

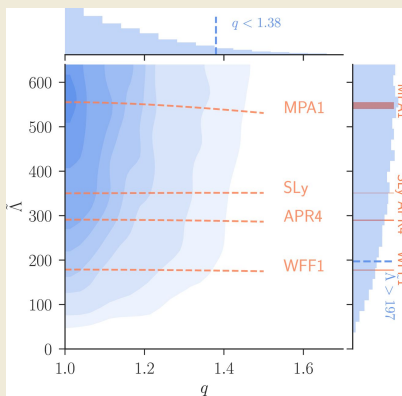
A Tool for Rapid Object Vetting and Examination

(TROVE)

Noah Franz
University of Arizona

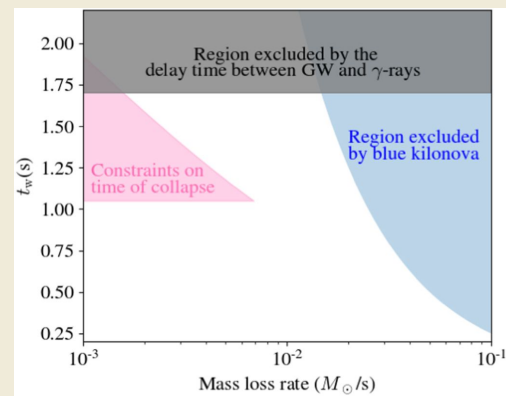
TDAMM 2025
Huntsville, AL



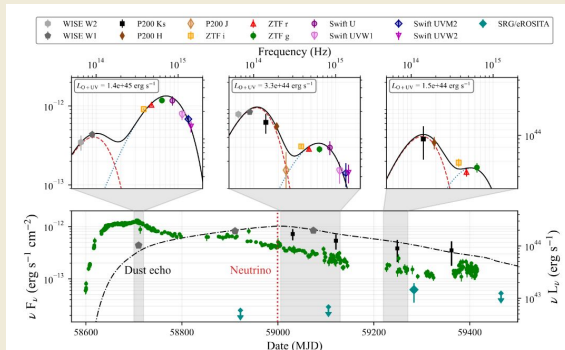


SGRB/Jet Constraints

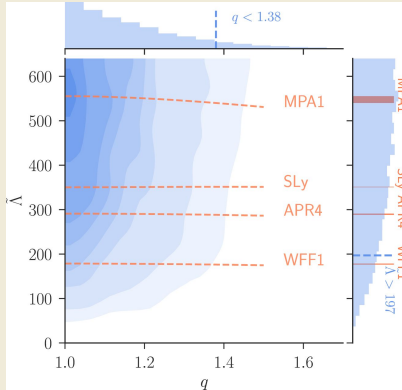
(e.g., Murguia-Berthier+17)



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



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

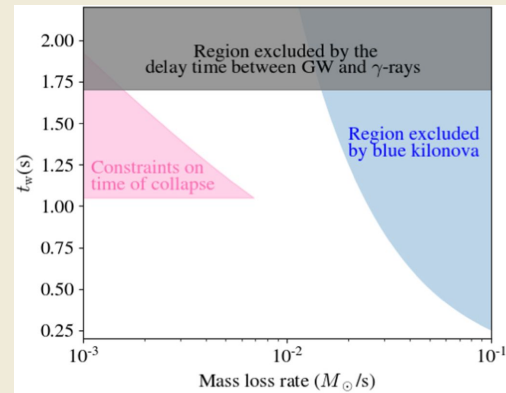


NS Constraints

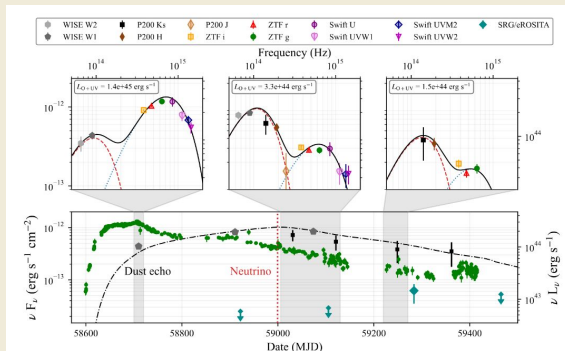
(e.g, Coughlin+18)

SGRB/Jet Constraints

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



...but they are hard to find!



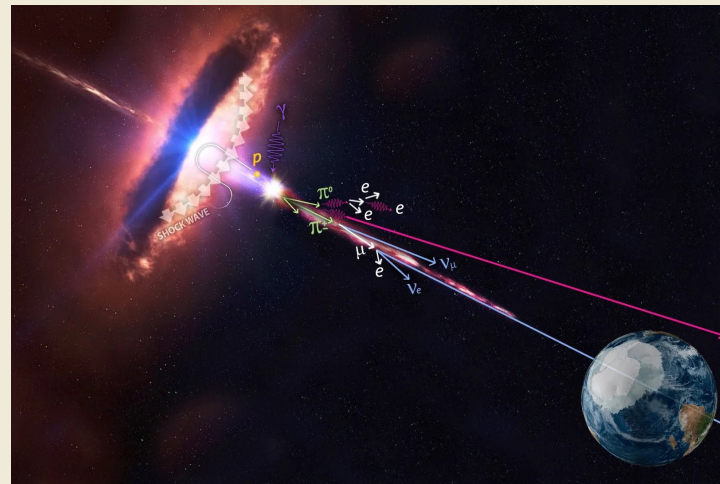
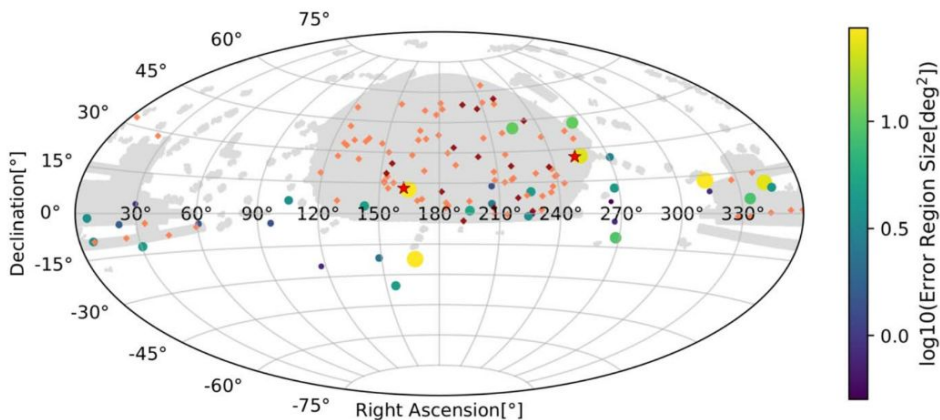
Extragalactic Neutrino
Sources

