Department of Physics “G. Occhialini”
Ph.D. in Physics and Astronomy
CNOC XII

Multi-messenger observations of binary neutron star mergers in the O4 run

Alberto Colombo,
O.S. Salafia, F. Gabrielli, G. Ghirlanda, B. Giacomazzo, A. Perego and M. Colpi

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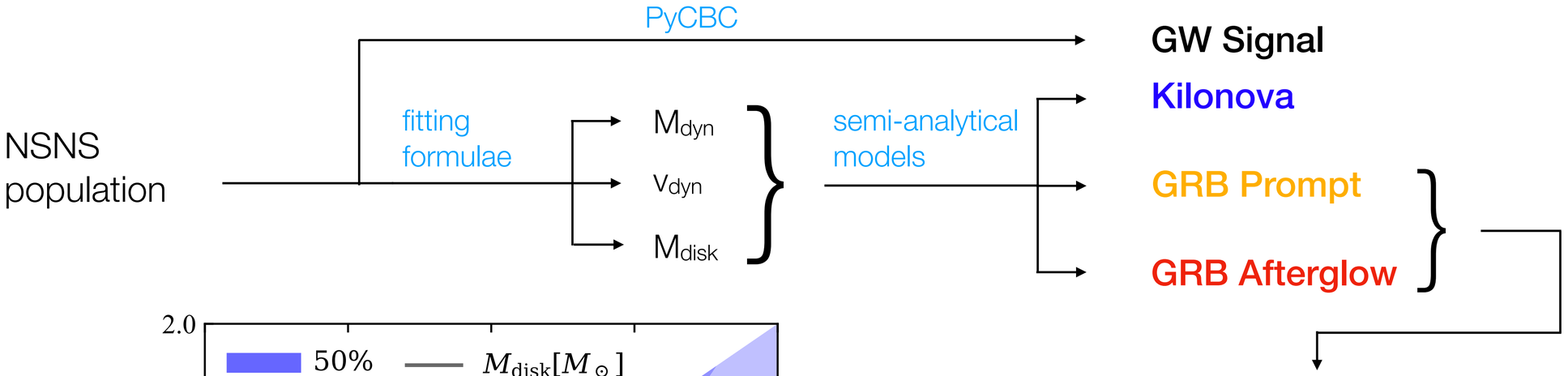
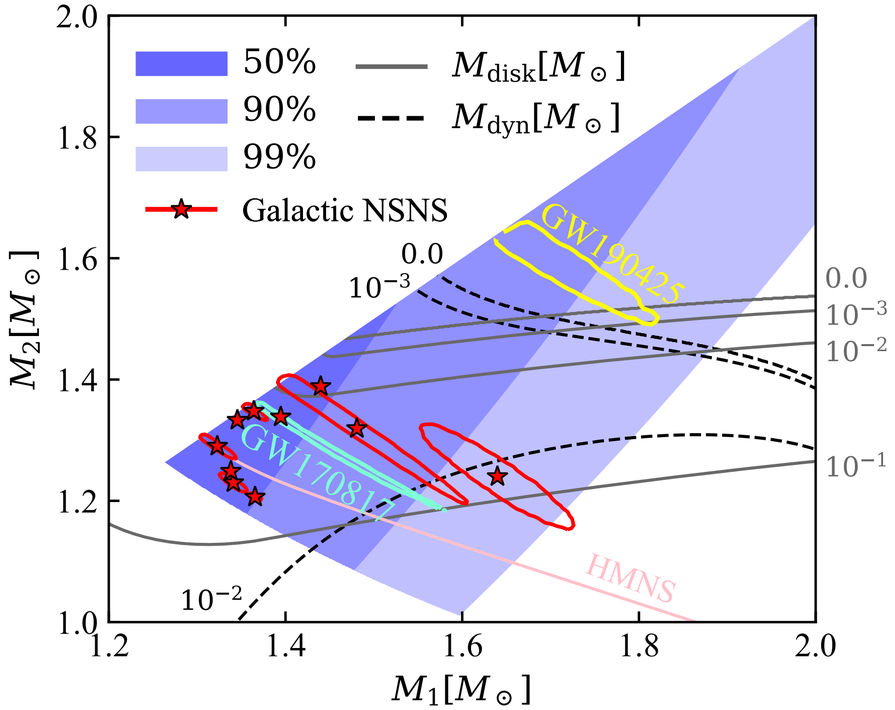
Who of you thinks we will have another GW170817-like event next year?

