

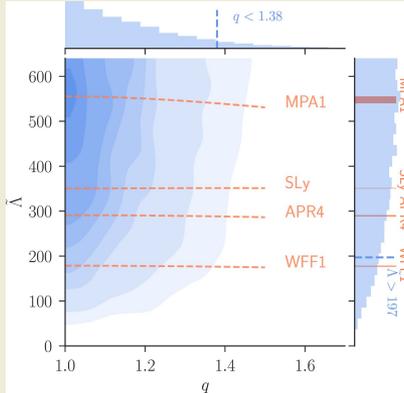
A Tool for Rapid Object Vetting and Examination

(TROVE)

Noah Franz
University of Arizona

TDAMM 2025
Huntsville, AL

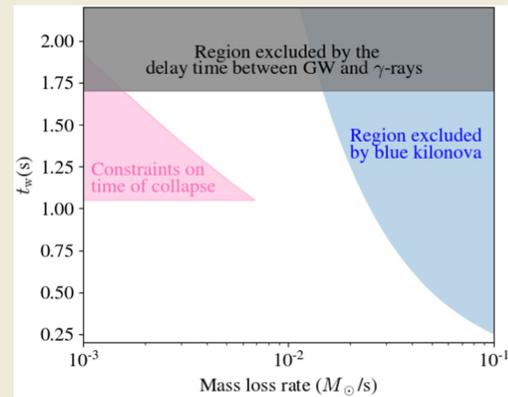




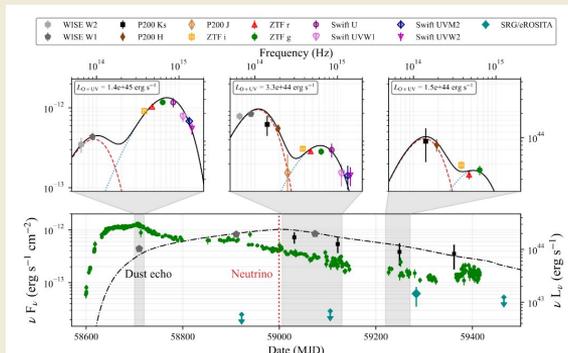
NS Constraints
(e.g., Coughlin+18)

SGRB/Jet Constraints

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



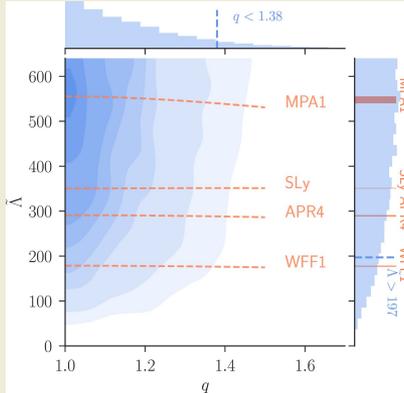
EM counterparts to MMA events provide a wealth of information...



Extragalactic Neutrino Sources

(e.g., Reusch+22)

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

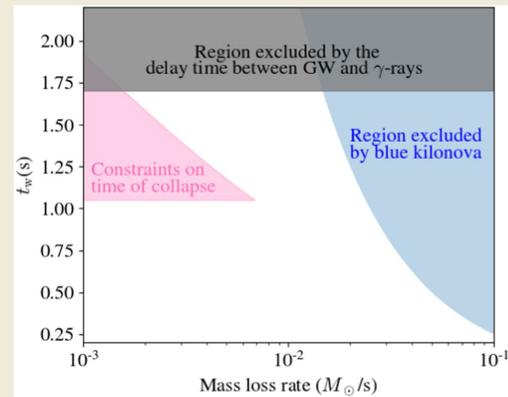


NS Constraints

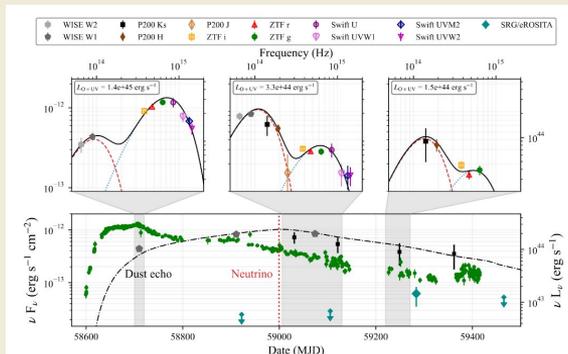
(e.g, Coughlin+18)

SGRB/Jet Constraints

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



...but they are hard to find!



