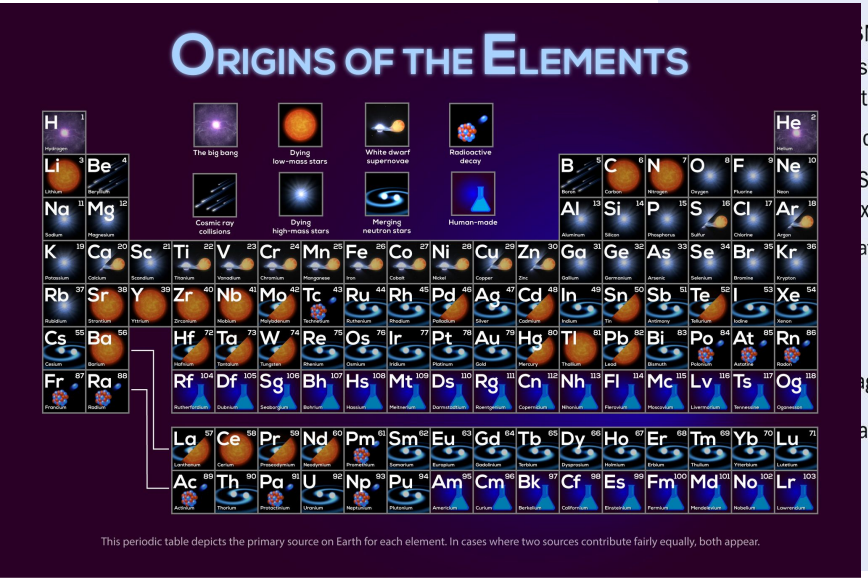
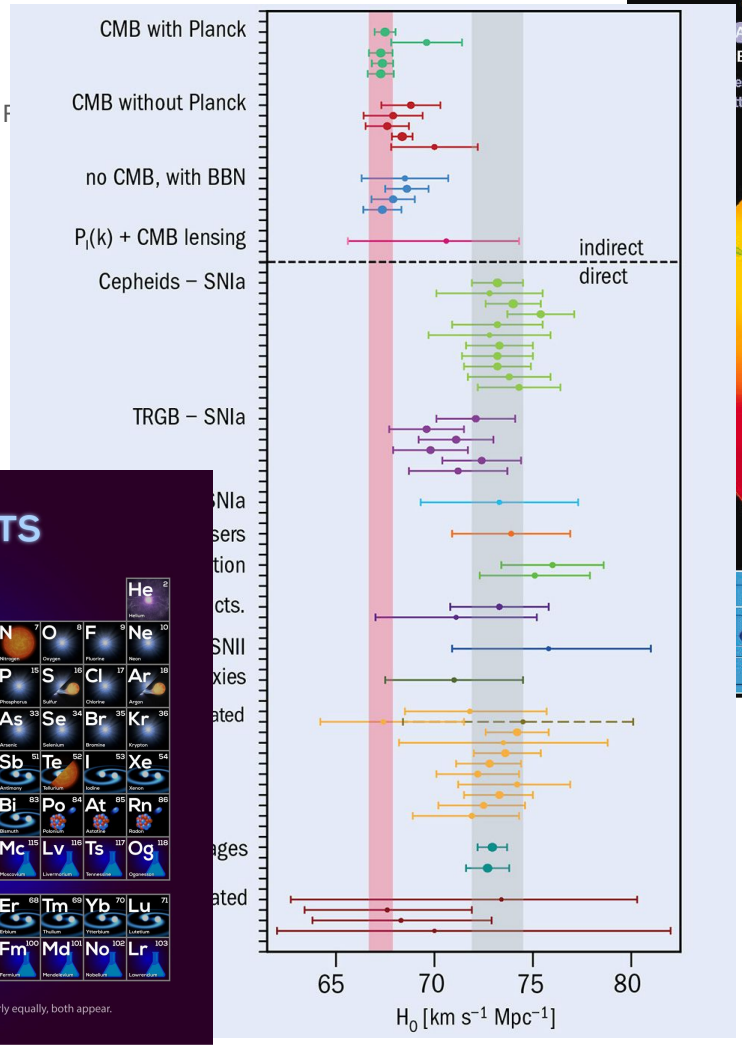
Kilonovae with Untriggered Roman searches

