Strategy for Radio Follow-up in aLIGO O2 and O3

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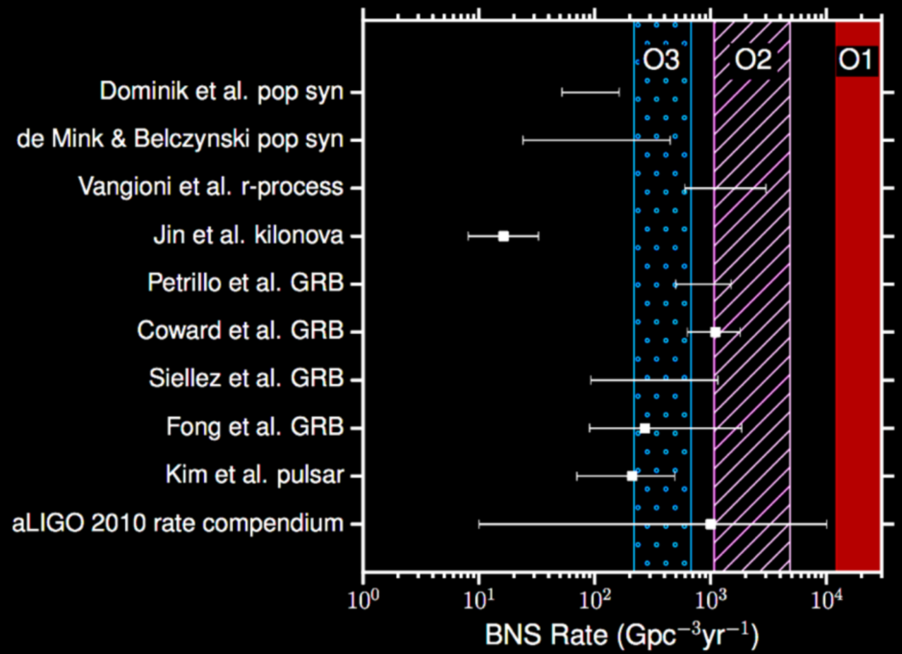
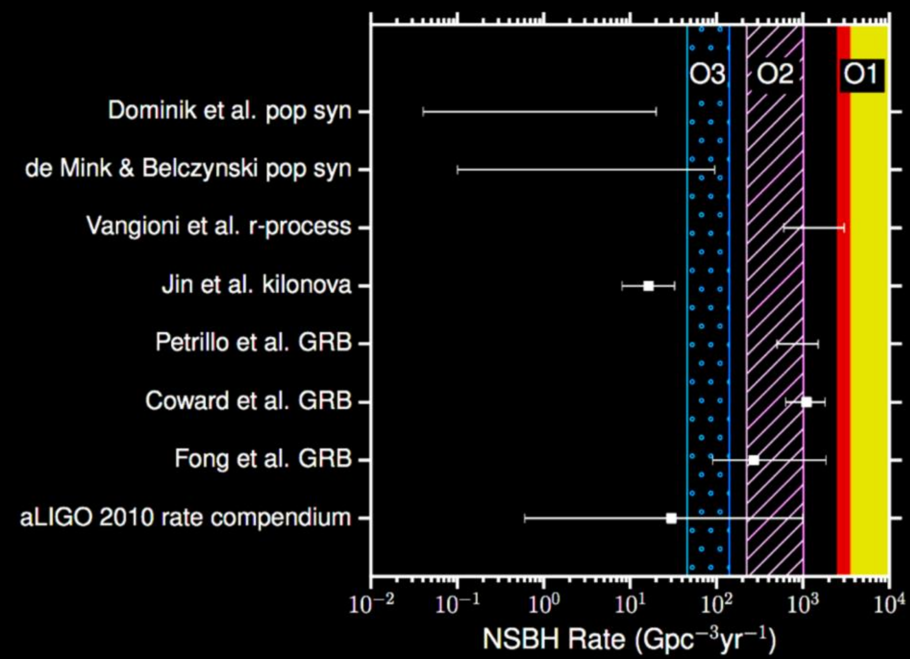
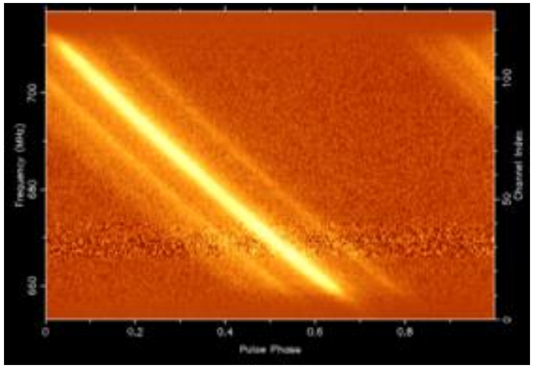
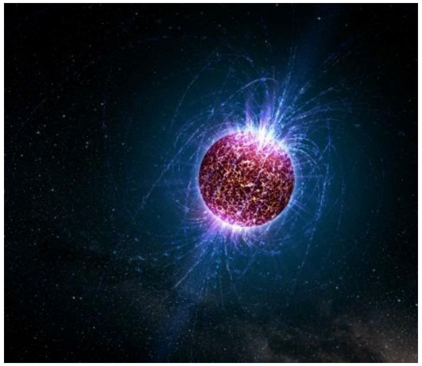
BNS and NSBH in O2/O3





