

Time-Domain Extragalactic Survey (TiDES)

LSST:UK All Hands Meeting 2021

Chris Frohmaier, Senior Research Fellow, University of Southampton

The Transient Revolution

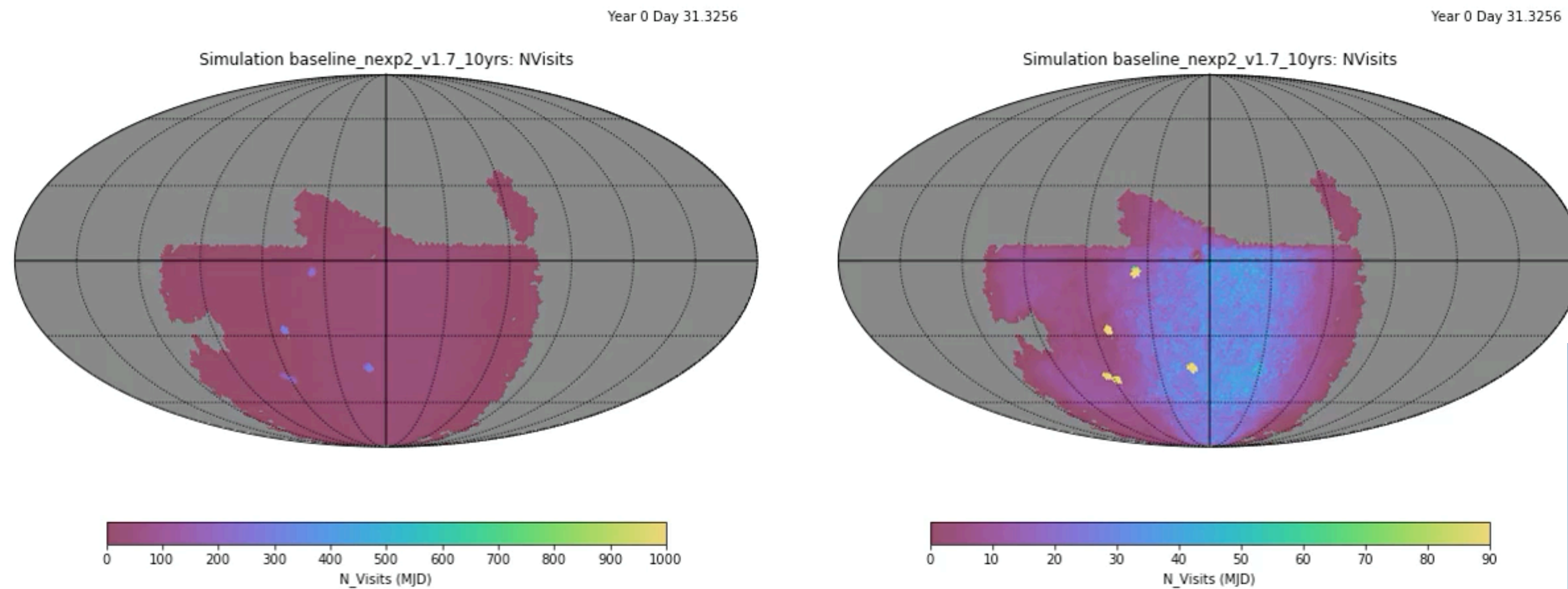
Time-varying universe in 2020s

WFD: Mapping the entire sky every few nights.

Result...