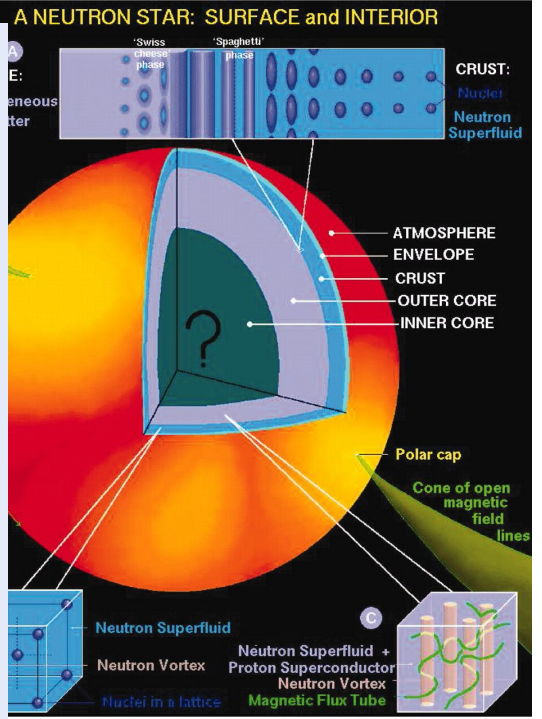
Jielai Zhang, Jeff Cooke
Swinburne University of Technology
Exploring the Transient Universe with the Nancy Grace Roman Space Telescope
Feb 9, 2022