(e.g., Reusch+22)

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

In MMA we have many poorly localized events

Neutrinos

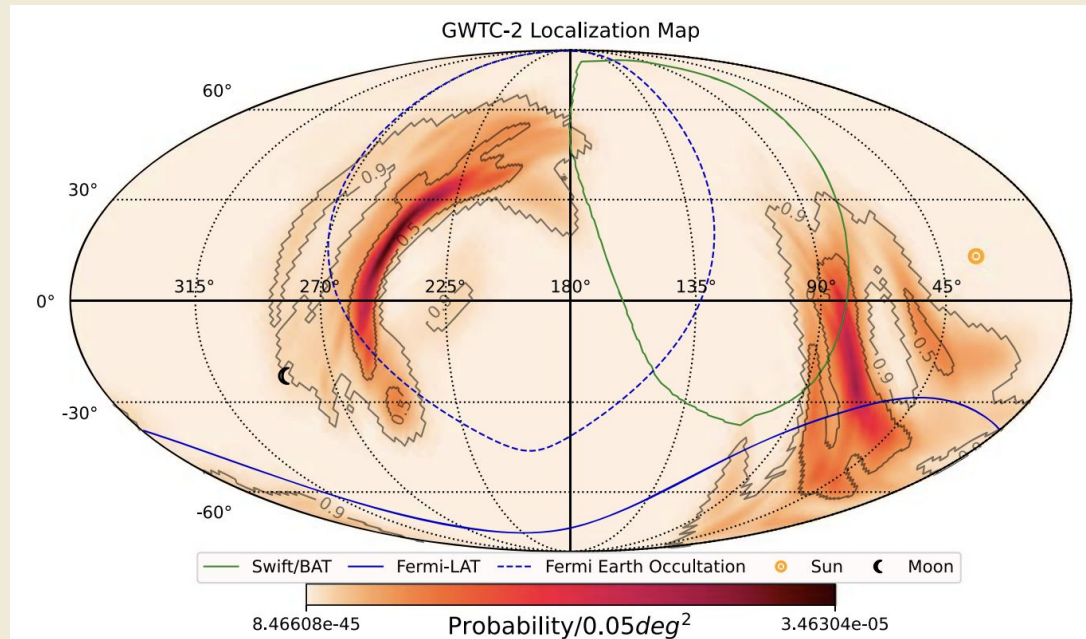


← Jiang+23

In MMA we have many poorly localized events

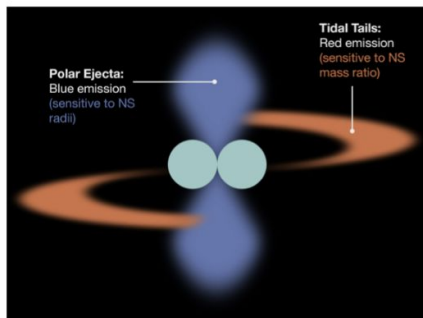
GW Events

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

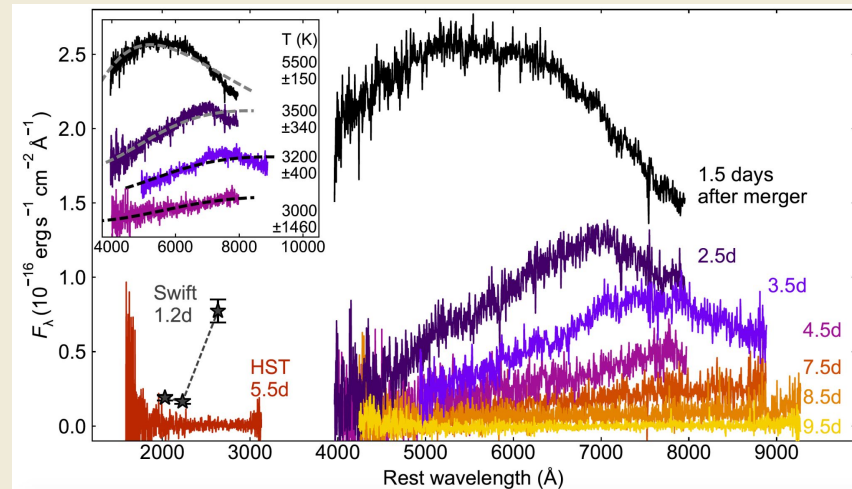