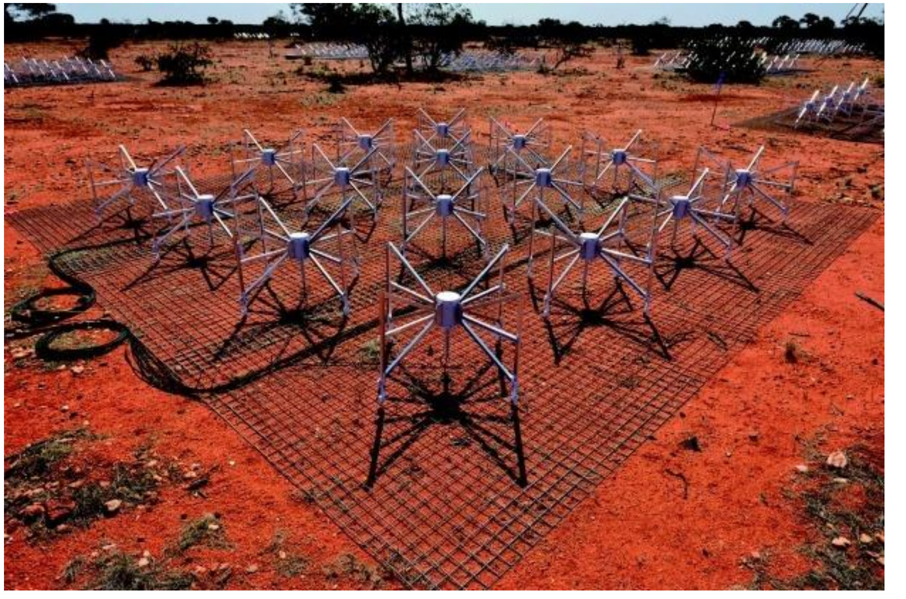
From Duncan's talk last week…

Optimizing a Strategy for your Target Population

			
Low frequency pulse	**Jet-ISM shock**	**Magnetar formation**	**Ejecta-ISM shock**
Prompt	**Days/Weeks**	**Weeks/Months**	**Months/Years**
Poorly constrained	**Rate uncertain**	**Rate uncertain**	**Ubiquitous**

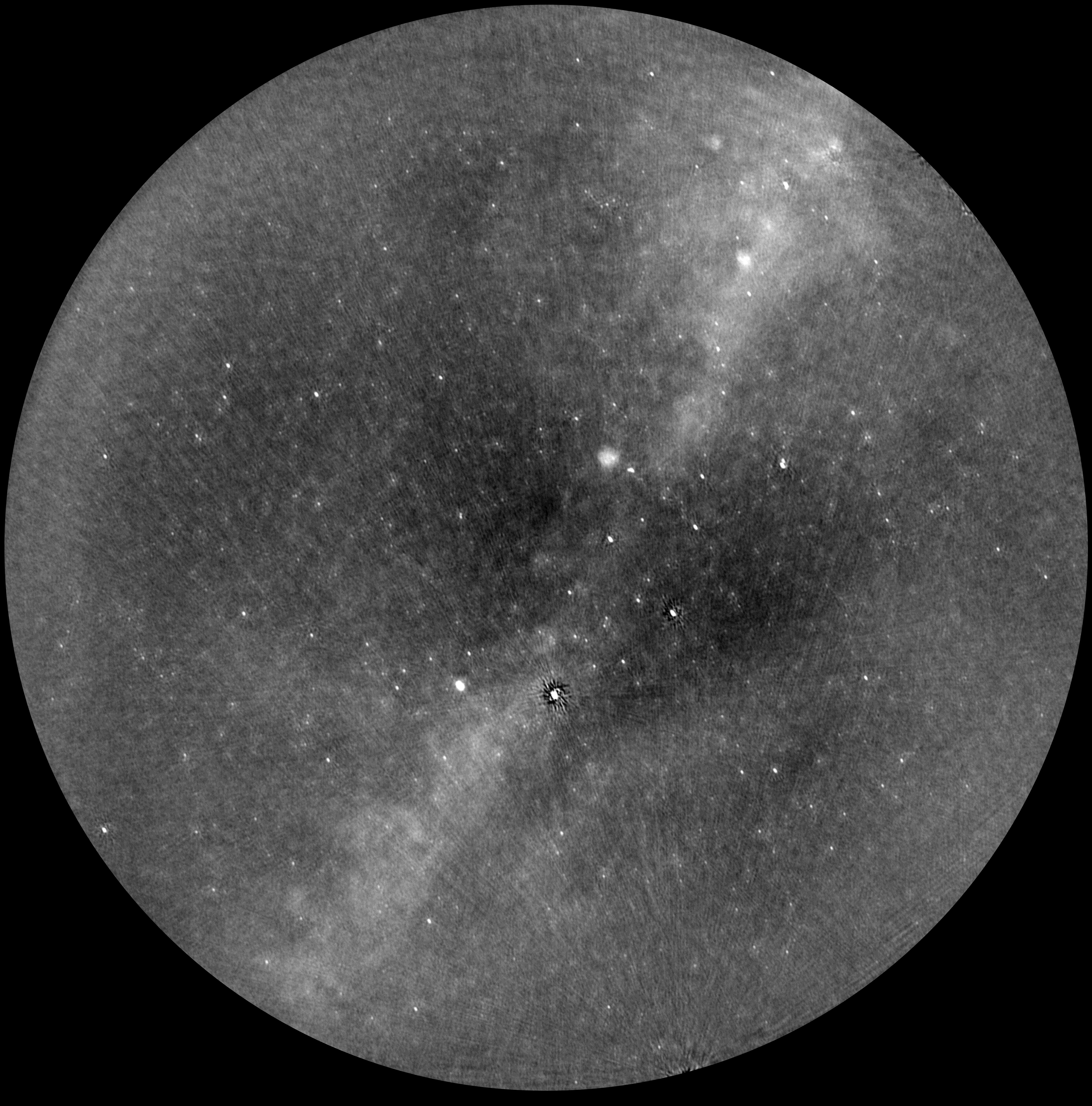
Low Frequency Facilities

LOFAR:
10-240 MHz

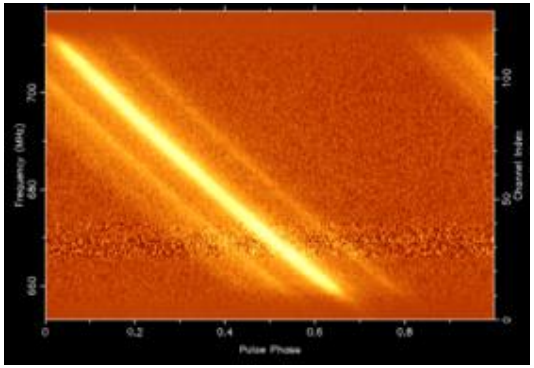
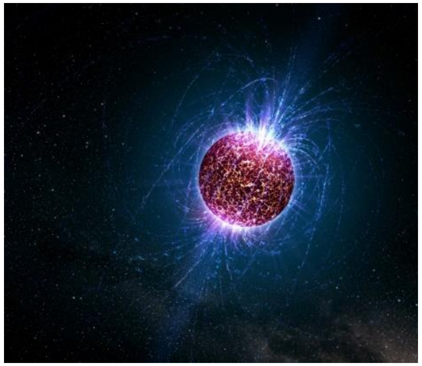