Why Kilonova

Roman Twitter Feed



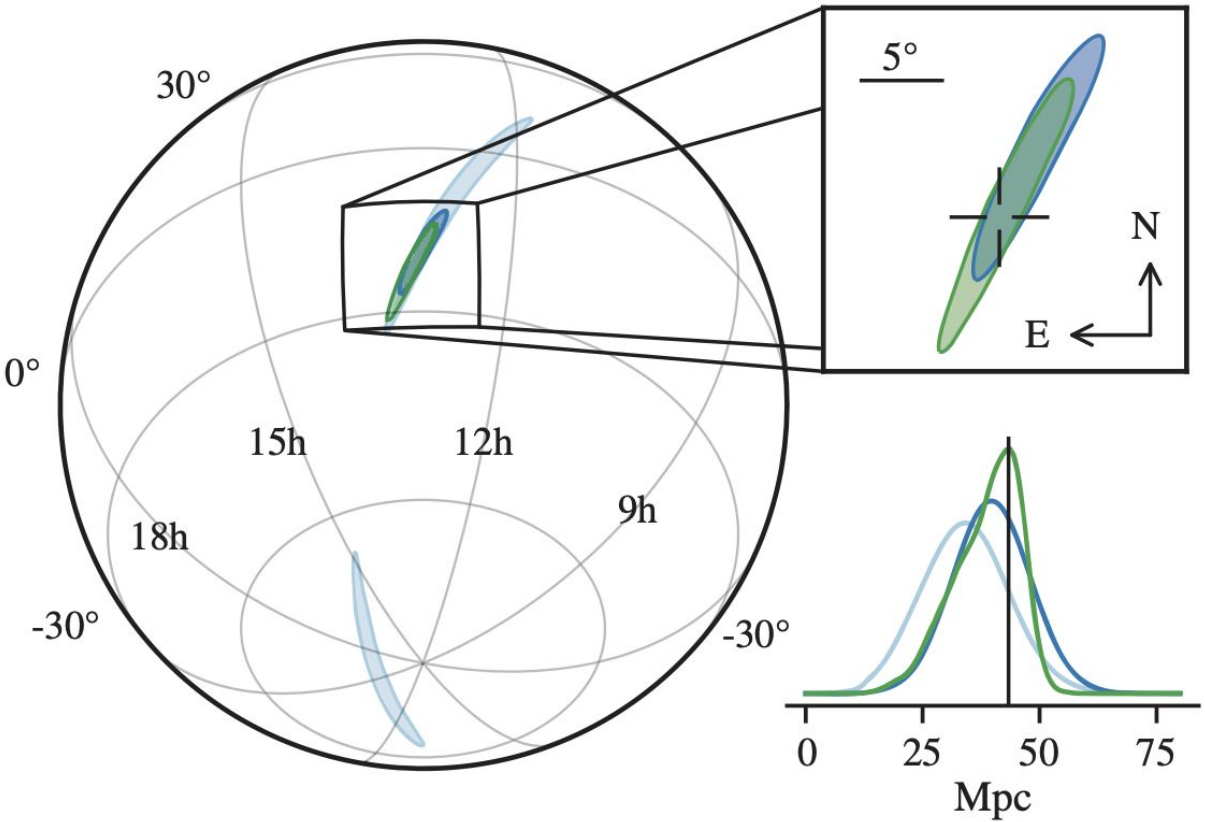




J. M. LATTIMER AND M. PRAKASH, *SCIENCE* • 2004 • V304

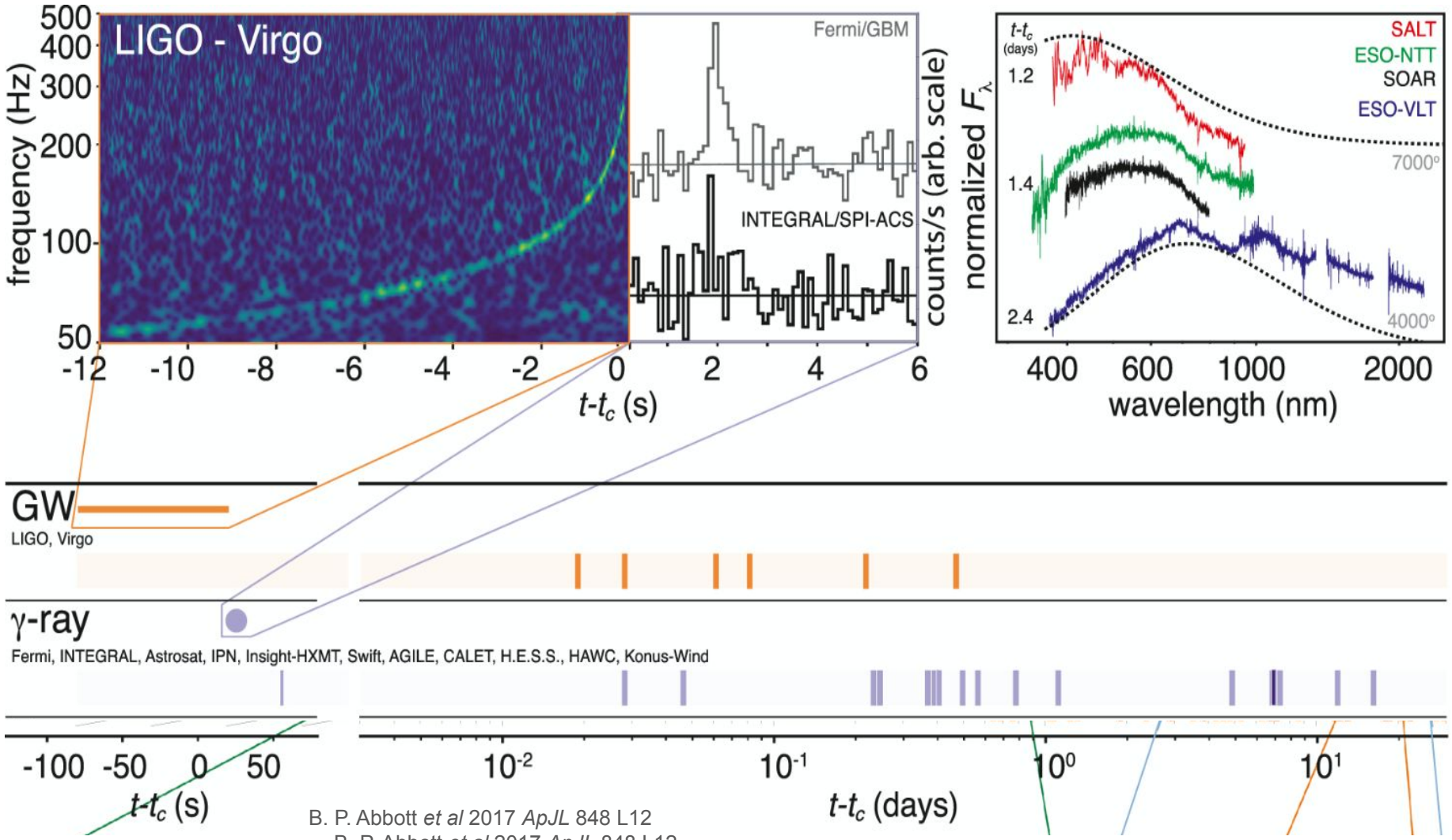
Eleonora Di Valentino *et al* 2021 *Class. Quantum Grav.* 38 153001

