

Mansi M. Kasliwal

Professor of Astronomy

California Institute of Technology

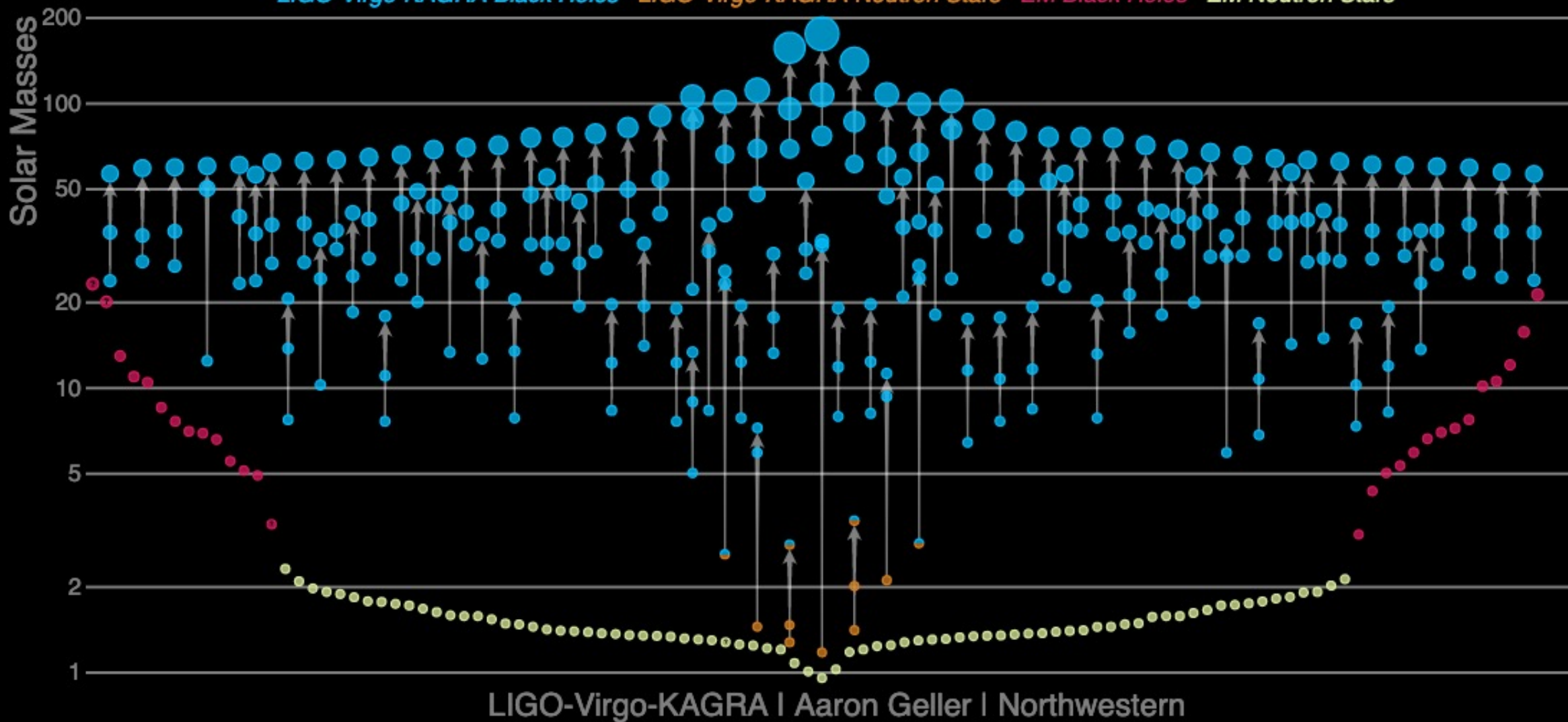


UVEX MMA Team

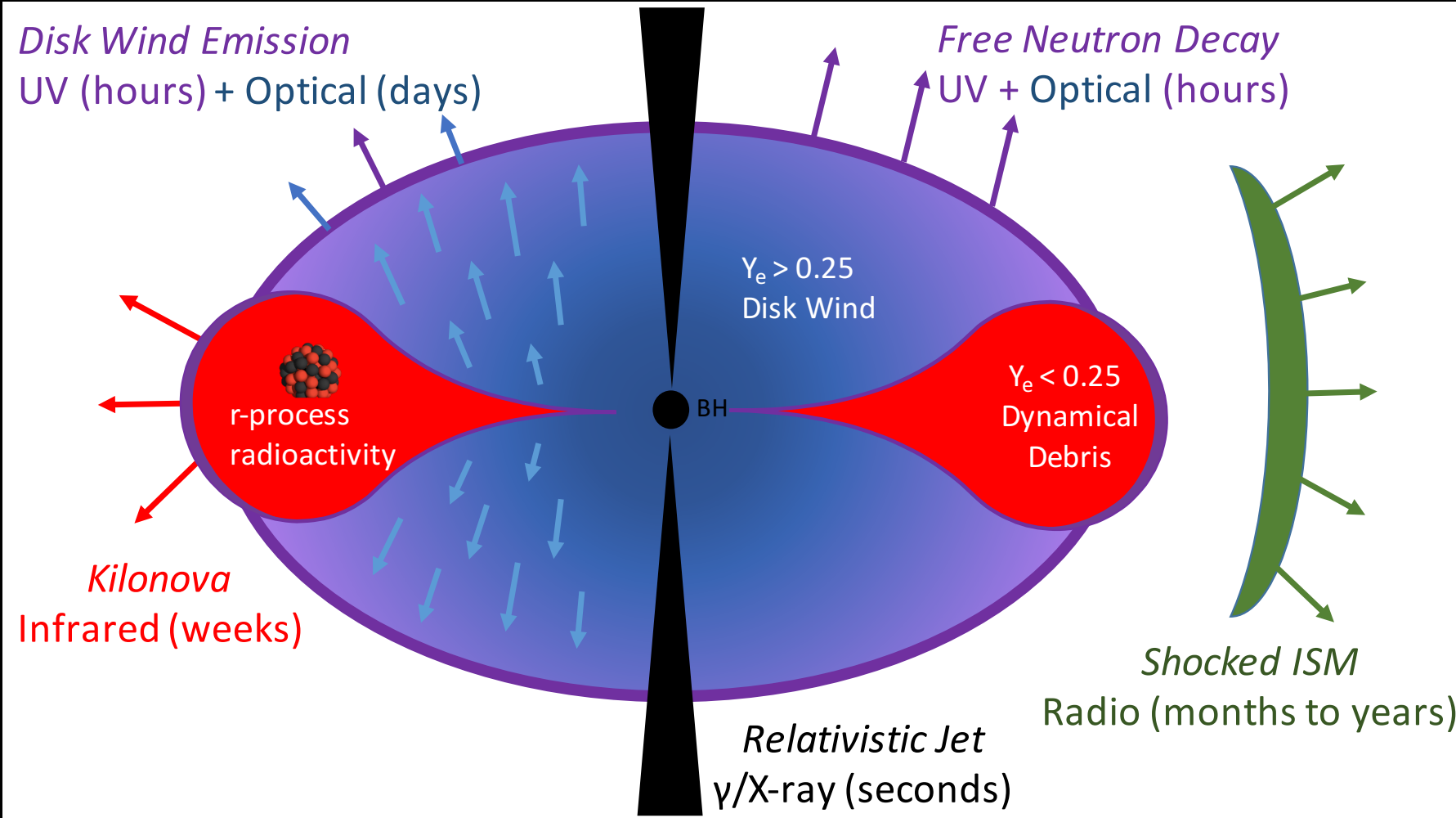
- Brad Cenko
- Michael Coughlin
- **Alexander Criswell**
- Leo Singer
- Samaya Nissanke
- **Geert Raaijmakers**
- Igor Andreoni
- Tony Piro
- Matthew Graham
- Dan Stern

Masses in the Stellar Graveyard

LIGO-Virgo-KAGRA Black Holes LIGO-Virgo-KAGRA Neutron Stars EM Black Holes EM Neutron Stars



Even before GW170817



The Majestic GW170817

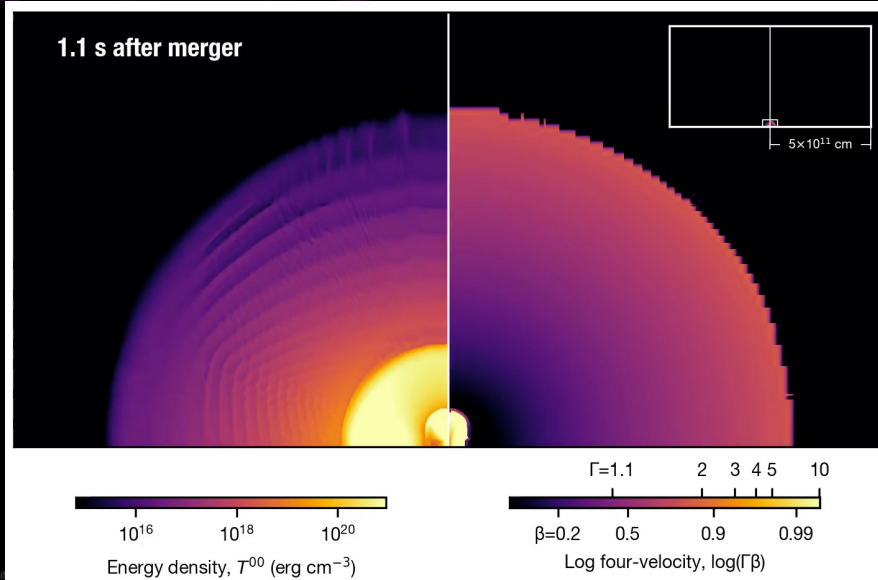


Element Origins

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
87 Fr	88 Ra																
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
		89 Ac	90 Th	91 Pa	92 U												