Tens of millions of alerts each year

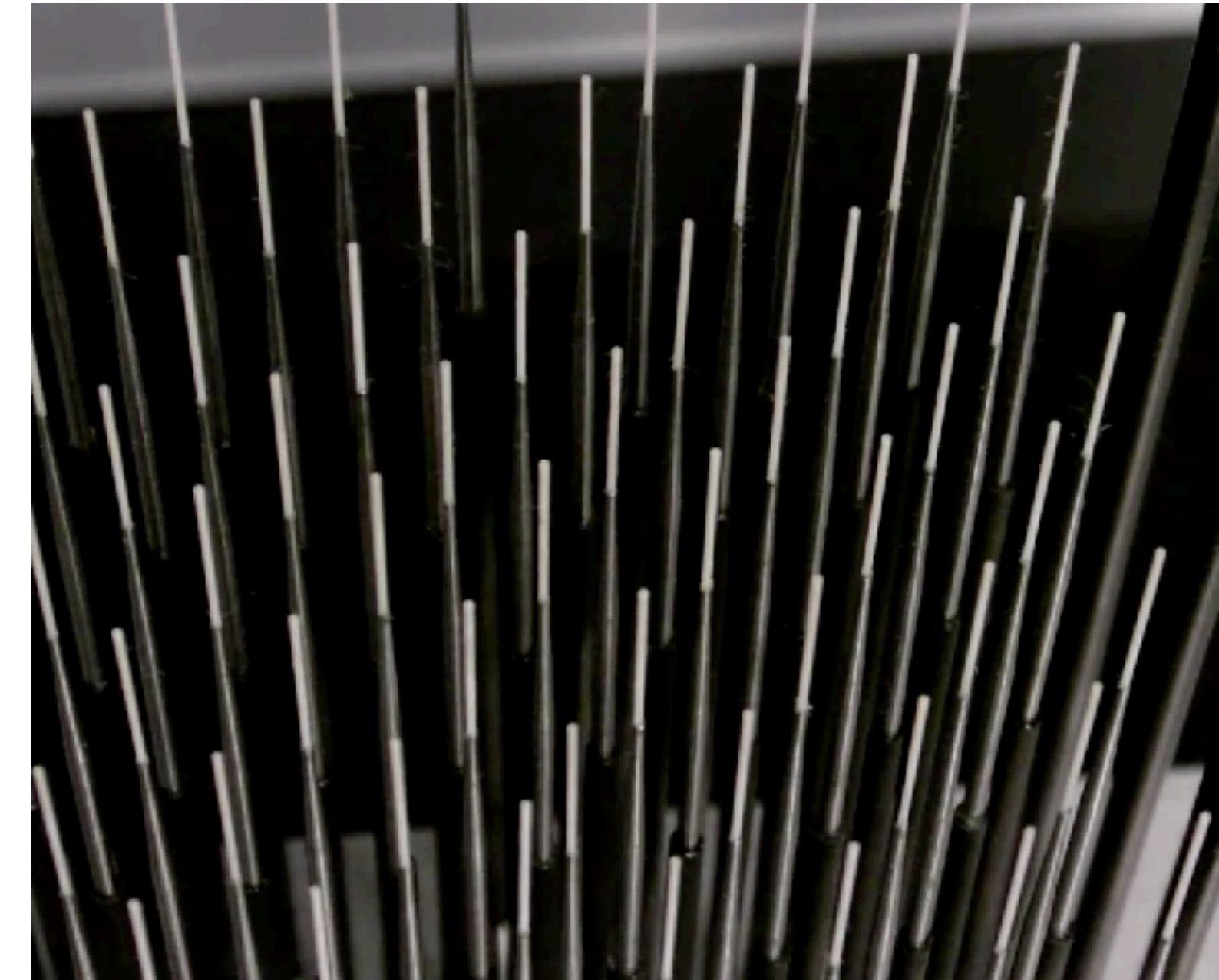
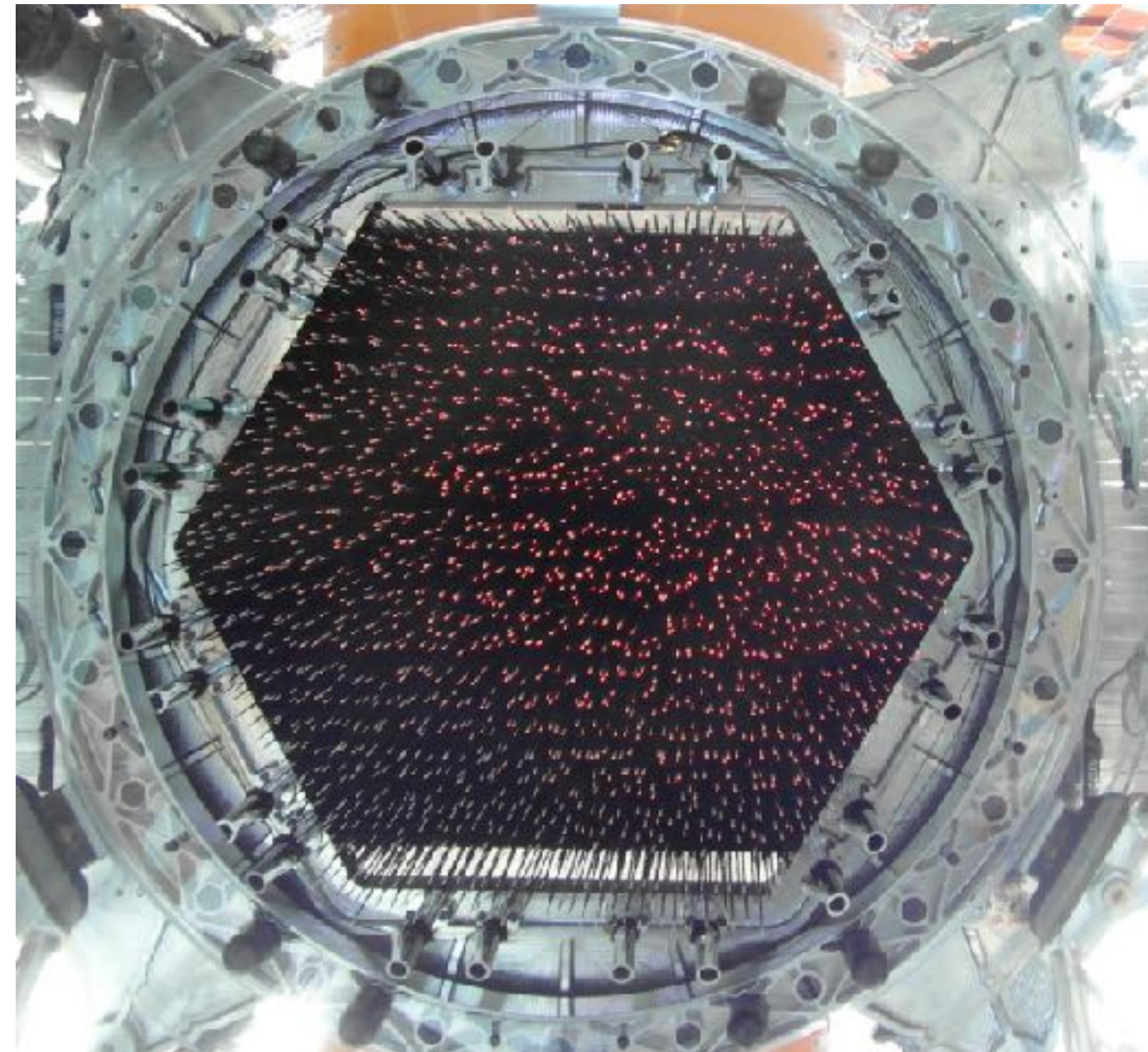