“Typical” approach to finding KN

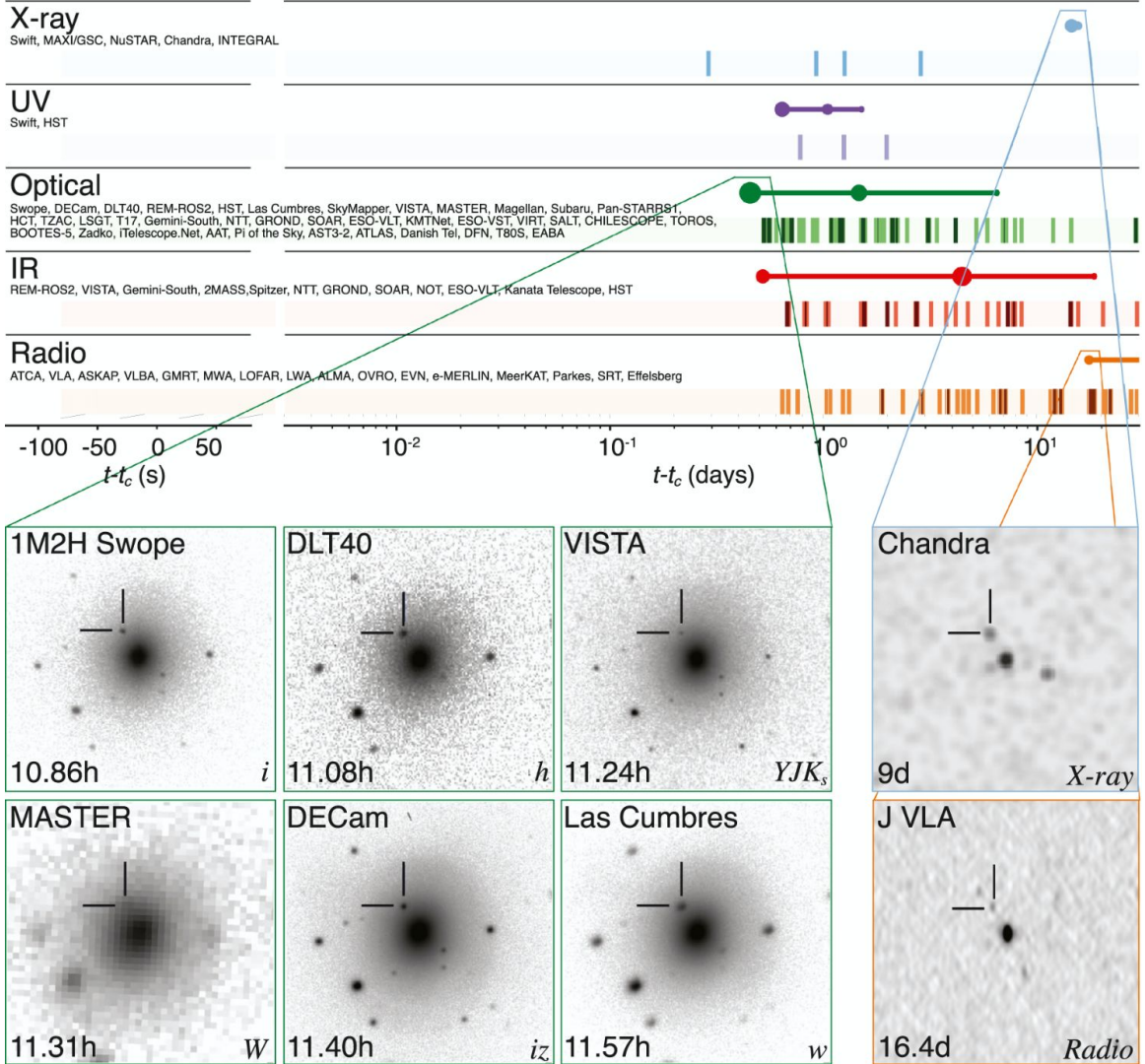


Localisation:
28 square degrees
(green contours).