Merging Neutron Stars Exploding Massive Stars Big Bang
Dying Low Mass Stars Exploding White Dwarfs Cosmic Ray Fission

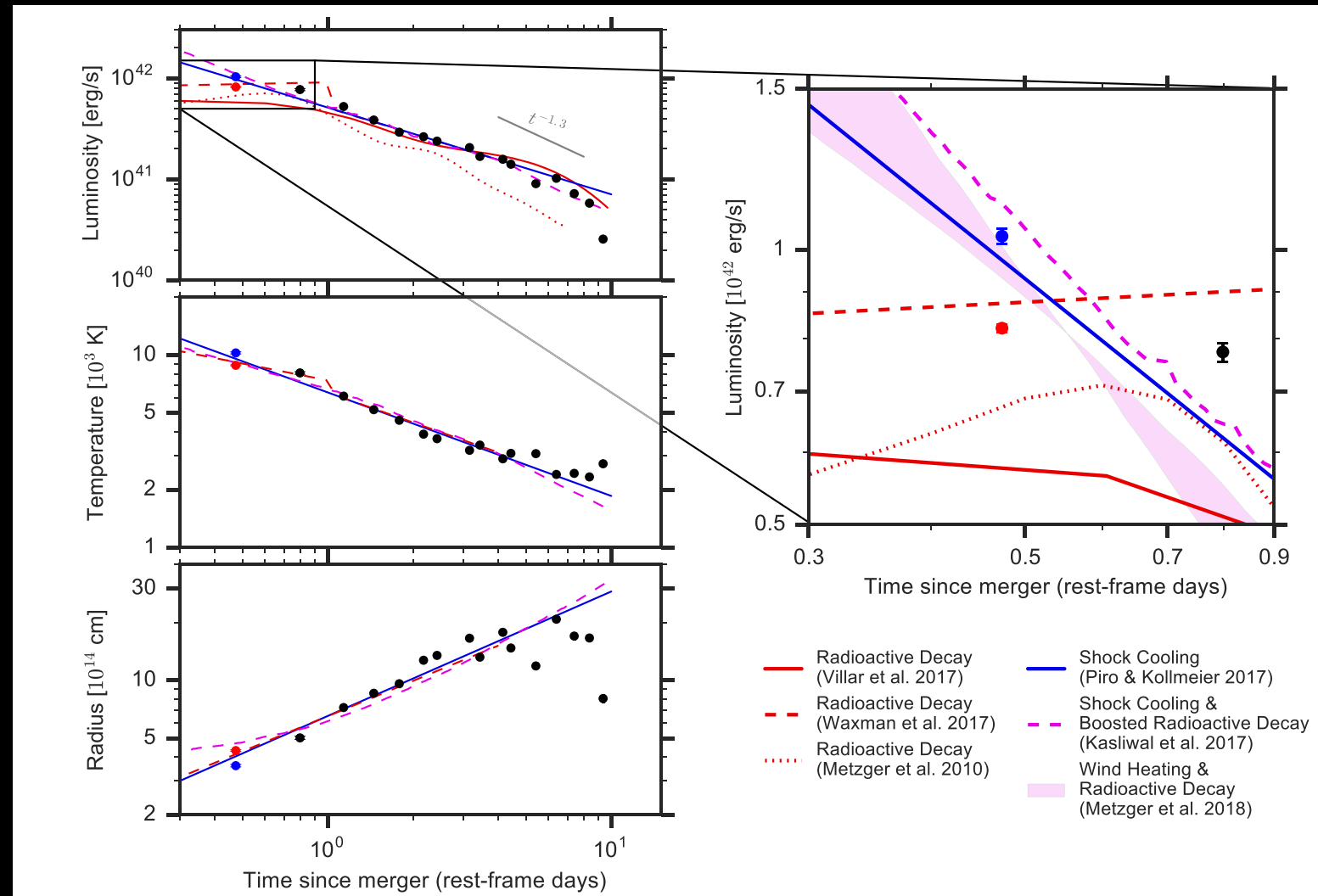
r-process nucleosynthesis - yellow



Simulation by Udi Nakar & Ore Gottlieb

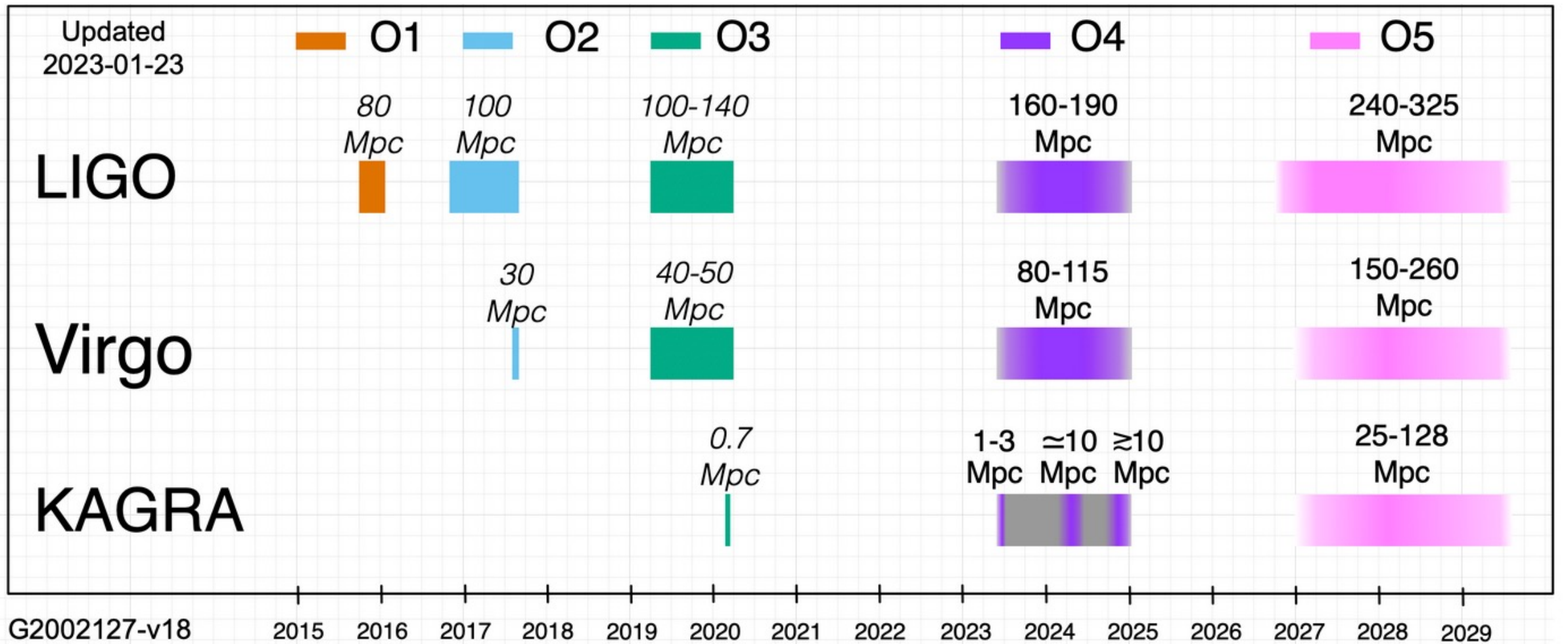
Kasliwal et al. 2017c

Early Time is Key

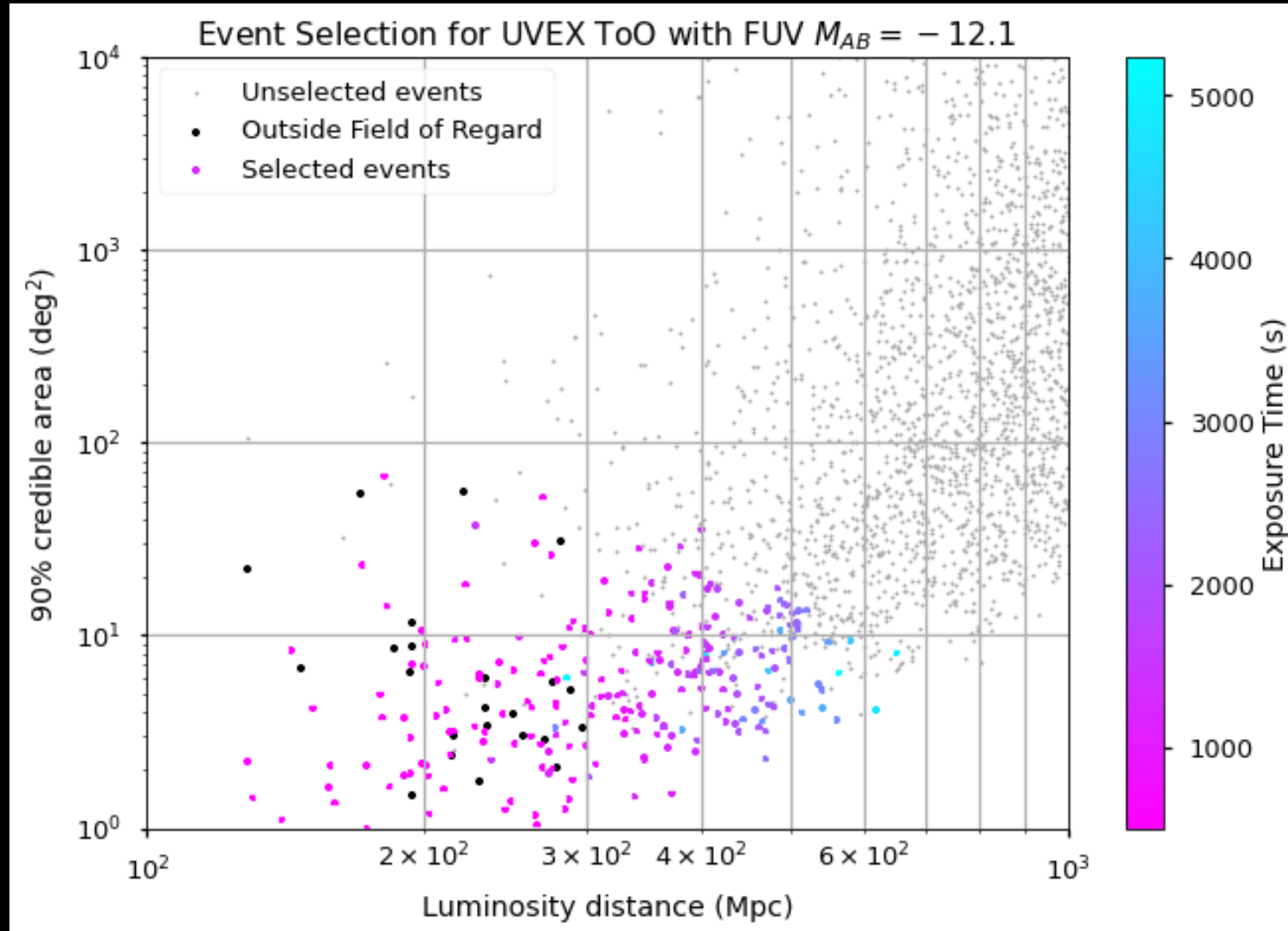


Arcavi (2018)