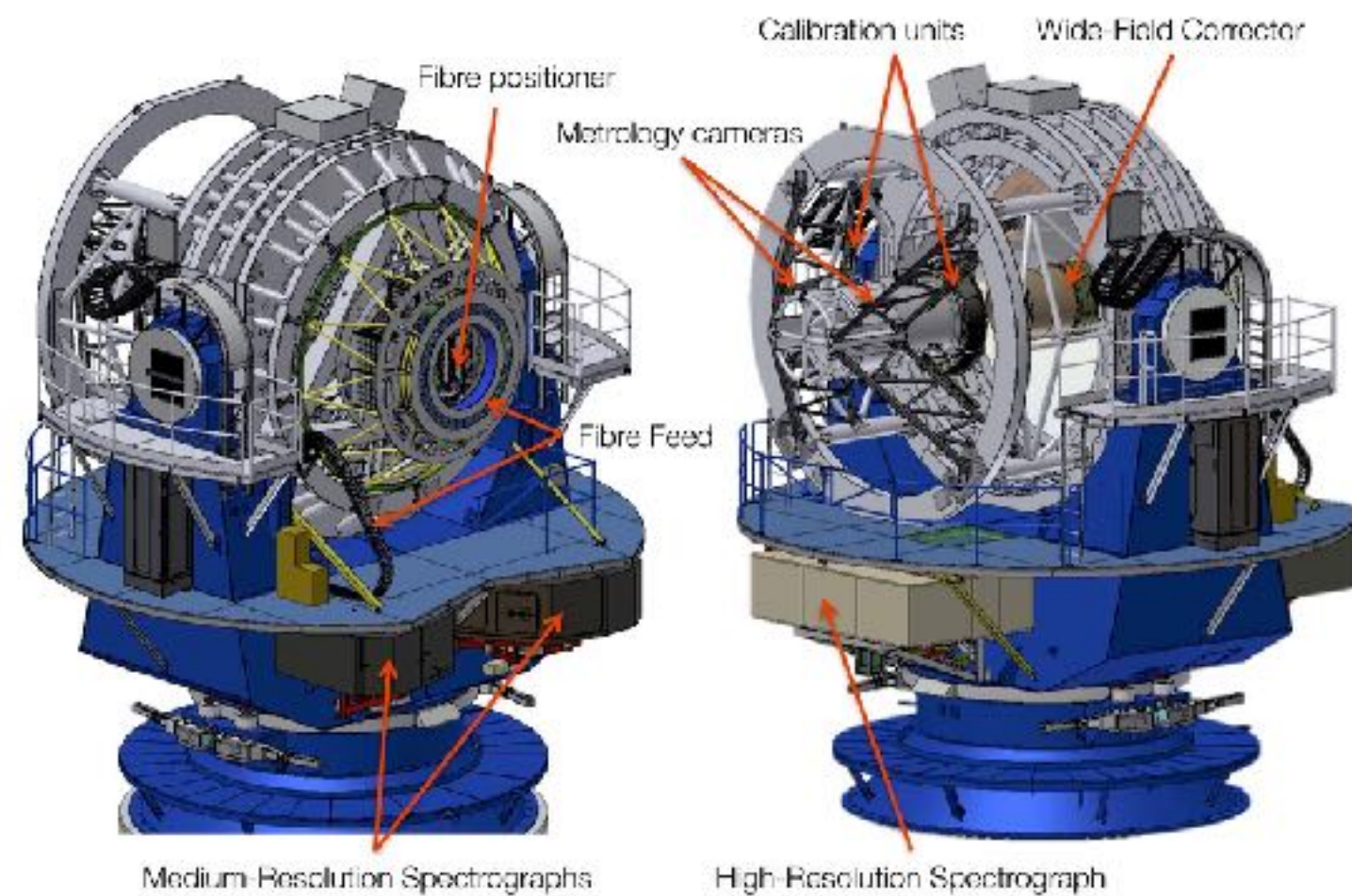
Everywhere that 4MOST points there will be live LSST supernovae and the host galaxies of 'dead' LSST supernovae