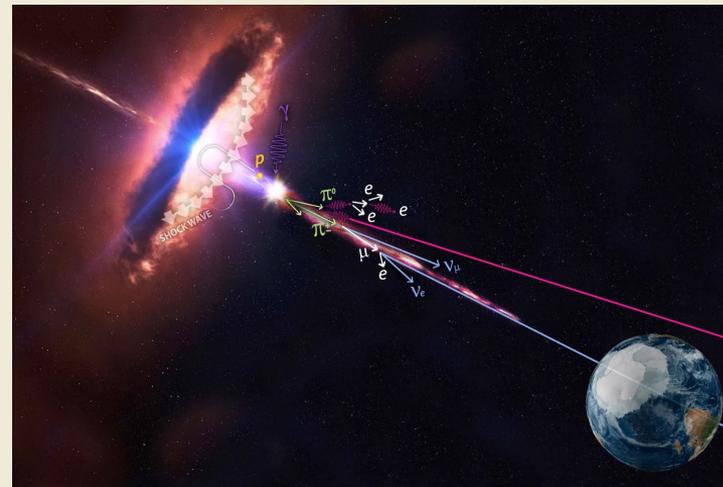
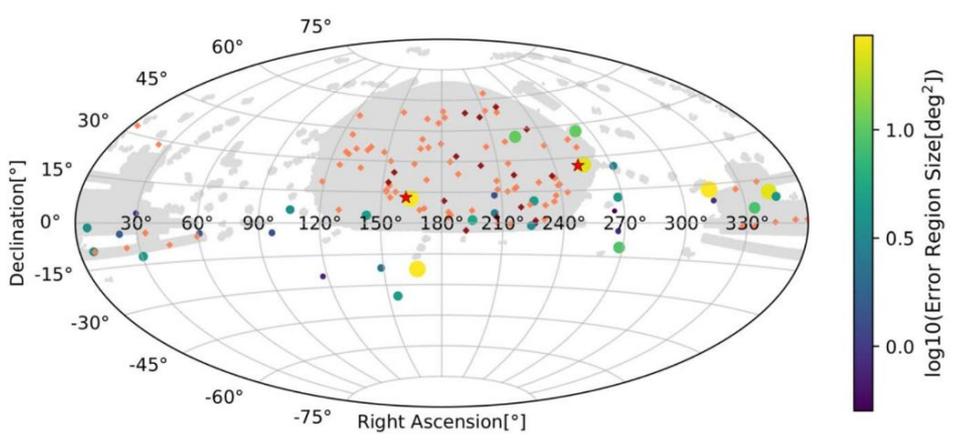
Extragalactic Neutrino Sources

(e.g., Reusch+22)

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

In MMA we have many poorly localized events

Neutrinos

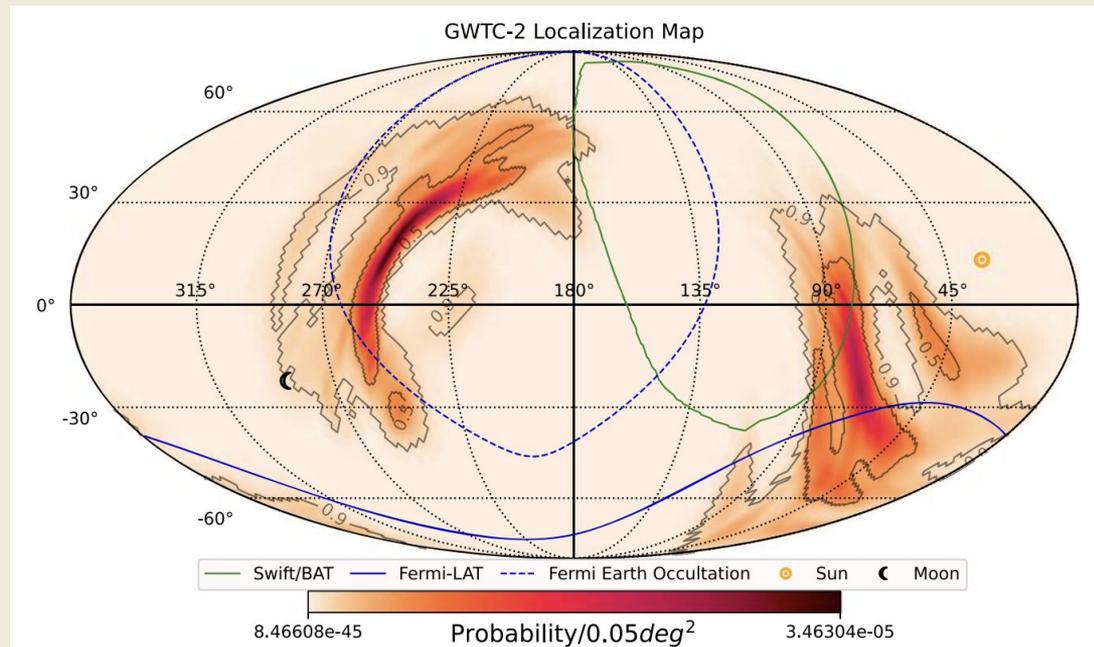


← Jiang+23

In MMA we have many poorly localized events

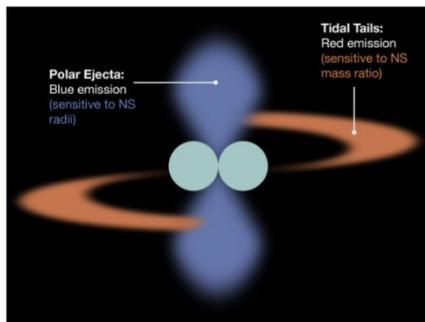
GW Events

GW190425: BNS with 90% localization of $\sim 8900 \text{ deg}^2$.
D=160 Mpc.