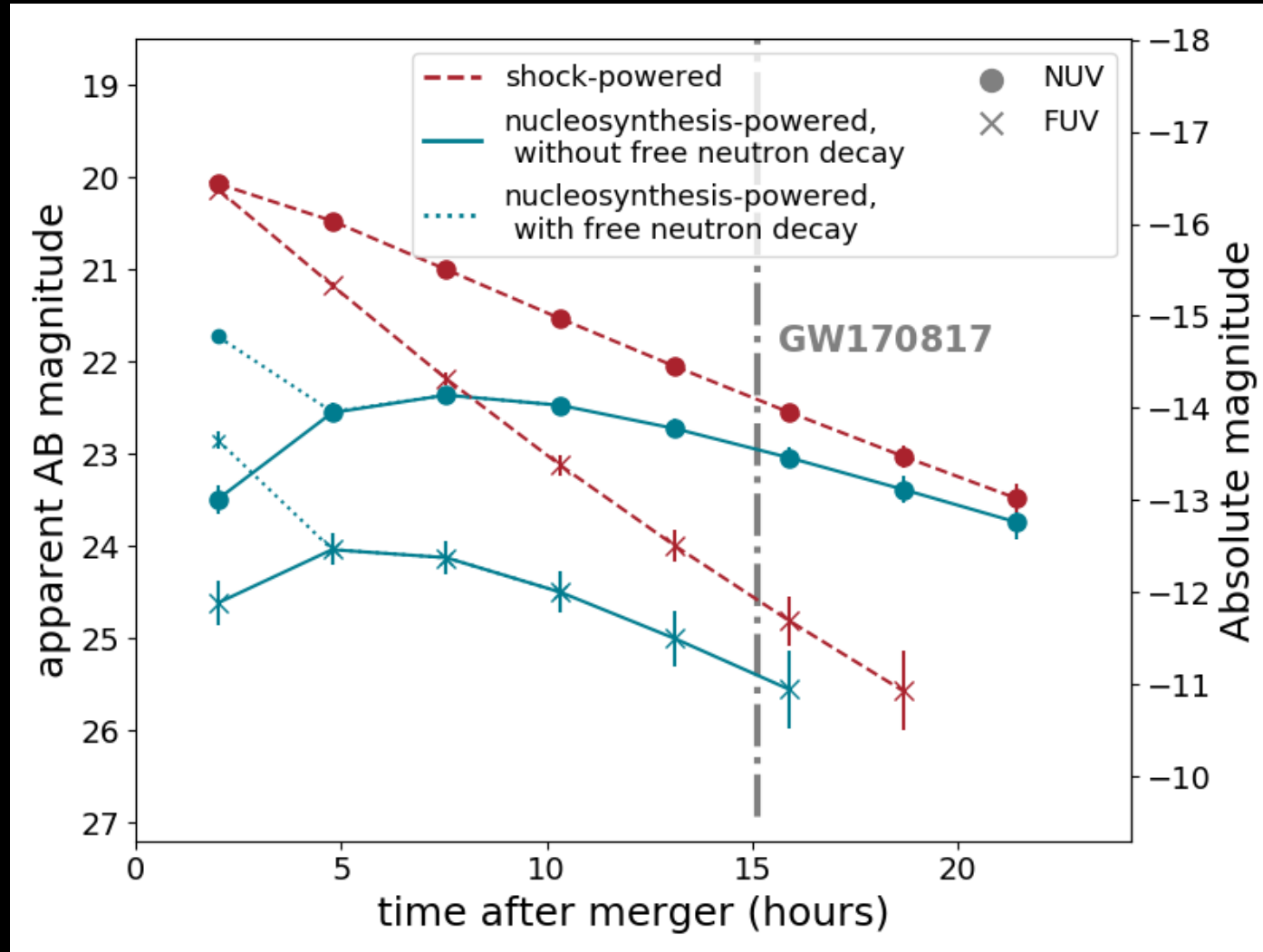
New UV Opportunity in O5



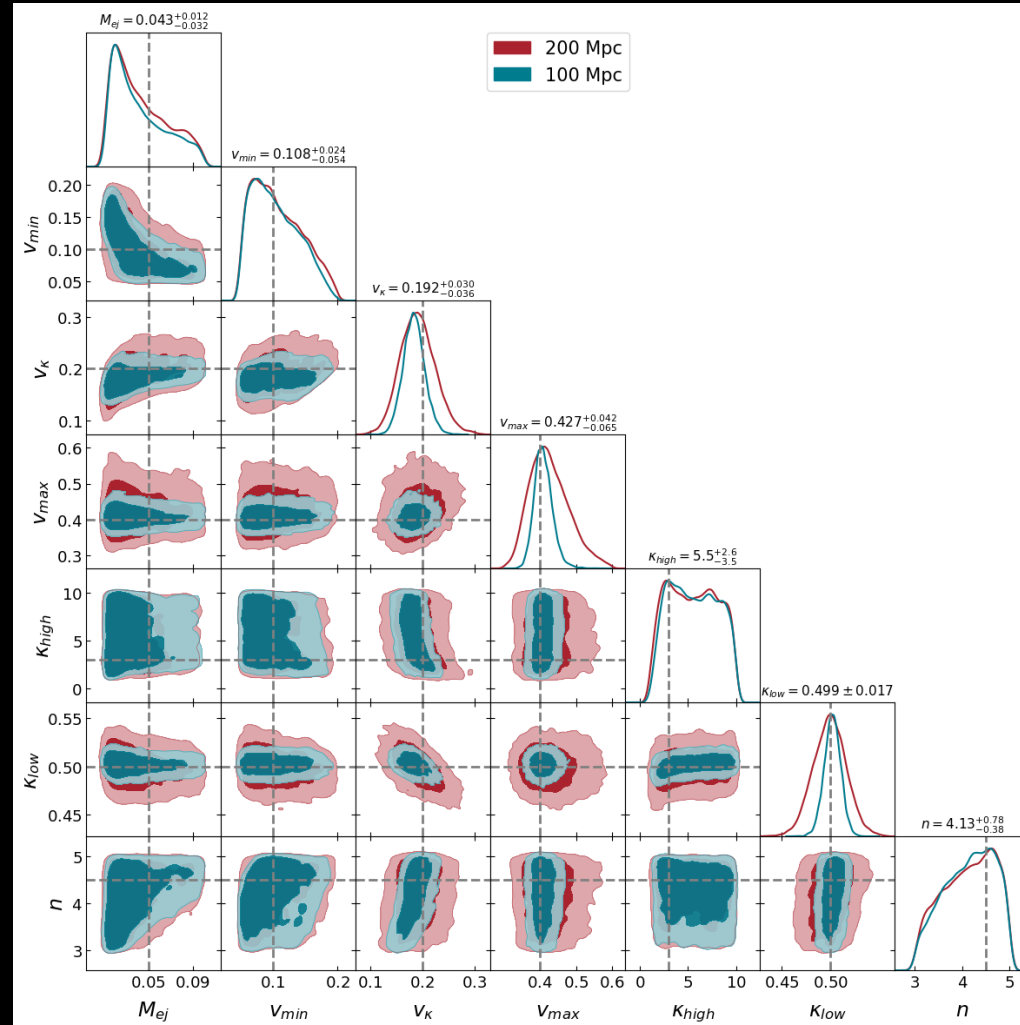
Simulations I: Selecting GW triggers



Simulations II: Distinguishing Models



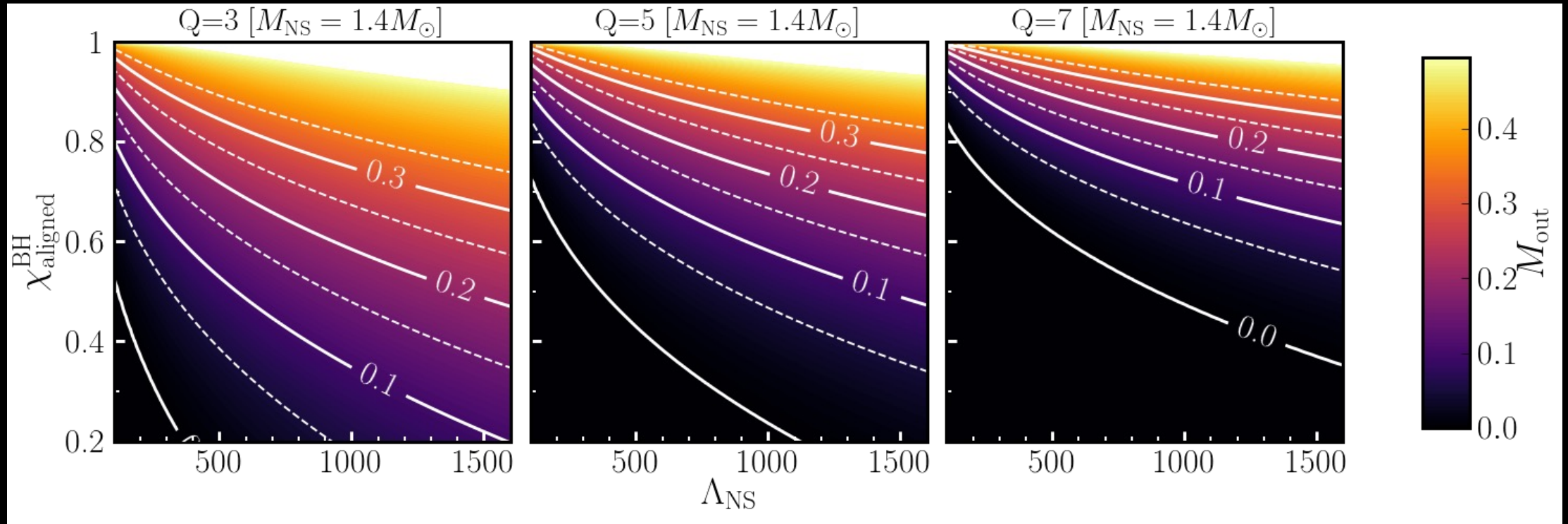
Simulations III: Constraining Parameters