4MOST

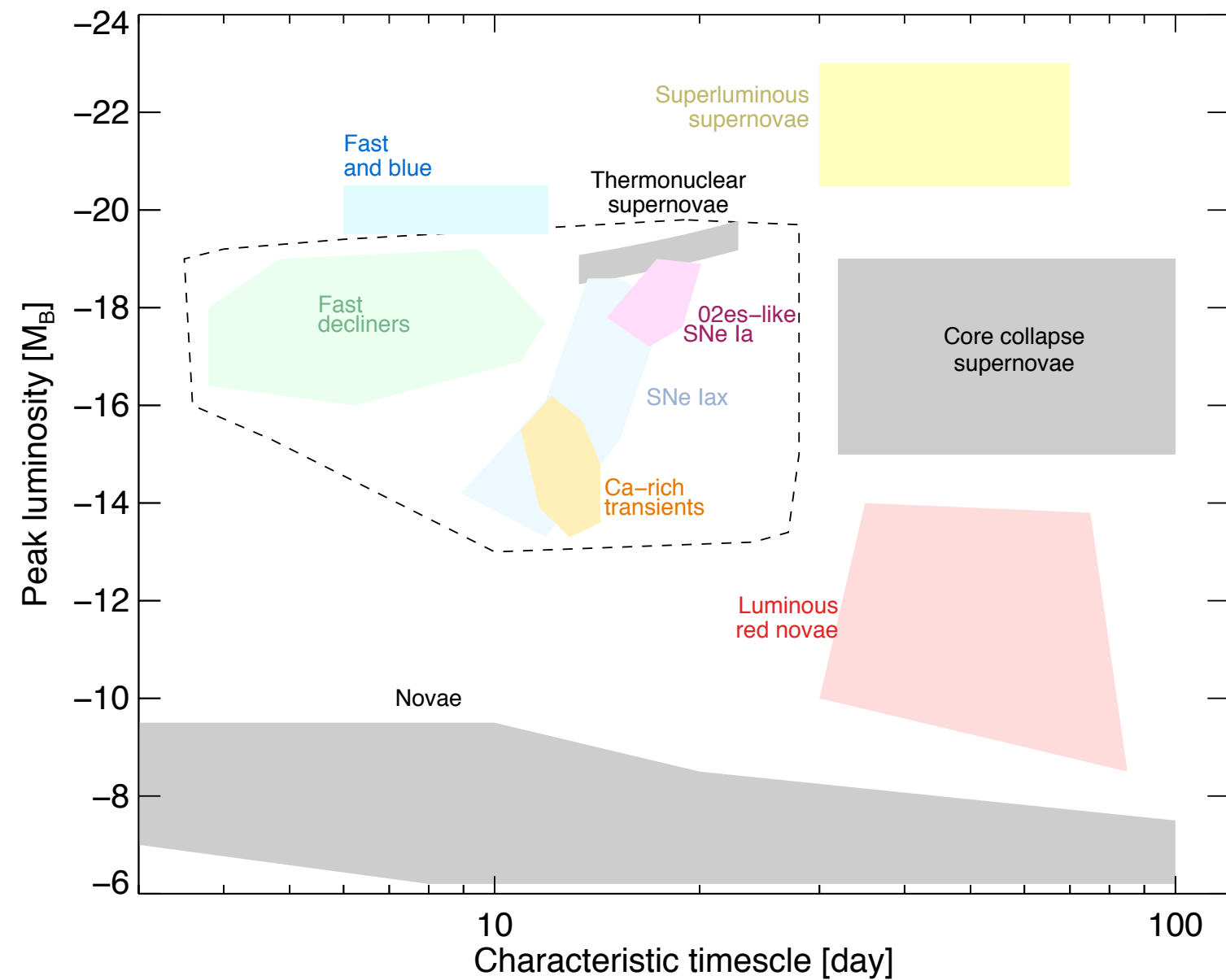
See Richard McMahon's talk on Thursday

TIDES: 250,000 fibre hours for time-domain science



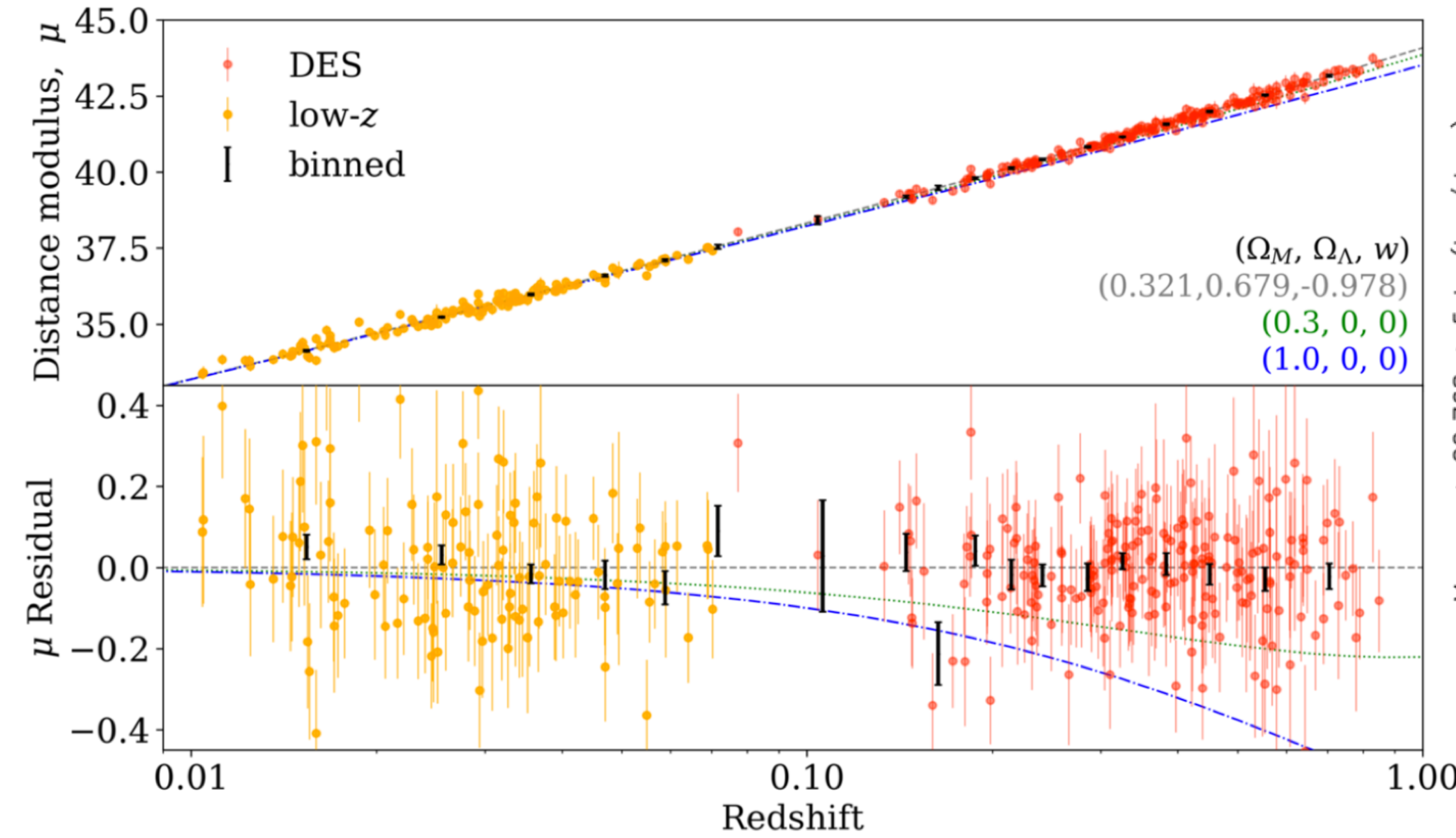
1

Map the diversity of the transient universe