LIGO/VIRGO collaboration, Physical Review Letters 119, 161101 (2017)



B. P. Abbott *et al* 2017 *ApJL* 848 L12



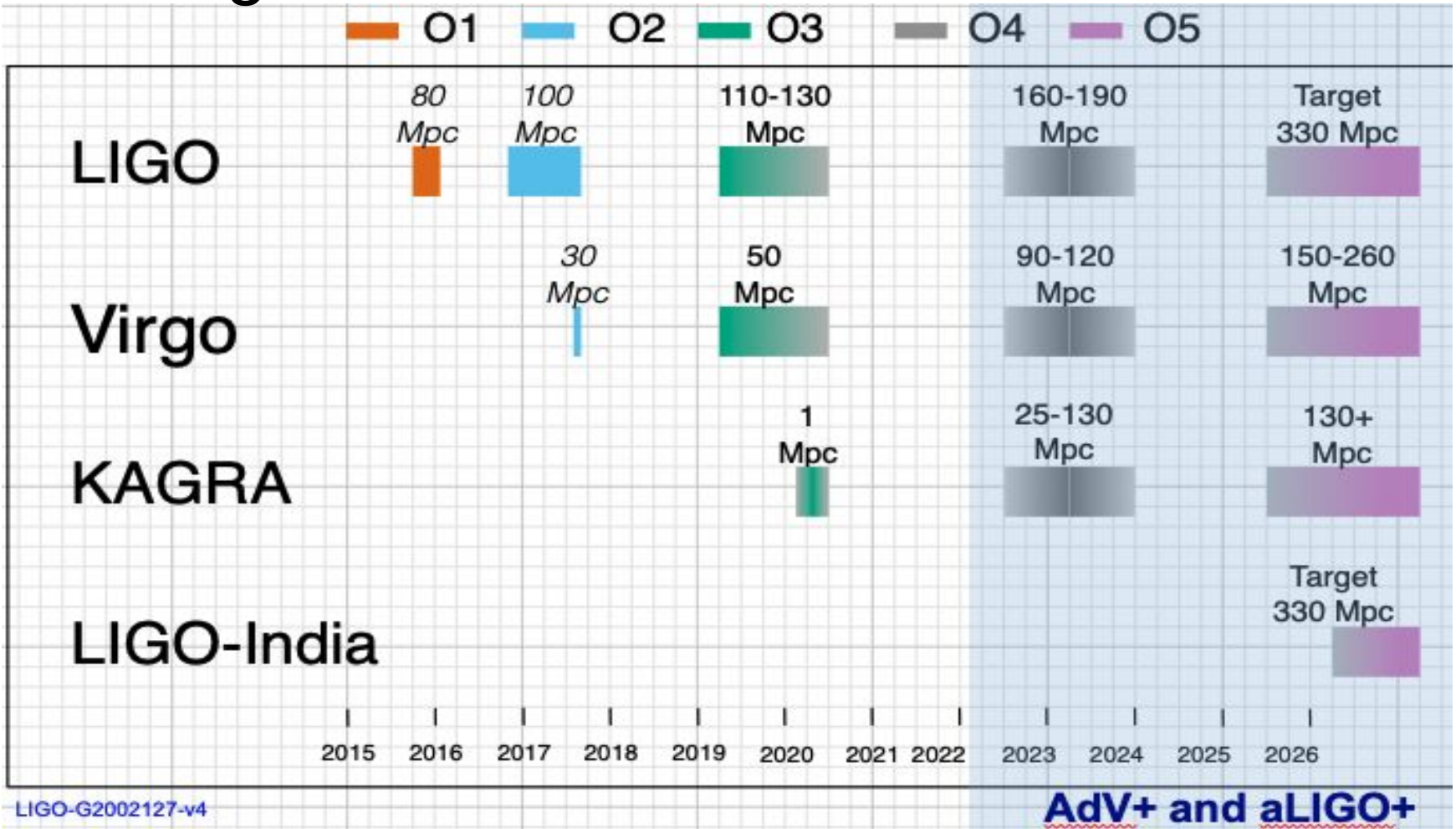
B. P. Abbott *et al* 2017 *ApJL* 848 L12