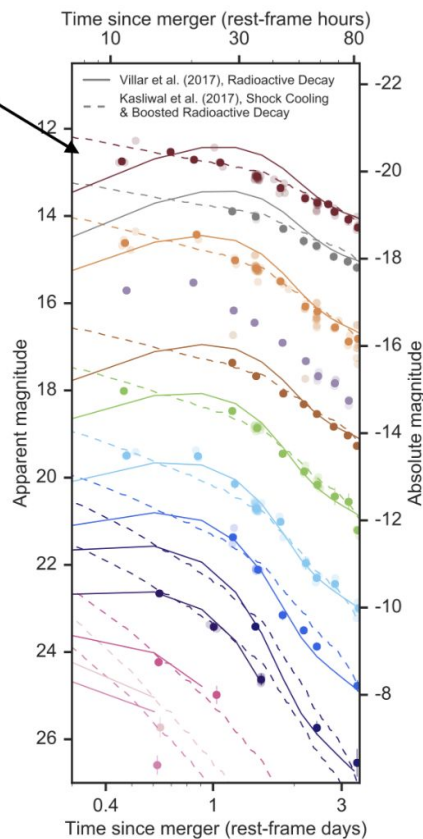
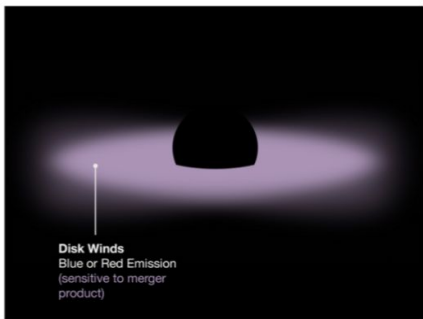


GW Counterparts are faint and fast

Early data can distinguish models.



Possible kilonova emission mechanisms



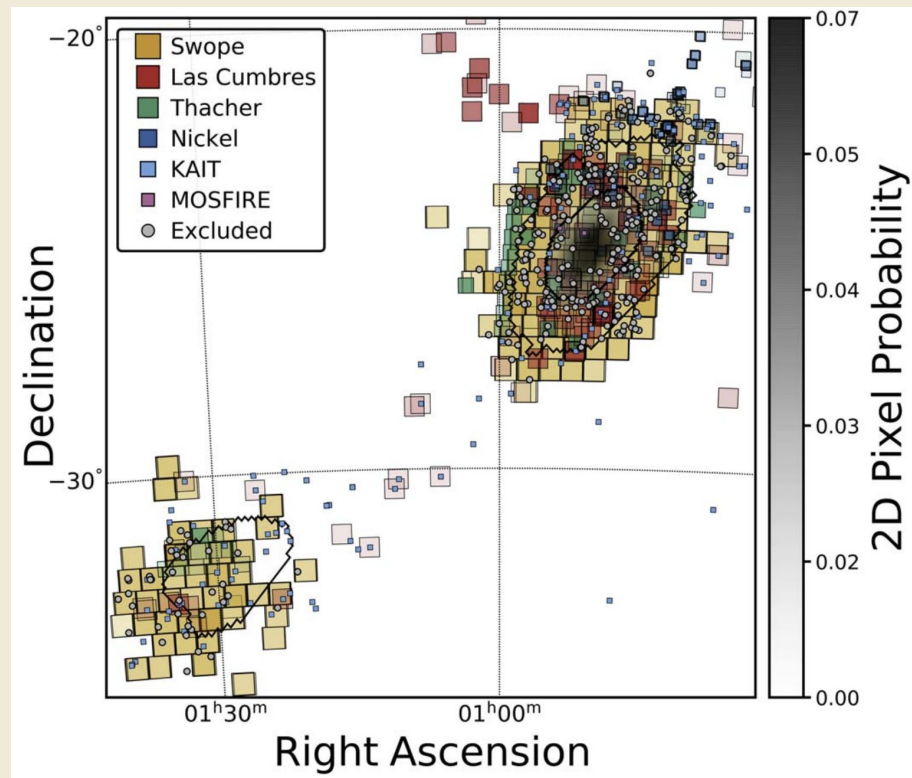
Science cases: r-process, neutron star equation of state, Hubble constant, explosion physics, etc etc.

Many viable candidates, but only one counterpart

GW190814:

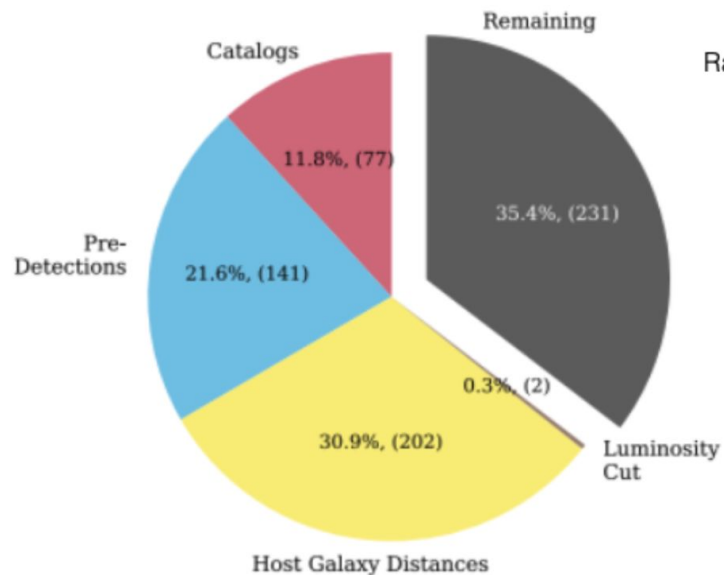
- NSBH merger
- 51 deg² localization

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

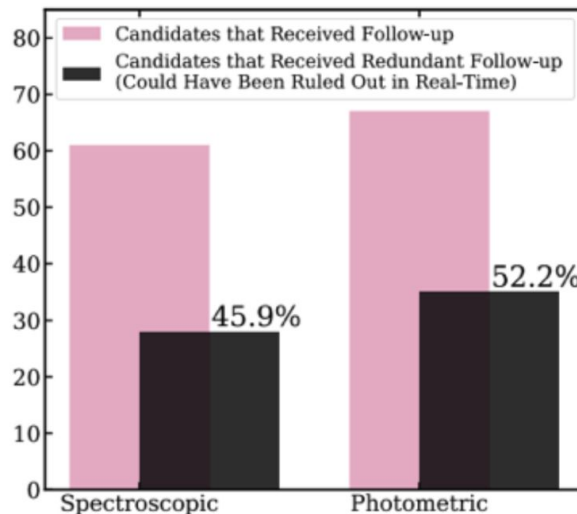


Many candidates can be ruled out before follow-up

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



~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 Bostroem
University of Arizona



Phil Daly
University of Arizona



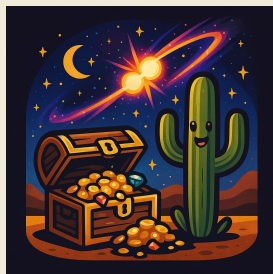
Wen-fai Fong
Northwestern University



Noah Franz
University of Arizona



Griffin Hosseinzadeh
UC San Diego



A result of the 2nd
TDAMM!



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

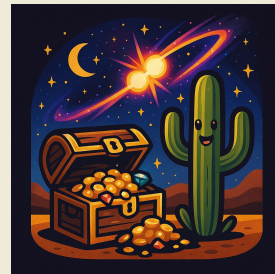


David Sand
University of Arizona



Nicholas Vieira
Northwestern University

TROVE Overview

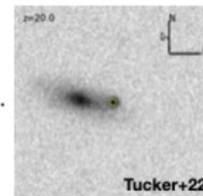
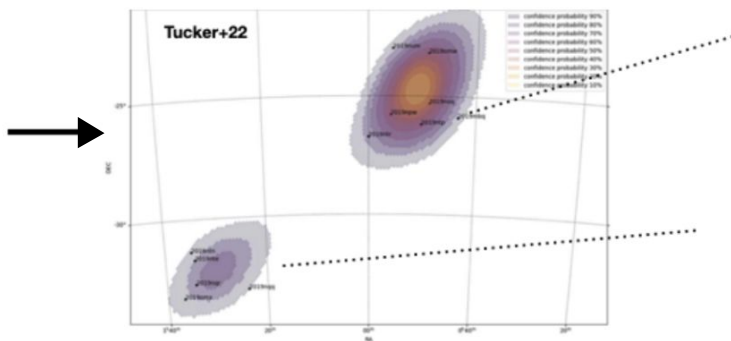


GW Alert and Localization

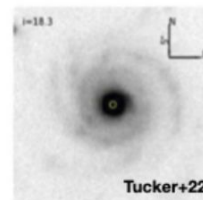


GW Candidate Follow-up & Vetting

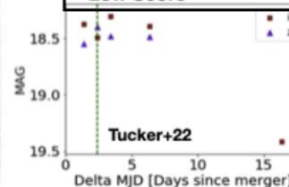
Many Viable Transients Within Localization



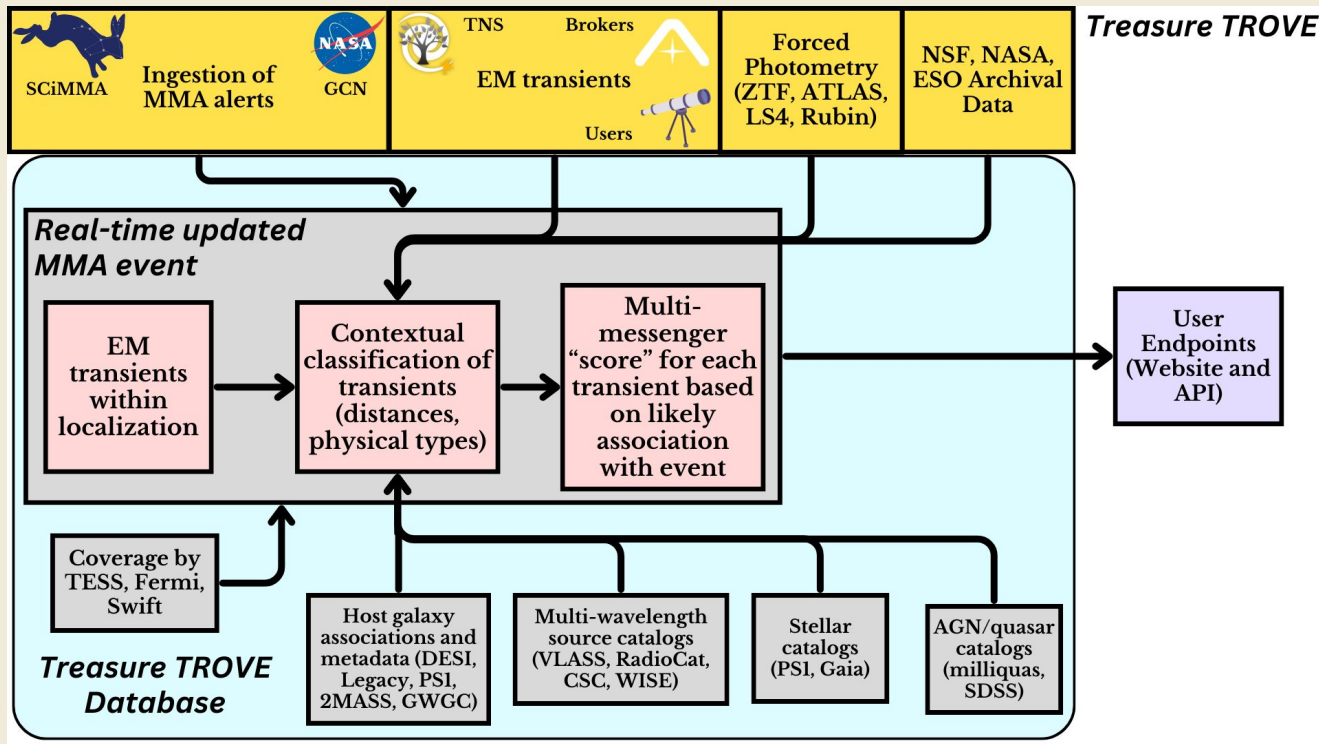
-Host at right distance
-No detection prior to merger
↳ High Score



