

Community outreach and engagement

MMA partners
Broader Astro/Physics

Samaya Nissanke
GRAPPA, University of Amsterdam

Dawn IV workshop, 31st August 2018

Community outreach and engagement

Necessary for building such
large scale project(s) and
maximising science

Community outreach and engagement

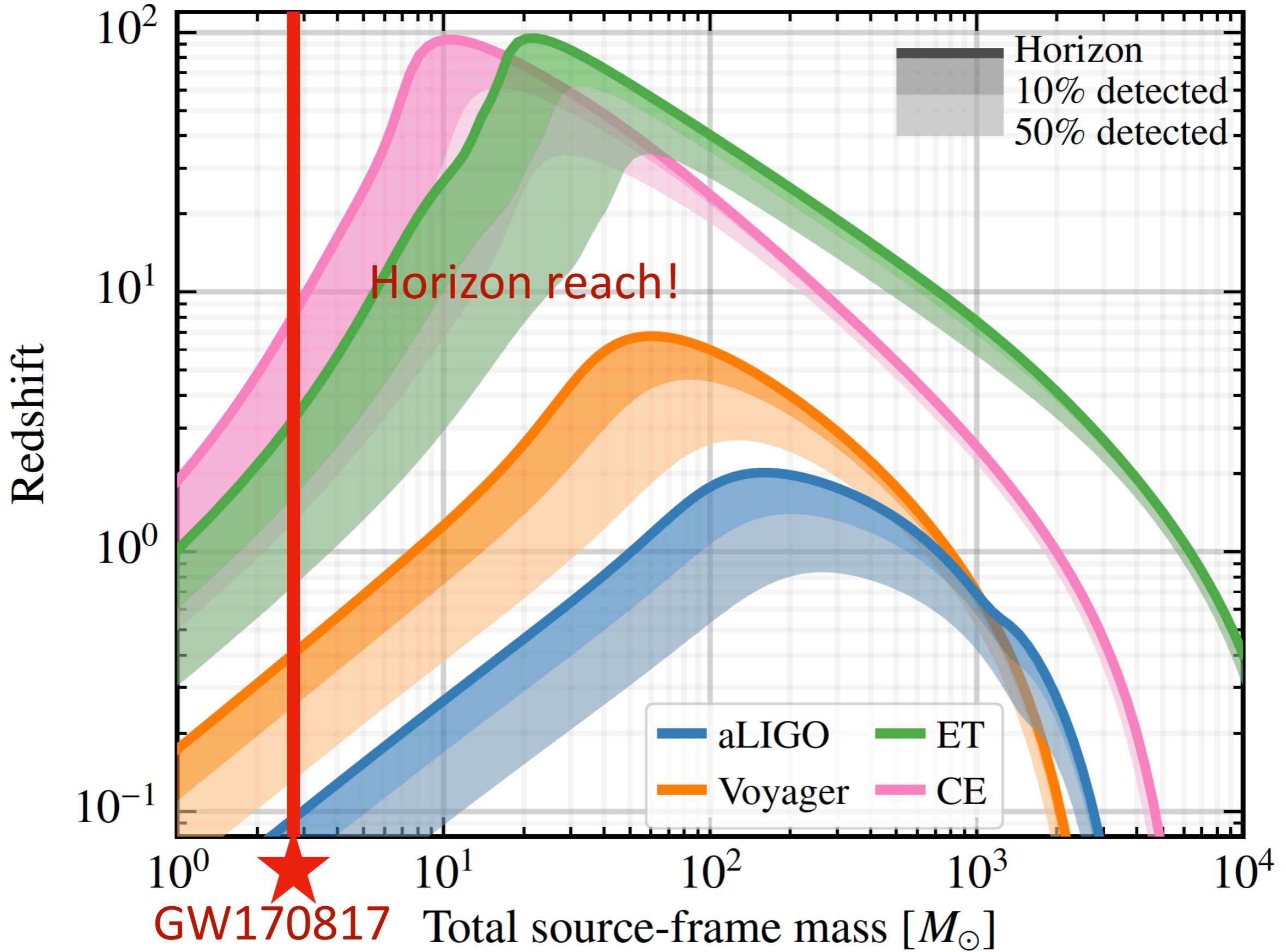
Thanks for input: Matthew Bailes, Shri Kulkarni, Varun Bahlerao, Brad Cenko, David Kaplan, Youjun Lu, Bryan Gaensler, Hiranya Peiris, Kunal Mooley, Dale Frail, Andreja Gomboc, Edo Berger, Alberto Sesana, Antonia Rowlinson, Eric Howell, Szabolcs Marka, Masaomi Tanka, Andrew Levan...

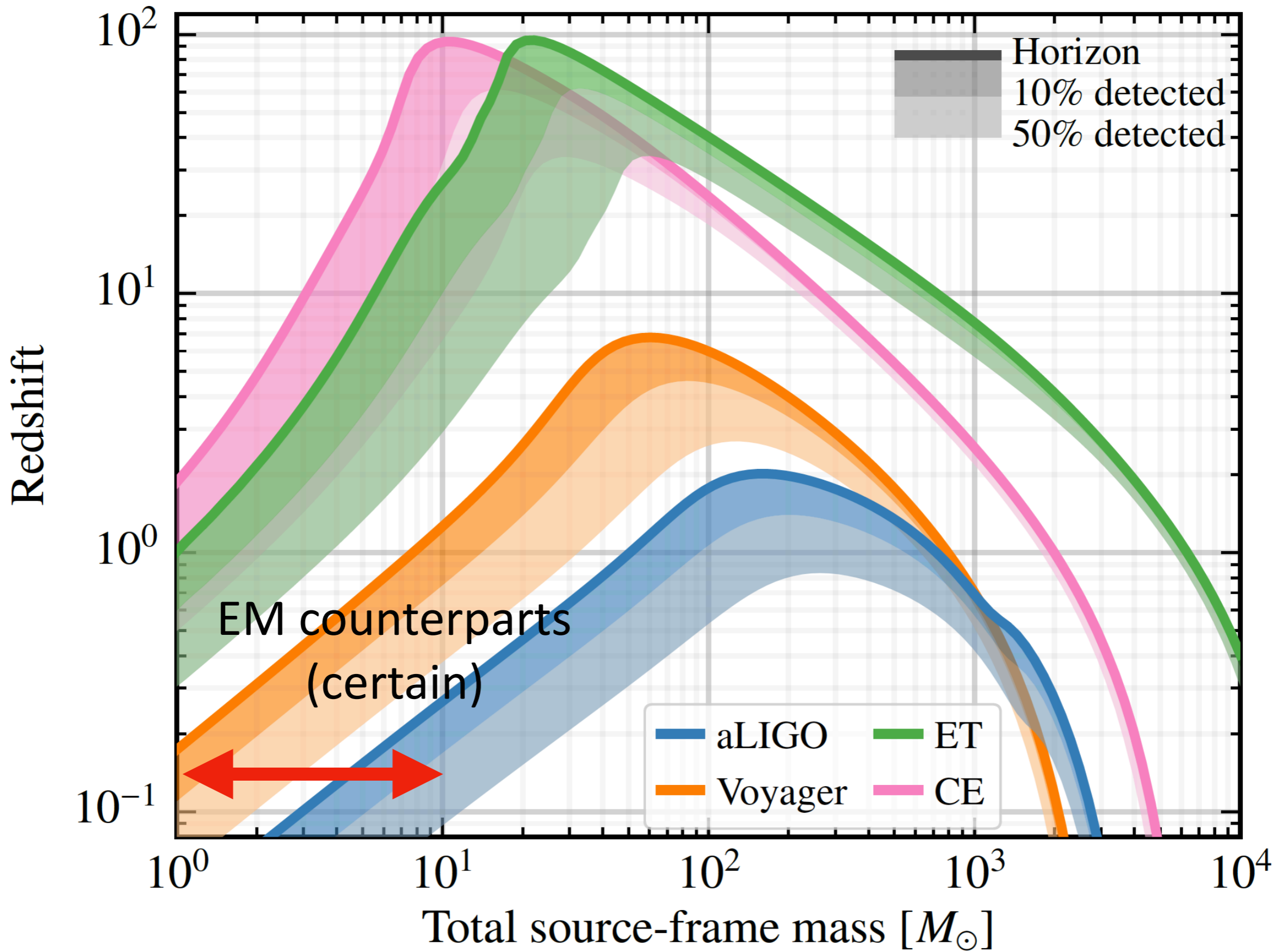
Overriding Challenge 1 for GW + MMO:

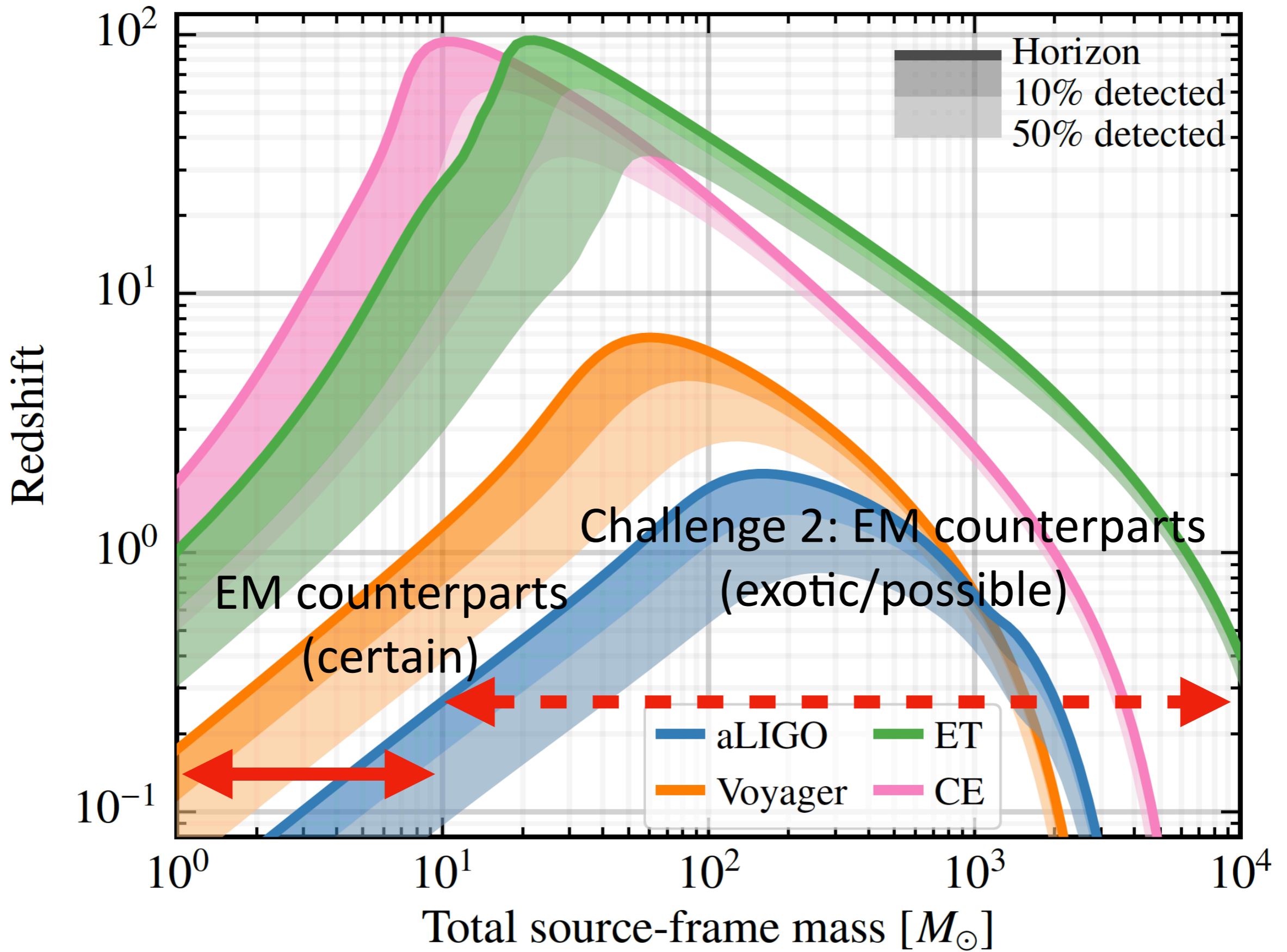
Designing a GW telescope over 20 years in a rapidly evolving and emerging observationally-driven scientific field

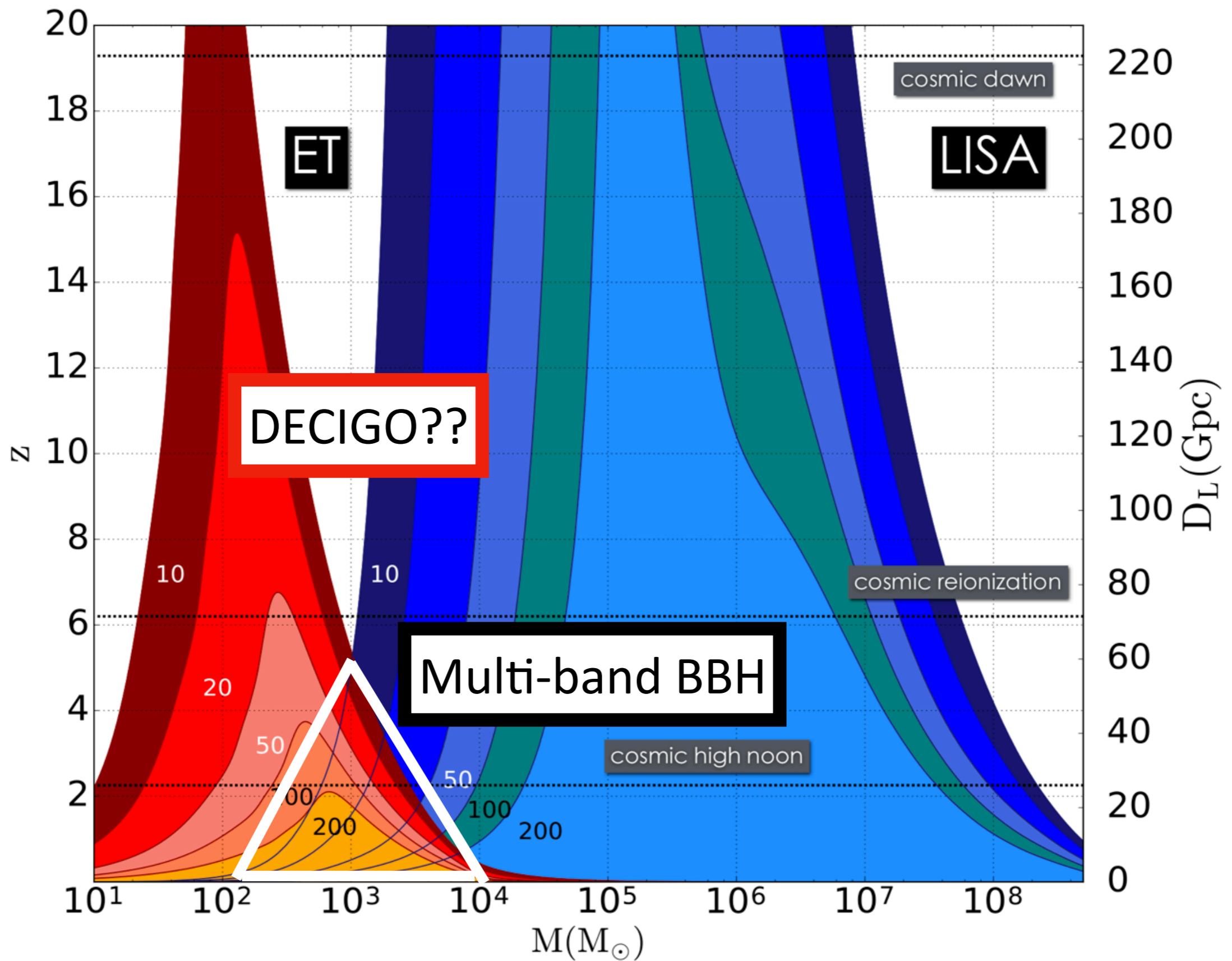
~1000 papers on GW170817
(one event)
over one year! ...