Neutron Star + Black Hole Merger



When is a neutron star swallowed whole by the black hole?

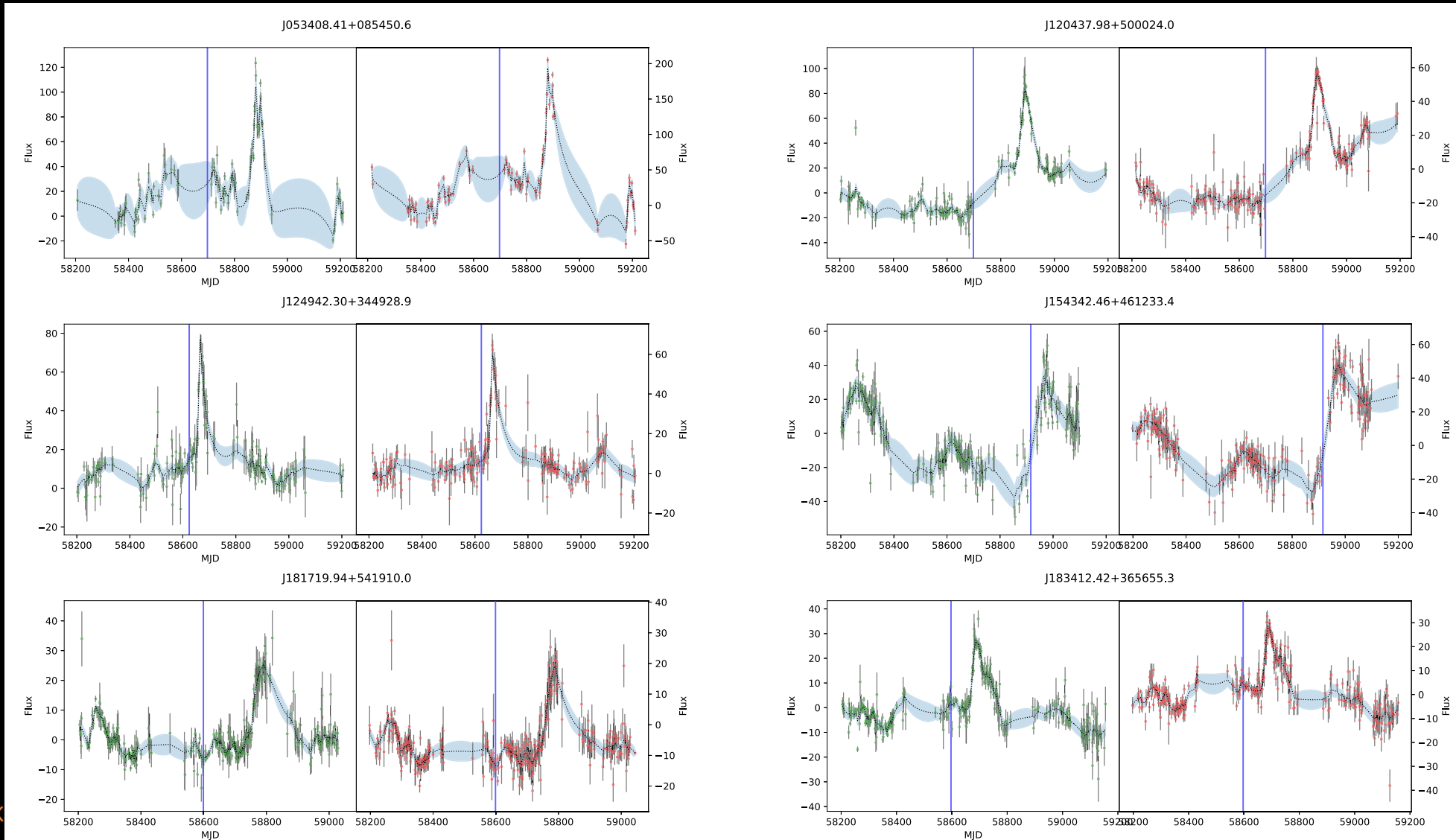


Foucart et al. 2018

Black Hole
+
Black Hole

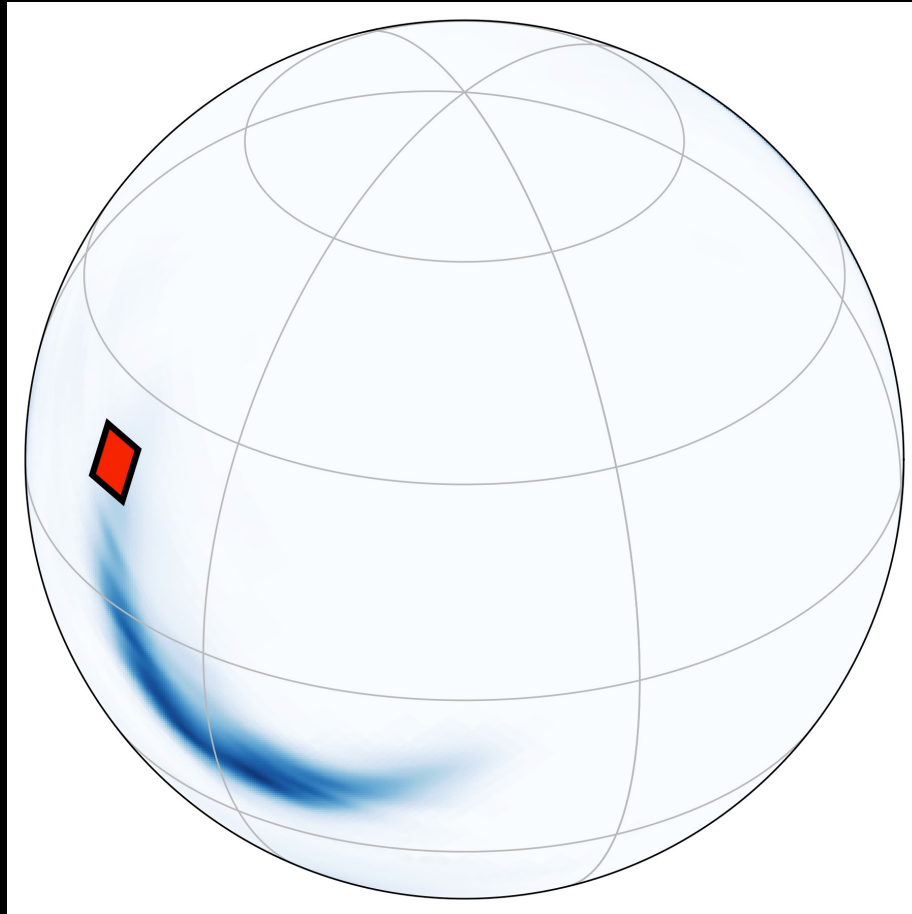
GW190521:

Candidate AGN Flare Counterparts by Graham et al. 2020, 2023



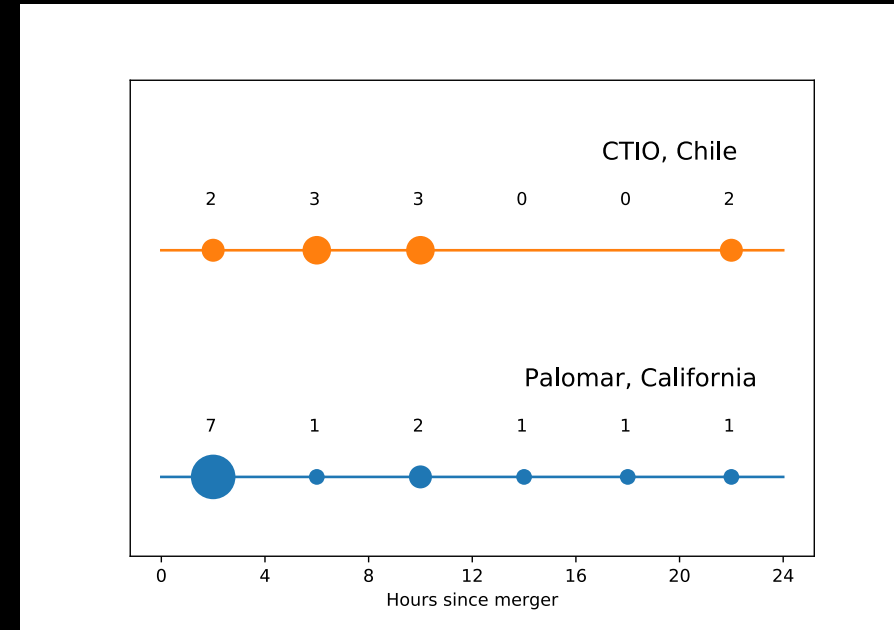
Lessons Learned

ZTF Promptly Mapped *Coarse* O3 localizations



Credit: Leo Singer

Median localization in O3: 4480 sq deg

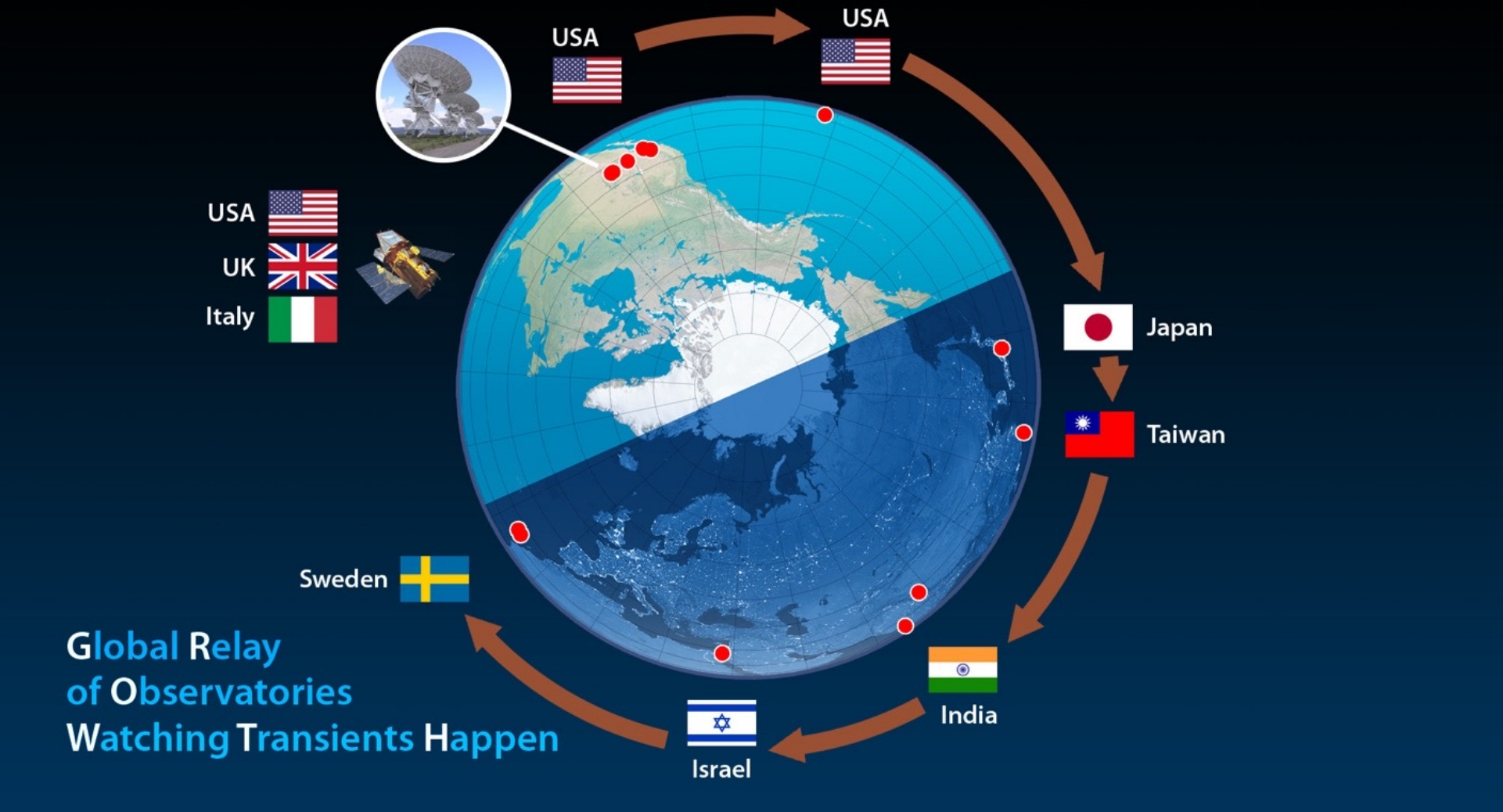


LVC O3a Summary: 13 Triggers

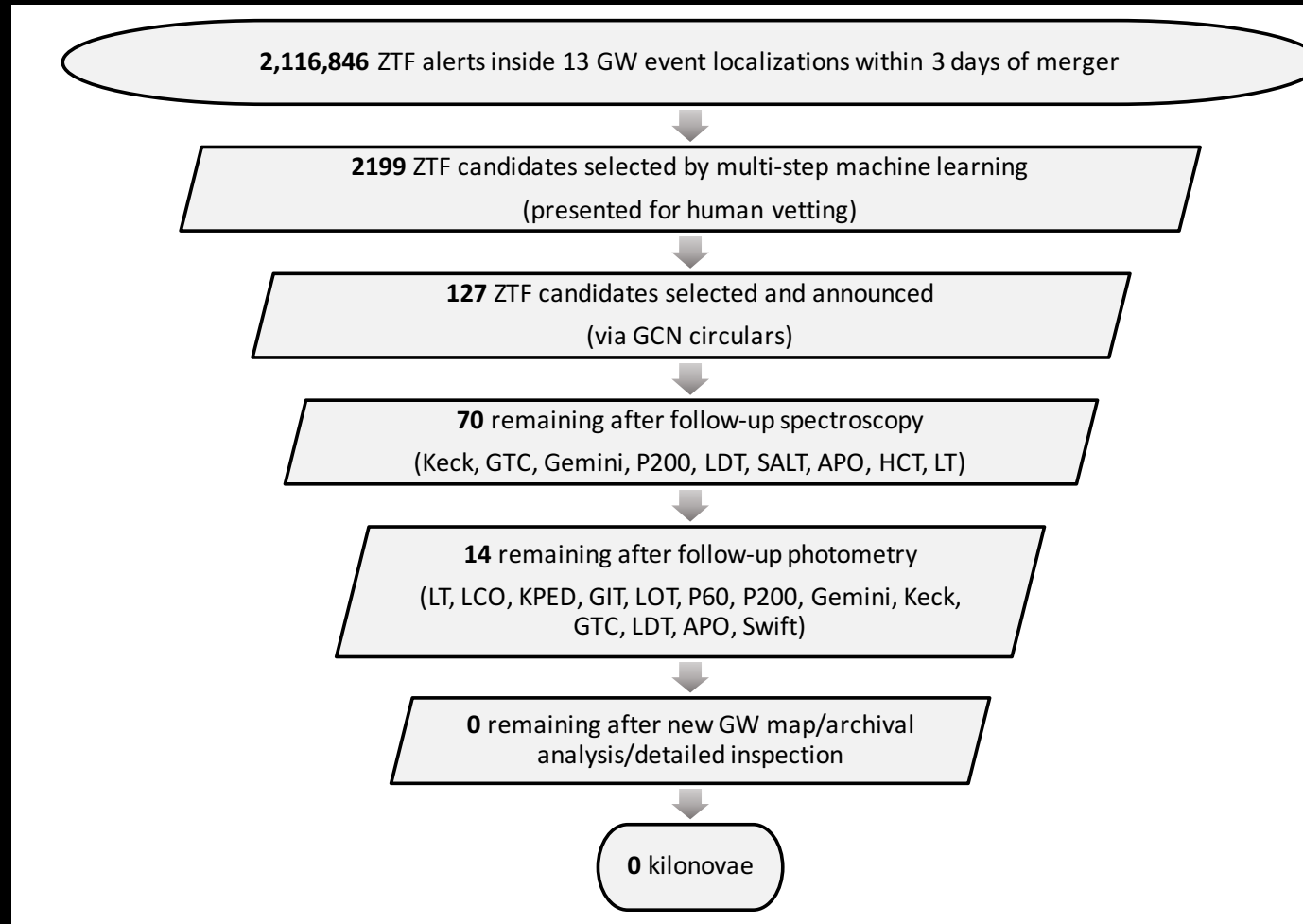
BNS: Five triggers
(median distance: 227 Mpc)