The Model





Jet:
Blandford-Znajek
GRB170817A-like

Launch condition:
$M_{rem} > 1.2\ M_{TOV}$
$M_{disk} > 0$
$E_{jet} > E_{bkt}$

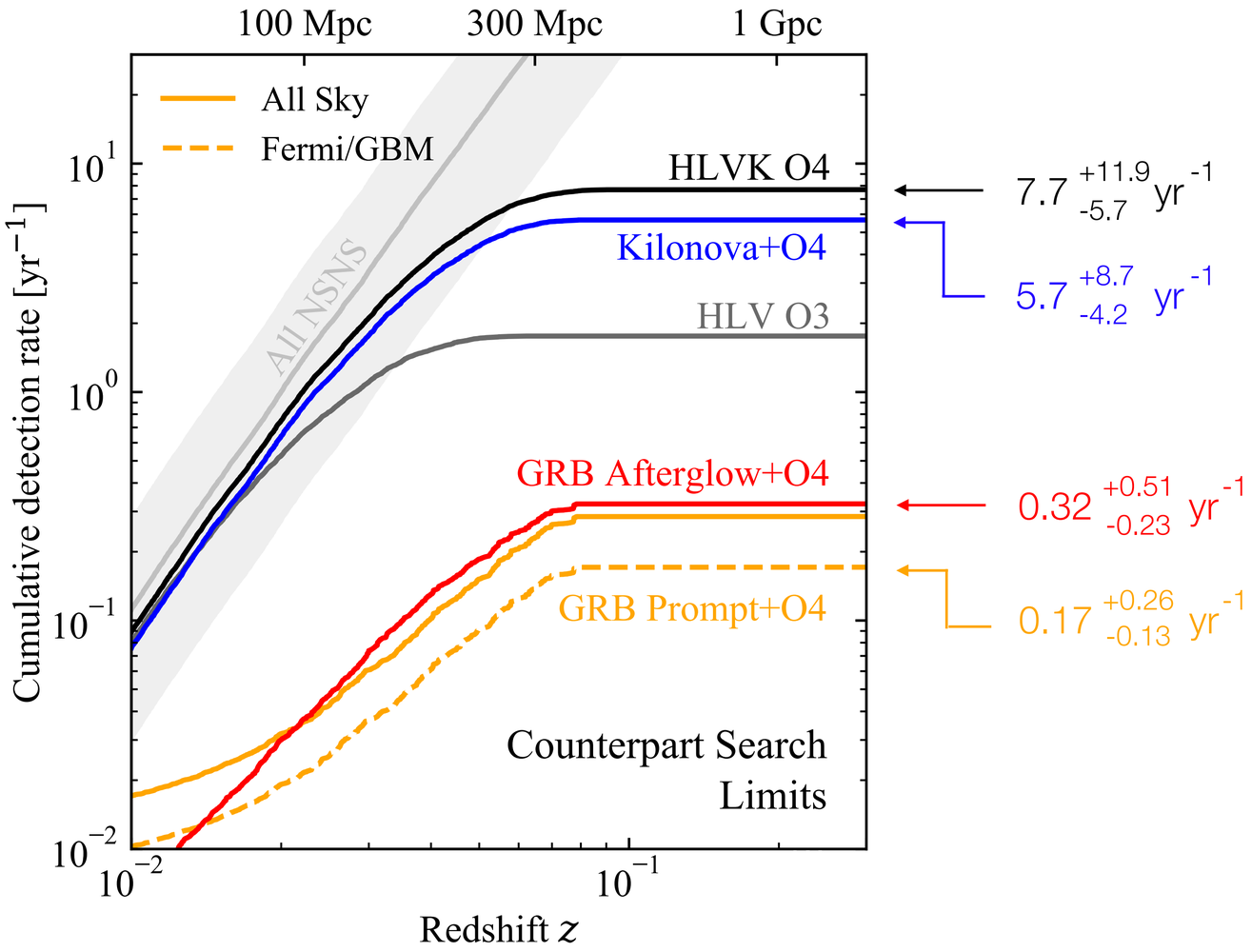
Cocoon shock breakout:
properties of GRB170817A
$\vartheta_v < 60°$