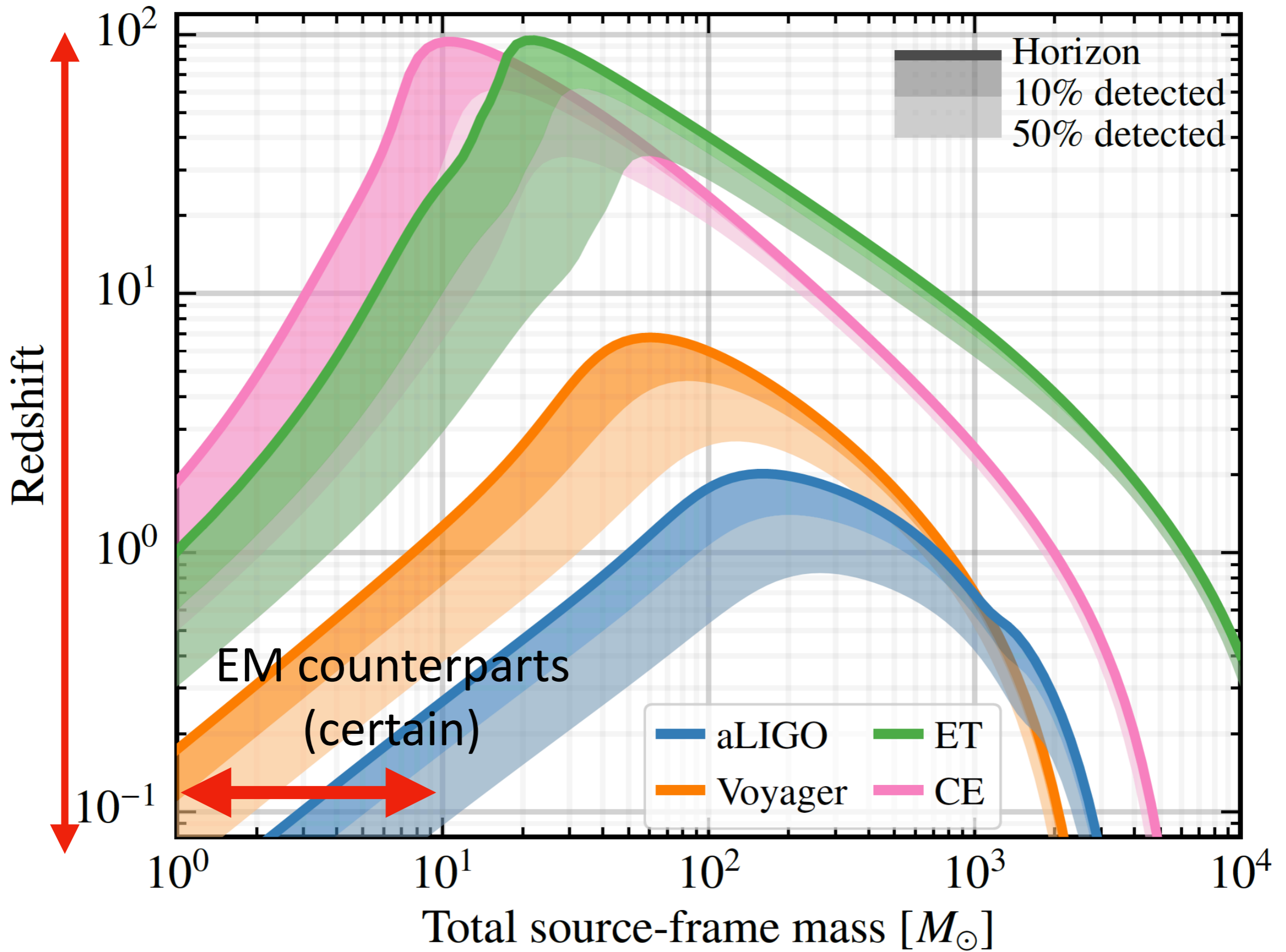
GW170817 masses

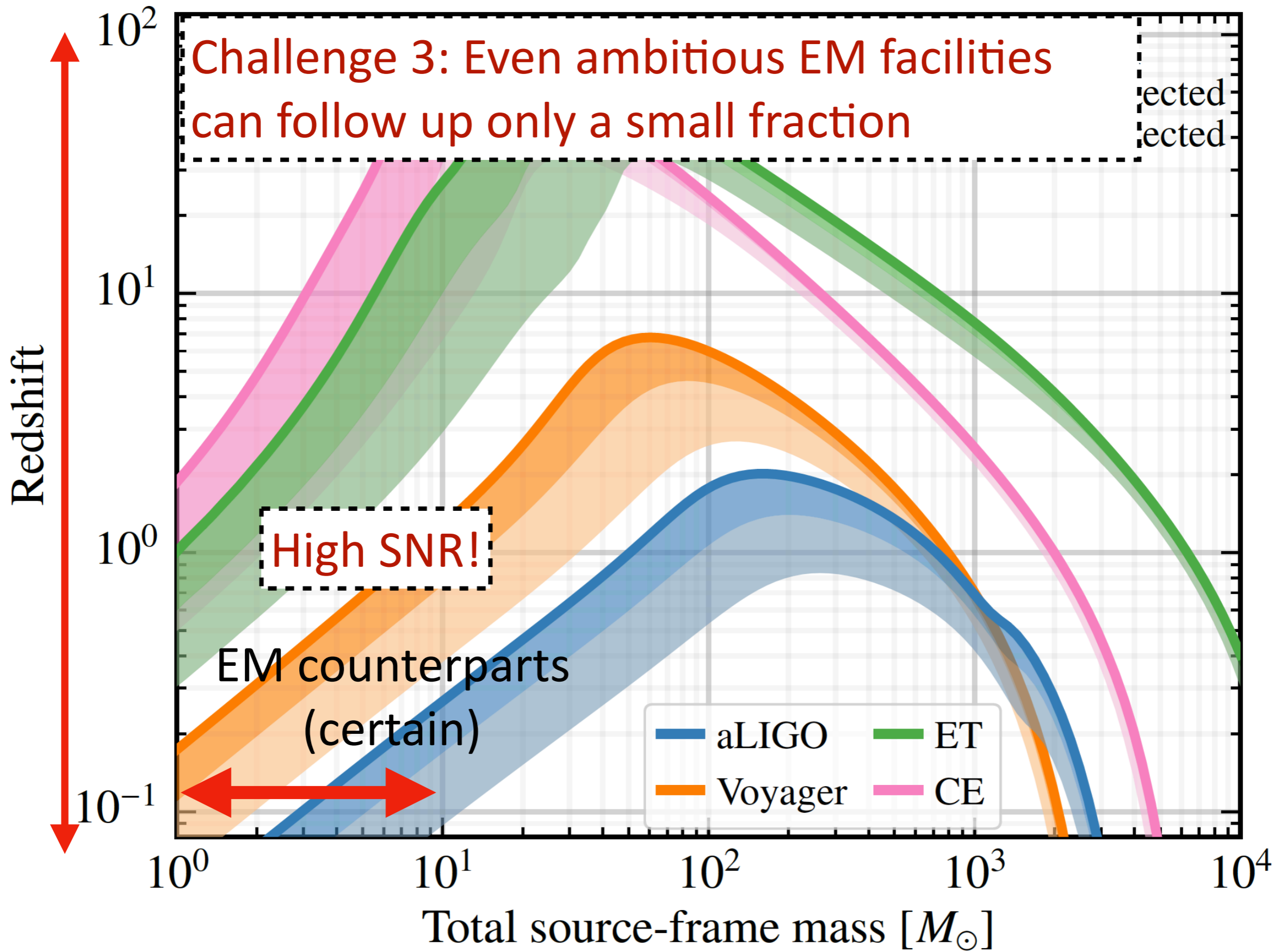


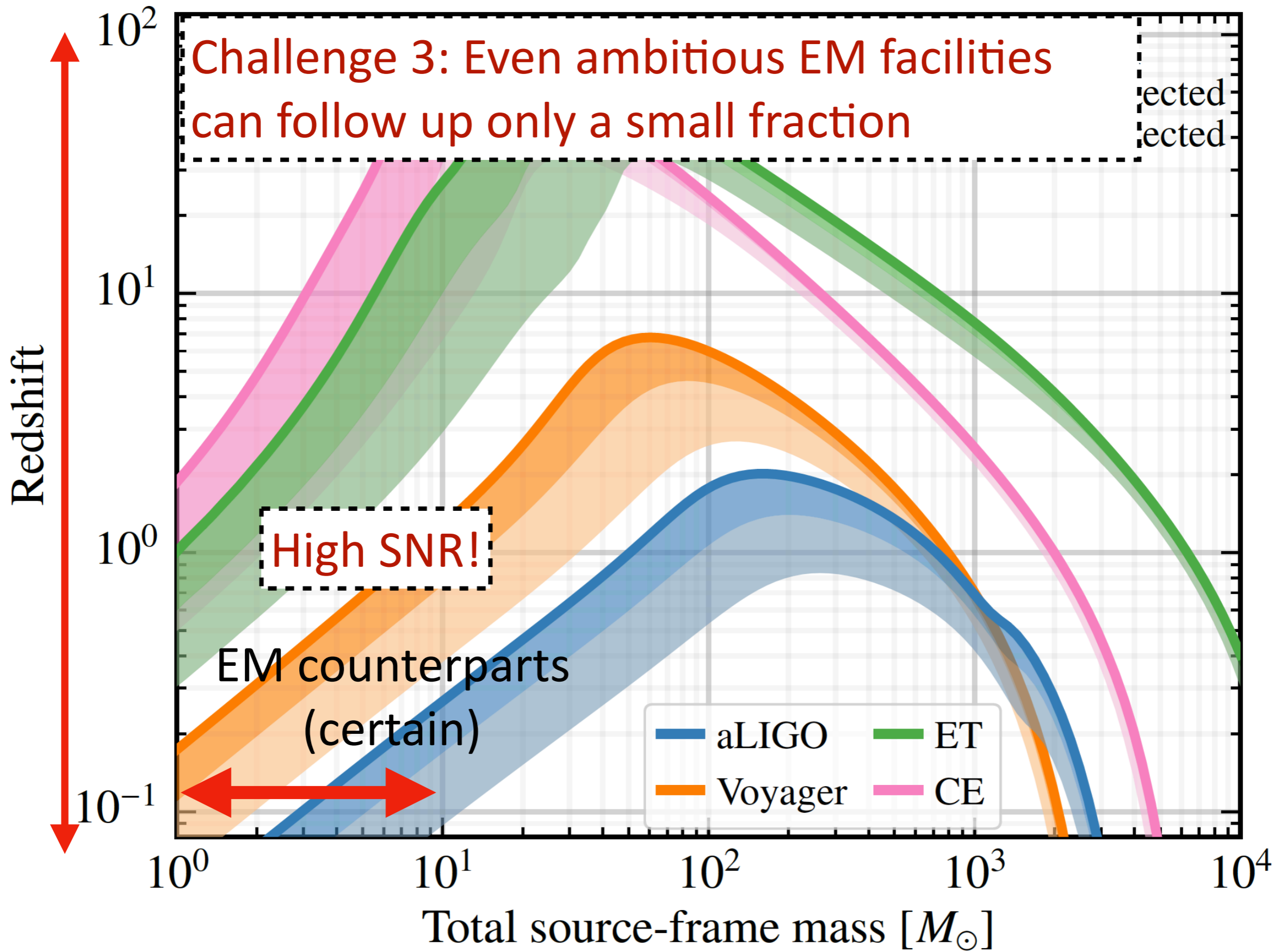


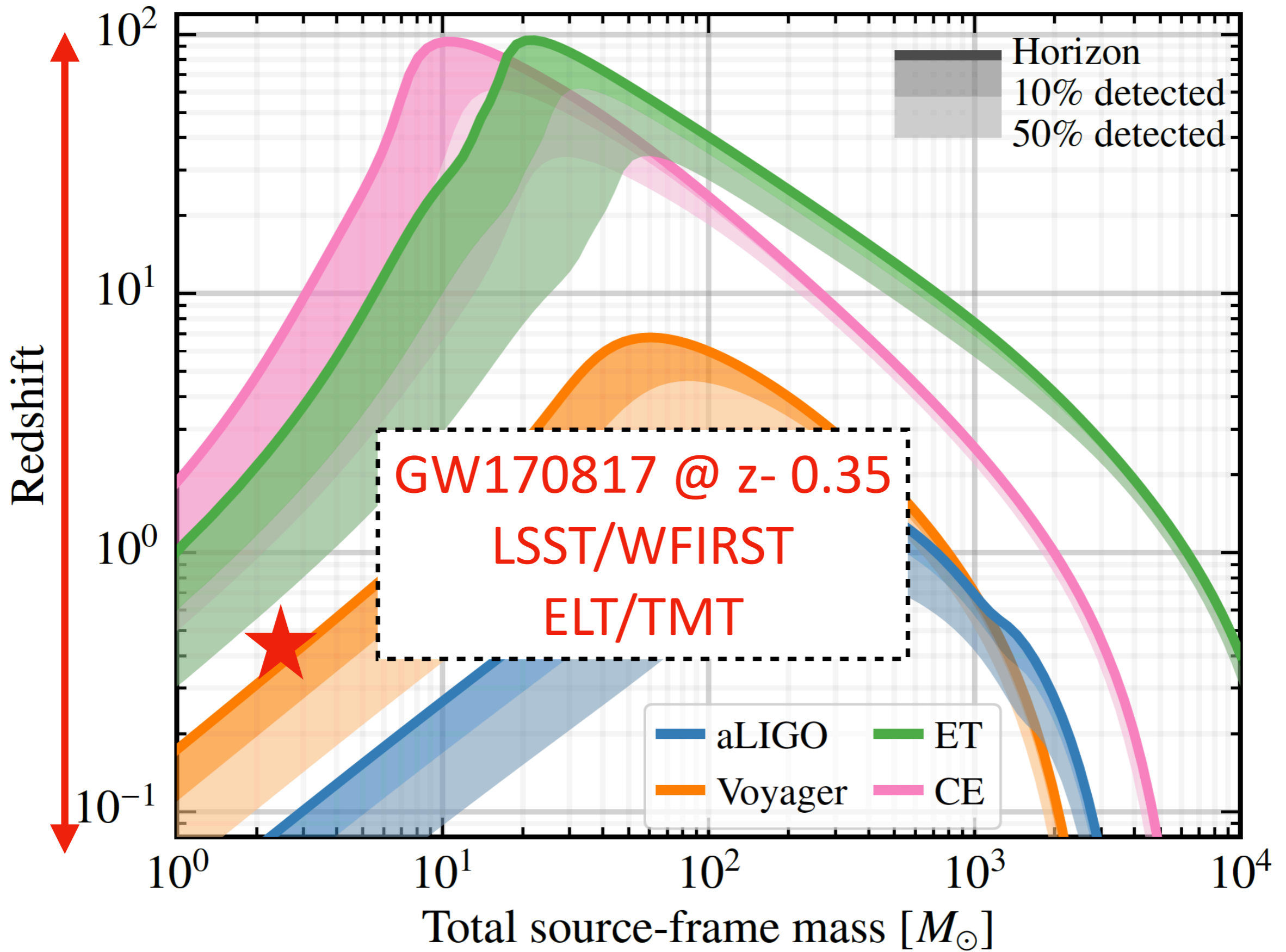






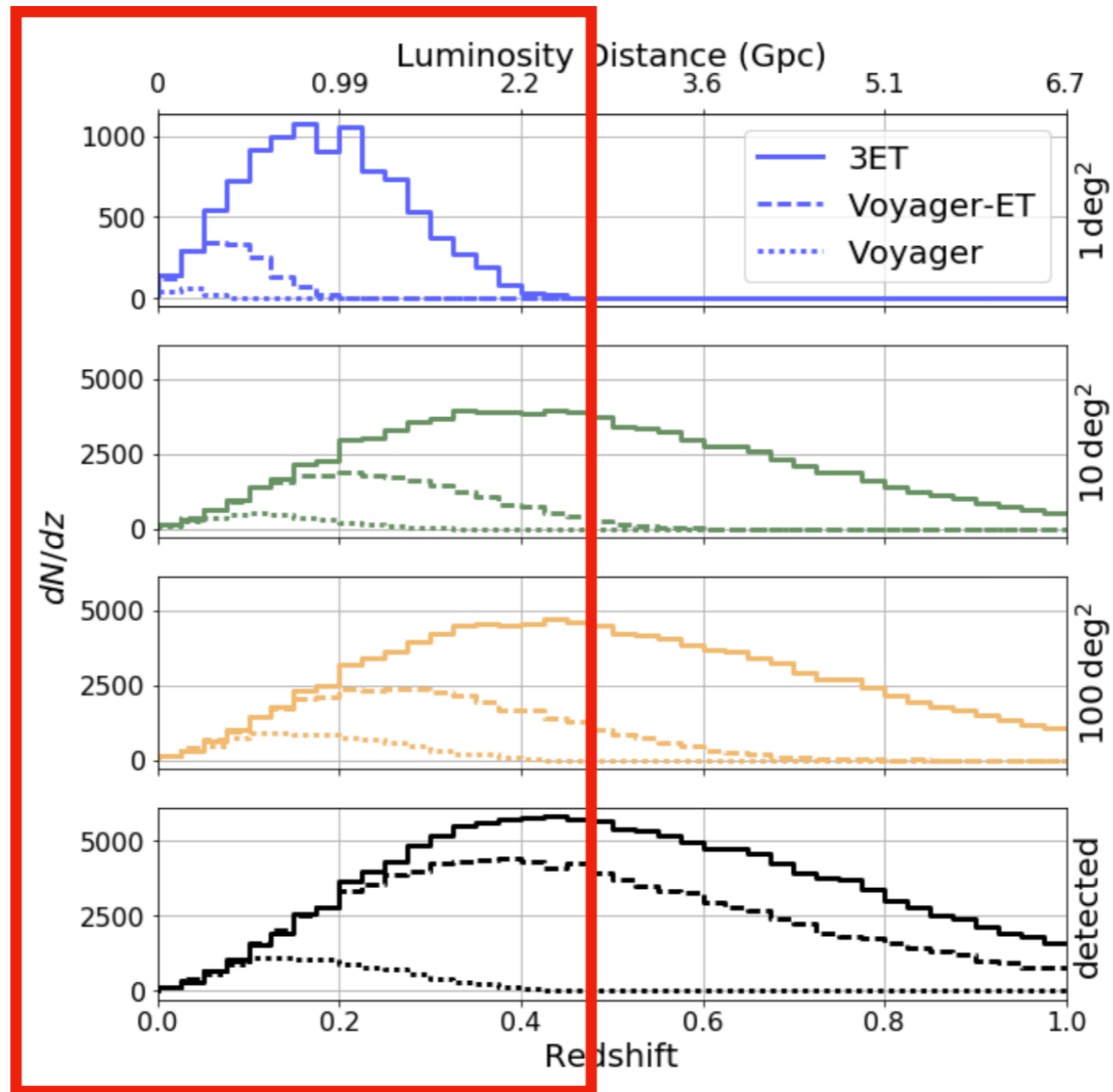






Challenge 4:

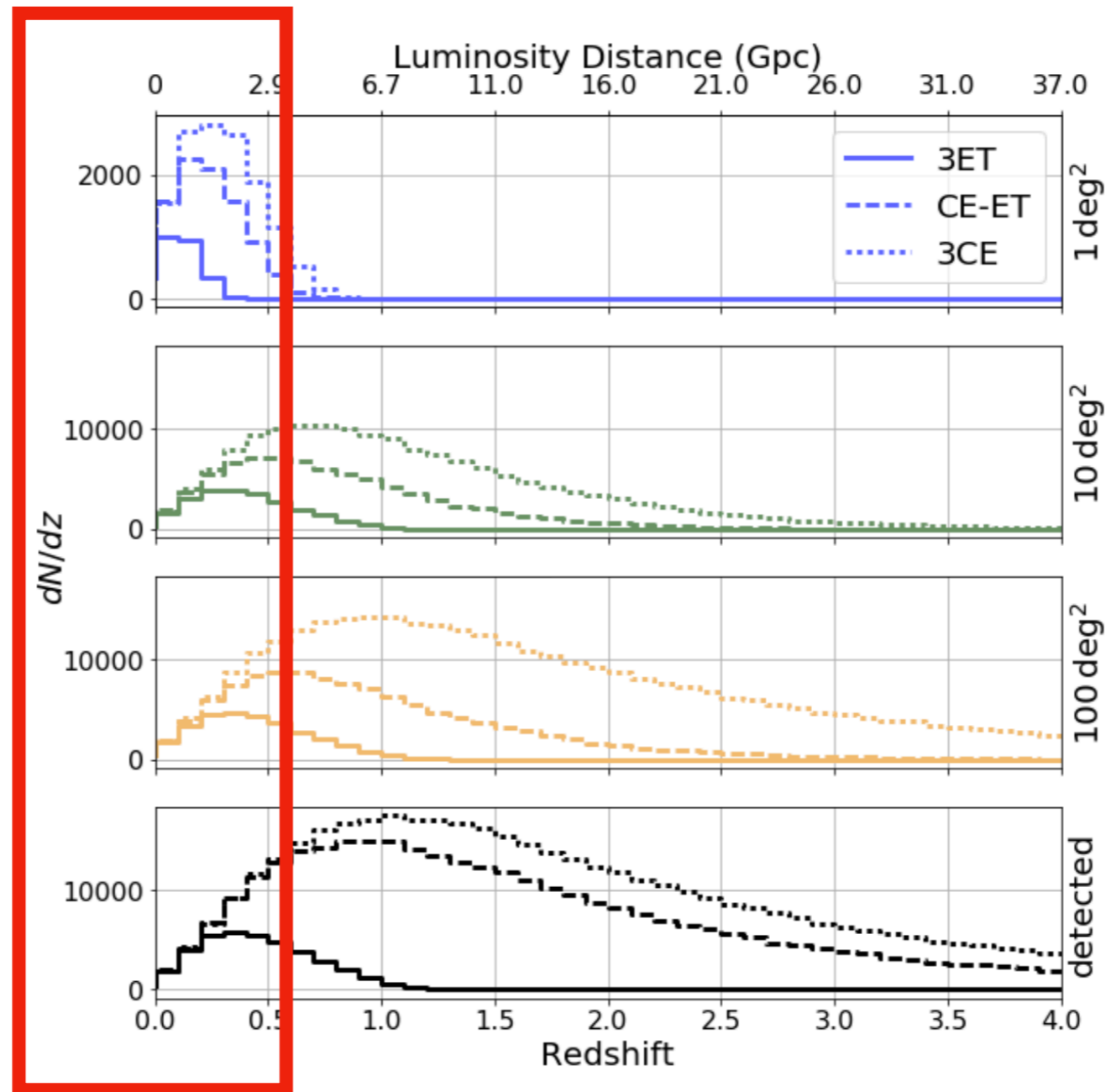