NSBH: Eight triggers
(median distance: 354 Mpc)

Kasliwal et al. 2020



Follow-Up Follow-Up Follow-Up



Kasliwal et al. 2020

GROWTH Followup Marshal

The screenshot shows the Fritz web interface with a dark blue header and a light blue sidebar. The main content area is divided into several panels:

- Recently Saved Sources:** A list of five sources, each with a thumbnail image, name, and coordinates. All are marked as "9 hours ago".
 - ZTF18abaponf: $\alpha, \delta: 19^{\text{h}}44^{\text{m}}07.59^{\text{s}}, +21^{\circ}03^{\text{m}}25.68^{\text{s}}$
 - ZTF19aayqqg: $\alpha, \delta: 18^{\text{h}}16^{\text{m}}52.84^{\text{s}}, +07^{\circ}48^{\text{m}}17.55^{\text{s}}$
 - ZTF21acbsyg: $\alpha, \delta: 18^{\text{h}}57^{\text{m}}17.32^{\text{s}}, +26^{\circ}36^{\text{m}}45.23^{\text{s}}$
 - ZTF18abryzqt: $\alpha, \delta: 03^{\text{h}}41^{\text{m}}08.32^{\text{s}}, +73^{\circ}22^{\text{m}}15.88^{\text{s}}$
 - ZTF18abwebms: $\alpha, \delta: 20^{\text{h}}10^{\text{m}}12.24^{\text{s}}$
- Top Sources:** A list of five sources with view counts. Filter tabs for DAY, WEEK, MONTH, 6 MONTHS, and YEAR are visible.
 - ZTF21acdmwae (Ia-03fg): 245 view(s), $\alpha, \delta: 02^{\text{h}}03^{\text{m}}35.80^{\text{s}}, +15^{\circ}44^{\text{m}}33.41^{\text{s}}$
 - ZTF21abyonuw (Ia-03fg): 142 view(s), $\alpha, \delta: 23^{\text{h}}01^{\text{m}}44.64^{\text{s}}, +28^{\circ}28^{\text{m}}08.00^{\text{s}}$
 - ZTF21acenkuf: 130 view(s), $\alpha, \delta: 22^{\text{h}}50^{\text{m}}11.27^{\text{s}}, +30^{\circ}21^{\text{m}}47.78^{\text{s}}$
 - ZTF21acbnfos (Ic-BL): 118 view(s), $\alpha, \delta: 05^{\text{h}}14^{\text{m}}10.99^{\text{s}}, +01^{\circ}52^{\text{m}}52.09^{\text{s}}$
- News Feed:** A list of recent updates with user avatars and source names.
 - JV: Lick spectrum obtained, but SNR is VERY low. Source: ZTF19acecitx | 4 hours ago
 - MC: Will upload, need to adjust code to submit SNIFS spectrum to TNS. Source: ZTF21abyonuw | 6 hours ago
 - S: New source saved. Source: ZTF18abaponf | 9 hours ago
 - S: New source saved. Source: ZTF19aayqqg | 9 hours ago
 - S: New source saved. Source: ZTF21acbsyg | 9 hours ago
- 1937 New Sources Last 7 days:** A summary box for a specific source.
- My Groups:** A list of groups including "Census of the Local Universe Caltech", "Collapsars", and "Fast Transients Caltech".
- Hobby-Eberly Telescope:** A weather widget showing "It is 14.8°C with 47% humidity & clear sky. Sunset 4 hours ago, sunrise in 8 hours".

add source

PGIRN20dpz and 380 other targets
4 hours ago

ido irani uploaded Swift photometry to ZTF20acedqis
4 hours ago

ZTF20acedqis (like)
276 views

ZTF20acedqis
262 views

jesper: Good signal! full moon, but 17 mag helps...
jesper: triggering NOT

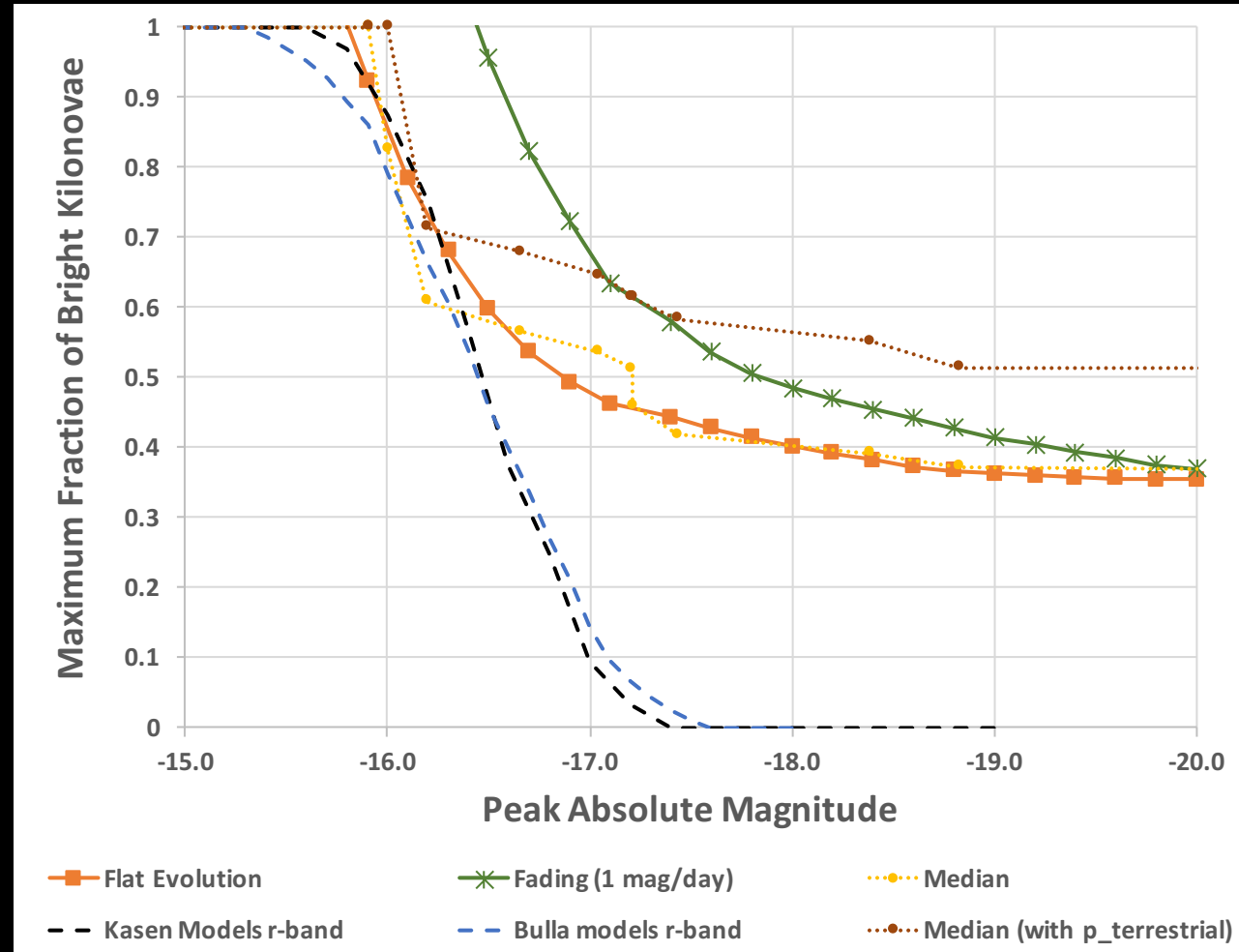
transfer source

h-index 42

Kasliwal et al. 2019a

In collaboration with UCB, the next generation open-source Fritz is now live

Is GW170817 the norm?