MWA:
80-300 MHz

OVRO-LWA: 25-85 MHz



Optimizing a Strategy for your Target Population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Blind Survey vs Targeting Galaxies

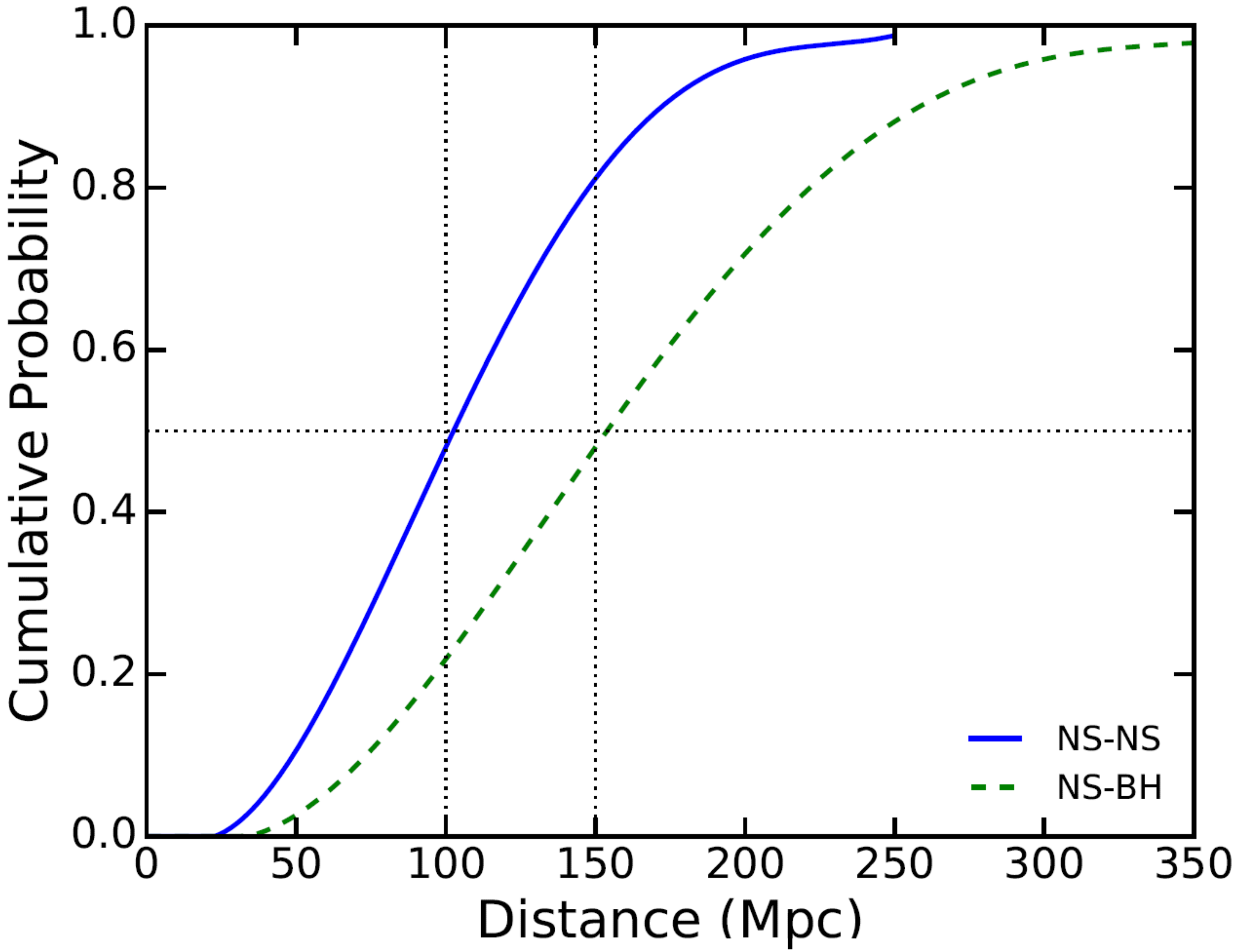
- Targeting galaxies in the aLIGO localization volume can greatly increase sensitivity to merger afterglows – e.g. Kasliwal et al. 2014

- Numerous catalogs being assembled – e.g. Census of the Local Universe (CLU)

- For radio observations of ejecta-ISM shocks, the trade off is between completeness and sensitivity to full range of ejecta energies and ISM medium densities

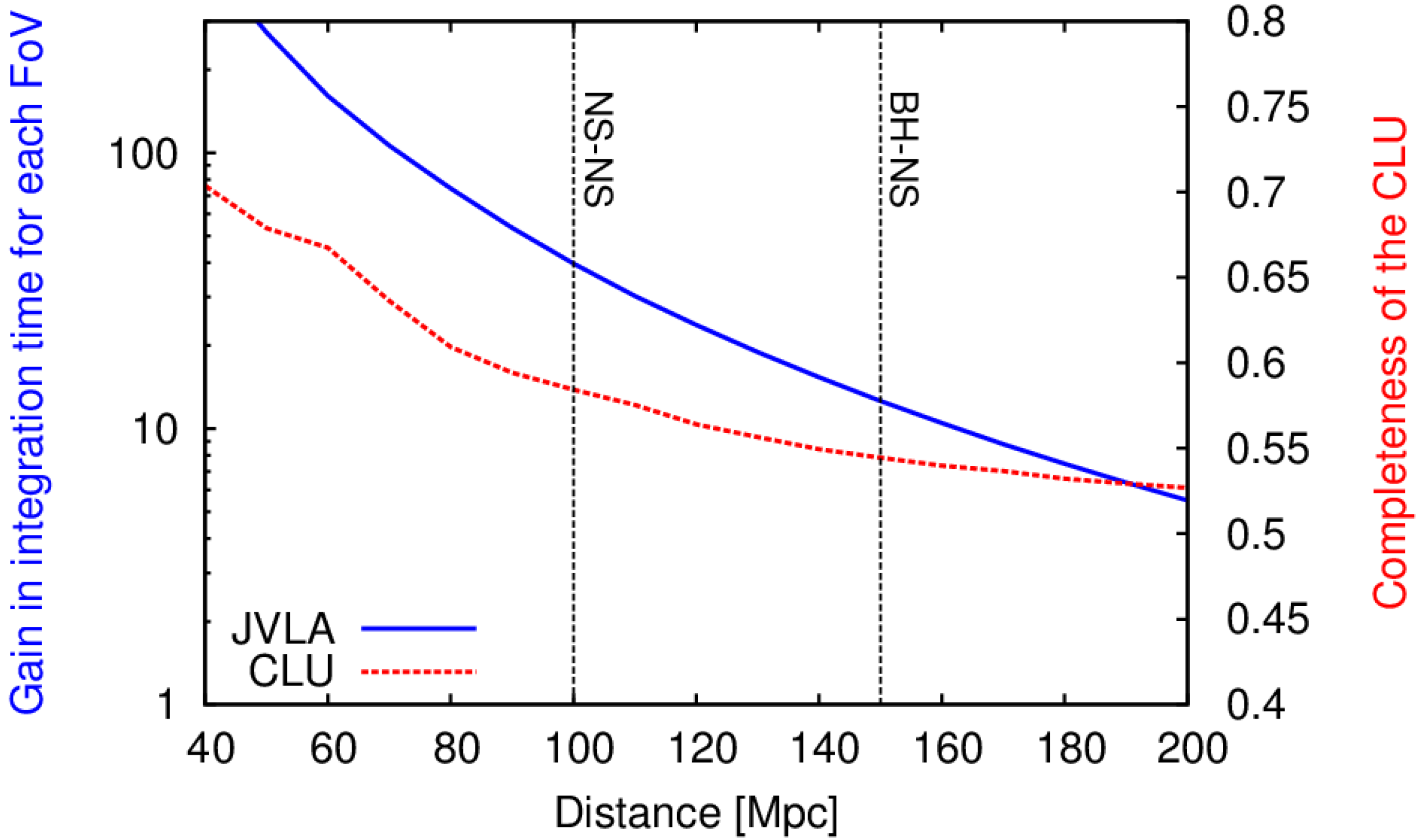
- Strategy must evolve for each aLIGO run