Sheer number of GW+EM sources even if cherry picking loudest



Within $z < 0.5$, 1000s of events per year

Challenge 4:

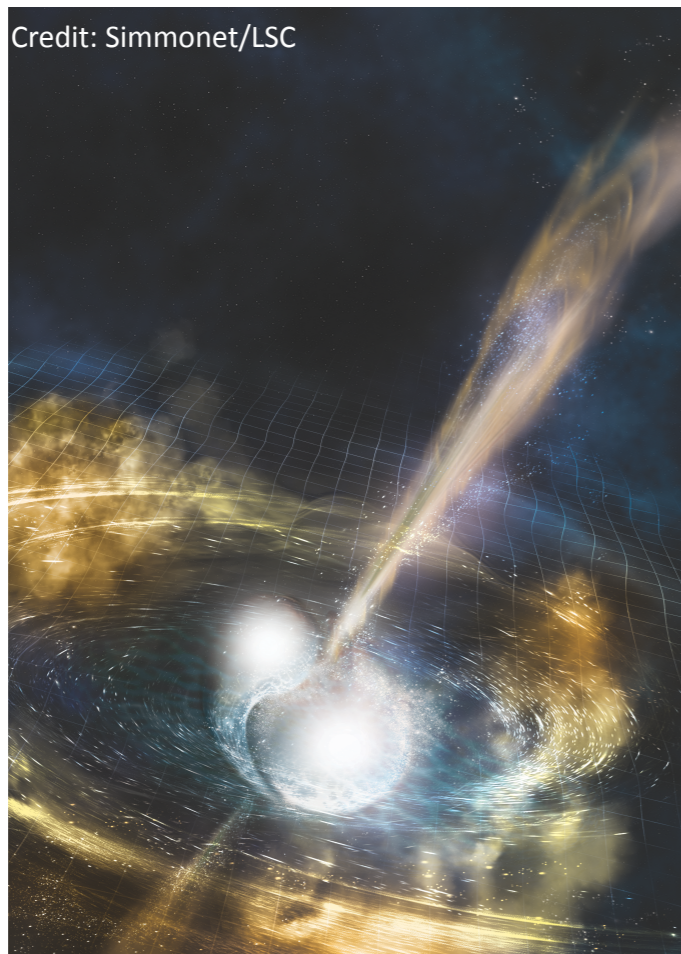
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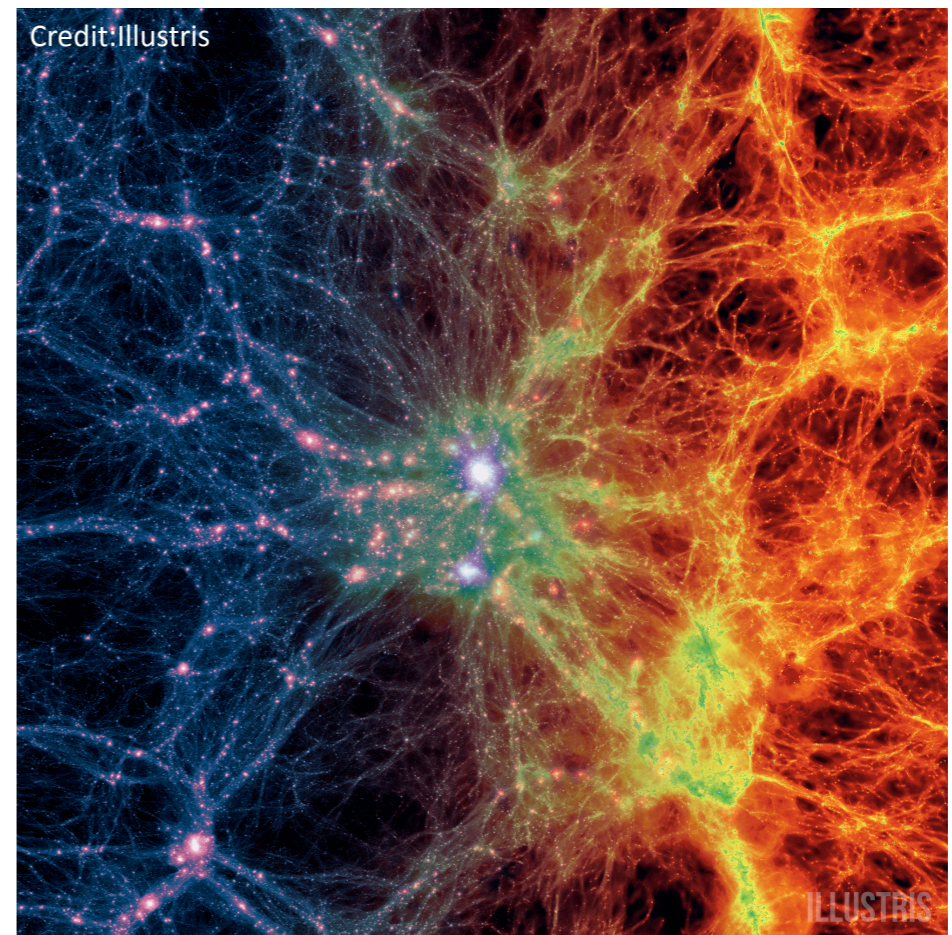
MMO in 2030s is not just EM follow up!