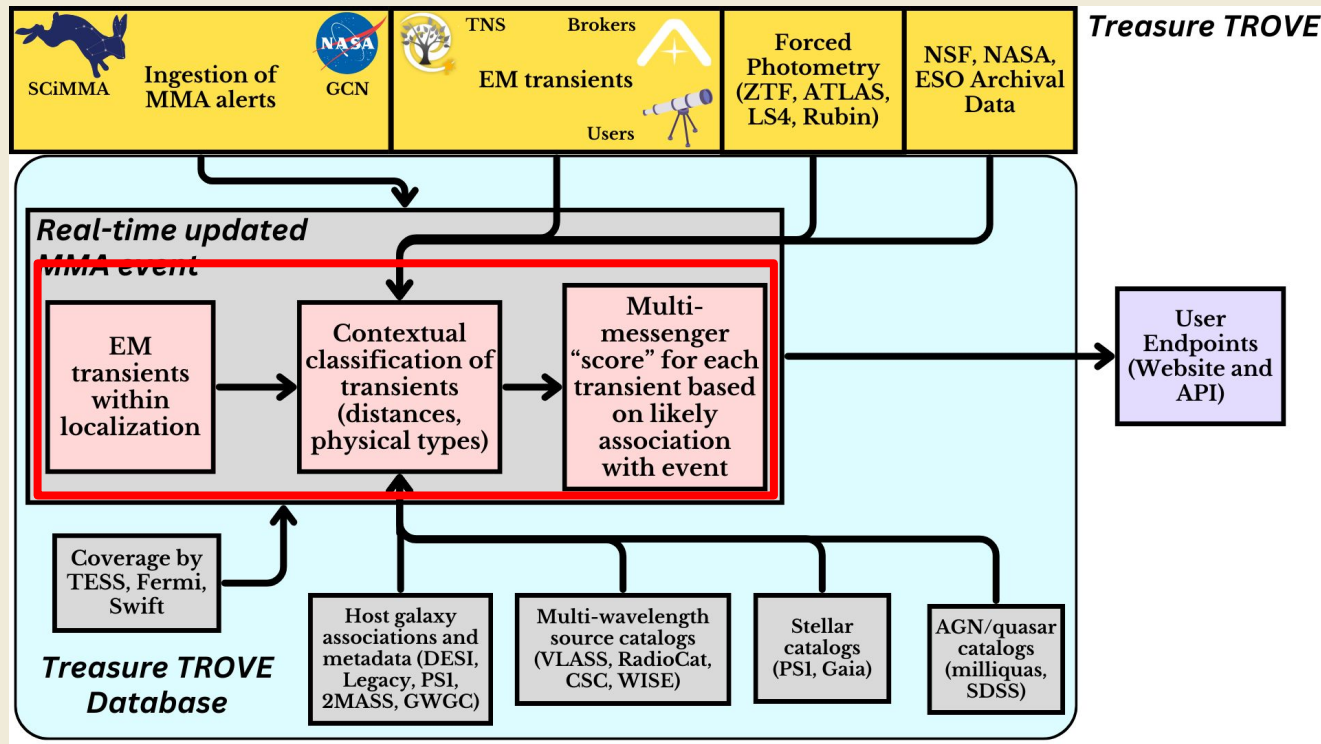
-Transient consistent with AGN position (NS merger)
-Detection prior to merger
↳ Low Score