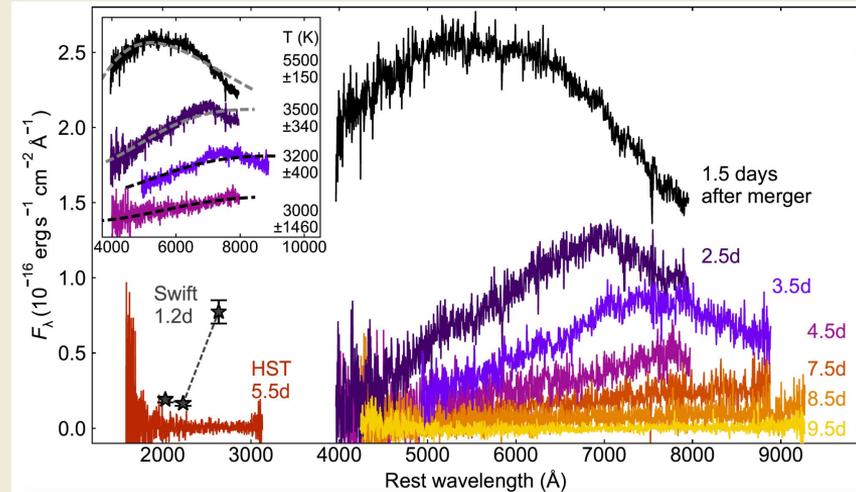
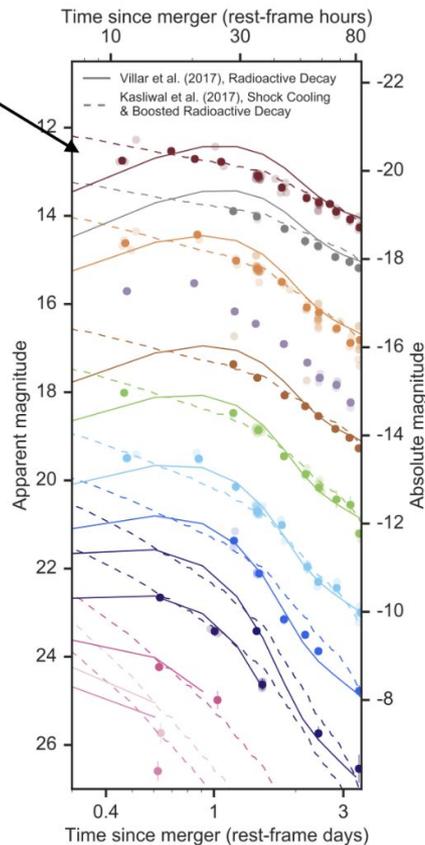
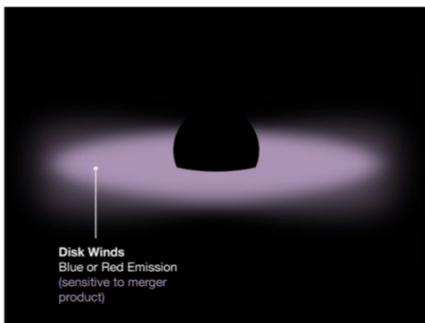


GW Counterparts are faint and fast

Early data can distinguish models.



Possible kilonova emission mechanisms



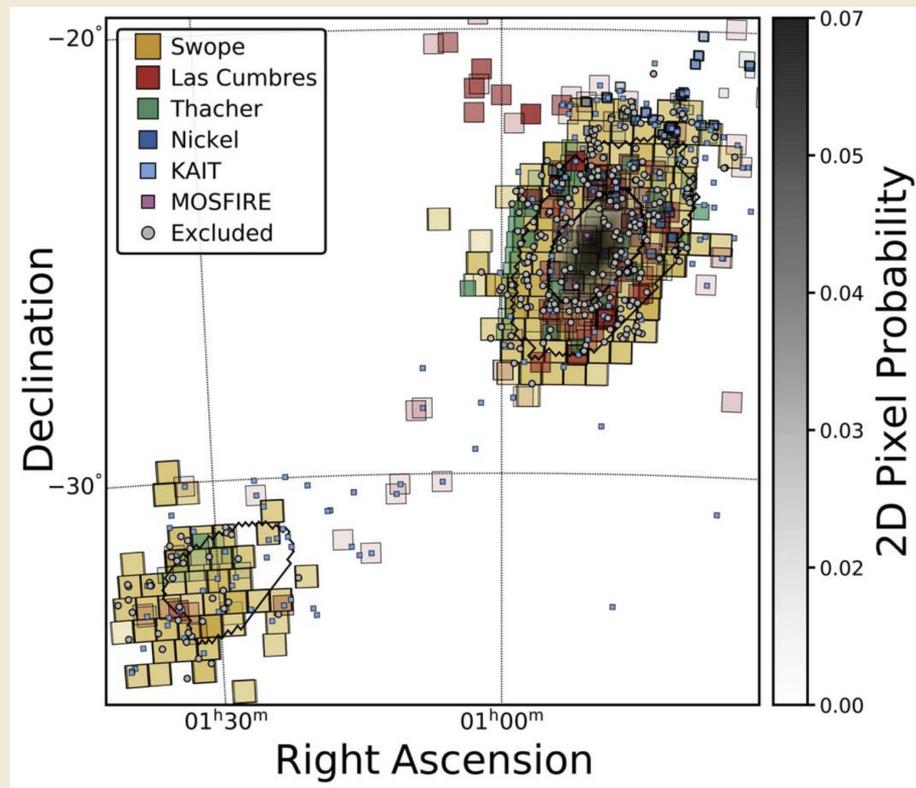
Science cases: r-process, neutron star equation of state, Hubble constant, explosion physics, etc etc.

Many viable candidates, but only one counterpart

GW190814:

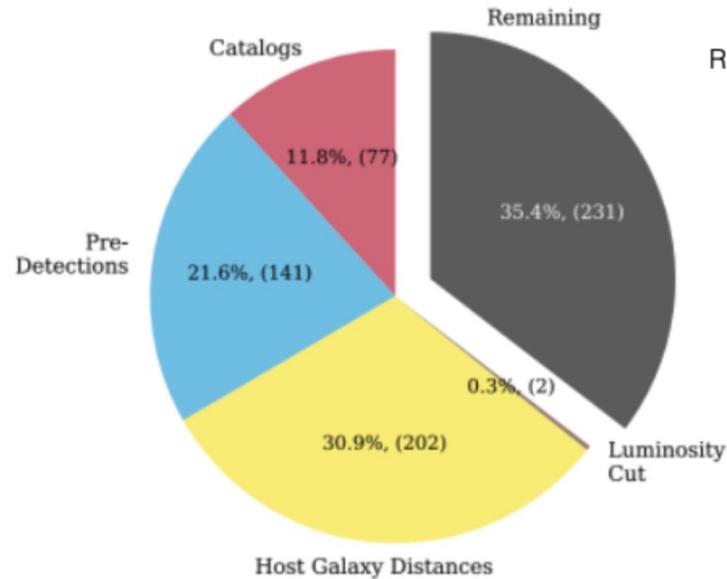
- NSBH merger
- 51 deg² localization

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



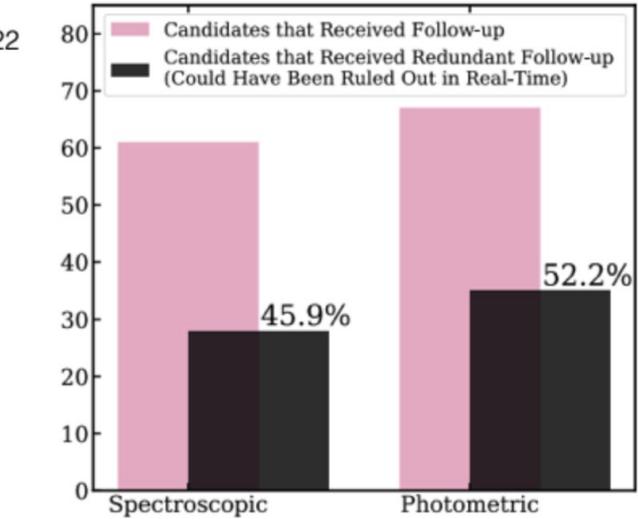
Many candidates can be ruled out before follow-up

Real-time Vetting of GW-EM Counterpart Candidates: Optimizing Follow-up Resources



Rastinejad+22

~65% of all O3 NS candidates culled



~50% of all candidates that received follow-up did not need it

One Solution? TROVE



Kate Alexander
University of Arizona



Azalee Bostrom
University of Arizona



Phil Daly
University of Arizona



Wen-fai Fong
Northwestern University



Noah Franz
University of Arizona



Griffin Hosseinzadeh
UC San Diego



Charlie Kilpatrick
Northwestern University



Jillian Rastinejad
University of Maryland



Manisha Shrestha
University of Arizona



Michael Lundquist
Keck Observatory



Conor Ransome
University of Arizona



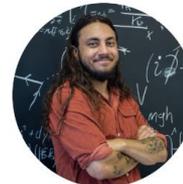
Bhagya Subrayan
University of Arizona



Kerry Paterson
Max Planck Institute for Astronomy



David Sand
University of Arizona



Nicholas Vieira
Northwestern University

University of Arizona

TROVE Overview

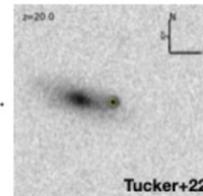
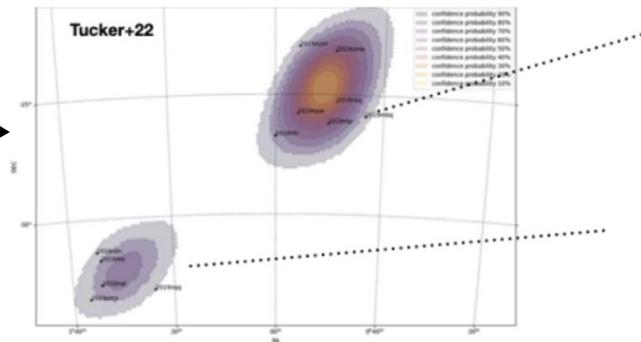


GW Alert and Localization

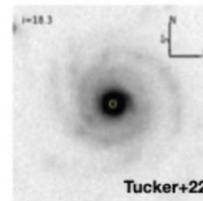


GW Candidate Follow-up & Vetting

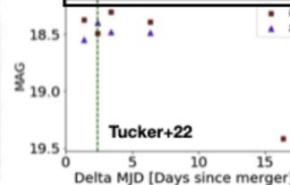
Many Viable Transients Within Localization



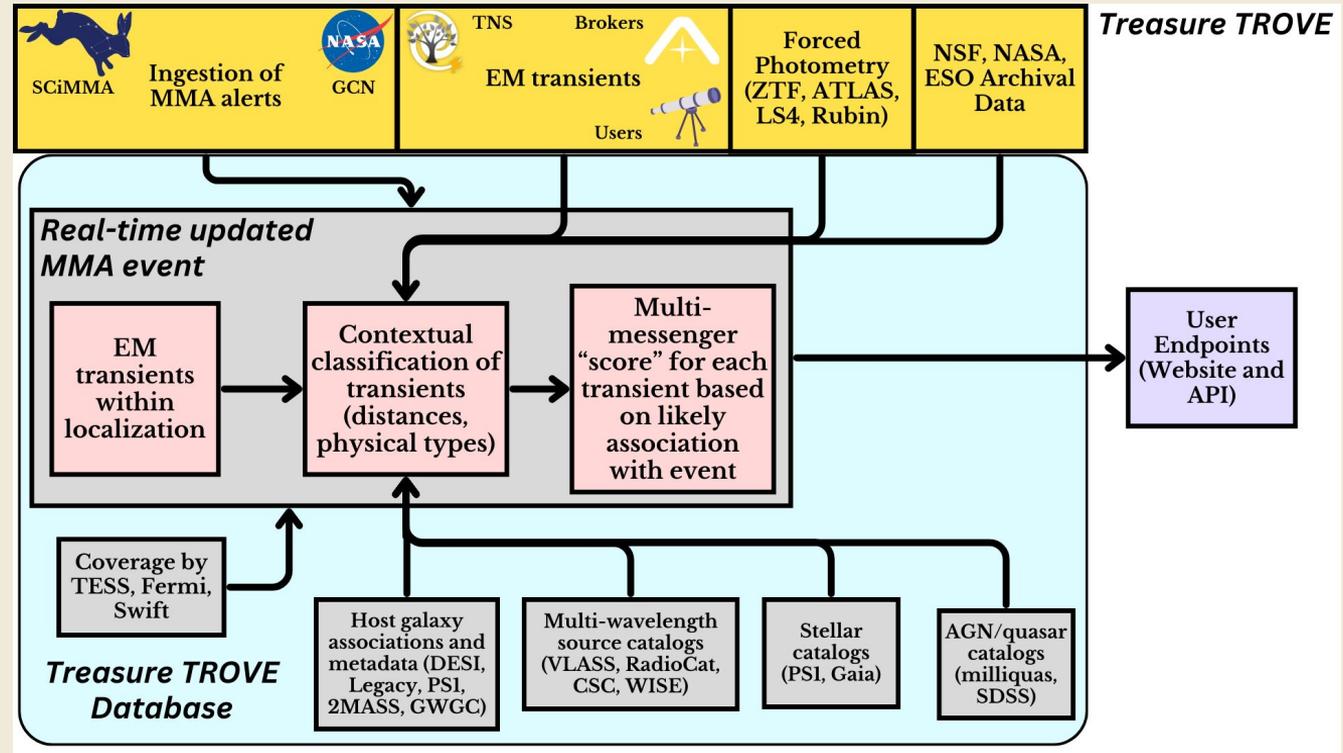
-Host at right distance
-No detection prior to merger
↳ High Score