EM follow up of single sources



Cherry Pick Loud SNR events
- golden for GW+EM

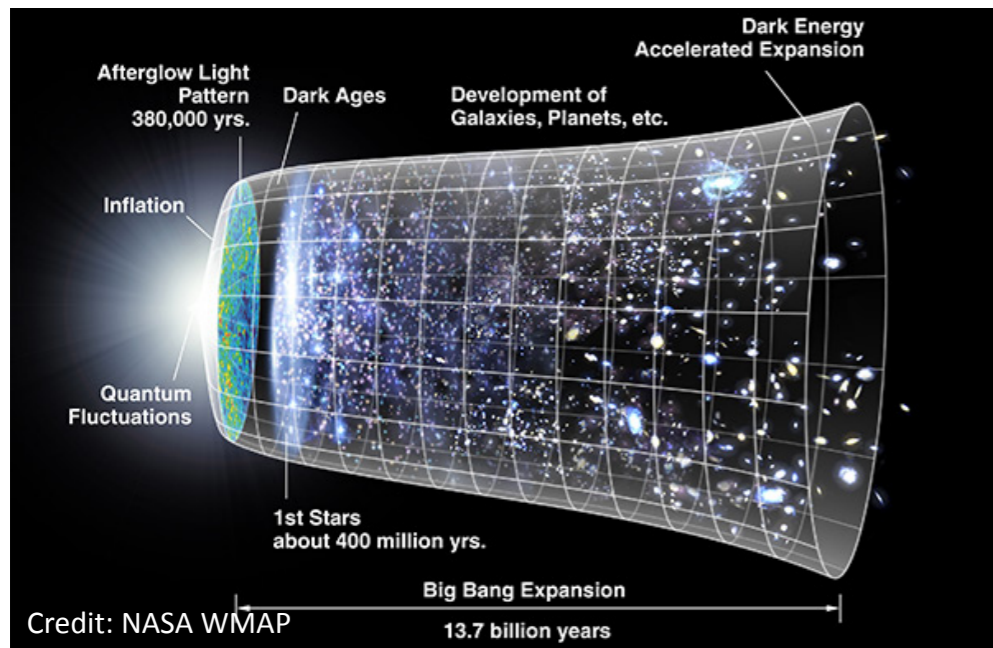
Cross correlating GW and EM source catalogs



Large Scale Structure;
Extragalactic Astronomy

Evolving Key Science Questions of 3G MMO

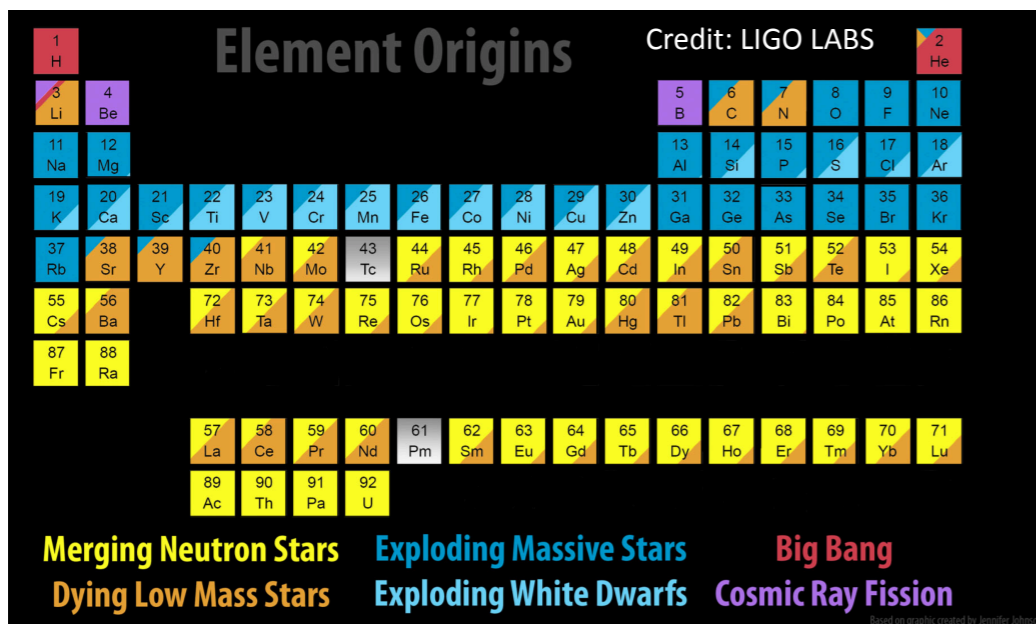
co-chairs: Matthew Bailes, Mansi Kasliwal, SN



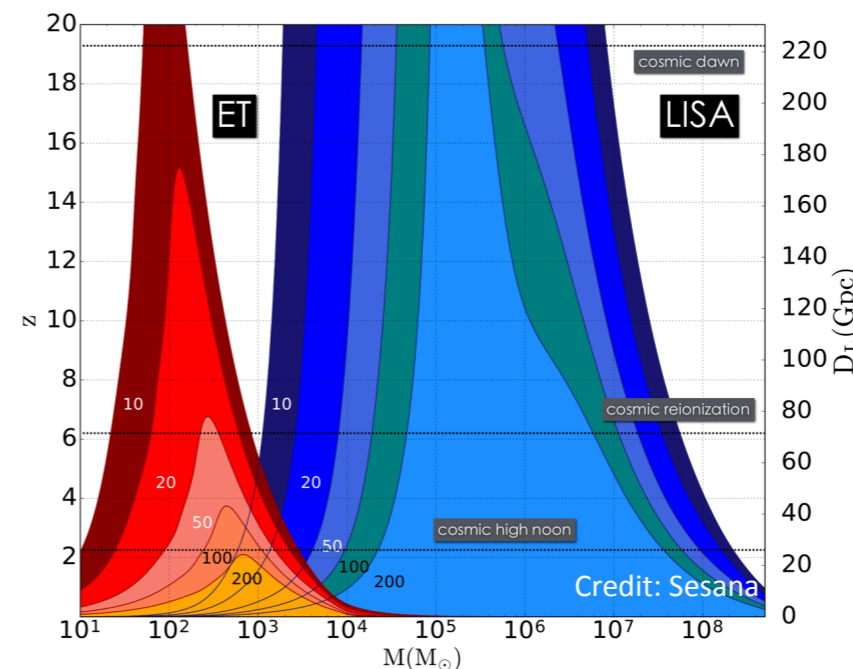
What is the local expansion history of the Universe (w for $z > 0.3$) ?



What is the central engine of relativistic jets?



Nucleosynthesis – a site or the site?

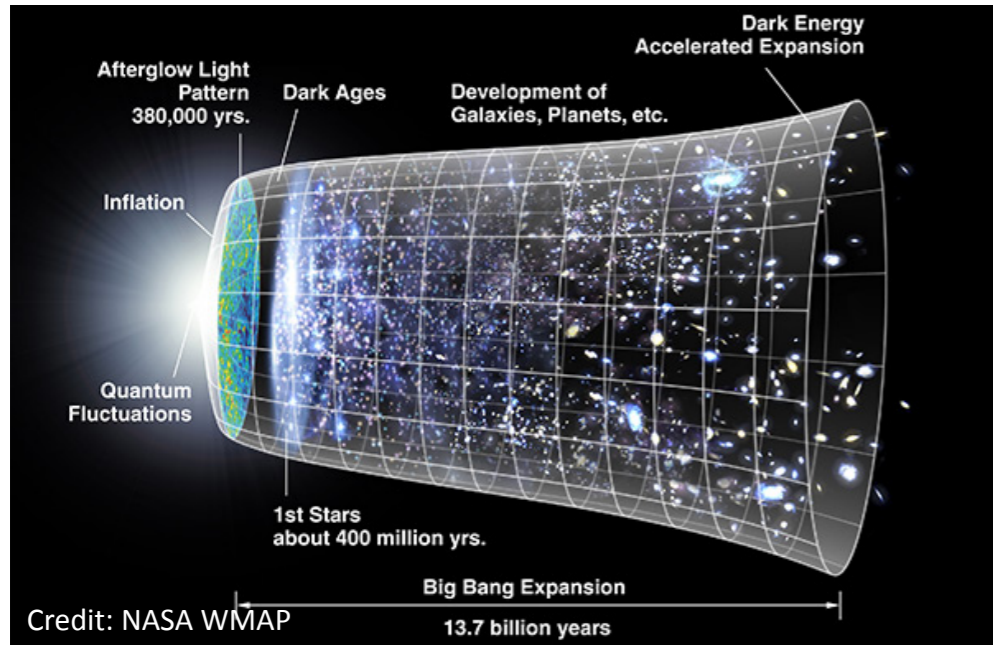


Are there EM counterparts to stellar mass BHs?

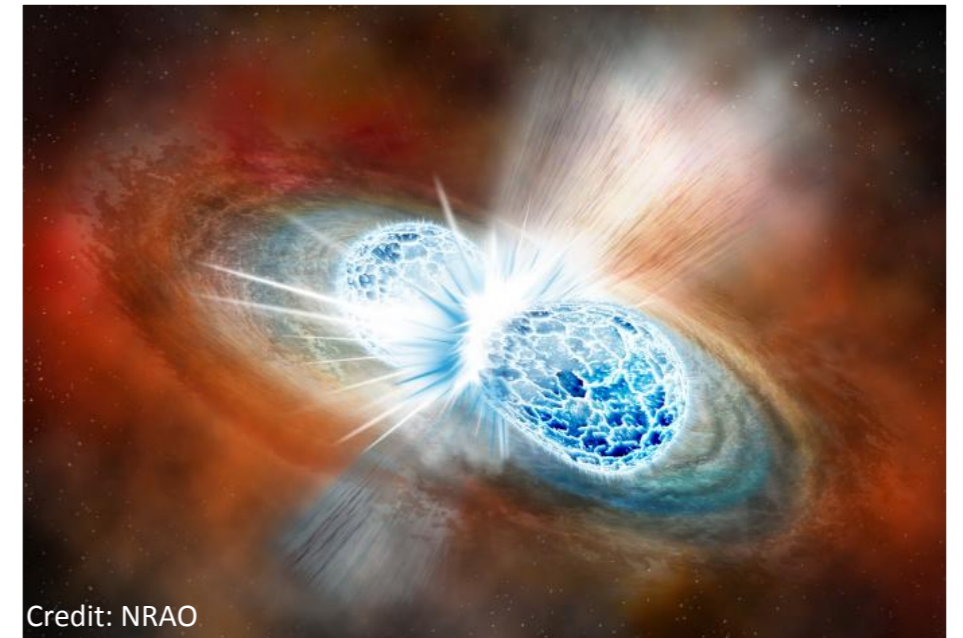
Nine key areas

What questions may be solved by 2030s?

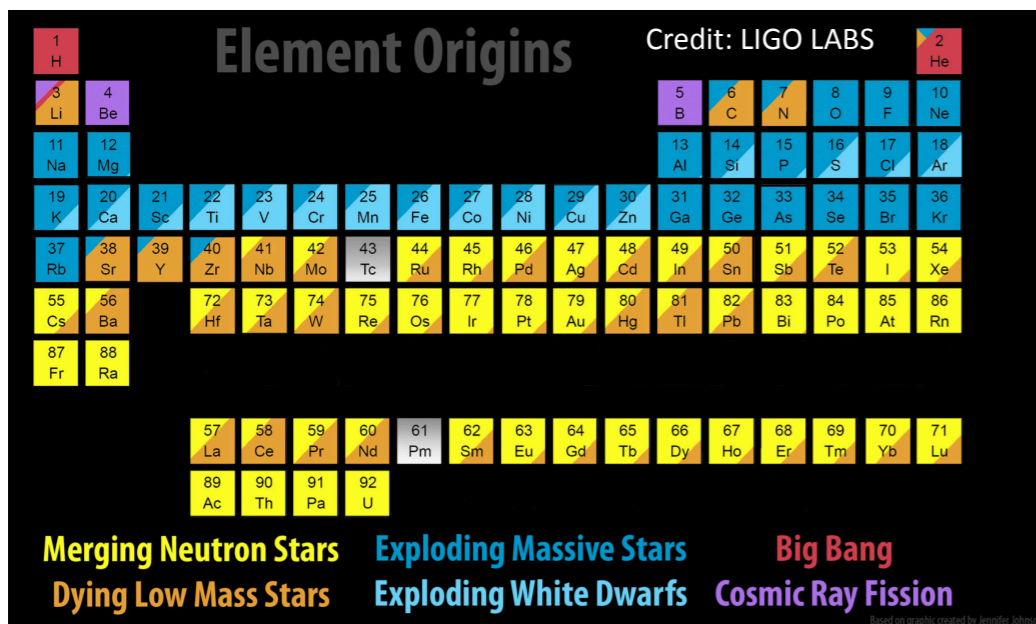
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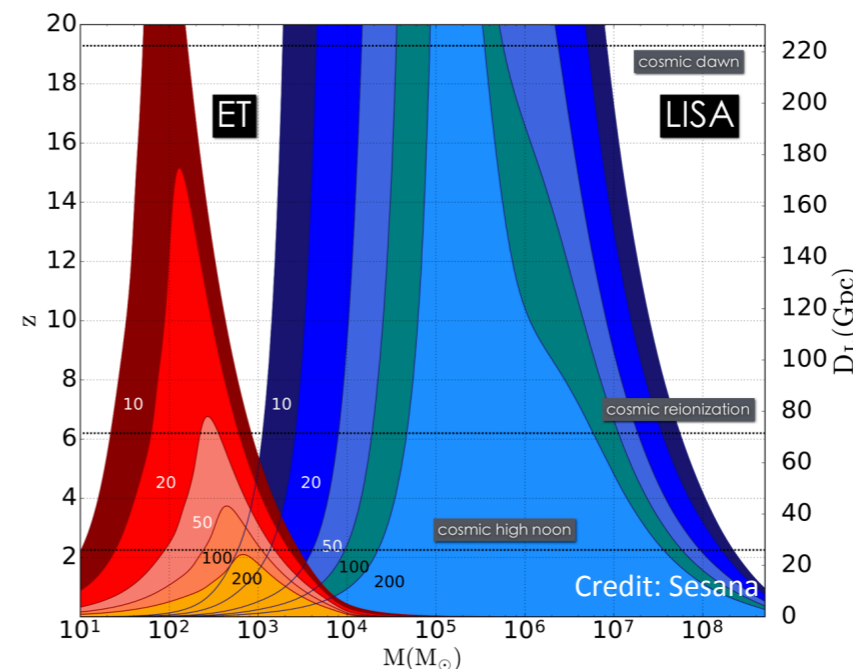
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Nucleosynthesis – a site or the site?



Are there EM counterparts to stellar mass BHs?

Nine key areas

Plan for rest of talk

- 1) What will be the GW+EM landscape in 2030s?
(routine, unchartered, unexpected discoveries)
- 2) EM facilities + beyond landscape
International
- 3) Community building and engaging diverse disciplines

2020s: What will we know from GW+EM astrophysics?

GW+EM NS-NS mergers will be routine;

GW+EM NS-BH mergers - several/tens;

GW+EM BBH mergers ??

SNe ?