NS-NS and NS-BH mergers during aLIGO run O2b



Based on Simulations from from Singer et al. 2016

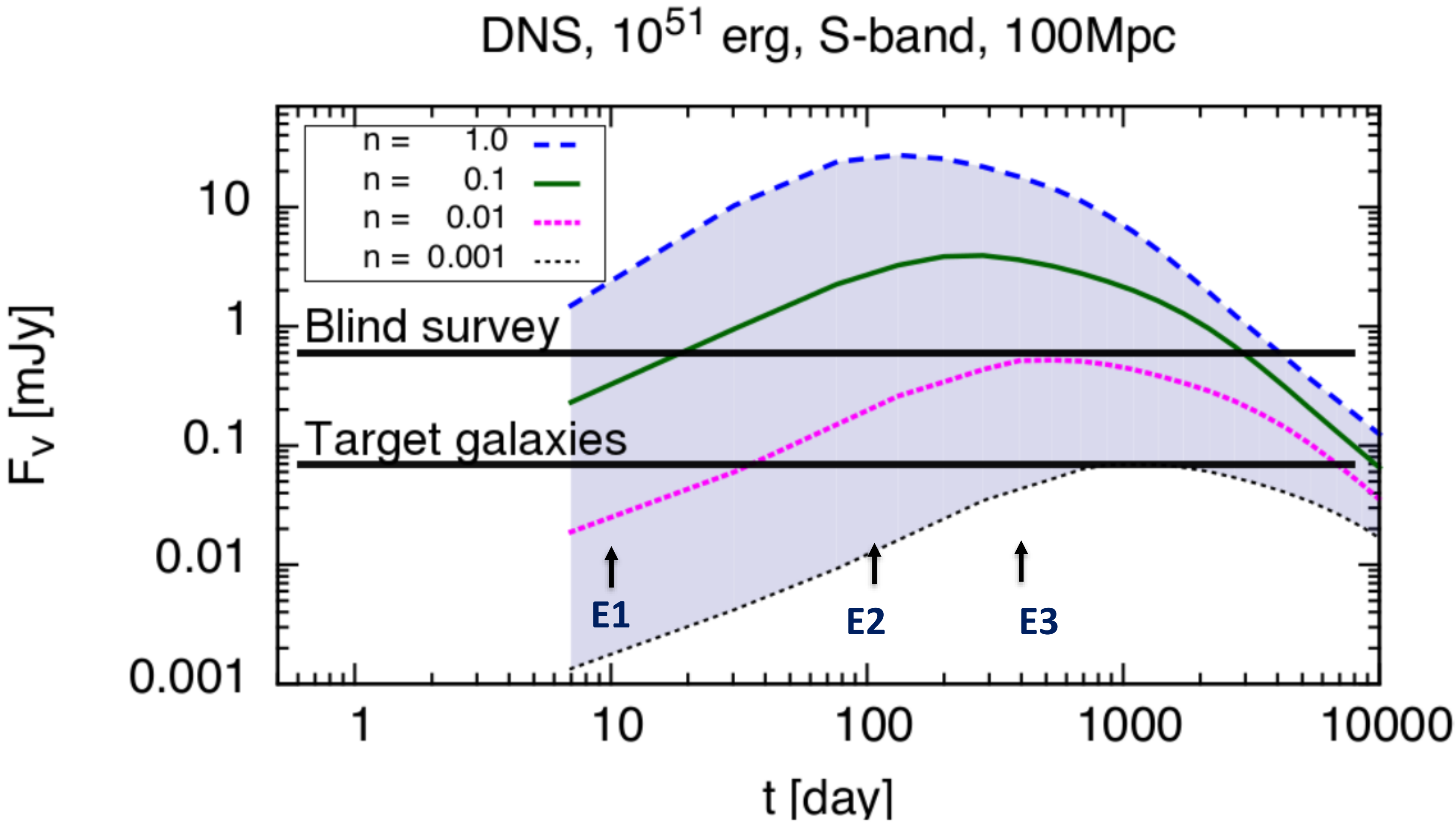
Blind Survey vs Targeting Galaxies



JVLA (3 GHz)	**~0.0625 deg^2 FoV**	**4 μJy in 1 hour**	**NH**	**Targeting galaxies greatly favoured**
MeerKAT (2017)	**~1 deg^2 FoV**	**5 μJy in 1 hour**	**SH**	**Targeting galaxies marginally favoured**
ASKAP (2017)	**~30 deg^2 FoV**	**40 μJy in 1 hour**	**SH**	**Blind survey greatly favoured**