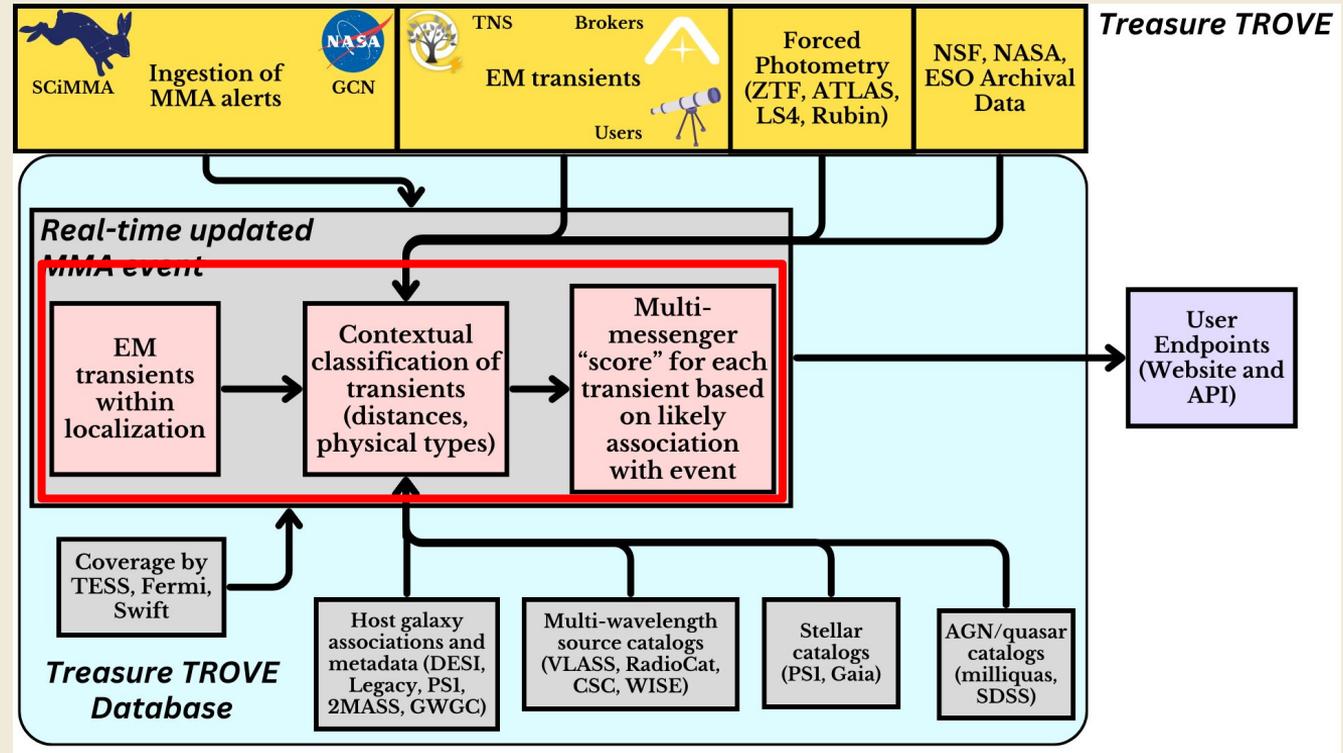
-Transient consistent with AGN position (NS merger)
-Detection prior to merger
↳ Low Score