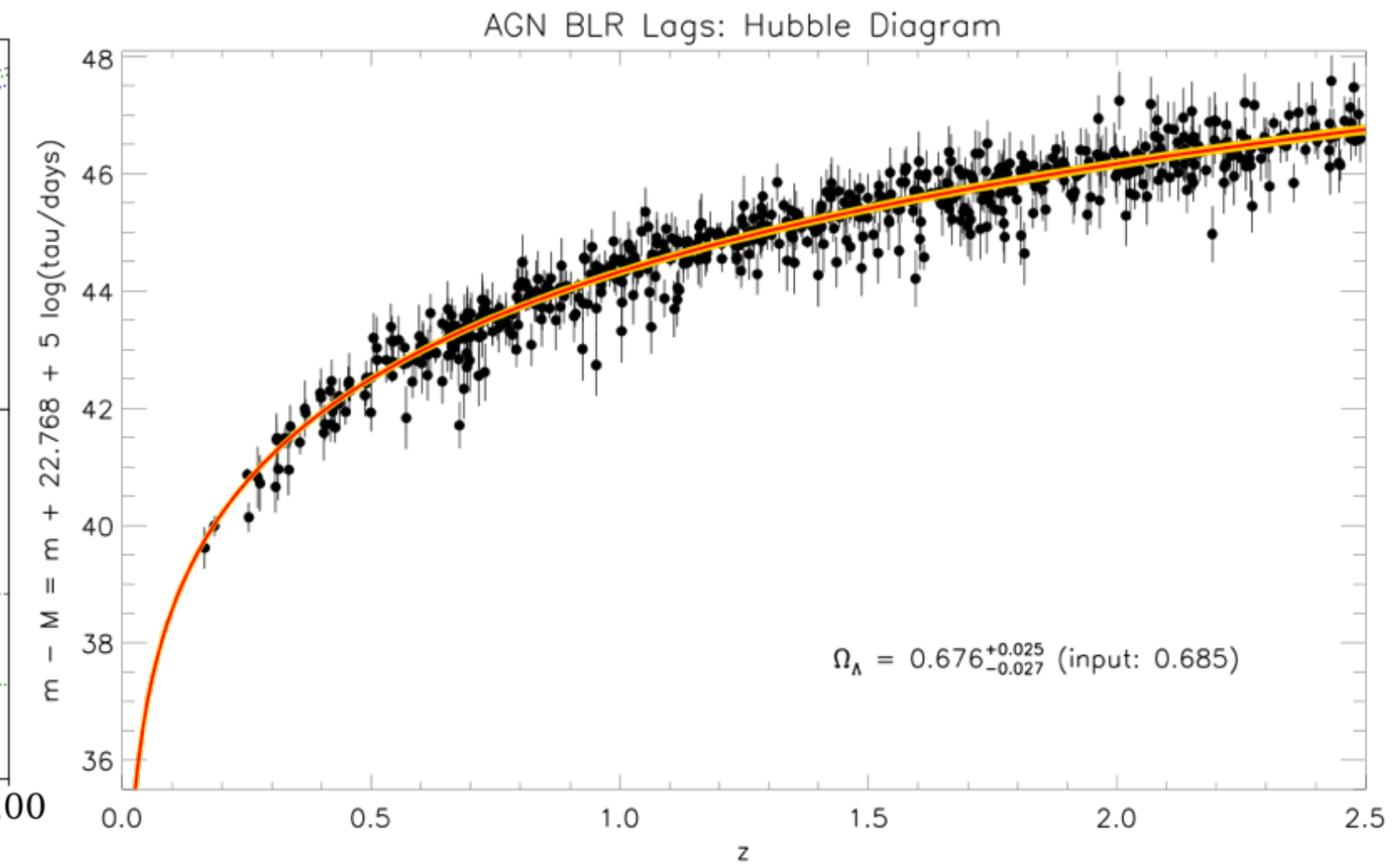
2

Dark Energy with SNe Ia



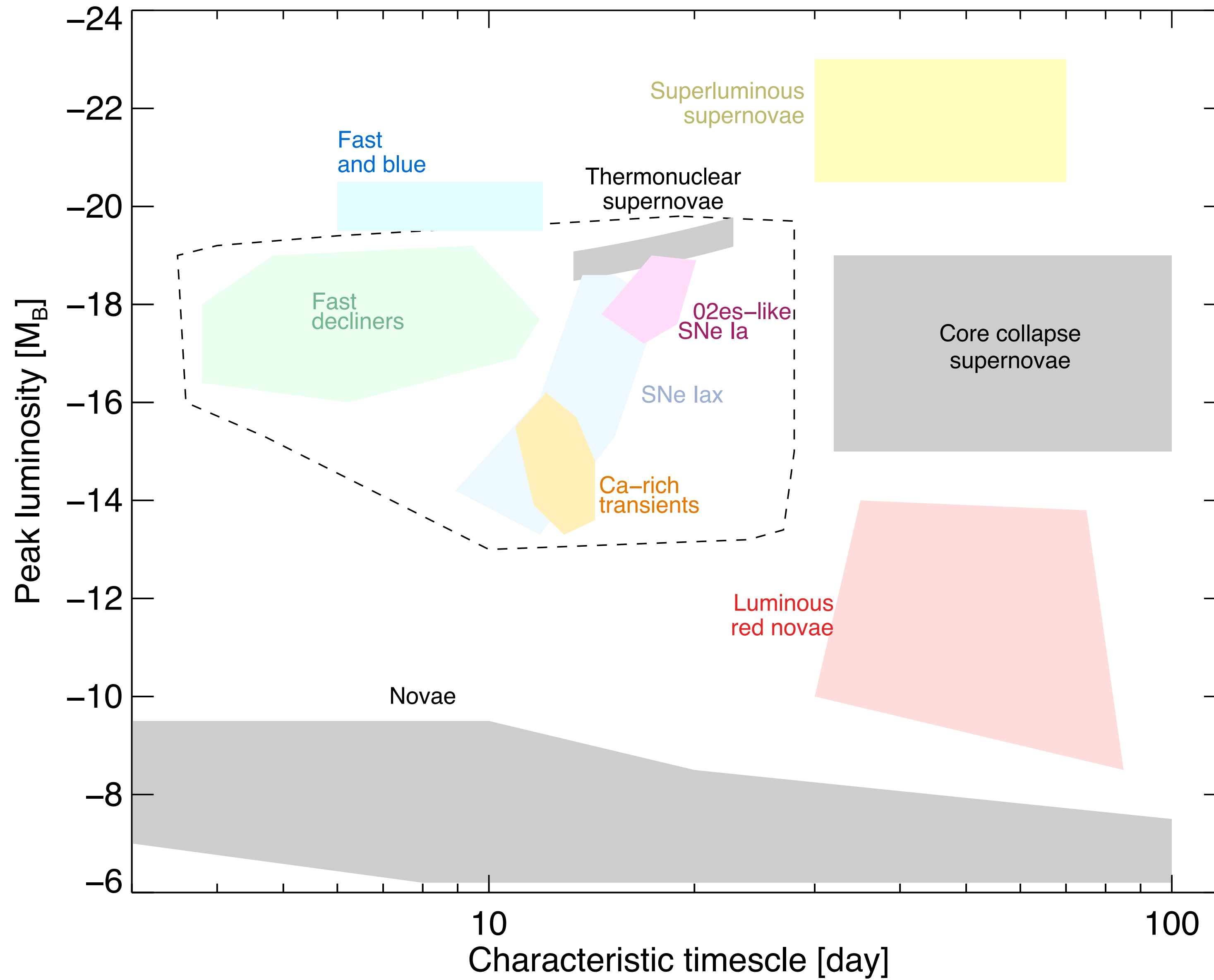
3

AGN Reverberation Mapping



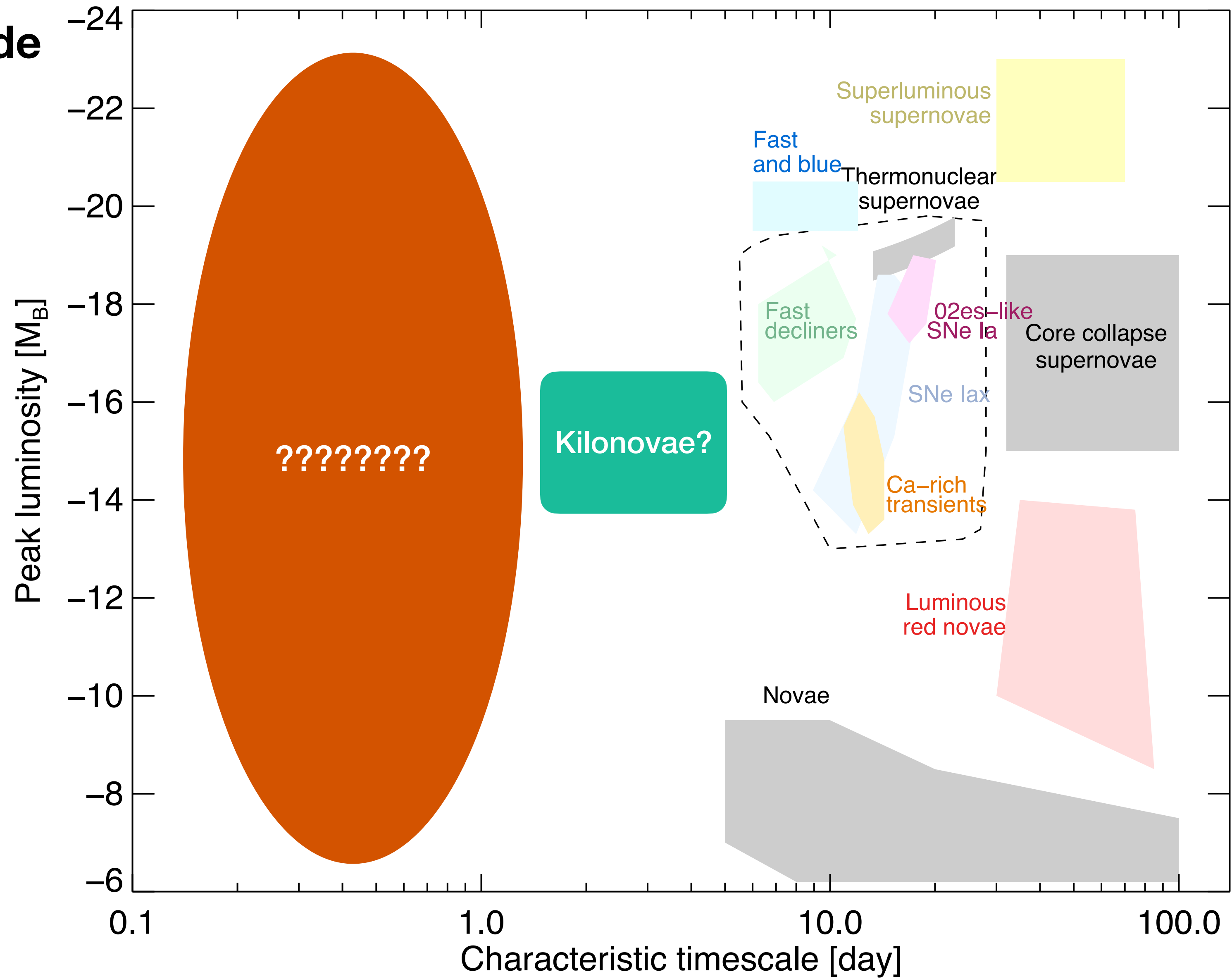
Transient Phase-Space