The completeness of the galaxy catalog can be improved *after* the GW detection

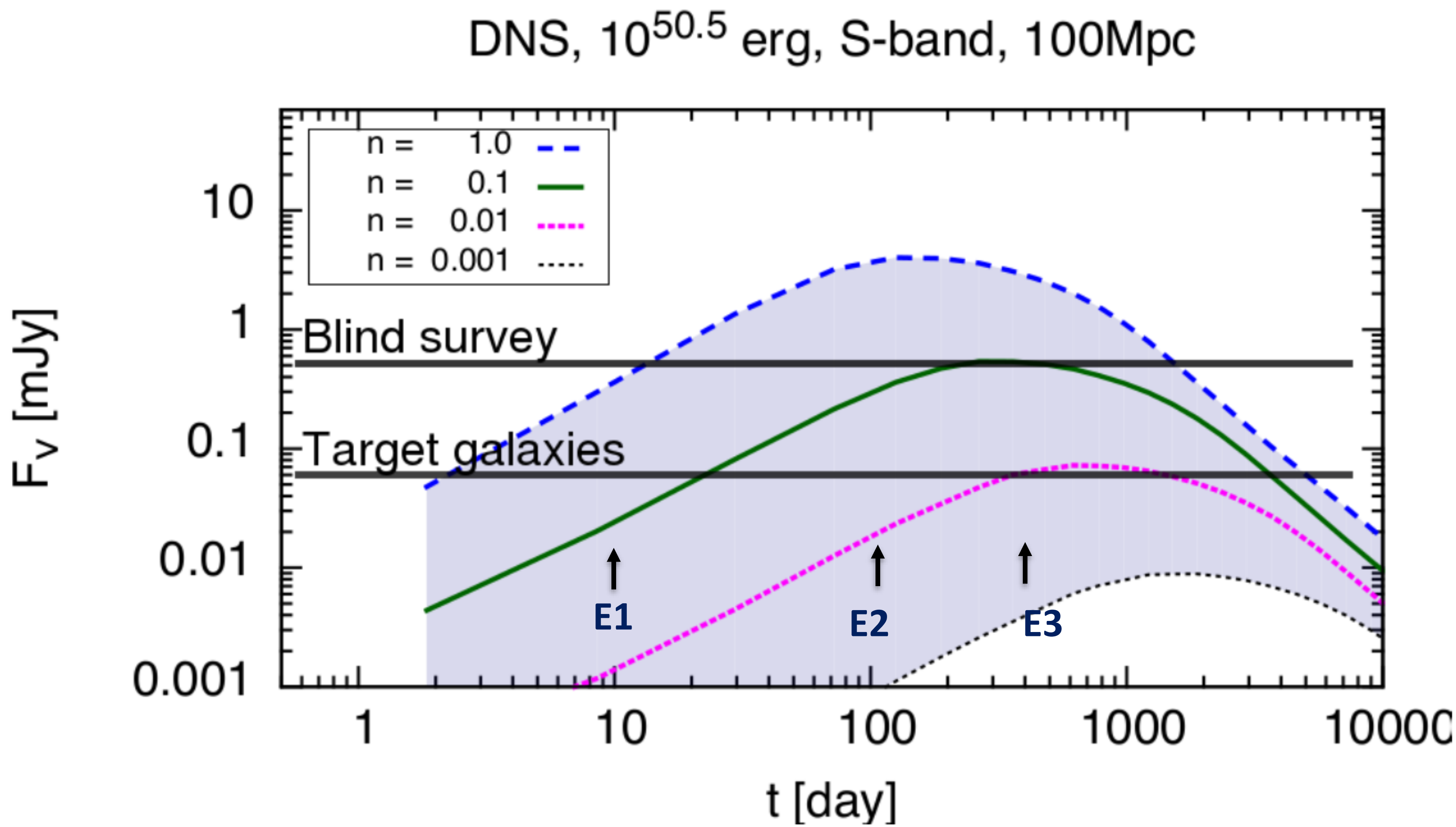
Optimized JVLA Strategy for O2/O3



15 hours per epoch of JVLA observations for a median O2b event
Distance of 100 Mpc, 150 deg^2 localization area, distance precision of 25%

Adapted from Hotokezaka et al. 2016

Optimized JVLA Strategy for O2/O3



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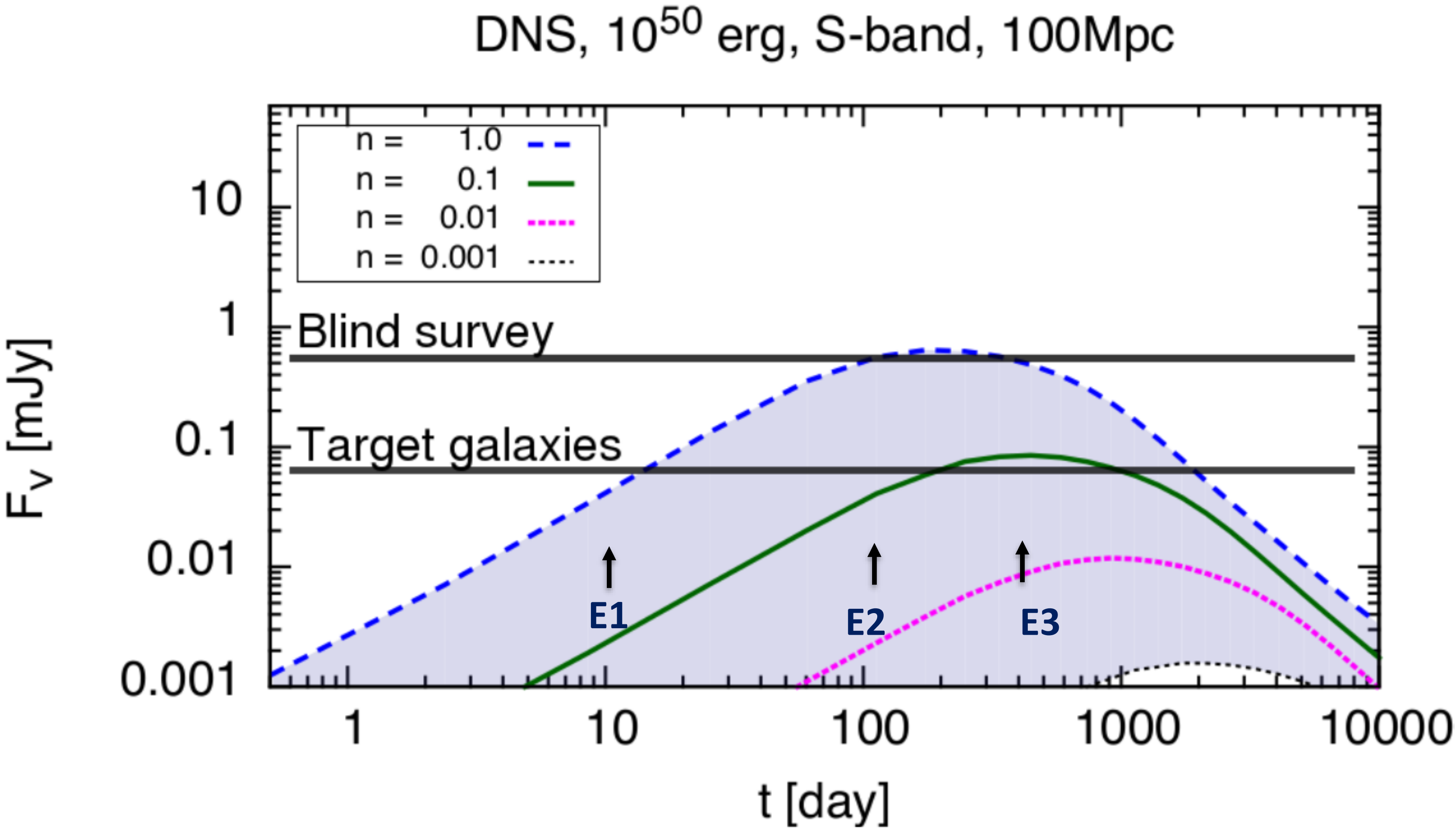