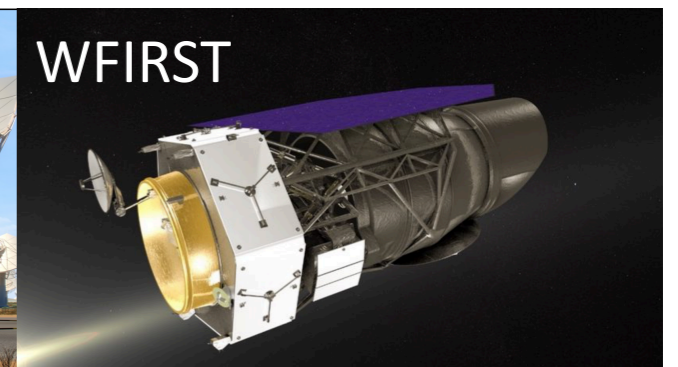
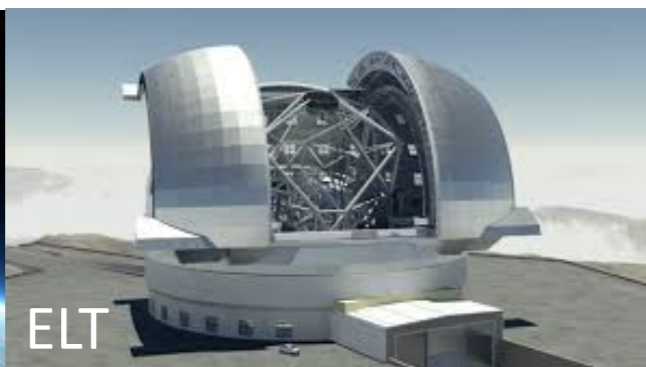
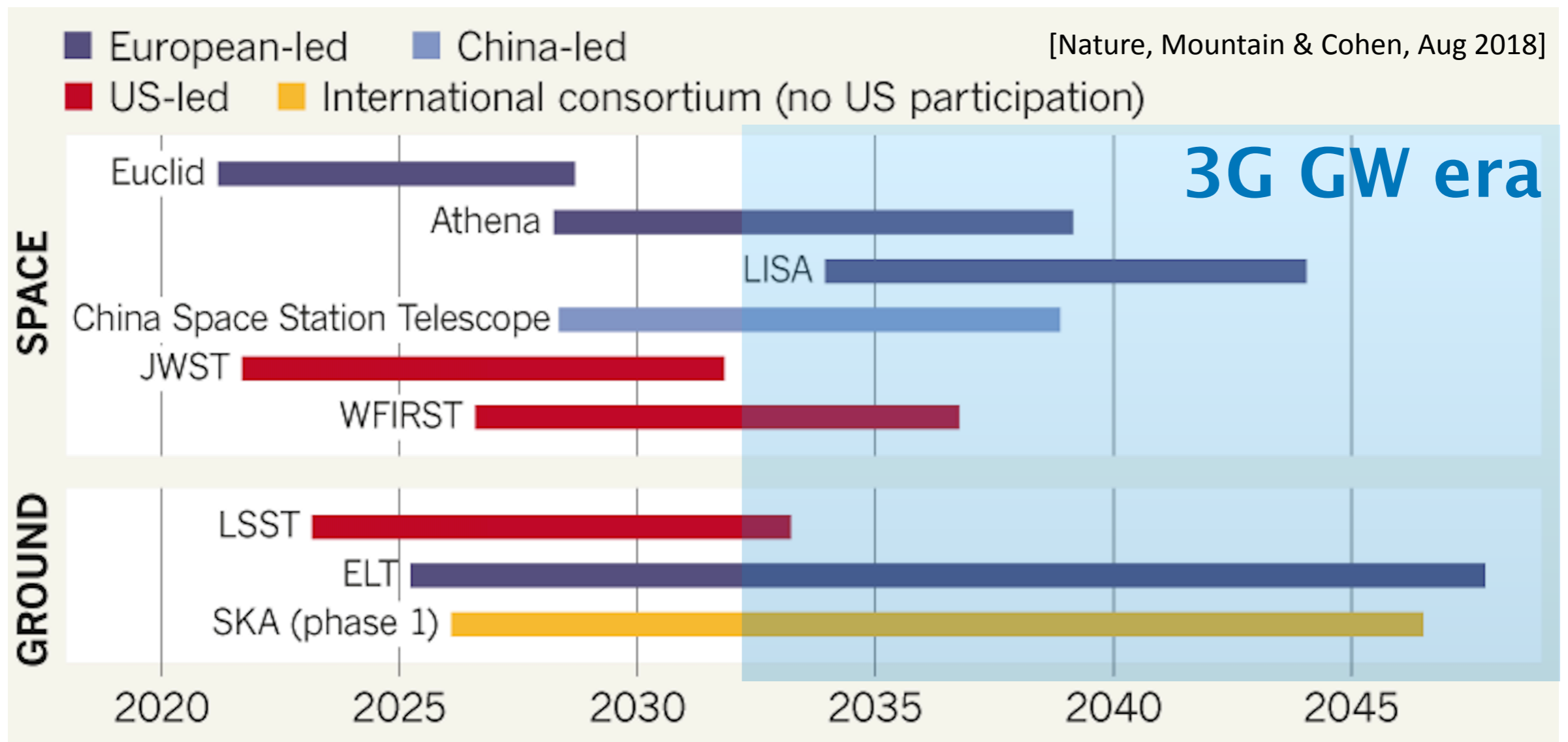
??

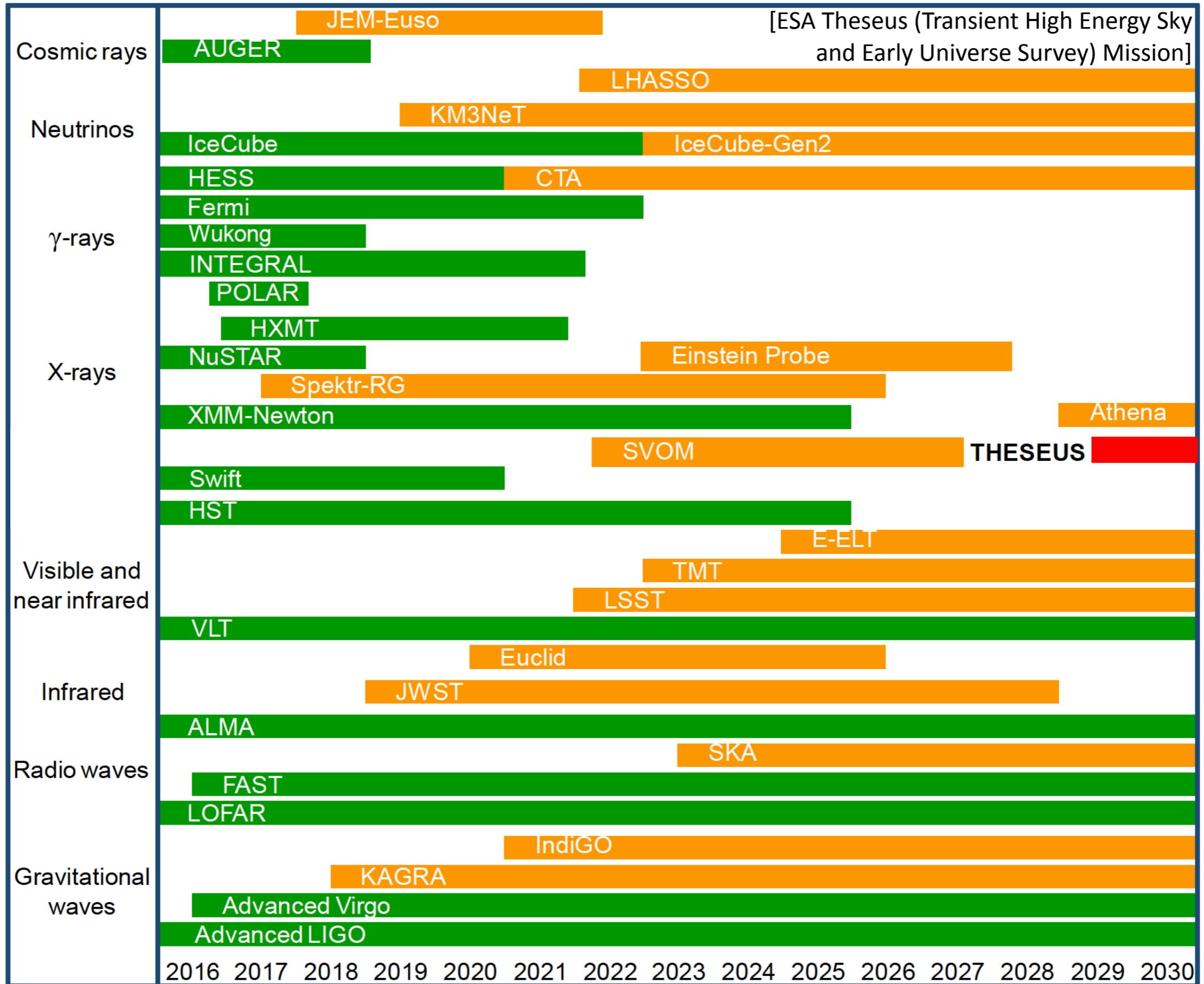
Equation-of-state of NSs would require 20-30 events - possible

Origin of heavy elements: ratio of r process peaks - possible

H0 “tension” resolved with standard sirens? - possible

2020s: Transformation of Astronomy into Big Data & International Large Projects

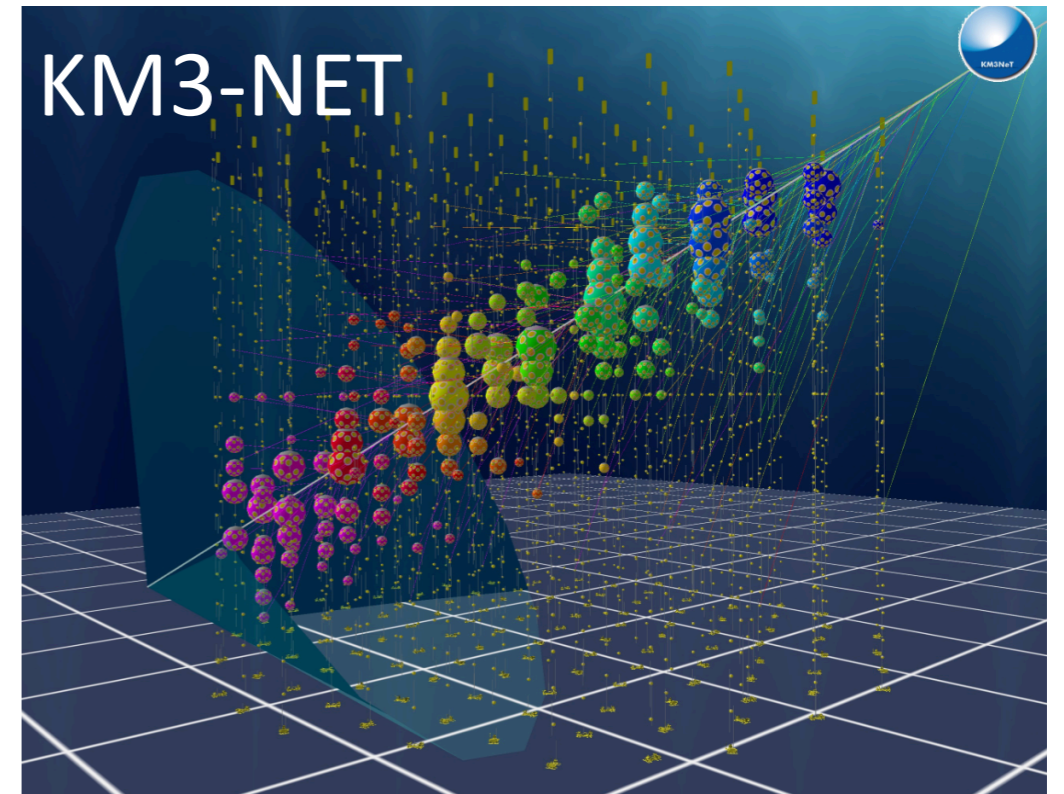
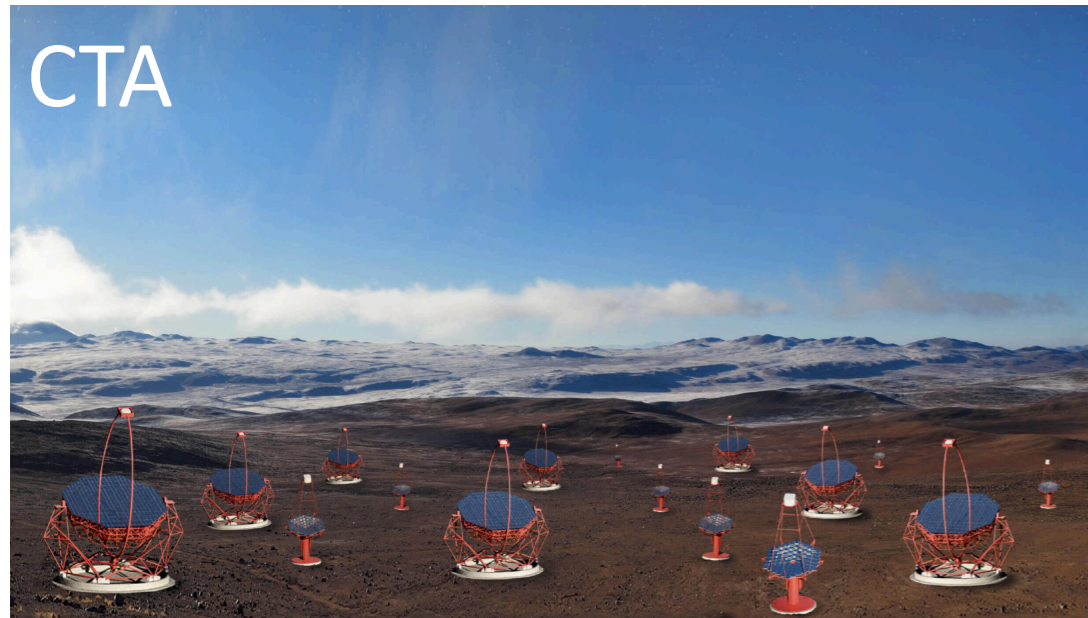




EM facility landscape in 2020s and 2030s

	High energy	UV-Optical-IR	Sub mm — Radio
Ground		<p><u>LSST</u> ZTF, BlackGEM, GOTO, ... CTIO-DECAM, Pan-STARRS, Subaru-HSC, many others</p> <p><u>ELT, TMT&GMT, VLT</u> Keck, Gemini, ...</p>	<p><u>ALMA</u> ngVLA <u>SKA-I</u> (MeerKAT, ASKAP) QTT GMRT FAST LOFAR II, Apertif SKA-II</p>
Space	<p>Neil Gehrels Swift (?) Fermi (?, consumables) AstroSAT (India) SVOM (France & China) GECAM (China, prop) Daksha (India, prop) eROSITA (Germany/Russia) <u>Athena (ESA)</u> <u>Einstein Probe (China,)</u> Theseus (ESA, phase I) EXTP (China, prop) Lynx (NASA, prop)</p>	<p>GAIA (ESA) HST (NASA), JWST (NASA), PLATO (ESA) TESS (NASA) EUCLID (ESA), <u>WFIRST (NASA)</u></p> <p>LUVOIR/Origin/HabEX (NASA + partners, most likely exoplanets)</p>	<p>Space VLBI ??</p>

Other messengers and experiments in 2020s and 2030s



...many more

Community building and engaging a wider user base:
“think BIG!!!”

Capitalise on MMA excitement!

MMA is key science for many missions & experiments

Our design choices will impact EM missions...

Conversation must begin now!

Beyond astronomy: nuclear physics, particle
astrophysics, cosmologists, HEP, LISA, DECIGO

International astro/physics landscape is changing
(China, India, Taiwan, Korea, Brazil, + other
emerging countries)

Community building and engaging a wider user base:
“think BIG!!!”