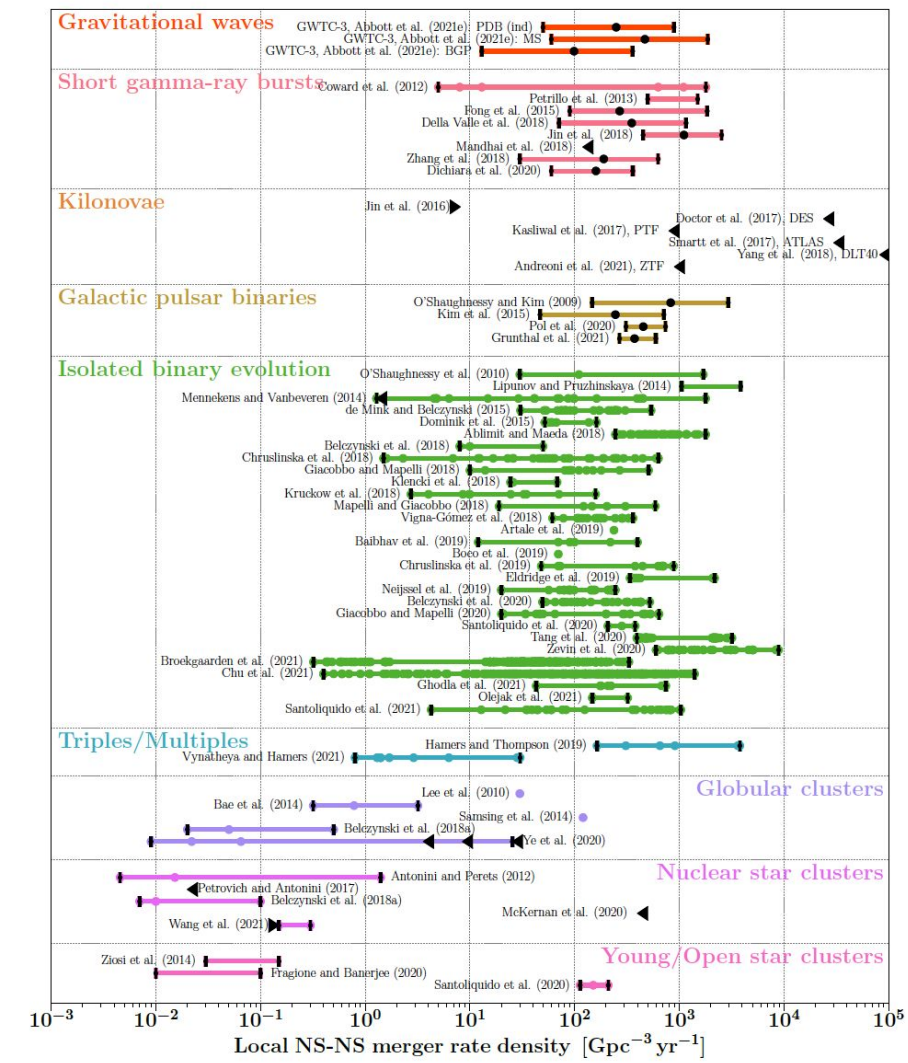
Untriggered Optical/IR Search: Why and How