Today



Transient Phase-Space

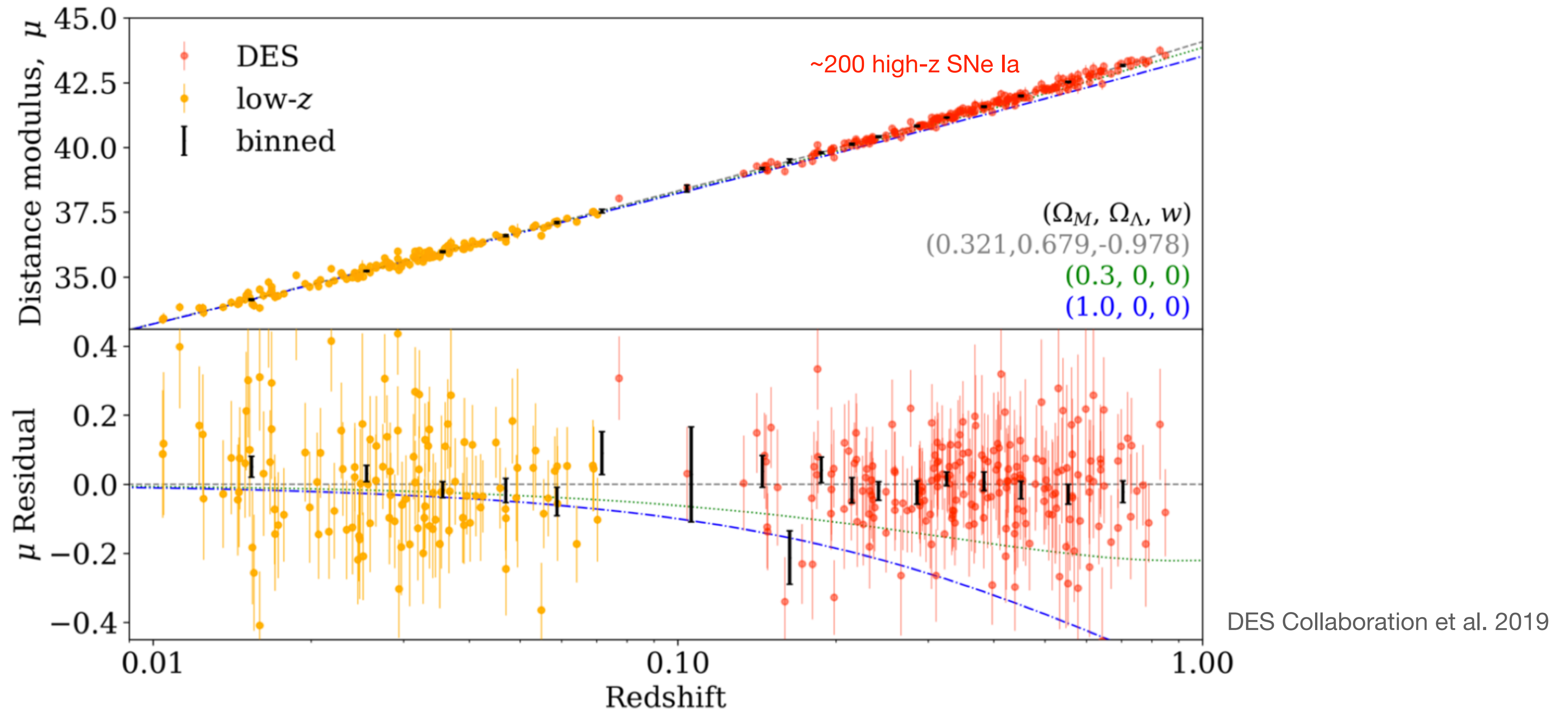
The next decade



Credit: Mark Sullivan

Type Ia supernovae

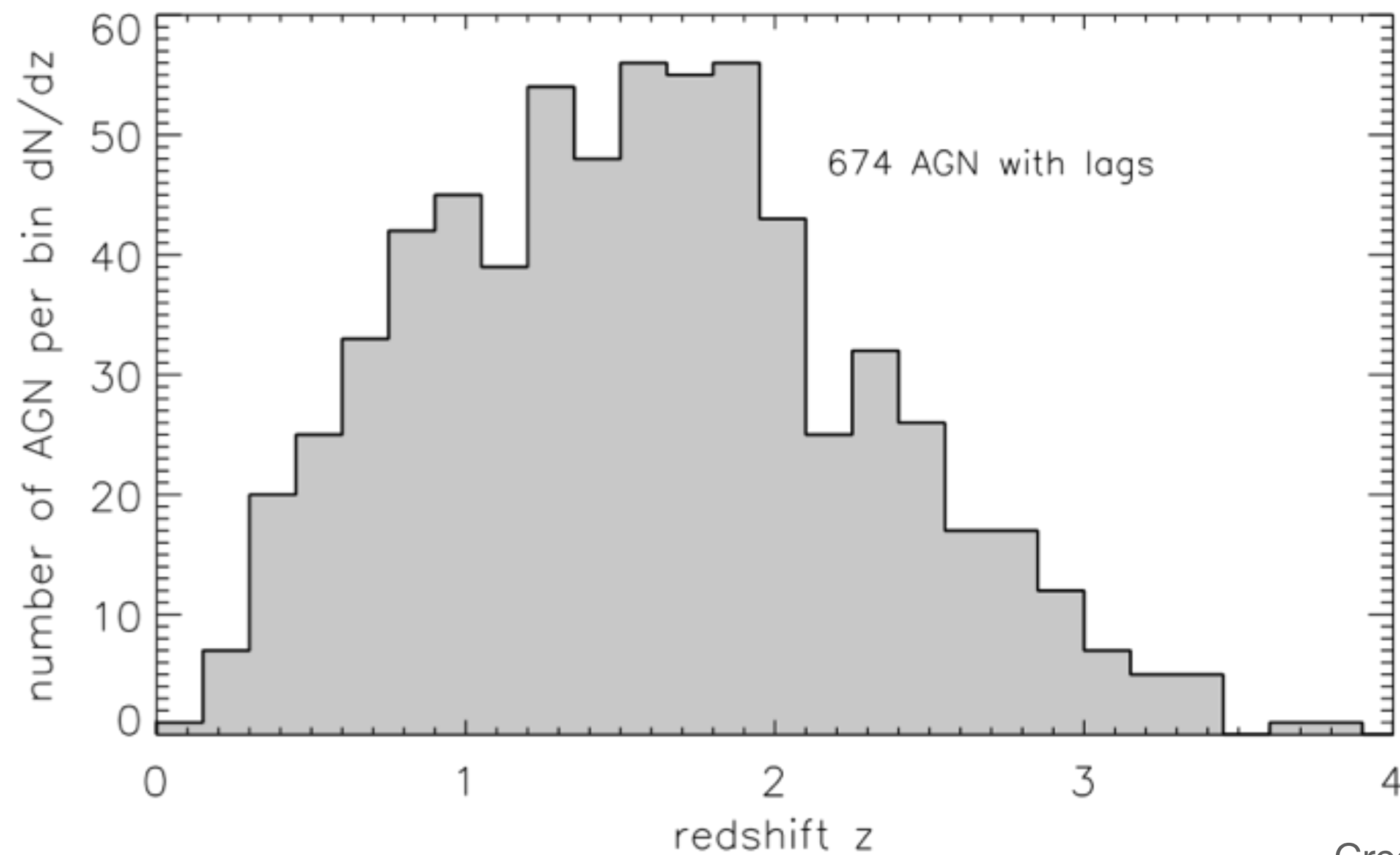
Cosmological Probes