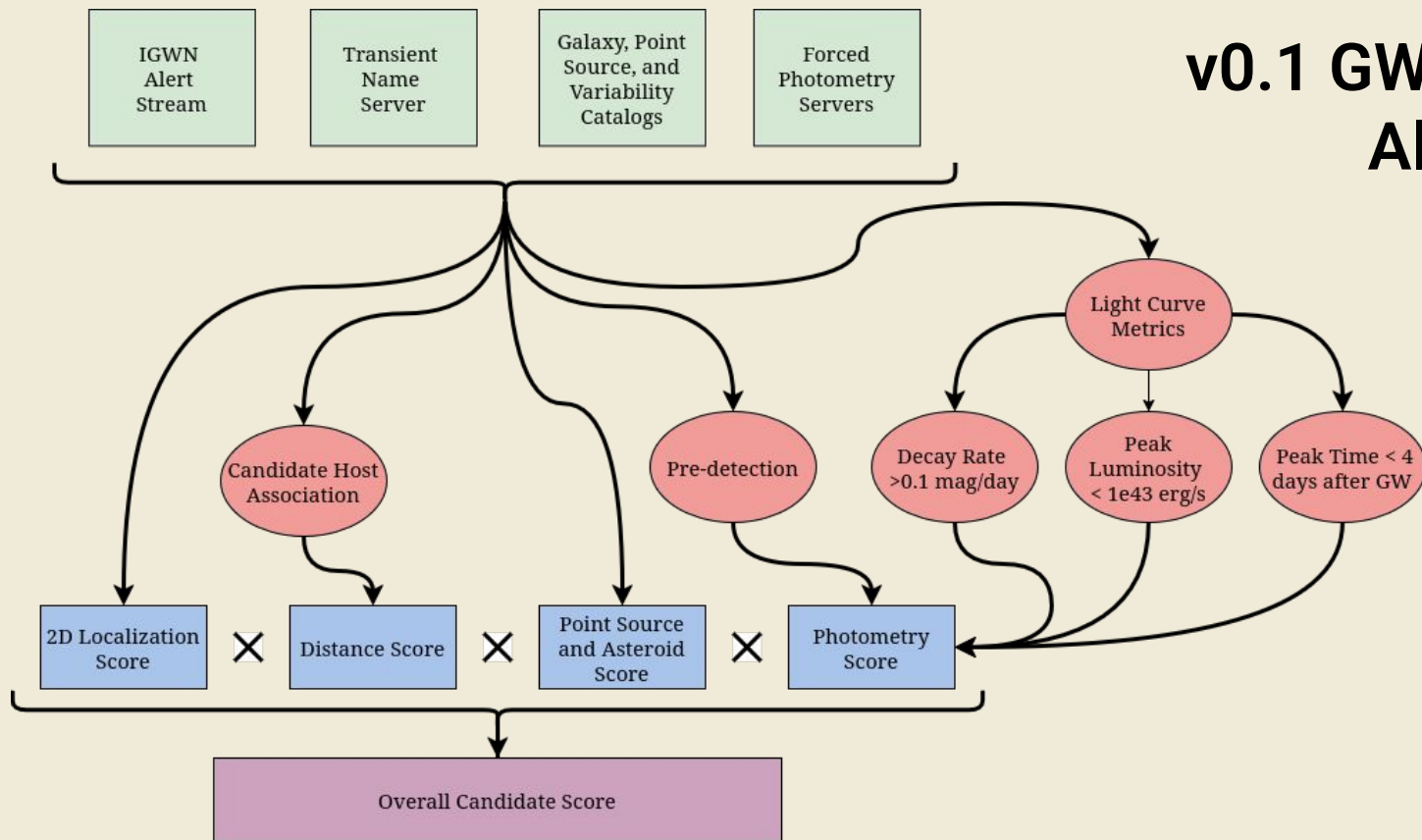


TROVE Overview



TROVE Overview



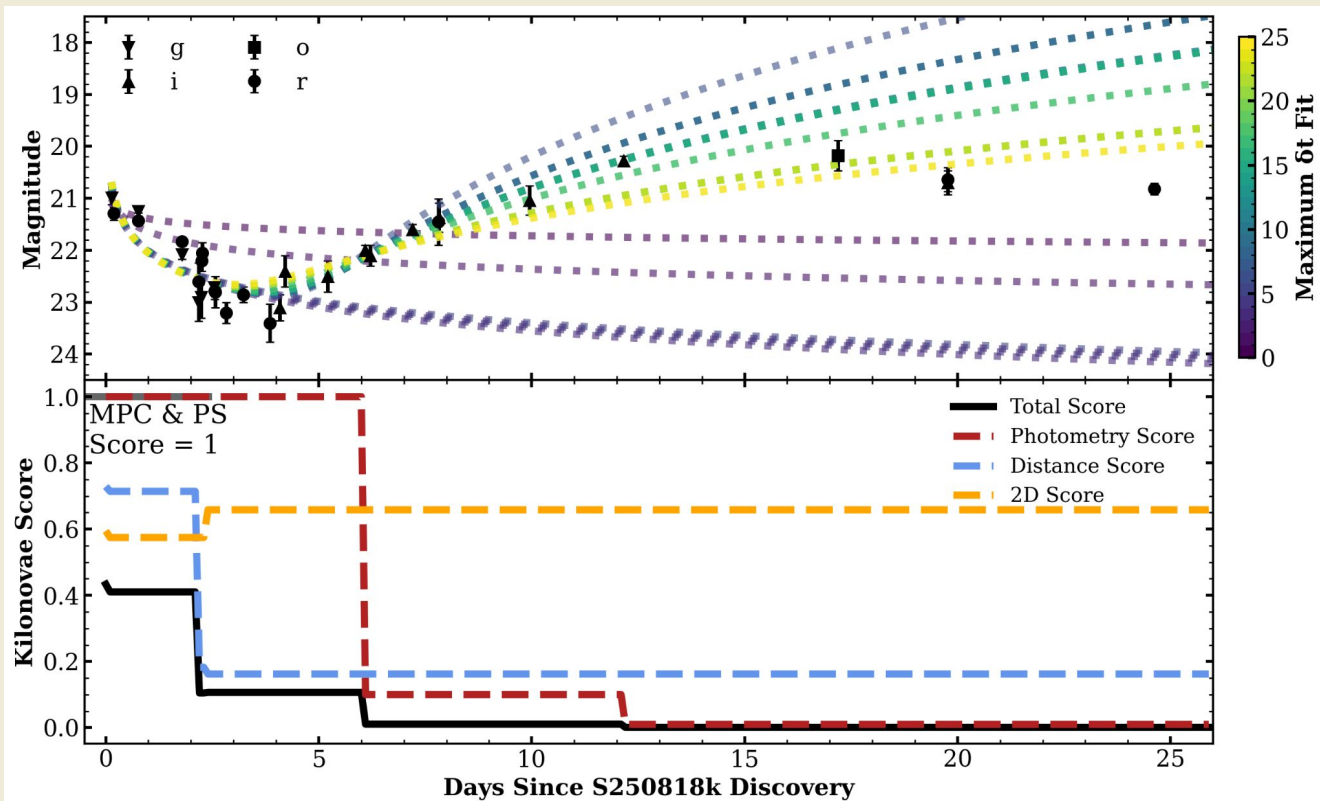


v0.1 GW Vetting Algorithm



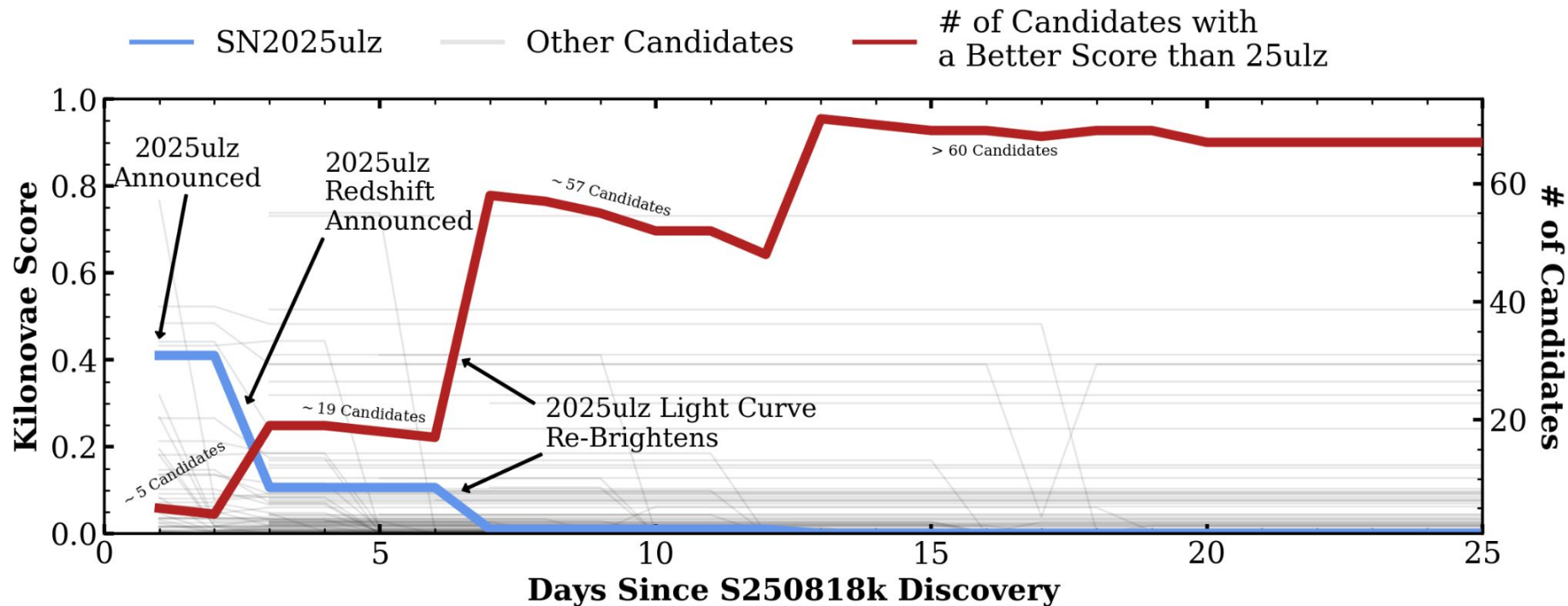
Franz+25
(Accepted)

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!

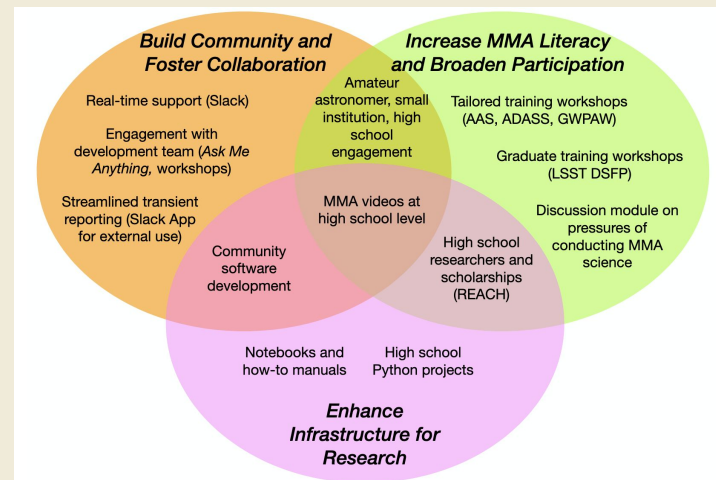


Checkout
Franz+2025
(Which was just
accepted!)