Kasliwal et al. 2020

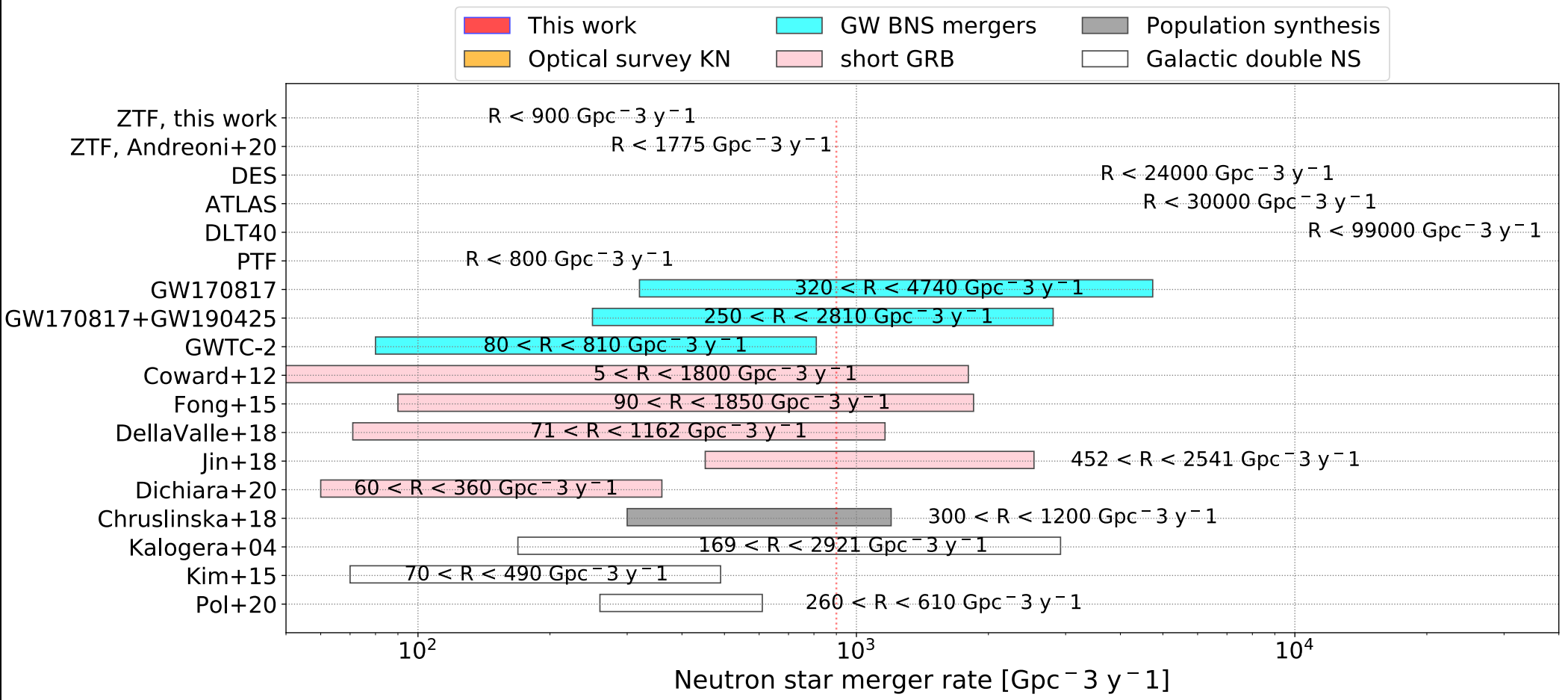


Igor Andreoni



Michael Coughlin

But what is the rate?



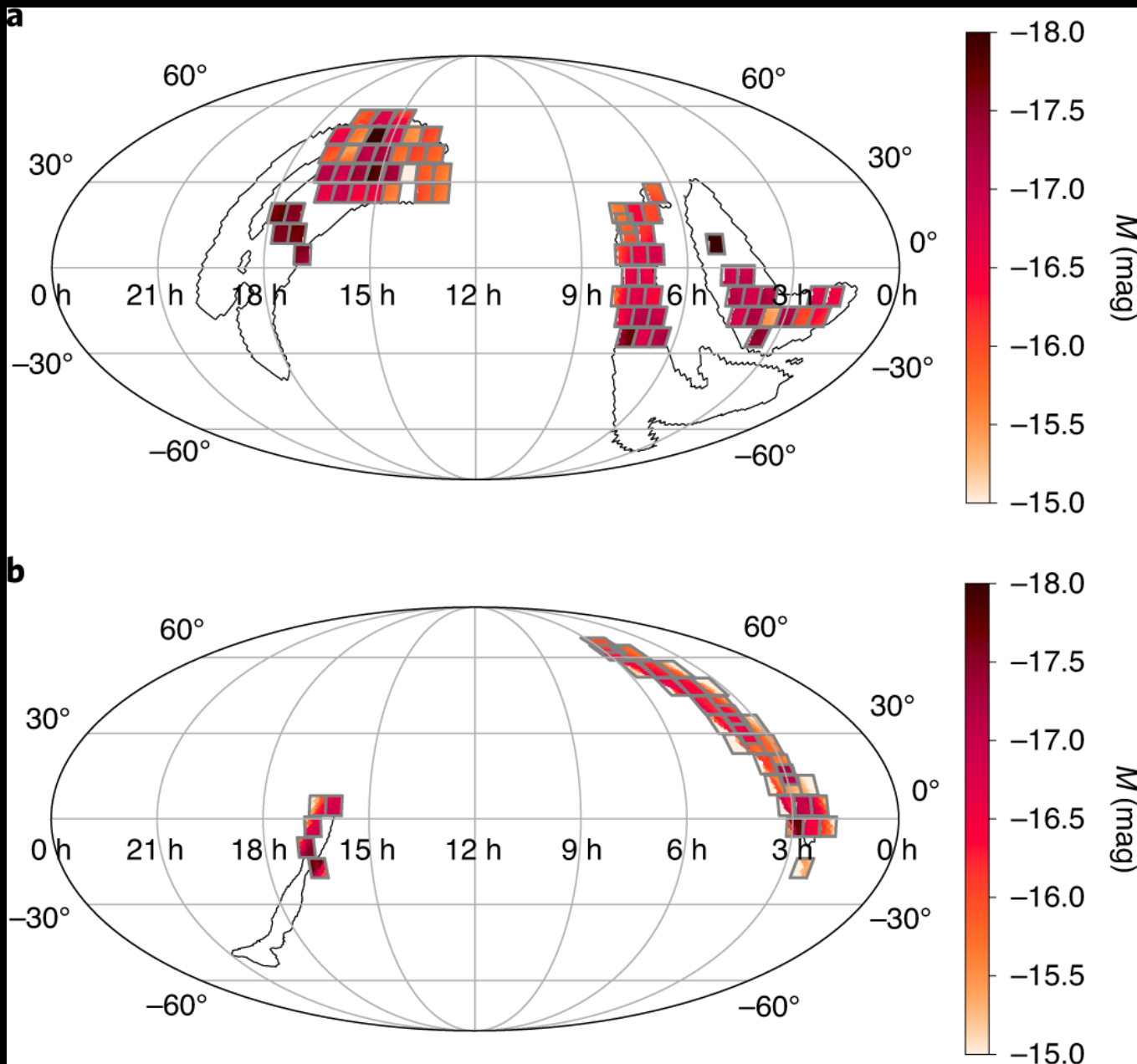
Andreoni, Coughlin et al. 2021



Namaskar



Shreya Anand
(Grad 3rd Year)