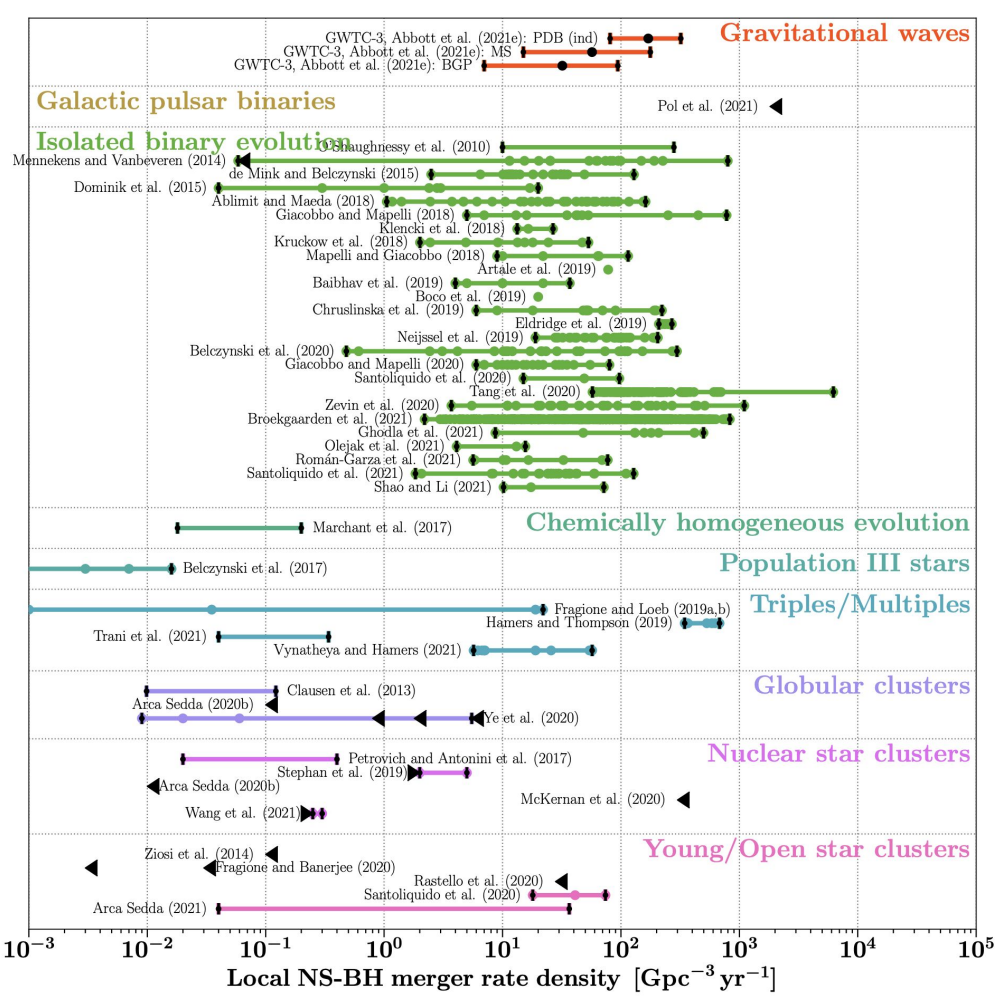
Want to increase rate of KN detection and confirmation.

An alternative is untriggered search in optical and IR.

BNS ranges


O1
O2
O3
O4
O5
LIGO
80 Mpc
100 Mpc
110-130 Mpc
160-190 Mpc
Target 330 Mpc
Virgo
30 Mpc
50 Mpc
90-120 Mpc
150-260 Mpc
KAGRA
1 Mpc
25-130 Mpc
130+ Mpc
LIGO-India
Target 330 Mpc
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
LIGO-G2002127-v4
AdV+ and aLIGO+