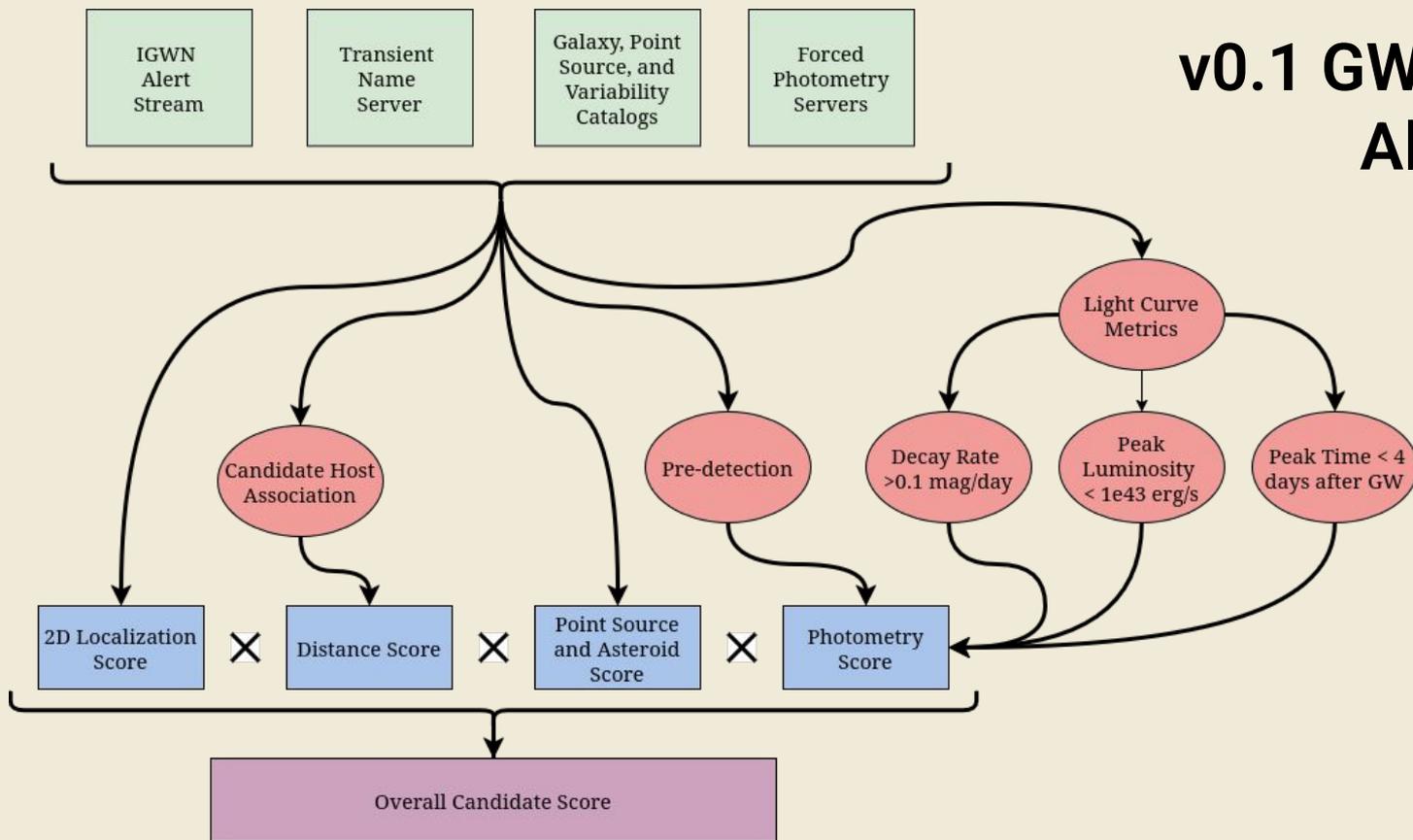
TROVE Overview



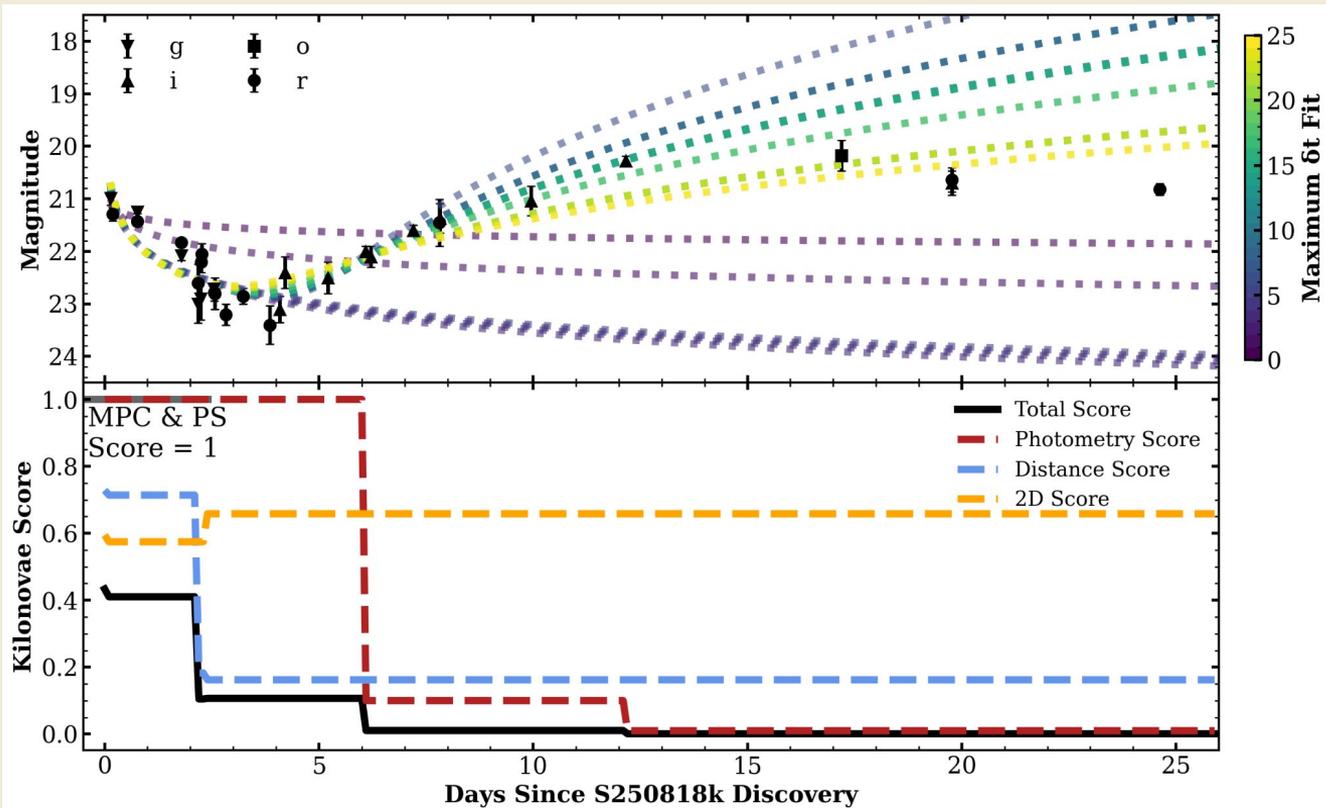
TROVE Overview



v0.1 GW Vetting Algorithm

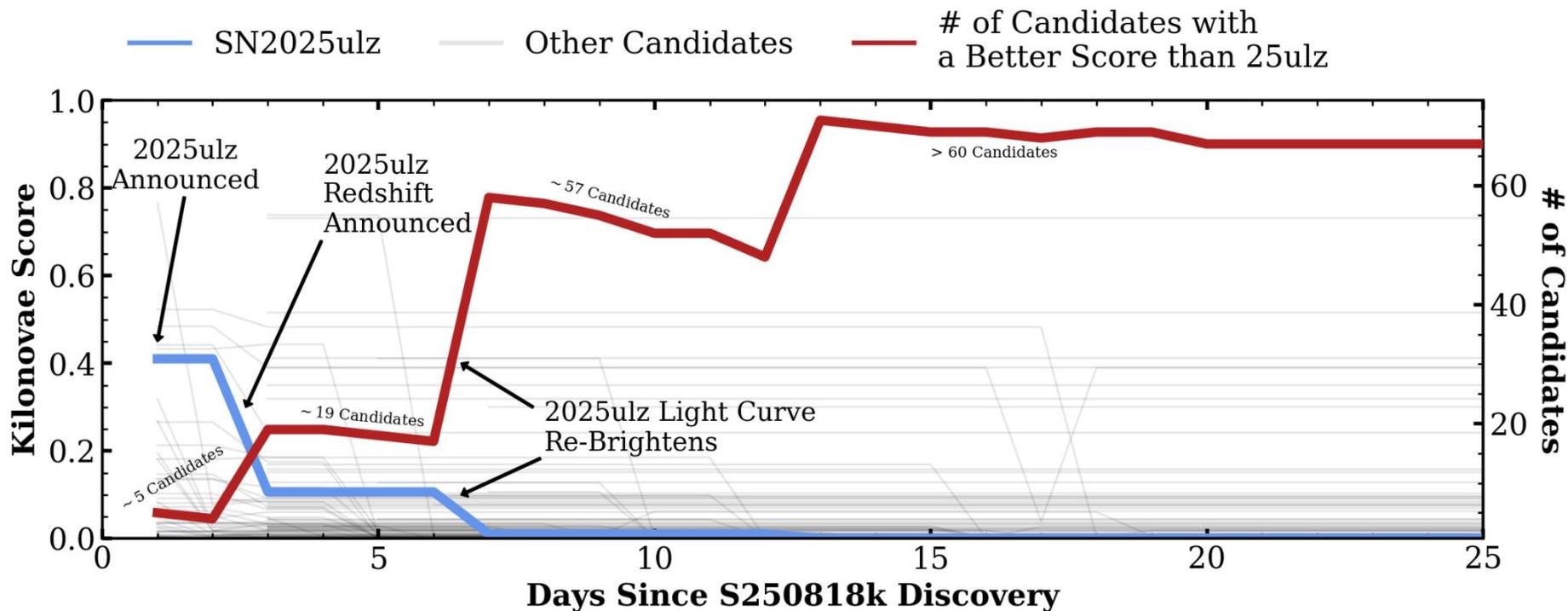


Application to 2025ulz



Franz+25
(Accepted)