Grassroots action/talks/brainstorming about 3G are essential

Necessity to be flexible: astronomy projects are transitioning from small to large.

Prepare for Decadal/APPEC etc.

Together: Identify a “killer app”! (think HST, WFIRST, ...)

Community building and engaging a wider user base:
“think BIG!!!”

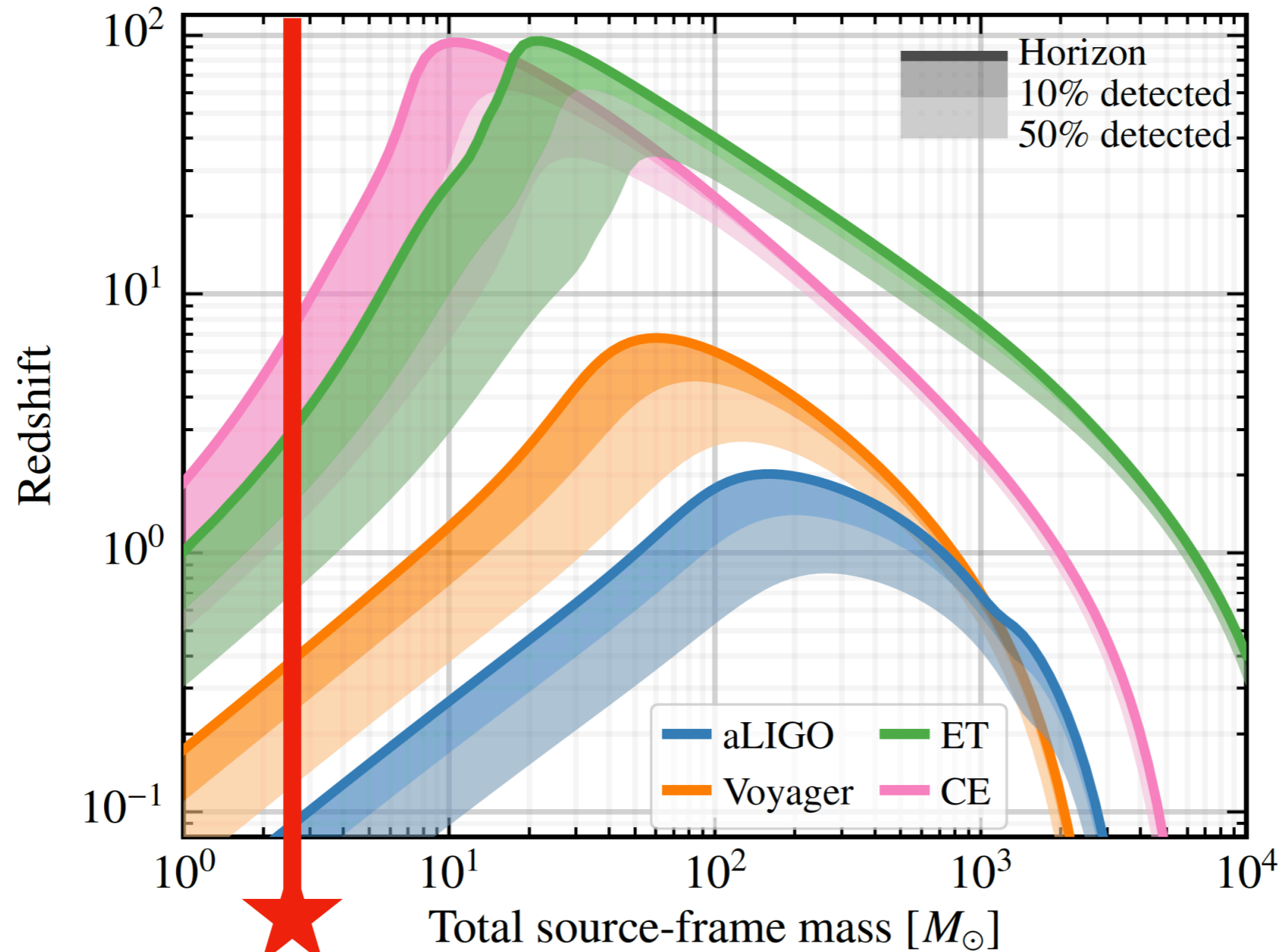
Define science: EM follow up of single source and statistical extragalactic studies

Today — no need to focus on technical aspects:
use pre-existing methods for alerts
(e.g., AMON, ASTERICS, VO)

Engage in public outreach

Train a diverse new generation of MMA scientists

Conclusions: Keep Staring, Discussing and ... Push New Frontiers



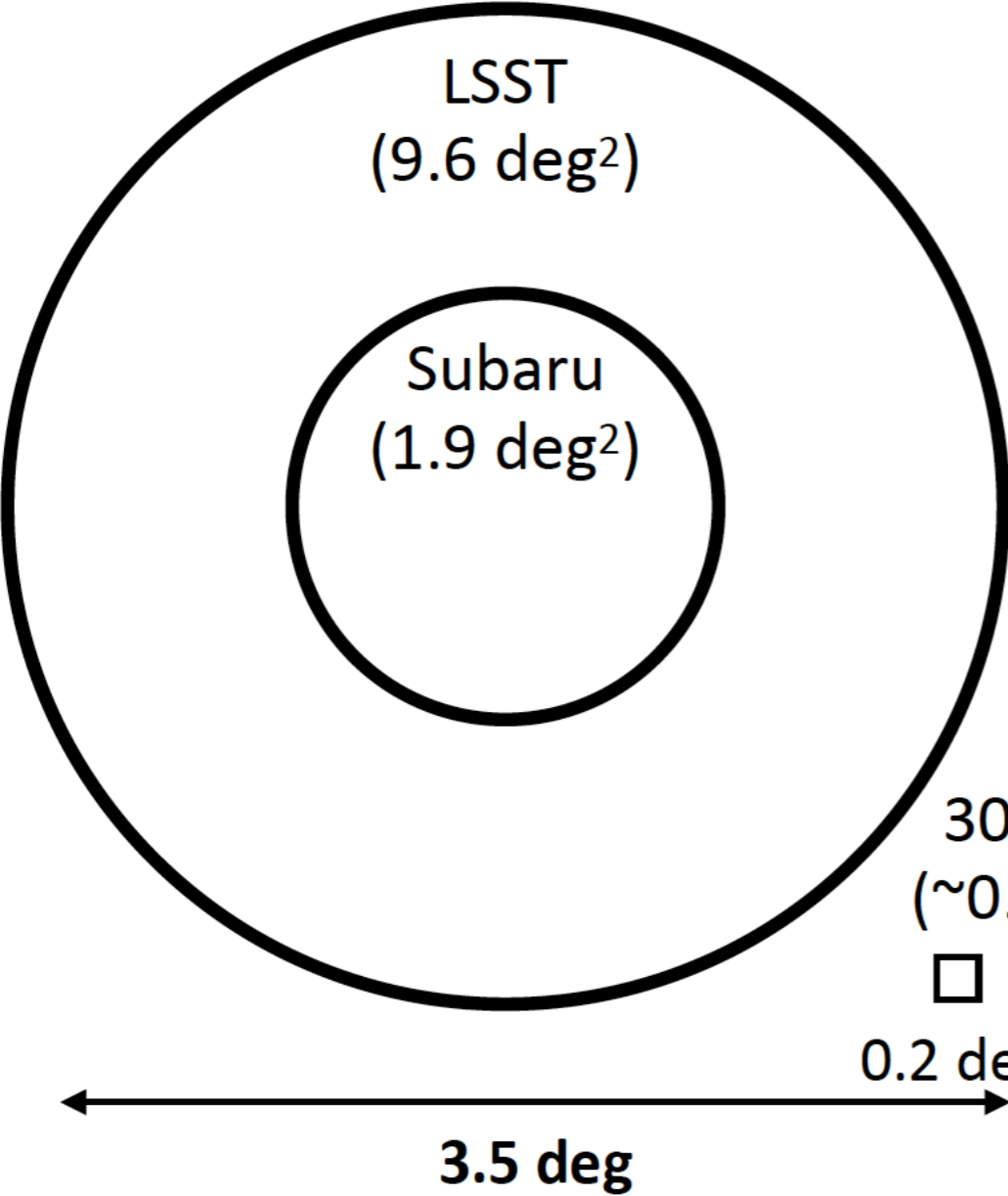
GW170817

$z \sim 10^{-2}$

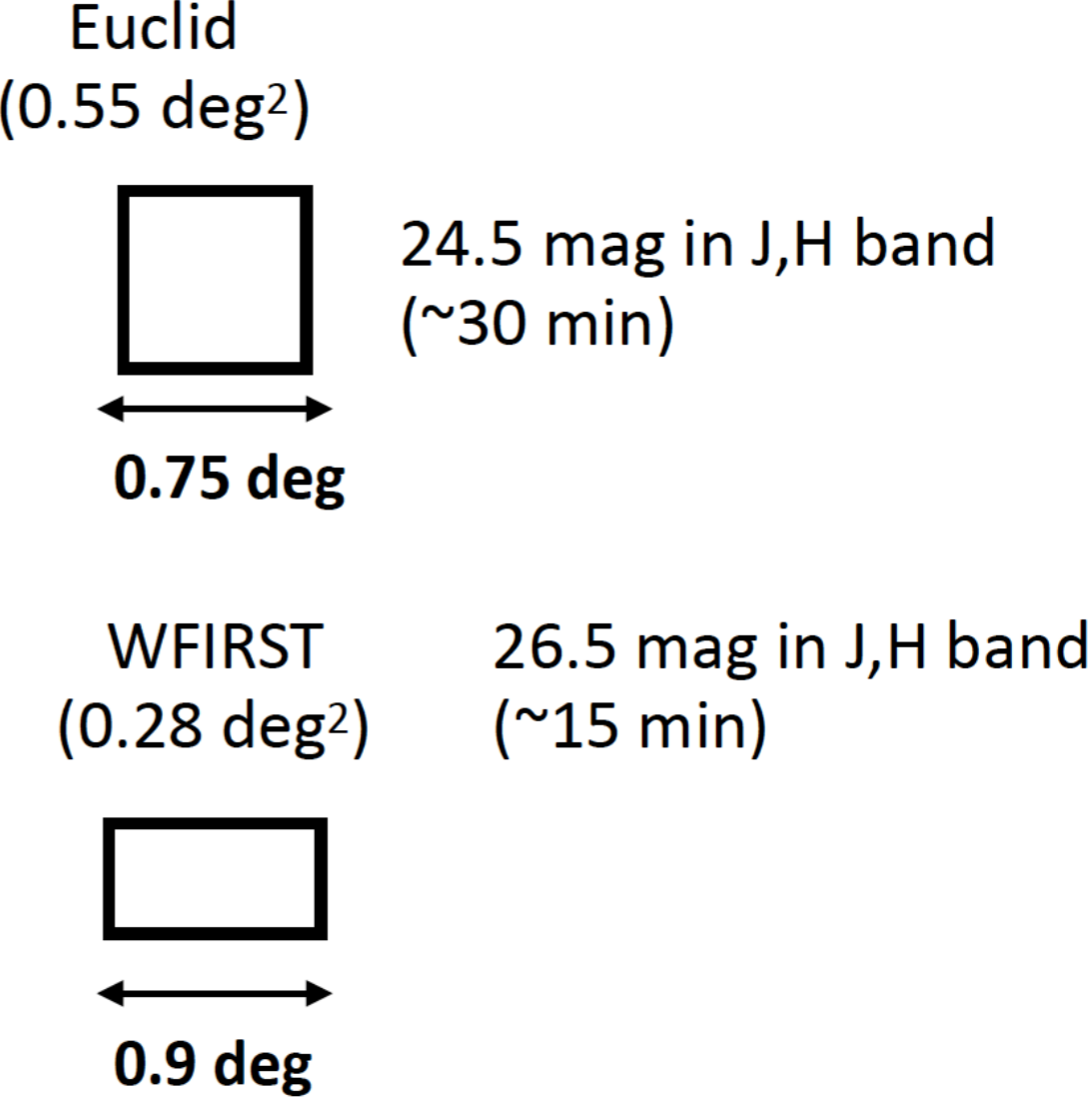
Wide field opt/IR facilities in 2020-2030s (for events at $d > 200$ Mpc)