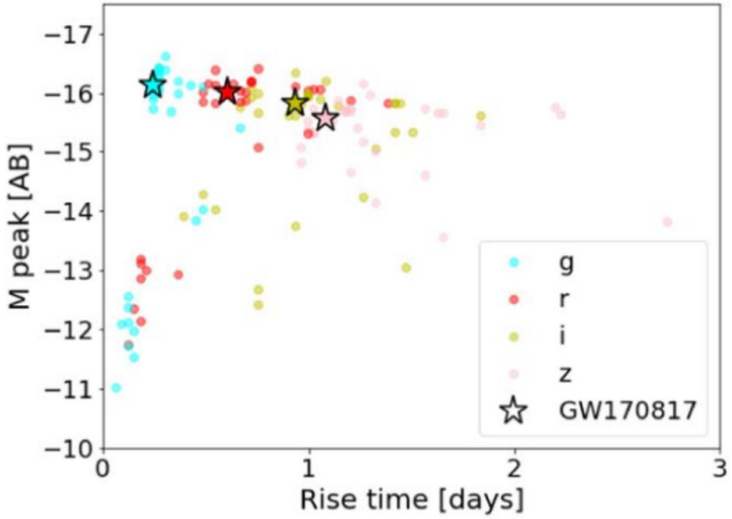


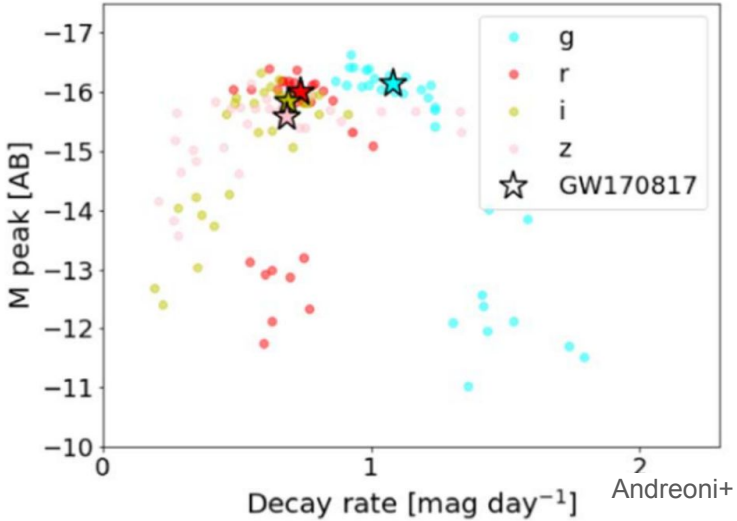
Mandel & Floor, 2021, Living Reviews in Relativity

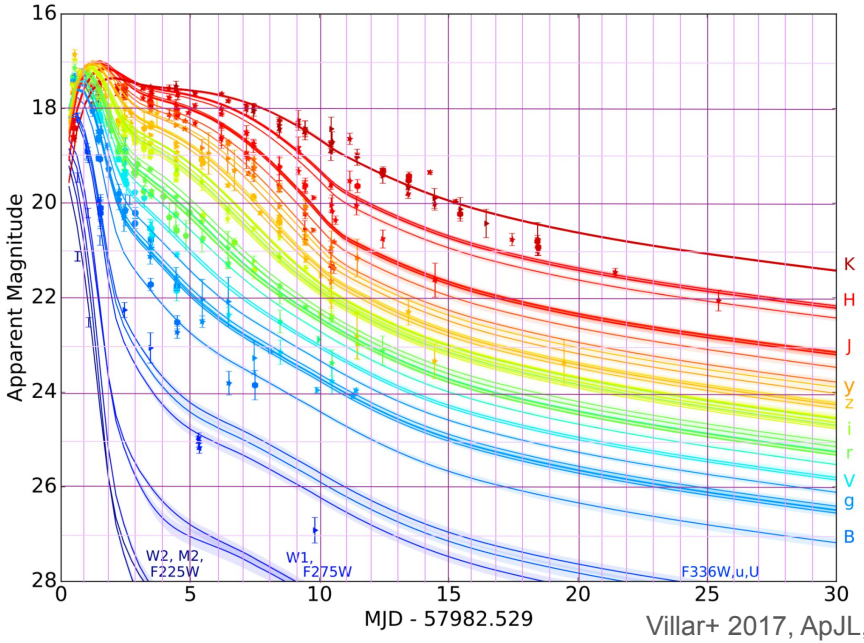
Optical/IR

@24 mag, z=0.26, D=1.1Gpc

Different selection effects







Villar+ 2017, ApJL, 851:L21

Optimal strategy for search in Optical/IR: 2 filters Day-cadence (optical) 2 day cadence (IR)

Andreoni+ 2019, PASP, 131:068004

Case Study: DECam
Up to 1KN/49 days

FOV: 3 sq deg, Assume M=-16.7, R=800/Gpc3/yr
420s g-band, 510s i-band (depth 24 mag, bright time)
23 fields / 8 hr night

Will happen Feb 11-21, 2022!
Together with
Igor Andreoni, Jeff Cooke, Armin Rest, Anais Moller, Dougal Dobie, Simon Goode, Frank Valdes, Katie Auchettl, Bruce Gendre, James Freeburn, Amy Lien, Lee Spitler

Case Study: Roman
Up to 1KN/16 days

FOV: 0.28 sq deg, Assume M=-16.7, R=800/Gpc3/yr
1hr F184 filter, 1hr Y106 filter (depth 27.5 mag)
24 fields / 2 days

Comparison: O4 LIGO/VIRGO

Up to 1 NS merger/16 days

(Finding KN depends on localisation and search success)

Assuming R=800/Gpc3/yr, best case sensitivity