Application to 2025ulz



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: 4.89×10^{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!

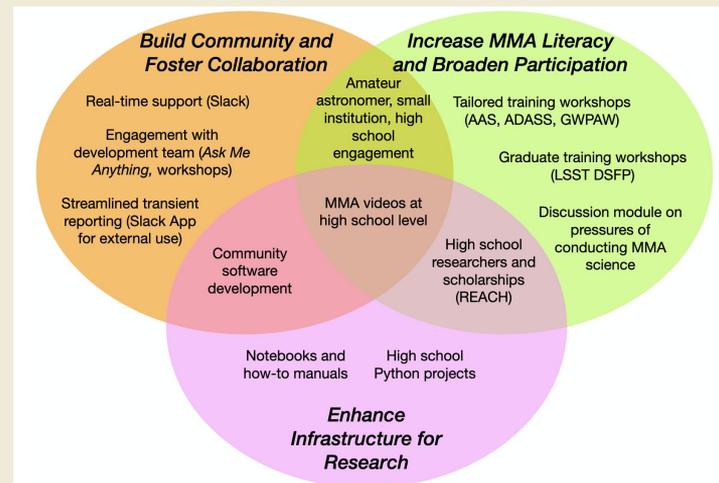


Checkout
Franz+2025
(Which was just
accepted!)