Optical

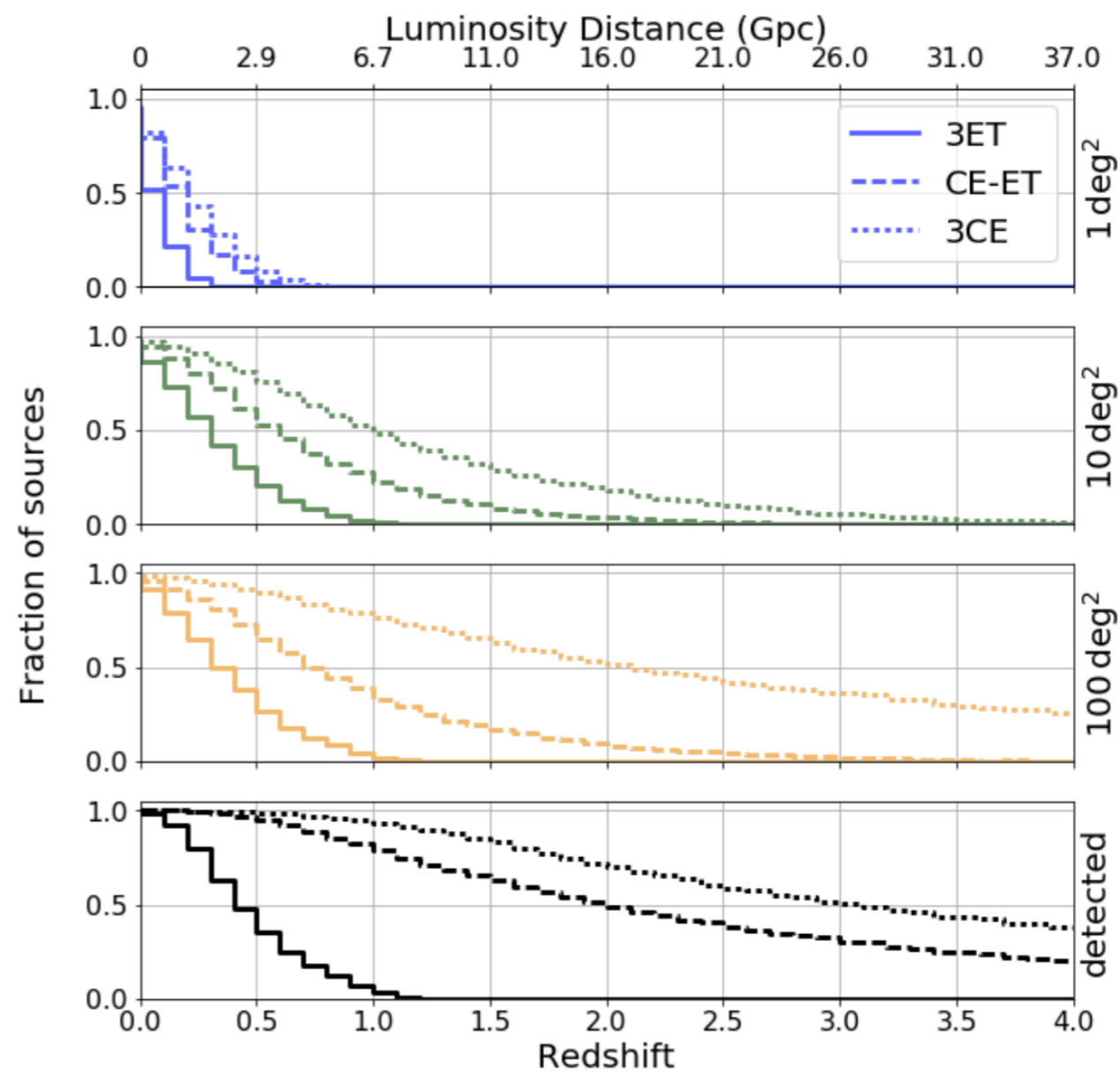
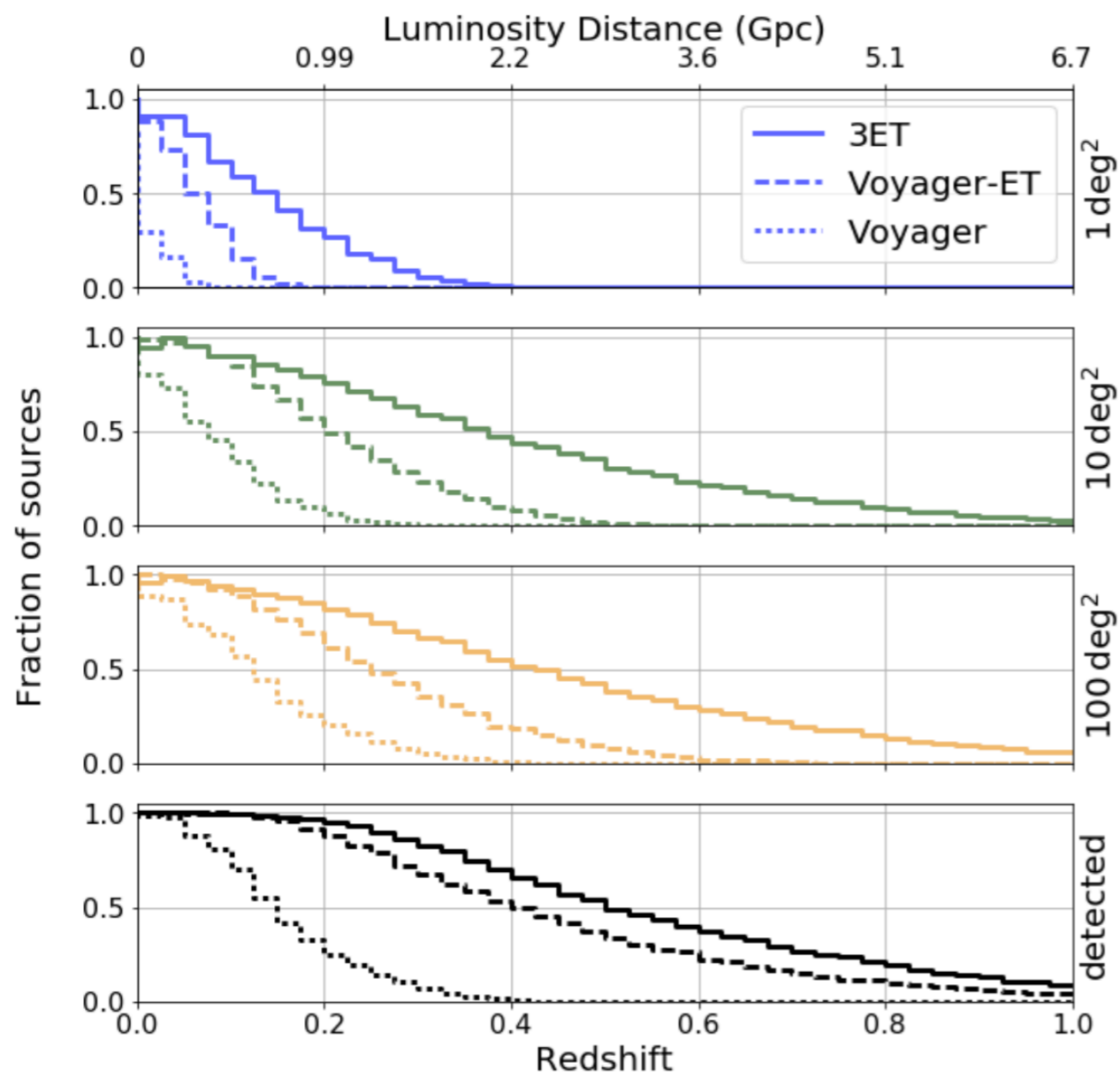
26 mag
(~10 min in g-band)
(~2 hr in z-band)
27 mag
(~ 1 hr in g-band)

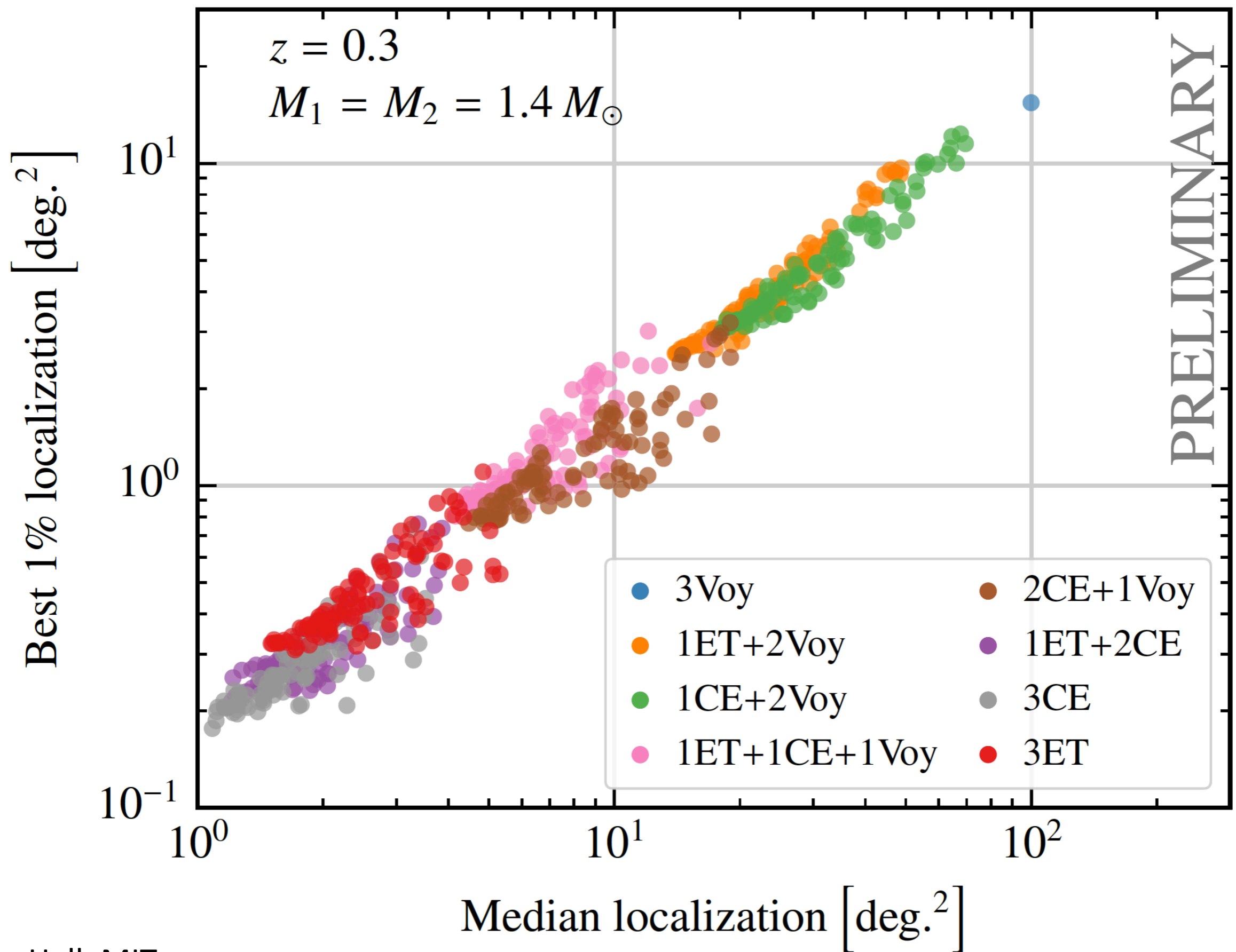


Infrared



END OF TALK



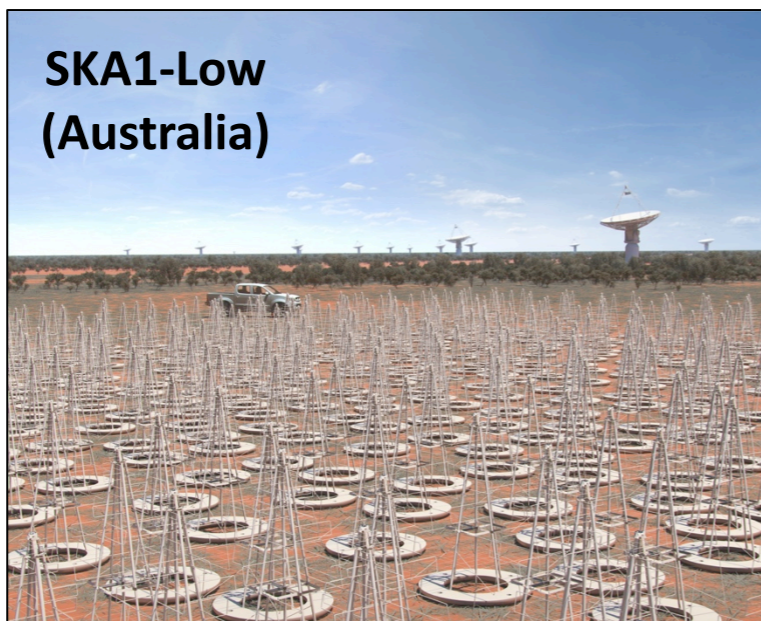


Exploring the Universe with the world's largest radio telescope

The Square Kilometre Array



- Vision: world's most powerful radio telescope
 - 10 member countries: AU, CA, CN, IN, IT, NL, NZ, SE, ZA, UK
 - Observers and other participants: BR, DE, ES, FR, JP, KR, MT, PL, PT, RU, US
- 2012: site decision; 2015: final baseline design for SKA1 (first ~10%)
 - “SKA1-Low” in Australia: 130,000 dipoles, 50-350 MHz, max baseline 40-65 km
 - “SKA1-Mid” in South Africa: 200 dishes, 350-14000 MHz, max baseline 120-150 km
 - Sensitivity: 8 x LOFAR, 5 x JVLA; resolution: 1.25 x LOFAR, 4 x JVLA
 - Survey speed: 135 x LOFAR, 60 x JVLA



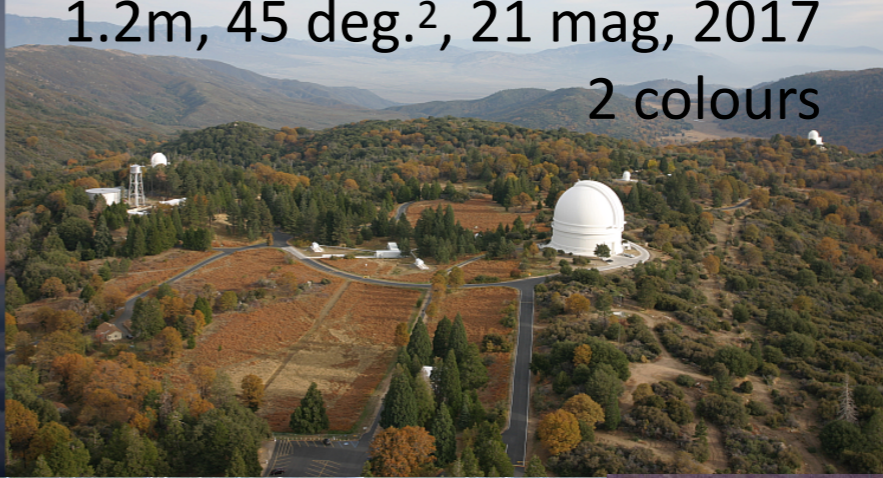
Today : Current wide-field optical telescopes

1m Class Telescopes

PanSTARRS, 1.8m, 23 mag, 7 deg.²



Zwicky Transient Facility (ZTF),
1.2m, 45 deg.², 21 mag, 2017
2 colours



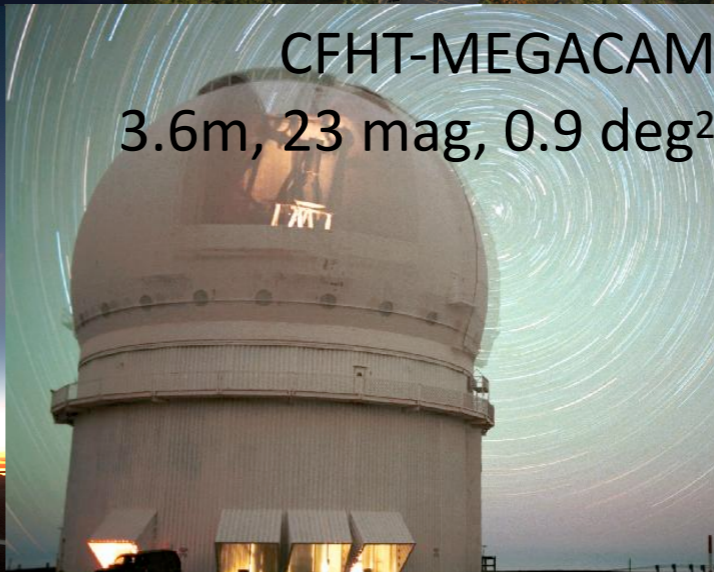
Skymapper
(1.3m; 5.8 deg.²);
La Silla Quest
(1.0m; 9.4 deg.²);
CRTS
(0.7m; 8 deg.²);
ROTSE
(0.45m; 3.4 deg.²) ...