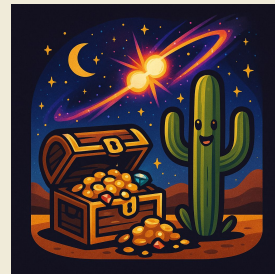
What to expect in the next year

- 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



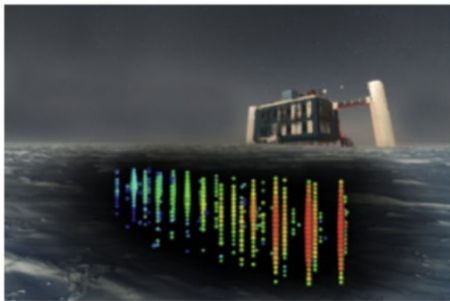
Extra Slides

TROVE Overview

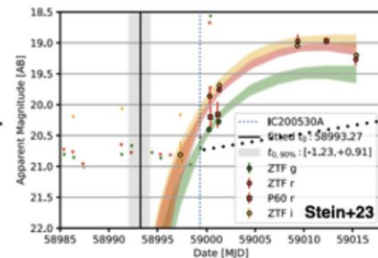
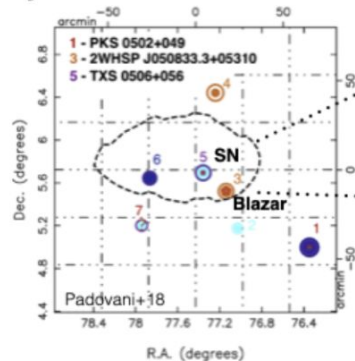


Neutrino Candidate Follow-up & Vetting

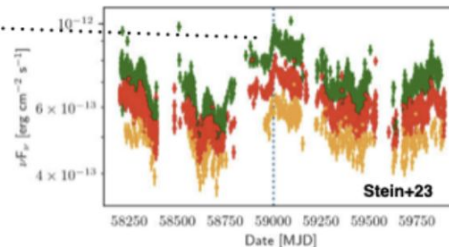
Neutrino Alert and Localization



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

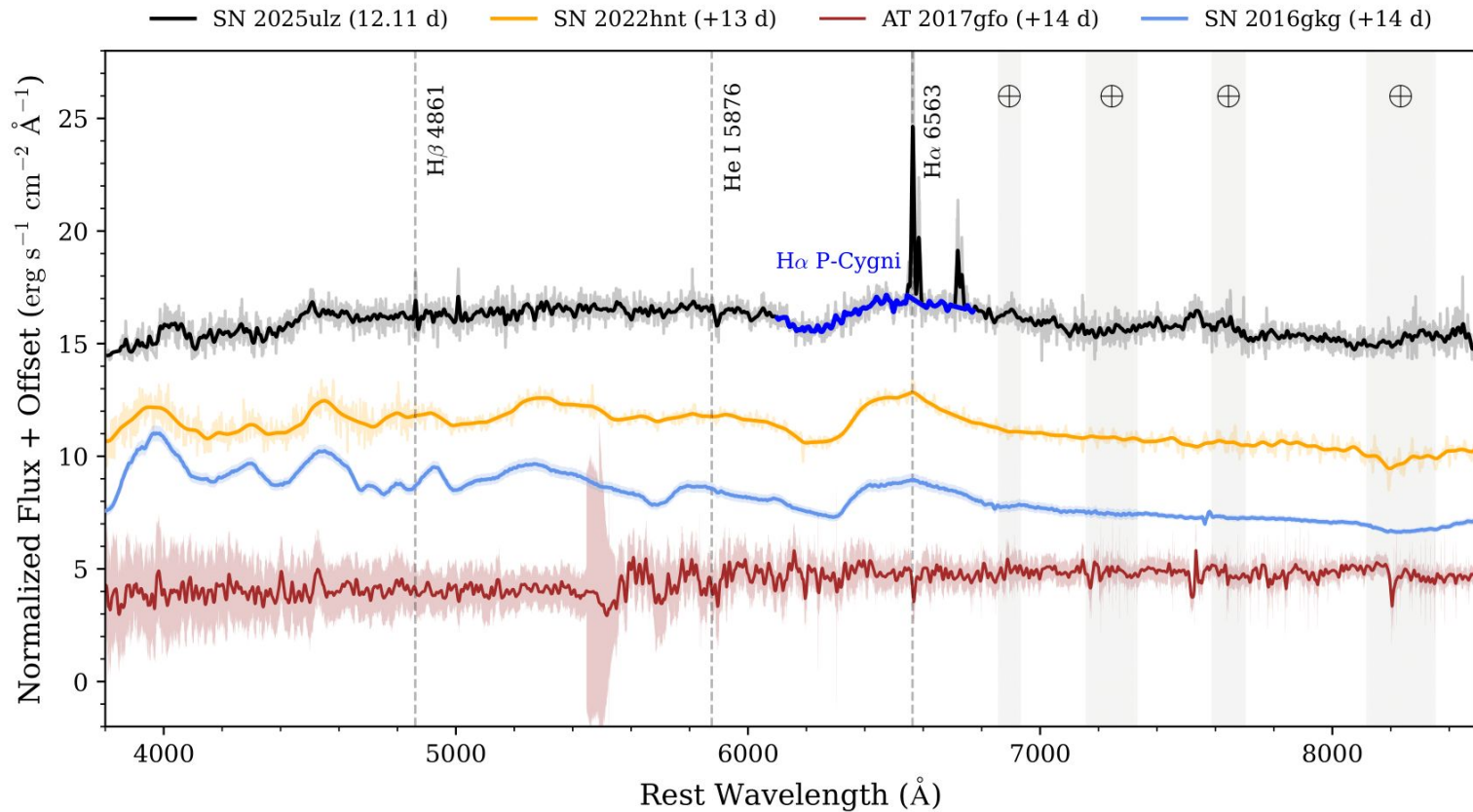


-Normal SN
-Detection Prior to Neutrino
↳ Low Score



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

2025ulz Spectra



2025ulz Photometry