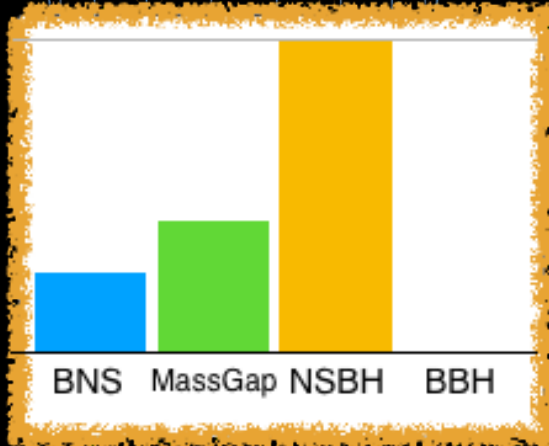
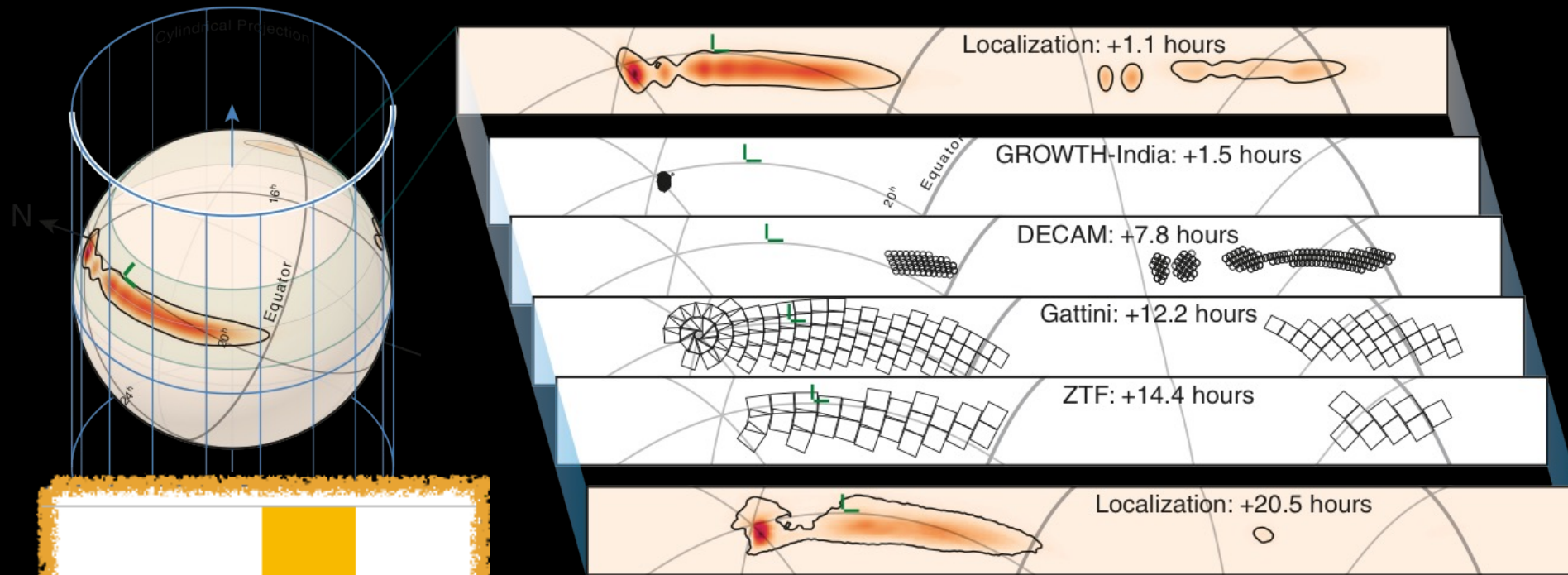


Anand, Coughlin et al. 2020

April 26, 2019



Shreya Anand
(Grad 3rd Year)

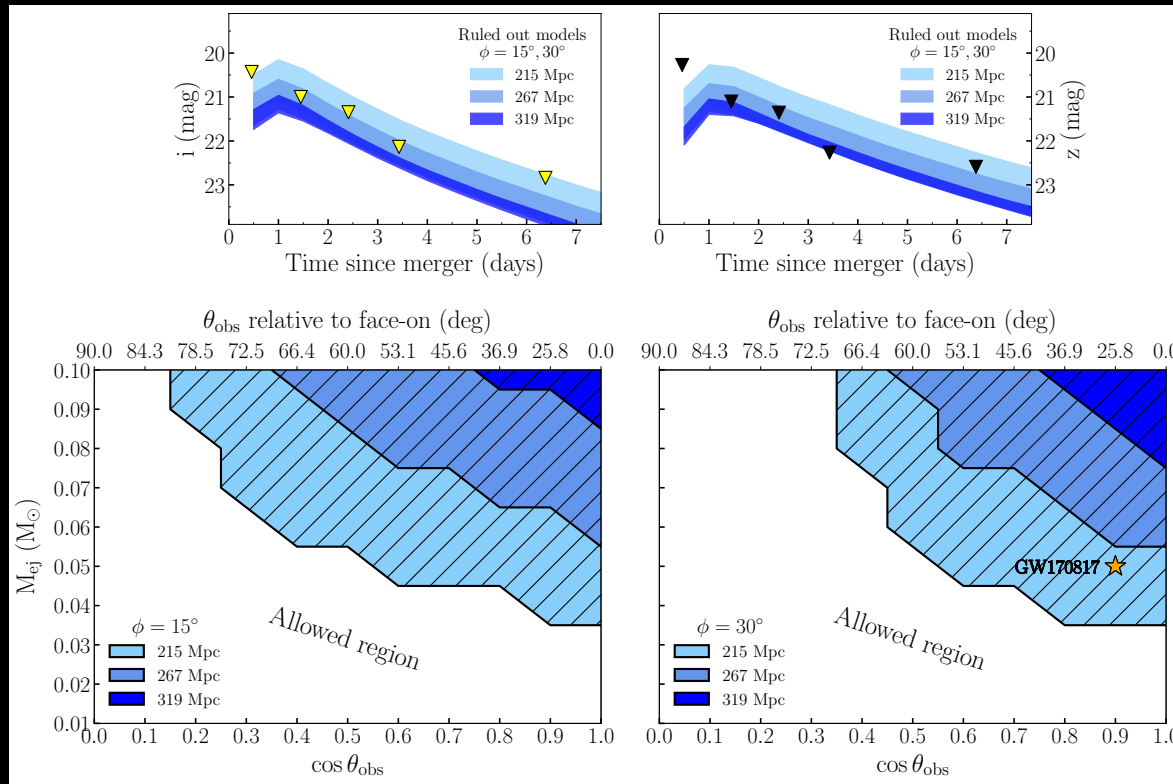


GROWTH Team undertook a co-ordinated search mapping the full area with four discovery engines worldwide.

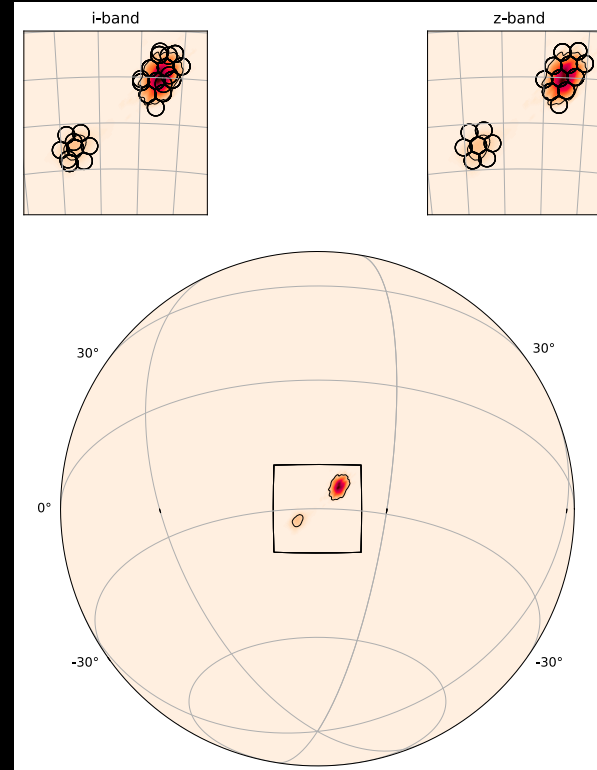
August 14, 2019



Igor Andreoni Danny Goldstein



Andreoni, Goldstein et al. 2019c



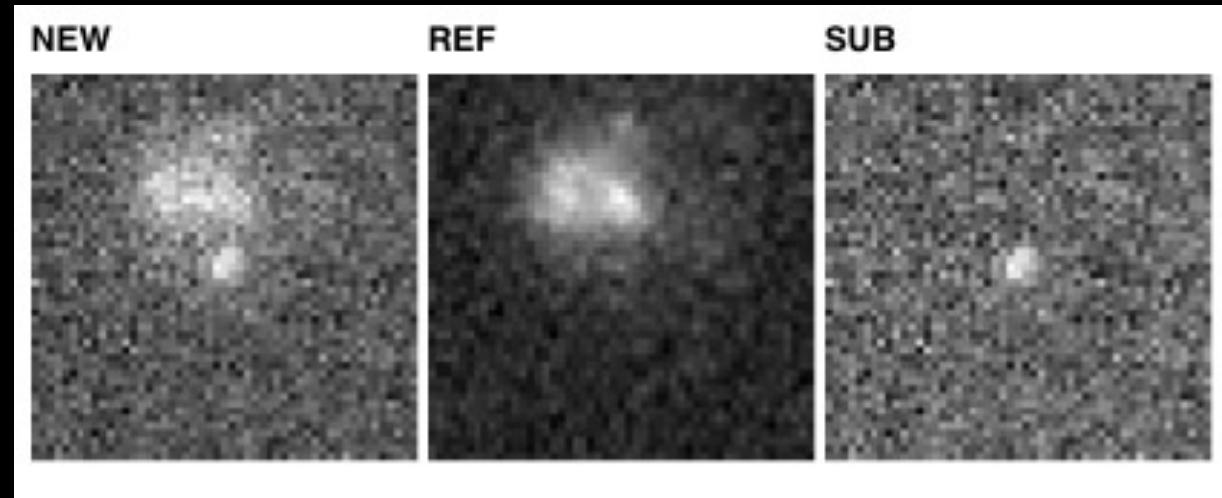
NSBH	>99%
MassGap	<1%
Terrestrial	0%
BNS	0%
BBH	0%

Upper limits suggest that either opacity was too high or the mass ratio was too high.
See also Morgan et al. 2020 (independent analysis by DESGW team)

DG19wxnjc



- Right Place
- Right Time
- Right Distance
- Right Luminosity
- Right Color Evolution



BUT... spectrum is truth