4m Class Telescopes

CTIO-DECAM
4m, 23.7 mag, 3 deg.²

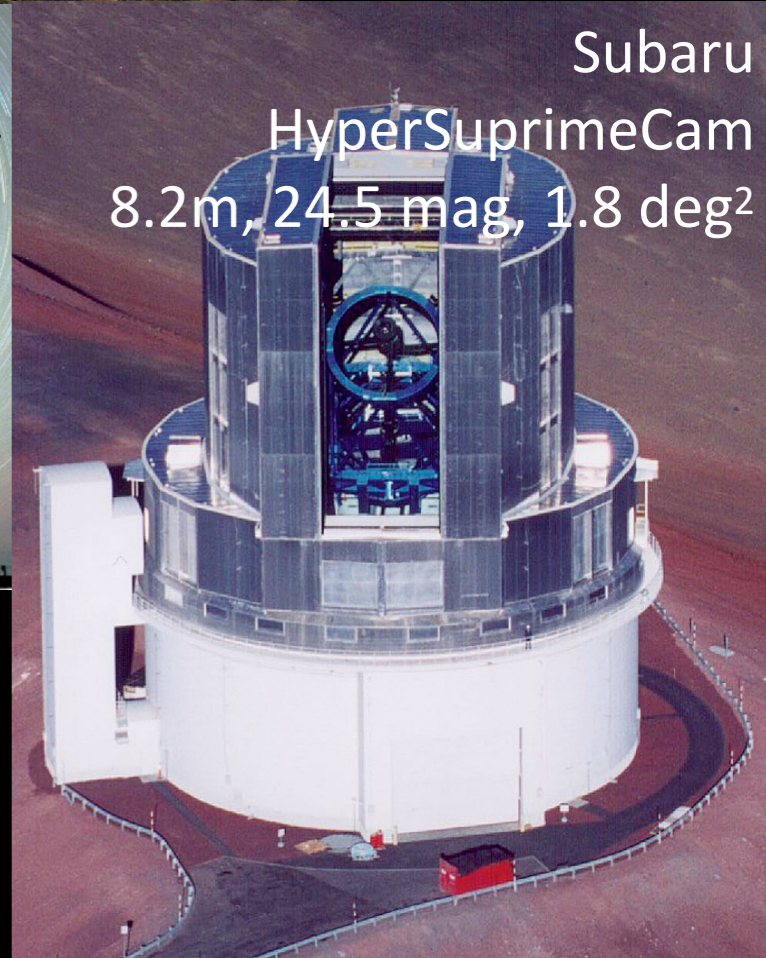


CFHT-MEGACAM
3.6m, 23 mag, 0.9 deg.²



8m Class Telescopes

Subaru
HyperSuprimeCam
8.2m, 24.5 mag, 1.8 deg.²



New wide-field optical telescopes

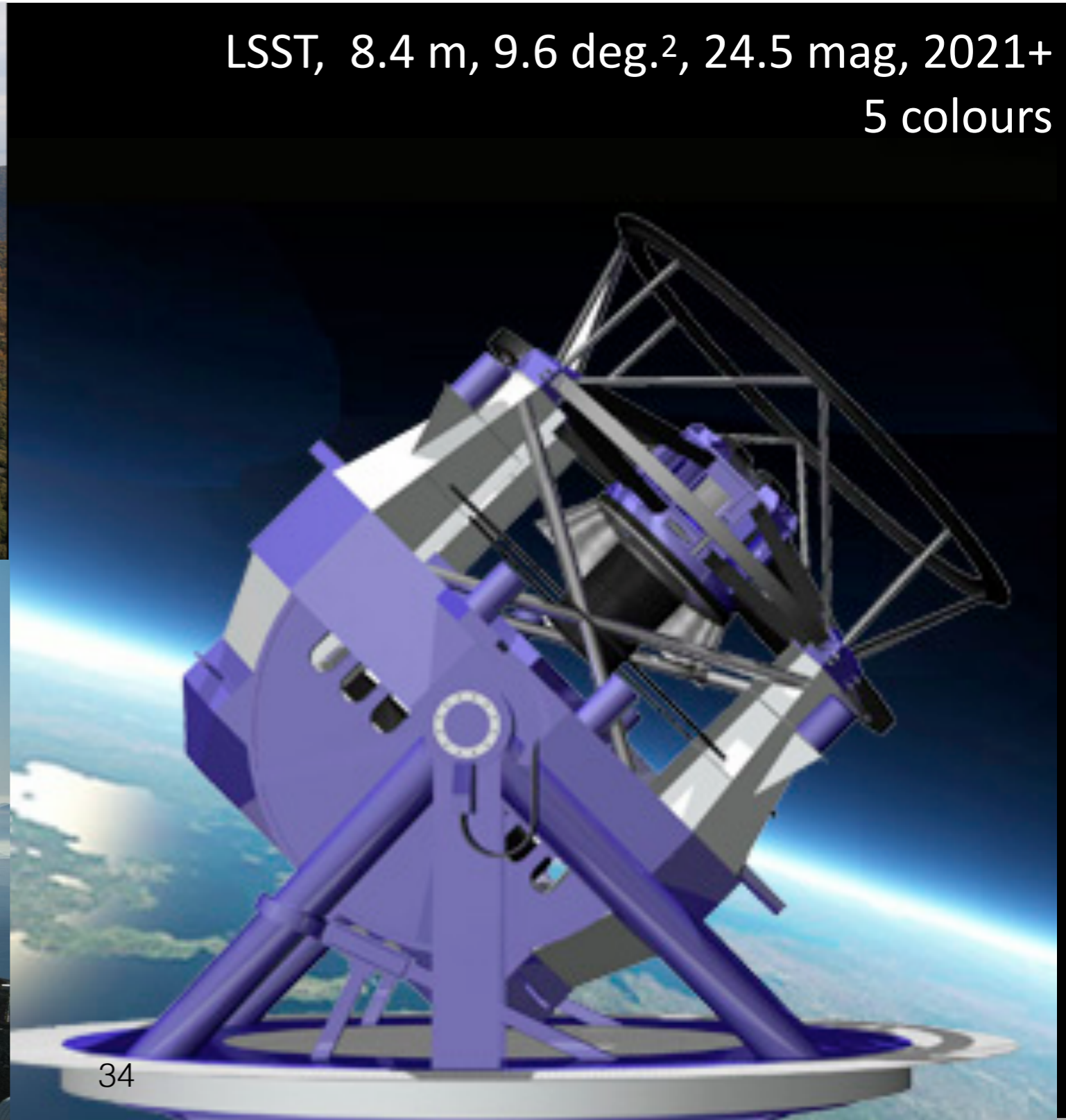
Zwicky Transient Facility (ZTF),
1.2m, 45 deg.², 21 mag, 2017
2 colours



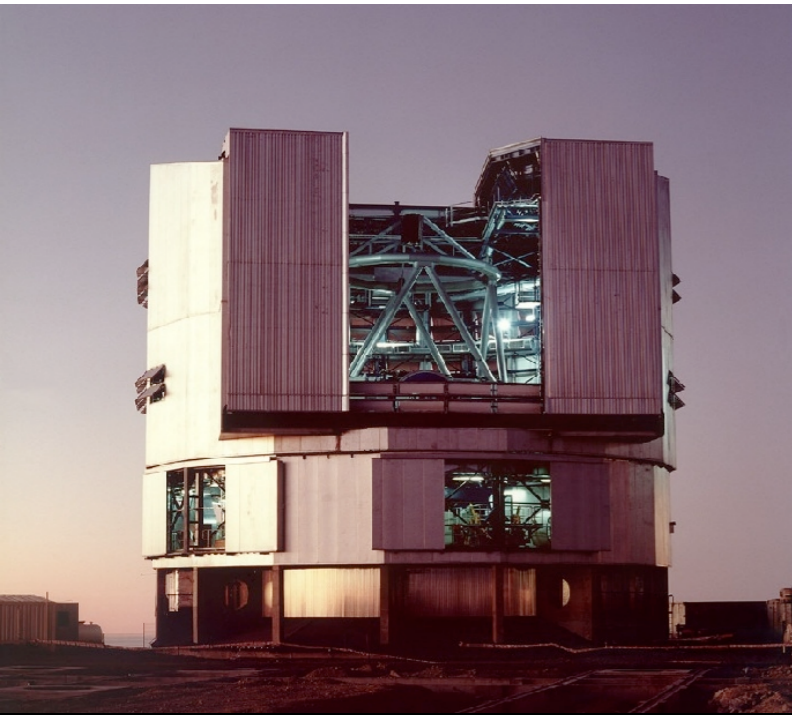
BlackGEM, 21 mag, 8/24 deg.², 2019
6 colours
www.blackgem.eu



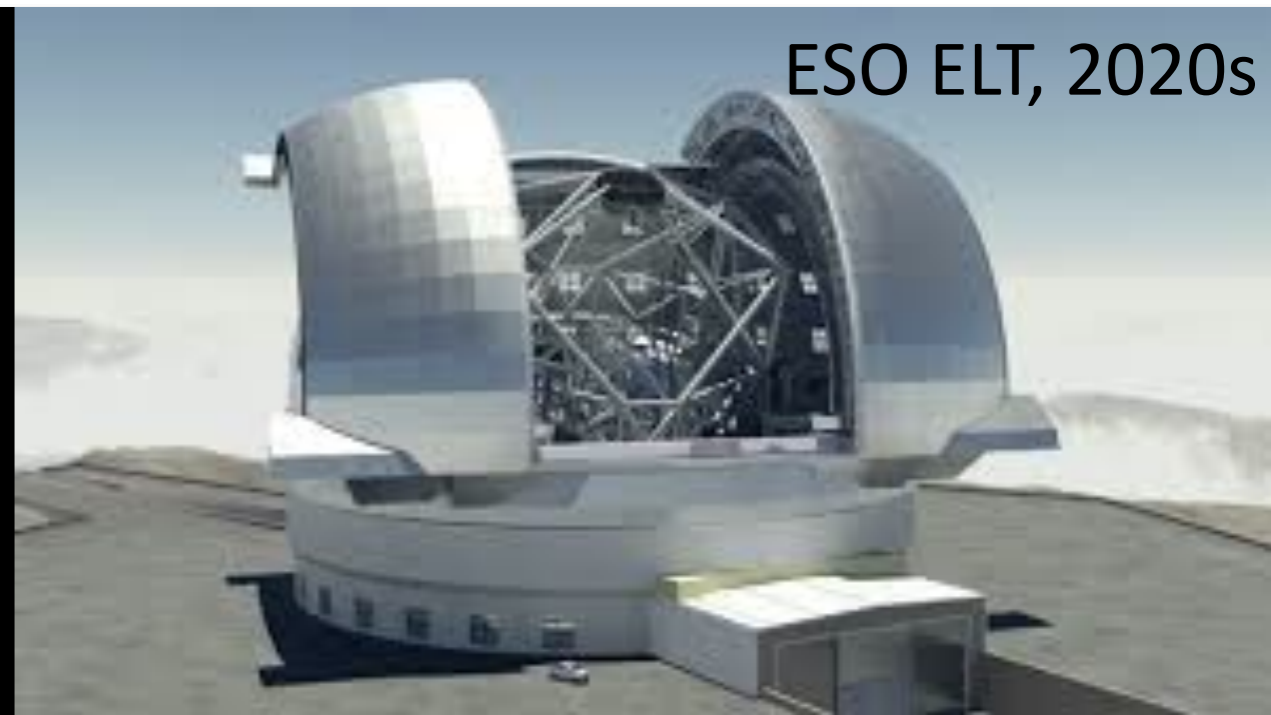
LSST, 8.4 m, 9.6 deg.², 24.5 mag, 2021+
5 colours



2. Spectroscopic follow-up telescopes



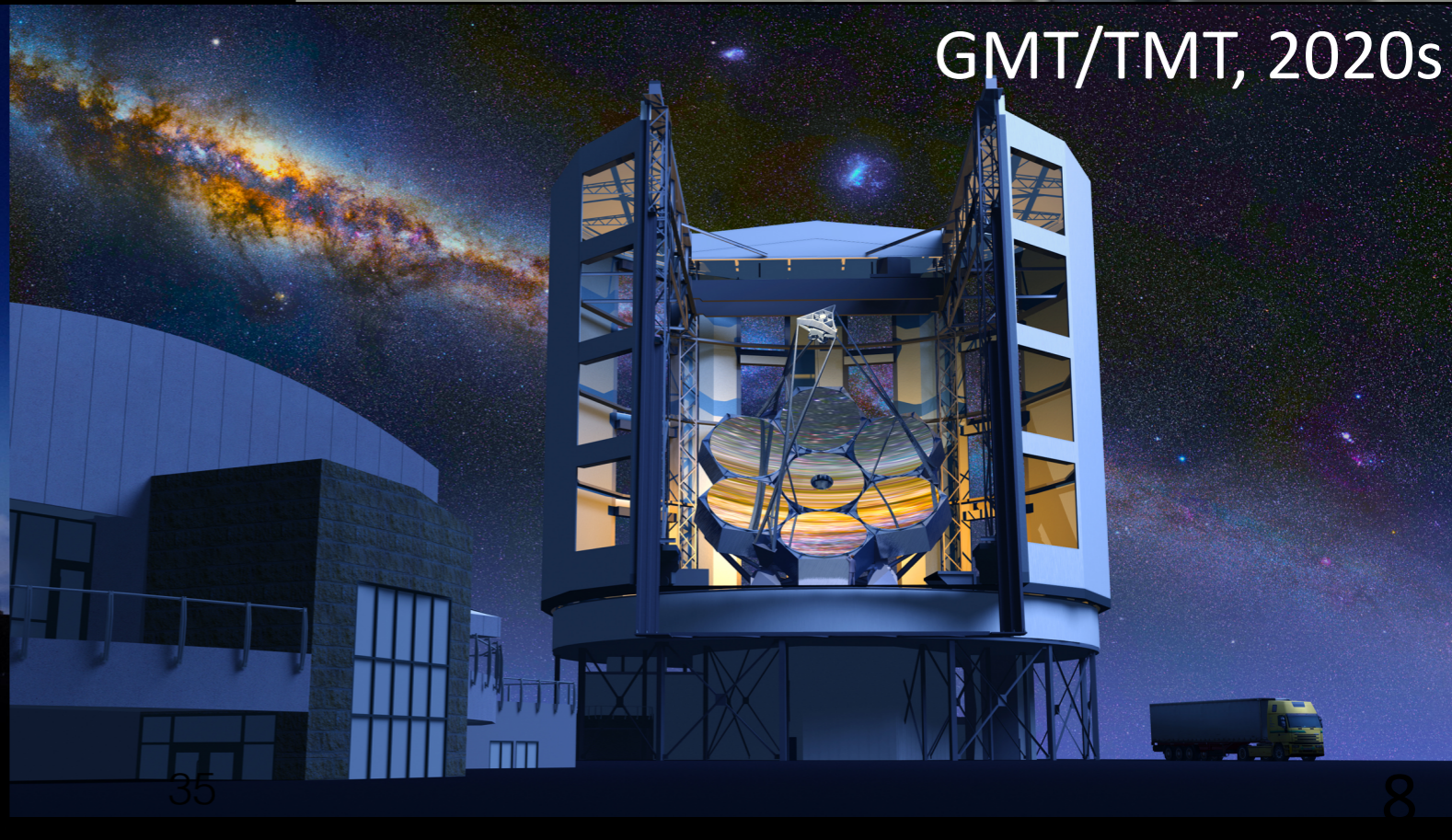
ESO VLT, Today
Potential to be
dedicated EM
follow up in
2030s?



ESO ELT, 2020s



Keck/Magellan/ Gemini
Today



GMT/TMT, 2020s

The future: Current & Upcoming Radio facilities

300 MHz



0.25 sq. deg.; $5 \mu\text{Jy hr}^{-1}$



1.4 - 3 GHz



MeerKAT, South Africa