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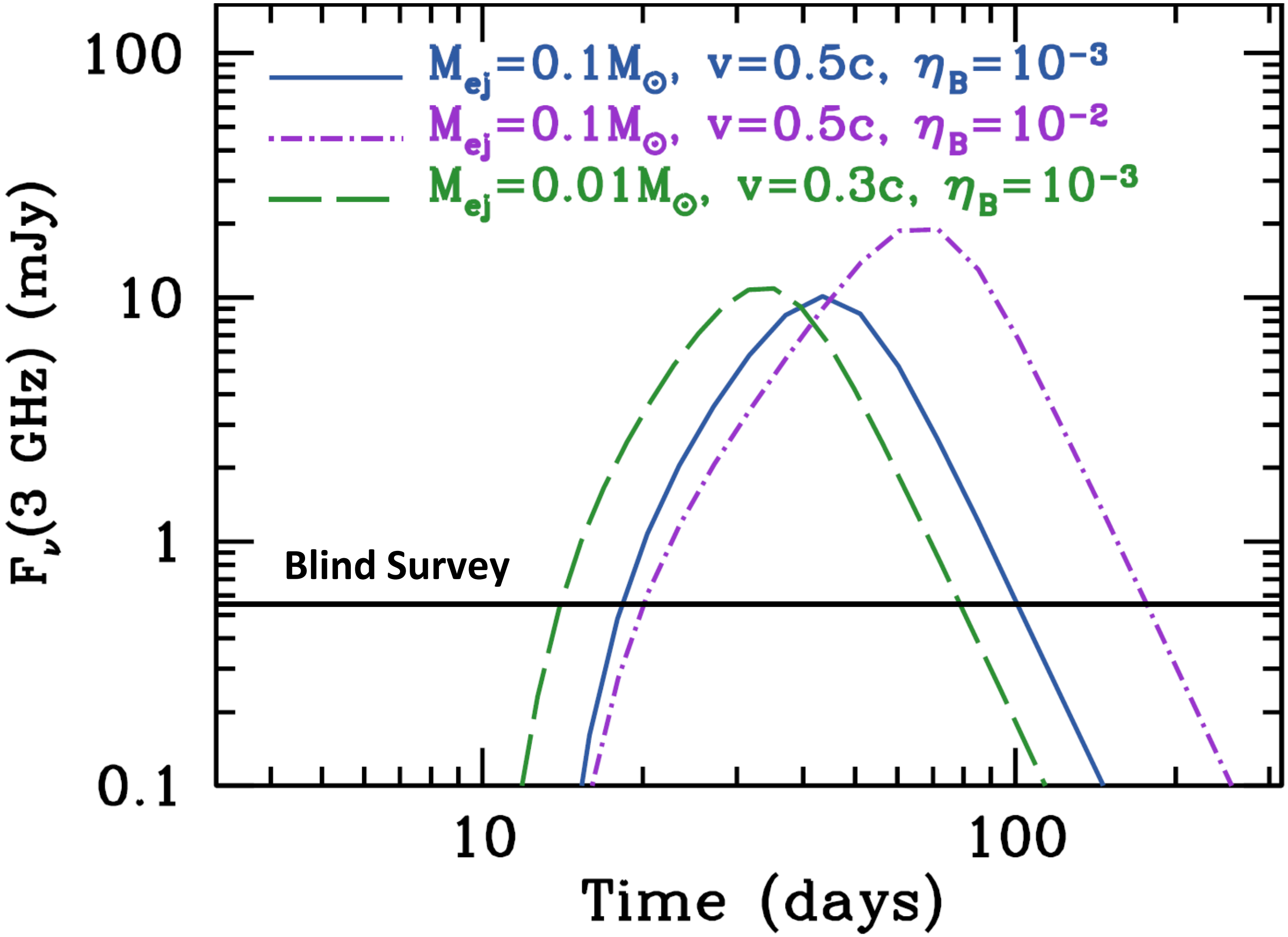
Magnetar Formation