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
- 03/04 paper and neutrino paper



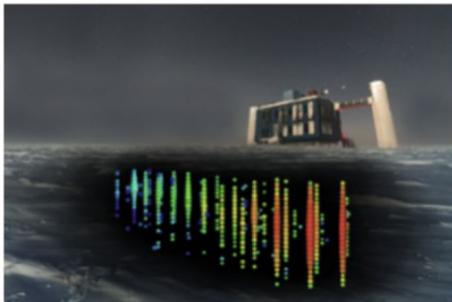
Extra Slides

TROVE Overview

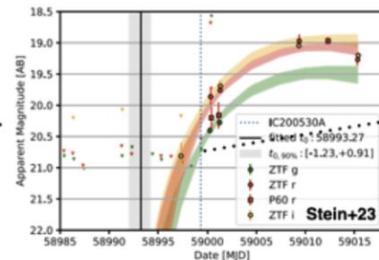
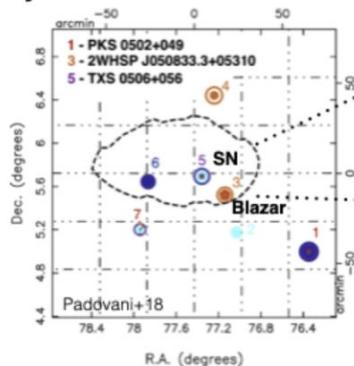


Neutrino Candidate Follow-up & Vetting

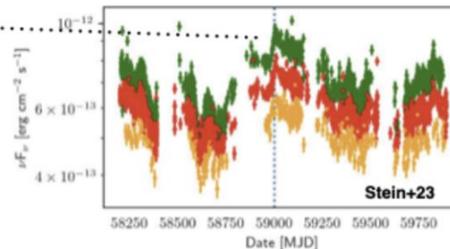
Neutrino Alert and Localization



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

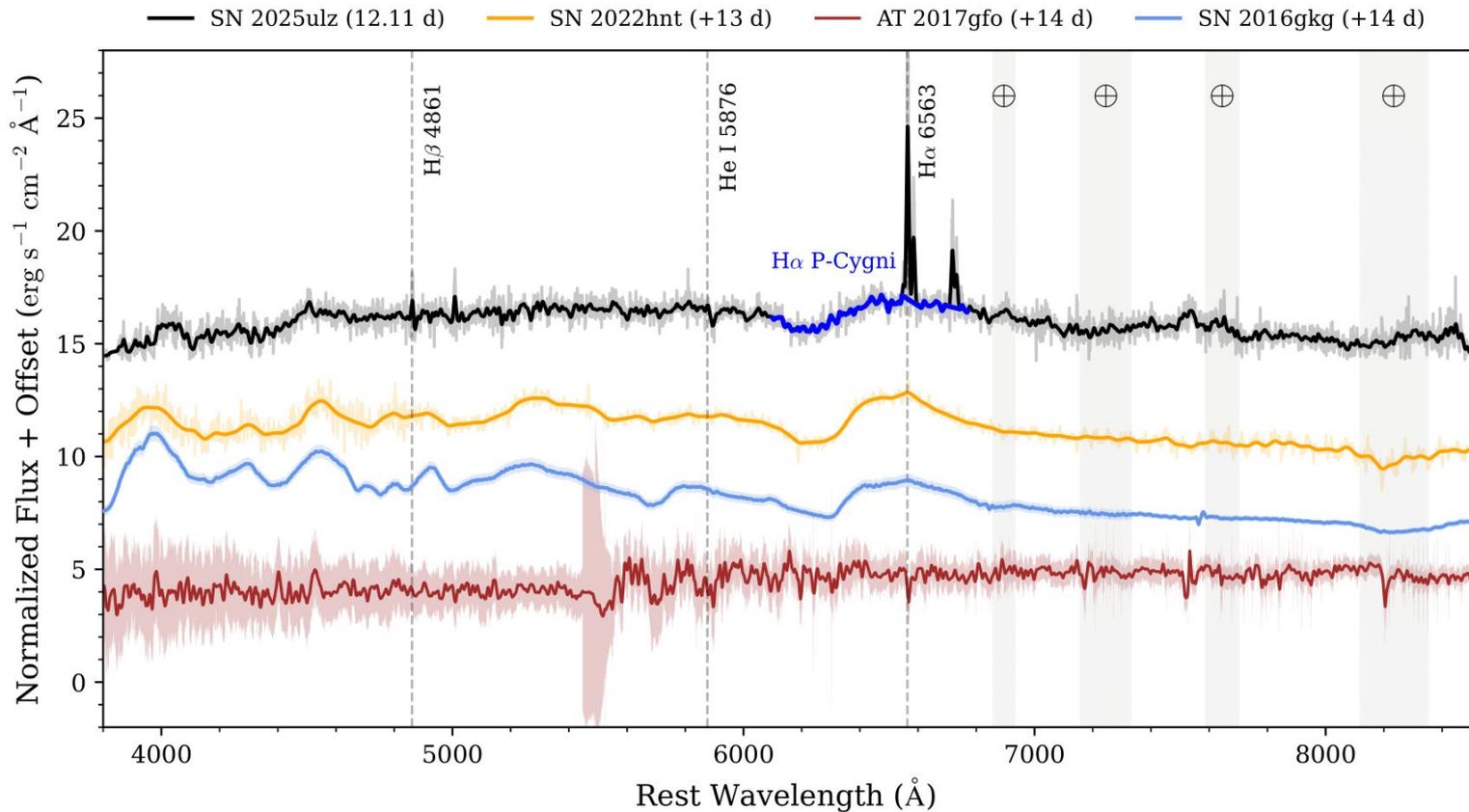


-Normal SN
-Detection Prior to
Neutrino
↳ Low Score



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

2025ulz Spectra



2025ulz Photometry