O4: Two Observing Scenarios

	Kilonova			GRB Afterglow			GRB Prompt	
	J [mag]	z [mag]	g [mag]	Radio [mJy]	Optical [mag]	X [erg cm^{-2} s^{-1} keV^{-1}]	BAT [ph cm^{-2} s^{-1}]	GBM [ph cm^{-2} s^{-1}]
Counterpart Search Limit	21	22	22	0.1	22	10^{-13}	3.5	4
Candidate Monitoring Limit	28	28	28	0.01	28	10^{-15}	1	1

$SNR_{NET} > 12$

O4 Predictions



$7.7\ ^{+11.9}_{-5.7}\ \mathrm{yr}^{-1}$

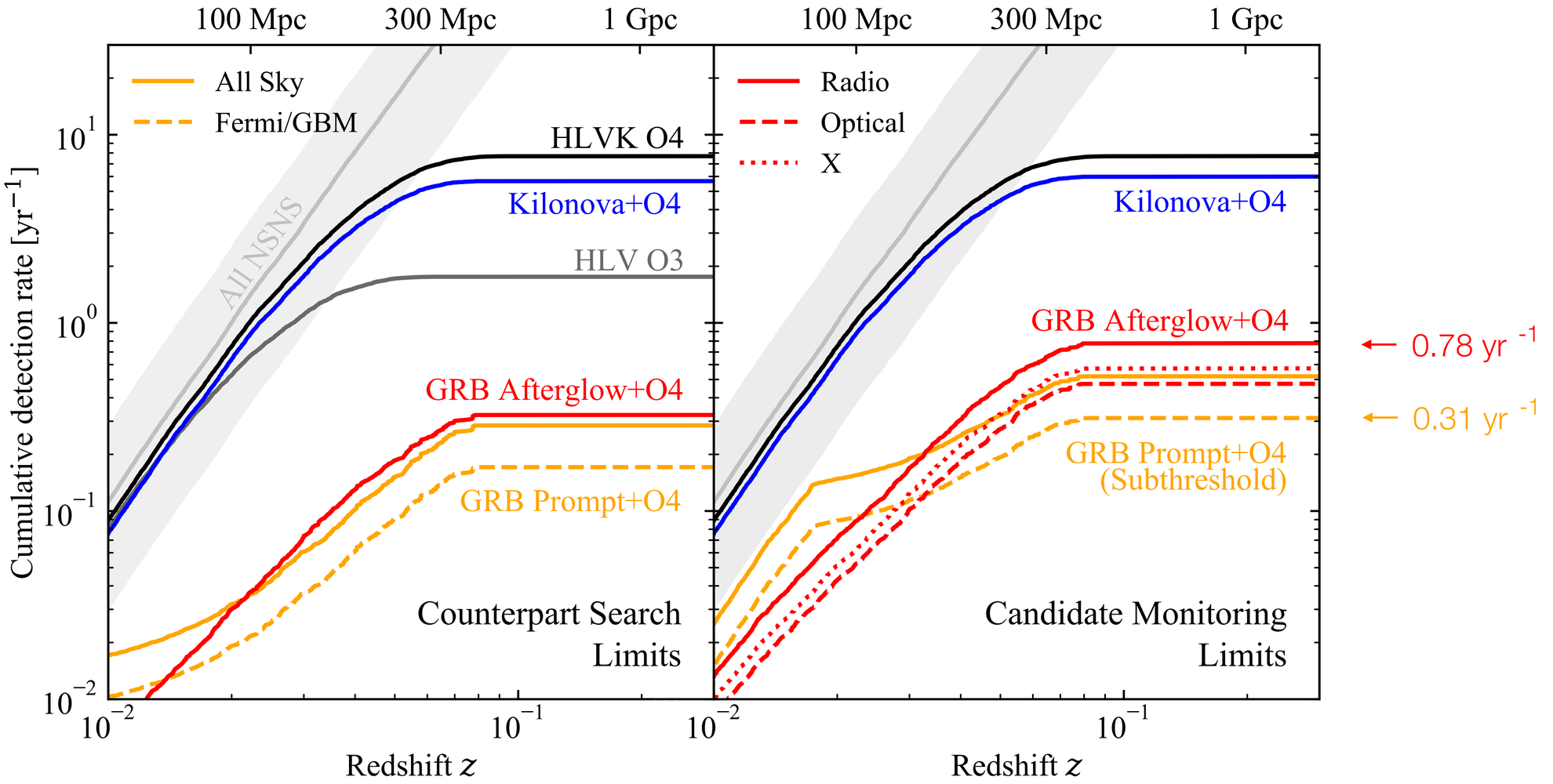
$5.7\ ^{+8.7}_{-4.2}\ \mathrm{yr}^{-1}$

$0.32\ ^{+0.51}_{-0.23}\ \mathrm{yr}^{-1}$

$0.17\ ^{+0.26}_{-0.13}\ \mathrm{yr}^{-1}$

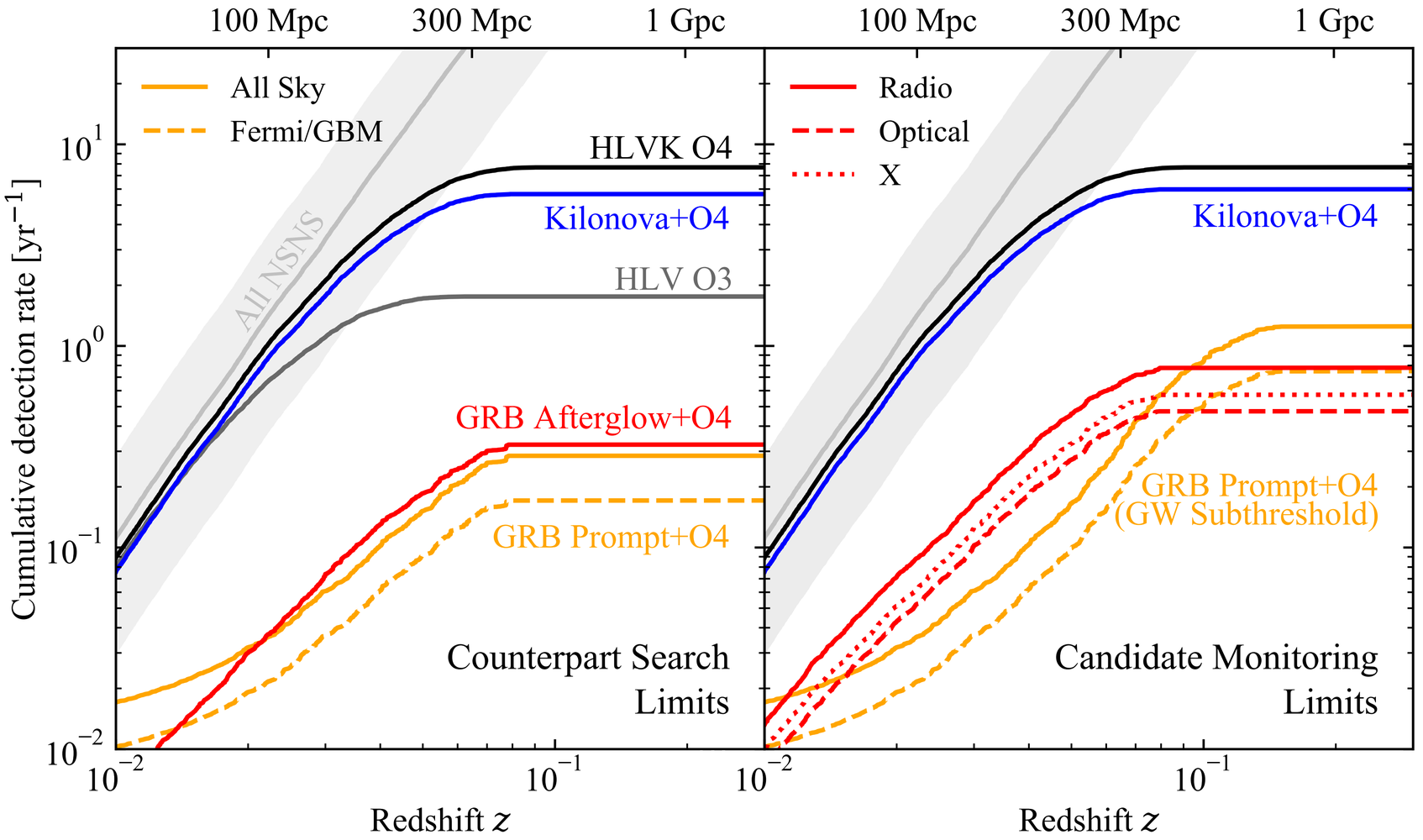
Colombo et al. (2022)