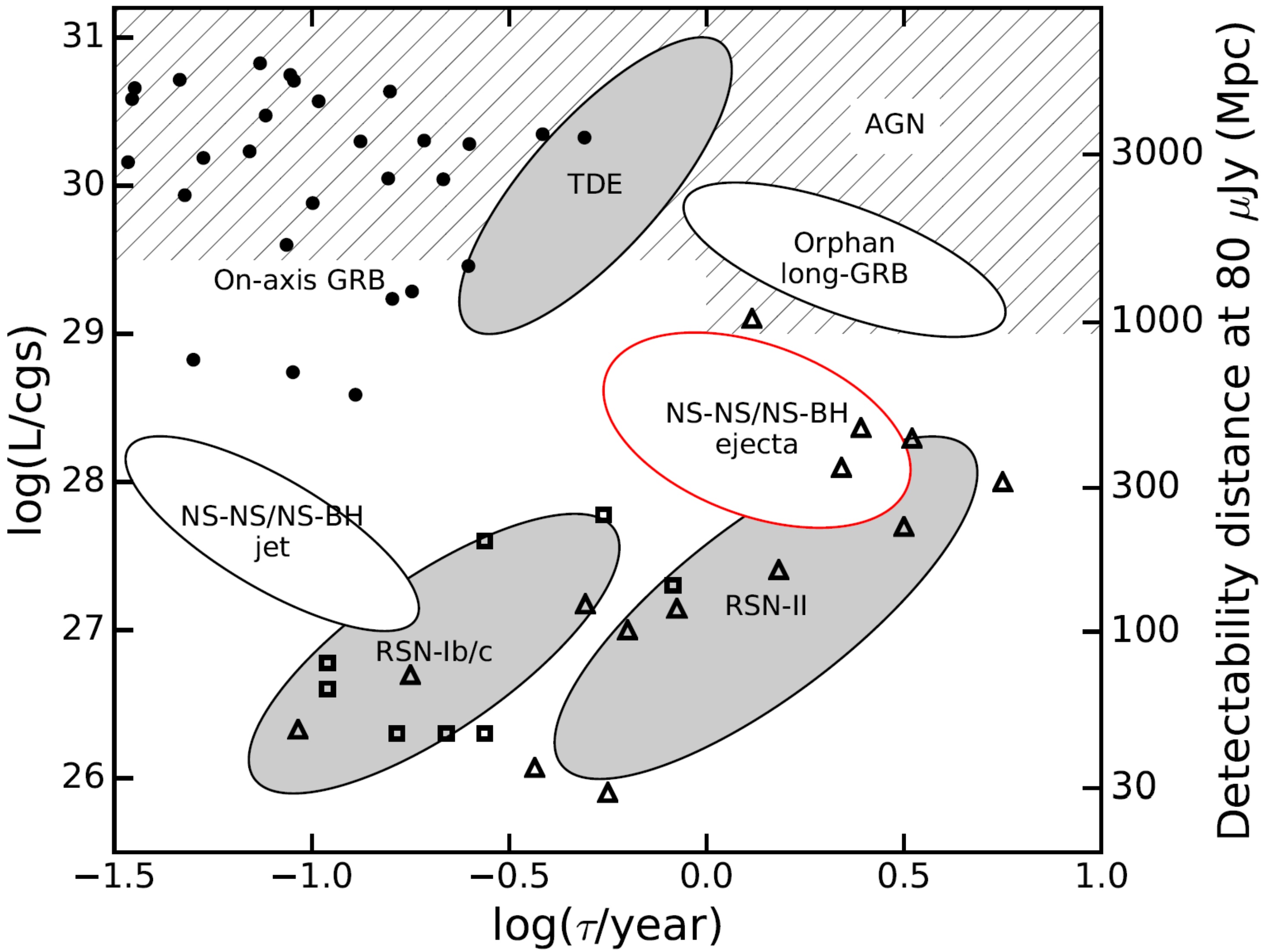


3 GHz light curve for a millisecond magnetar powered plerion for an assumed distance of 100 Mpc

Early time shallow survey is the correct strategy!

Contamination?

The Radio Sky is "Quiet"

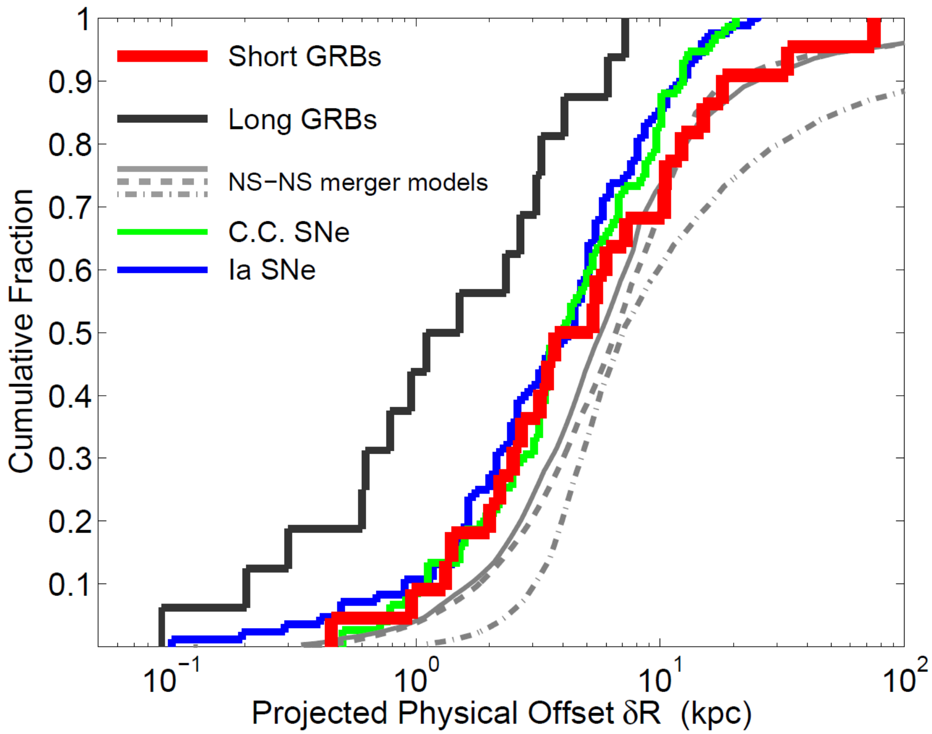


Adapted from Frail et al. (2012) and Mooley et al. (2016)

AGN – A Background Haze

AGN inside the localization volume – needs to be an AGN within a galaxy in the localization volume with >25% variability

