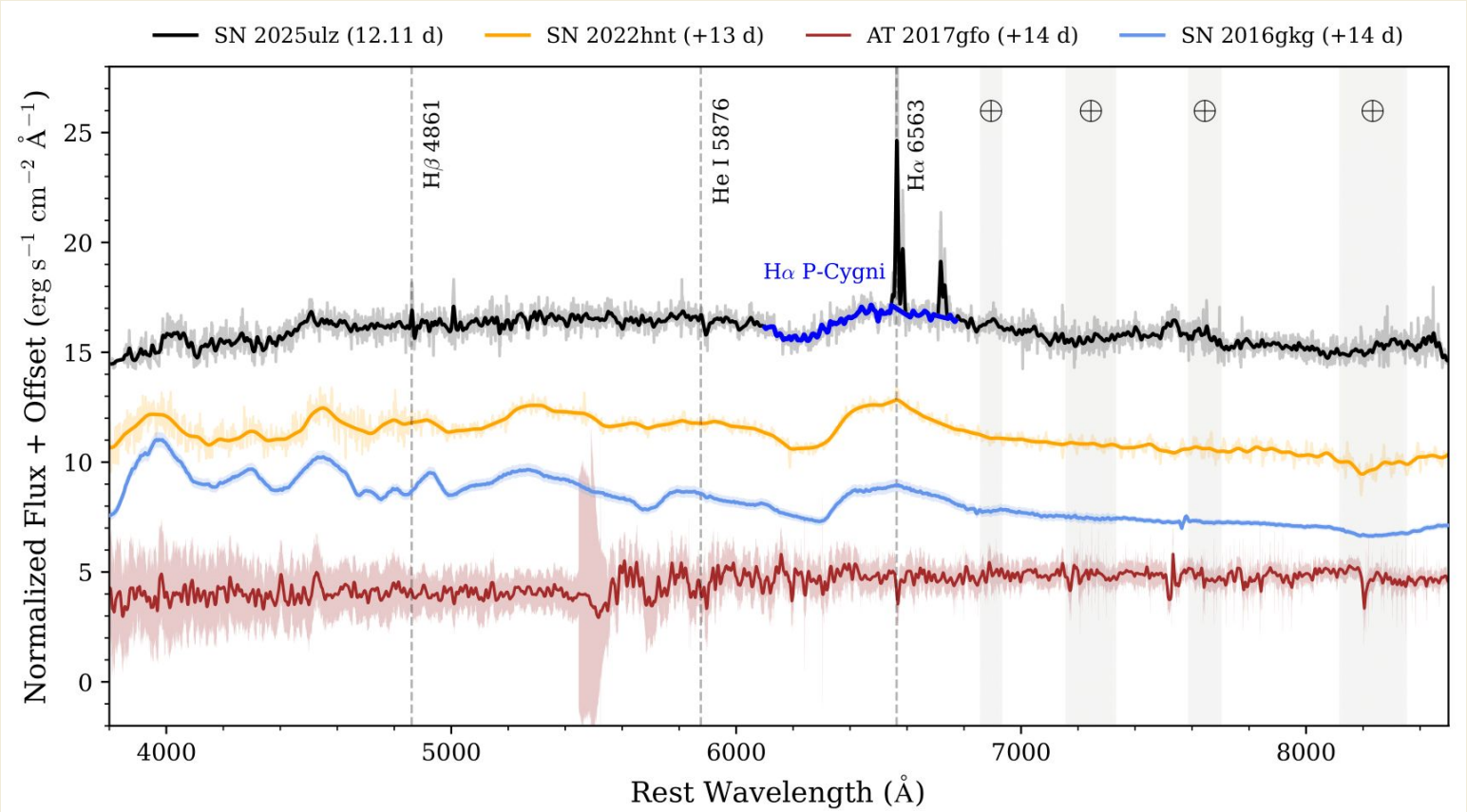


-Normal SN
-Detection Prior to Neutrino
↳Low Score



-Blazar Light Curve Before/After Neutrino
-Flaring at Time of Neutrino
↳High Score

2025ulz Spectra



2025ulz Photometry