O4 Predictions



Colombo et al. (2022)

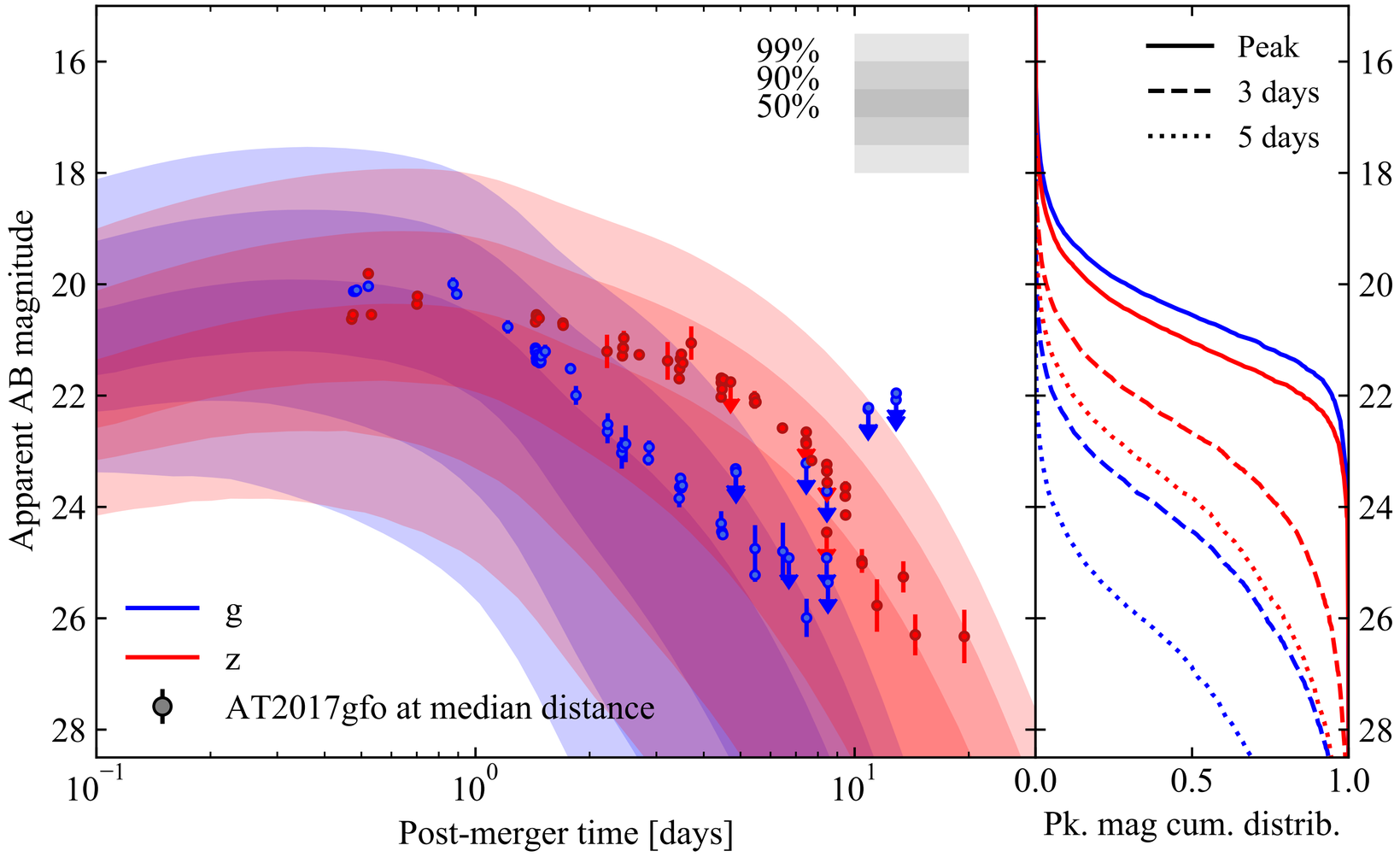
O4 Predictions