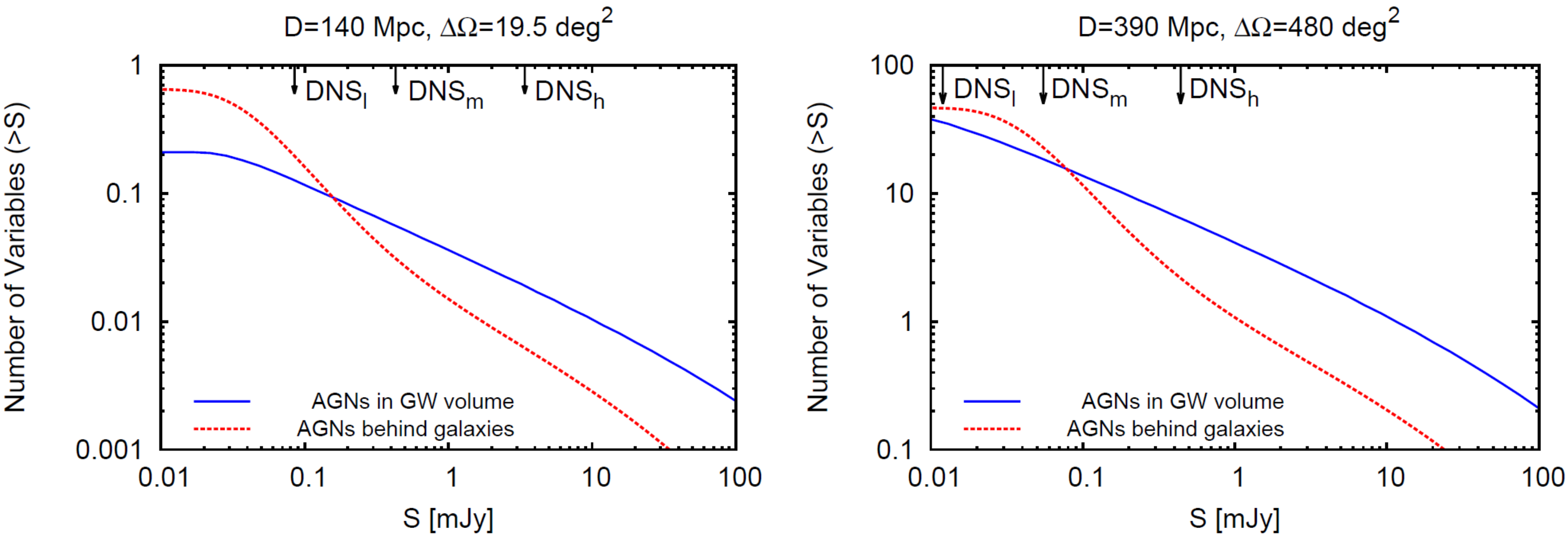
Contamination rate is very low and can be removed through observations at higher frequencies (or VLBI)



Berger et al. 2014

AGN – A Background Haze

AGN behind galaxies in the localization volume

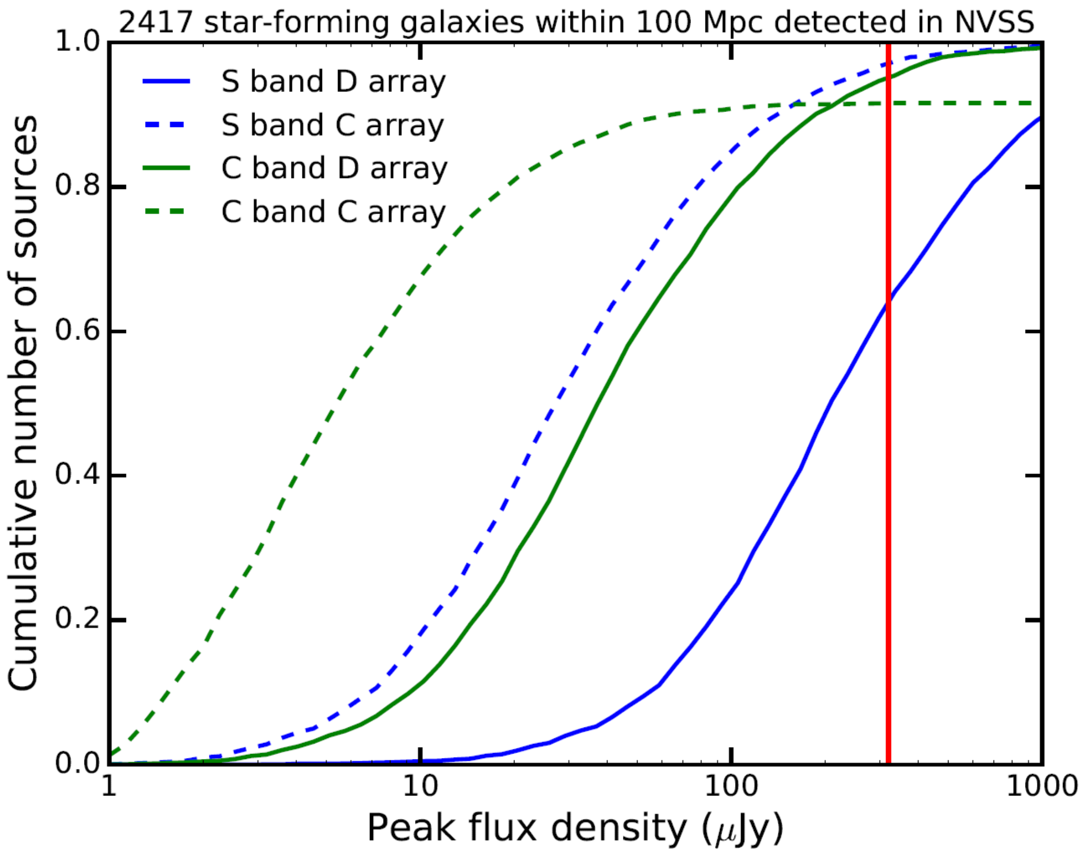


Hotokezaka et al. 2016

Star Formation

VLA Configuration Schedule

2018 Jun29 - 2018 Sep 24	D
2018 Mar 02 - 2018 Jun 11	A
2017 Sep 13 - 2018 Jan 29	B
2017 May 25 - 2017 Aug 28	C
2017 Feb 10 - 2017 May 15	D
2016 Sep 23 - 2017 Jan 23	A



Follow-up high frequency observations essential for D configuration

Conclusions

New radio facilities are on-line and in the search for radio afterglows from NS-NS and NS-BH mergers

Strategy must be carefully adapted to the target population

JVLA is exceptionally well suited to the search for ejecta-ISM afterglows in O2 and O3 probing almost all parameter space for ejecta energy and ISM density with a high level of completeness

Contamination issues are negligible for O2/O3