← 0.75 yr $^{-1}$

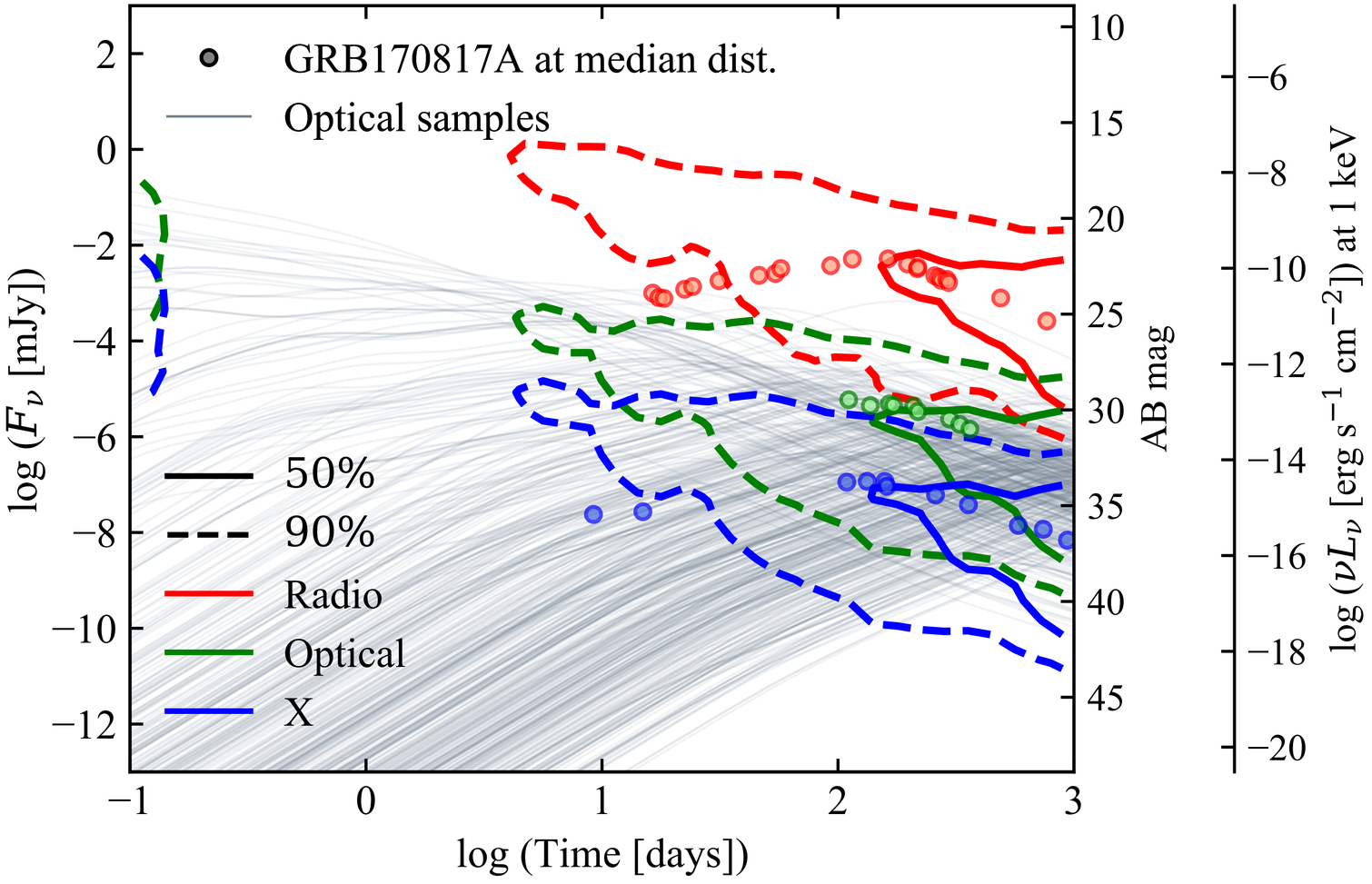
Colombo et al. (2022)

O4 Kilonovae



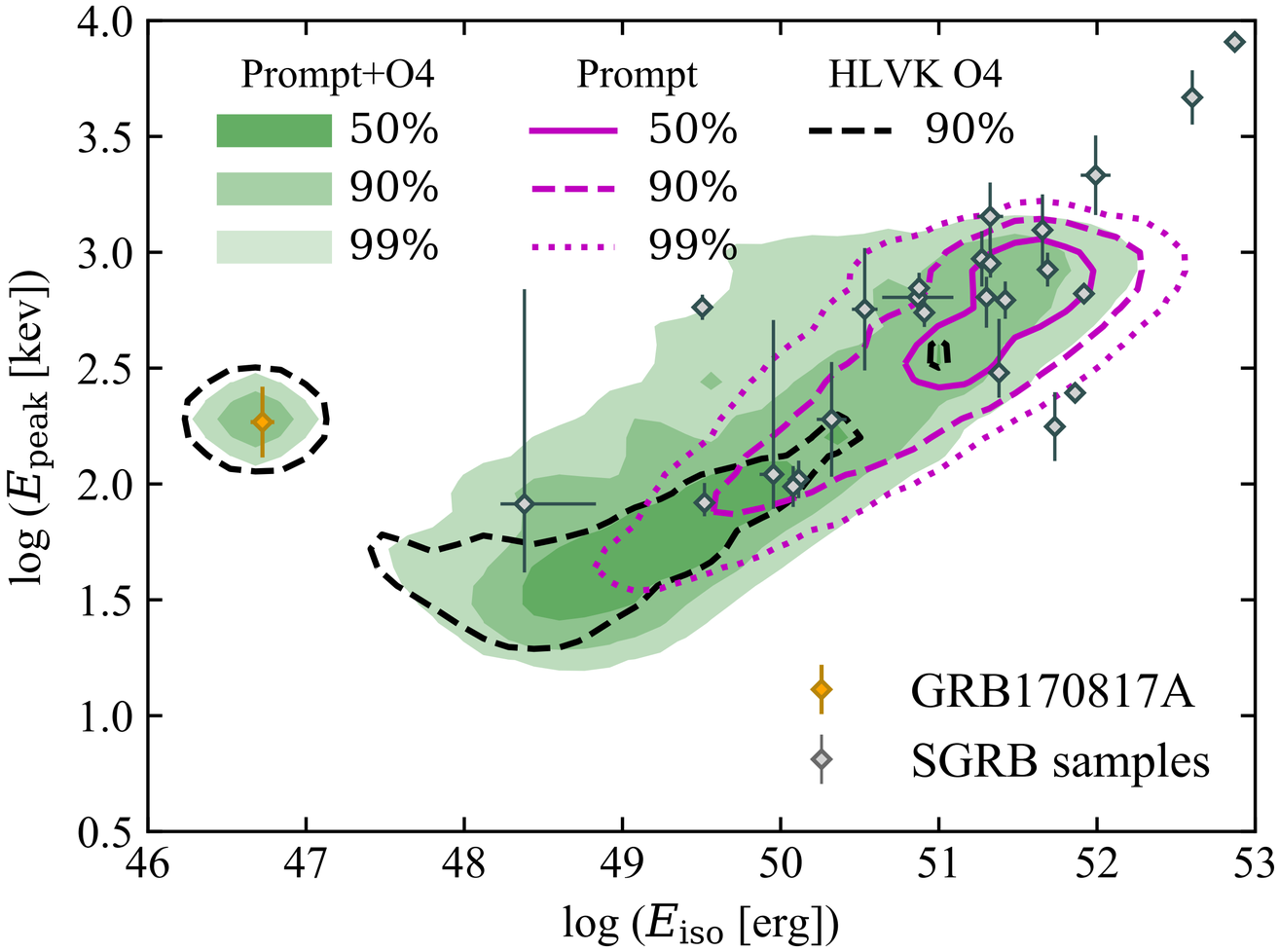
Colombo et al. (2022)

O4 GRBs Afterglow



Colombo et al. (2022)

O4 GRBs Prompt



Colombo et al. (2022)

Summary

- NSNS GW detection rate and horizon: $7.7^{+11.9}_{-5.7}\ \mathrm{yr}^{-1}$ - 300Mpc
- 78% will emit a KN, most are detectable but for limited time
- 52% will emit a jet, just 2% - 10% is detectable
- GW subthreshold in response to GRB trigger: $0.75^{+1.1}_{-0.5}\ \mathrm{yr}^{-1}$

Take a look at the paper:

arXiv: 2204.07592

Thank you for your attention!