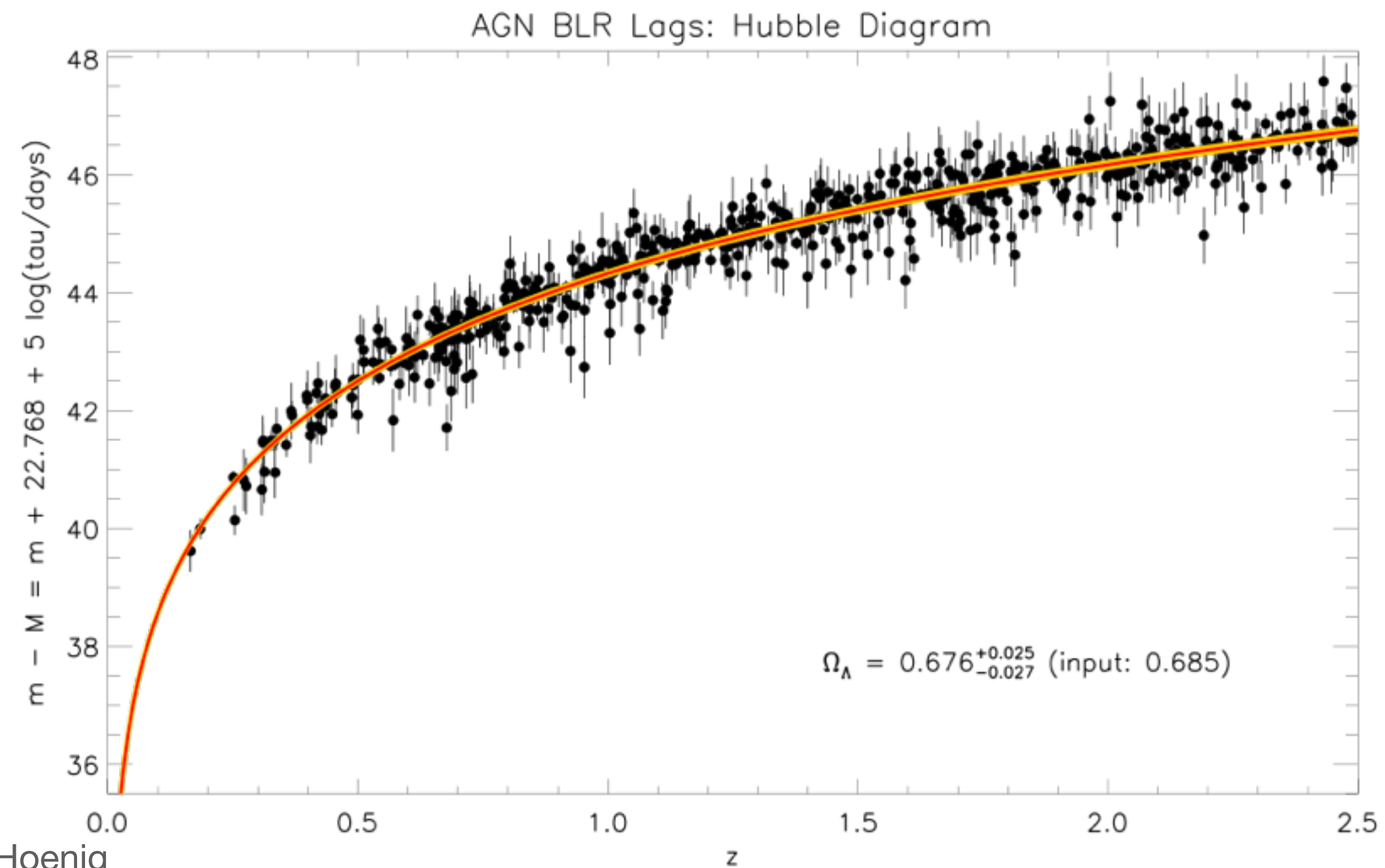
Split into sub-samples of $\sim 10,000$ s SNe in LSST/4MOST era

AGN Reverberation Mapping

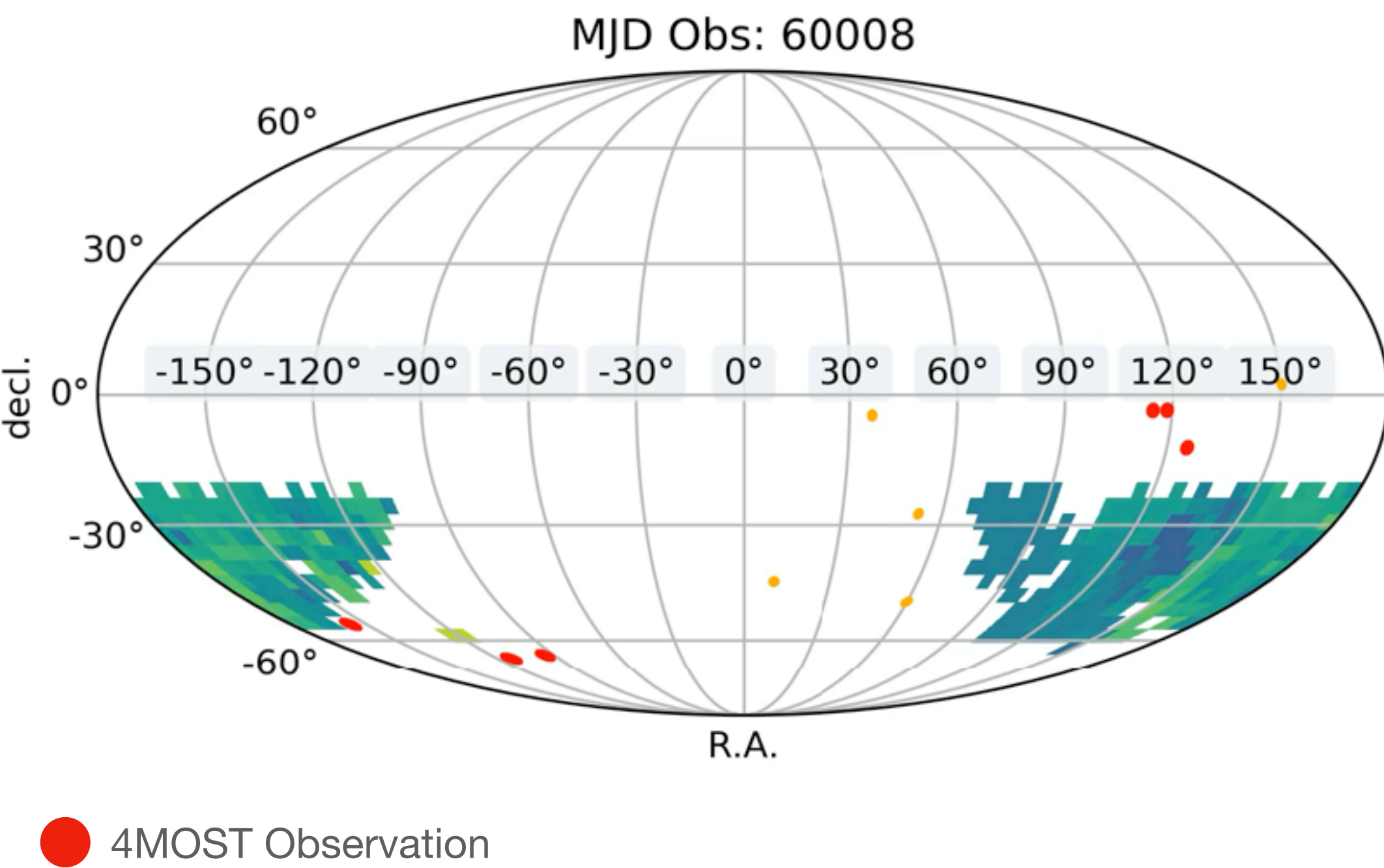
- Standardisable candles similar to SNe Ia
- Lag–luminosity relation for broad lines gives a length scale that can be calibrated for a given line (‘reverberation mapping’ [RM])
- Systematic RM campaign via repeat observations:
 - 700 AGN RM measurements at $z < 2.5$



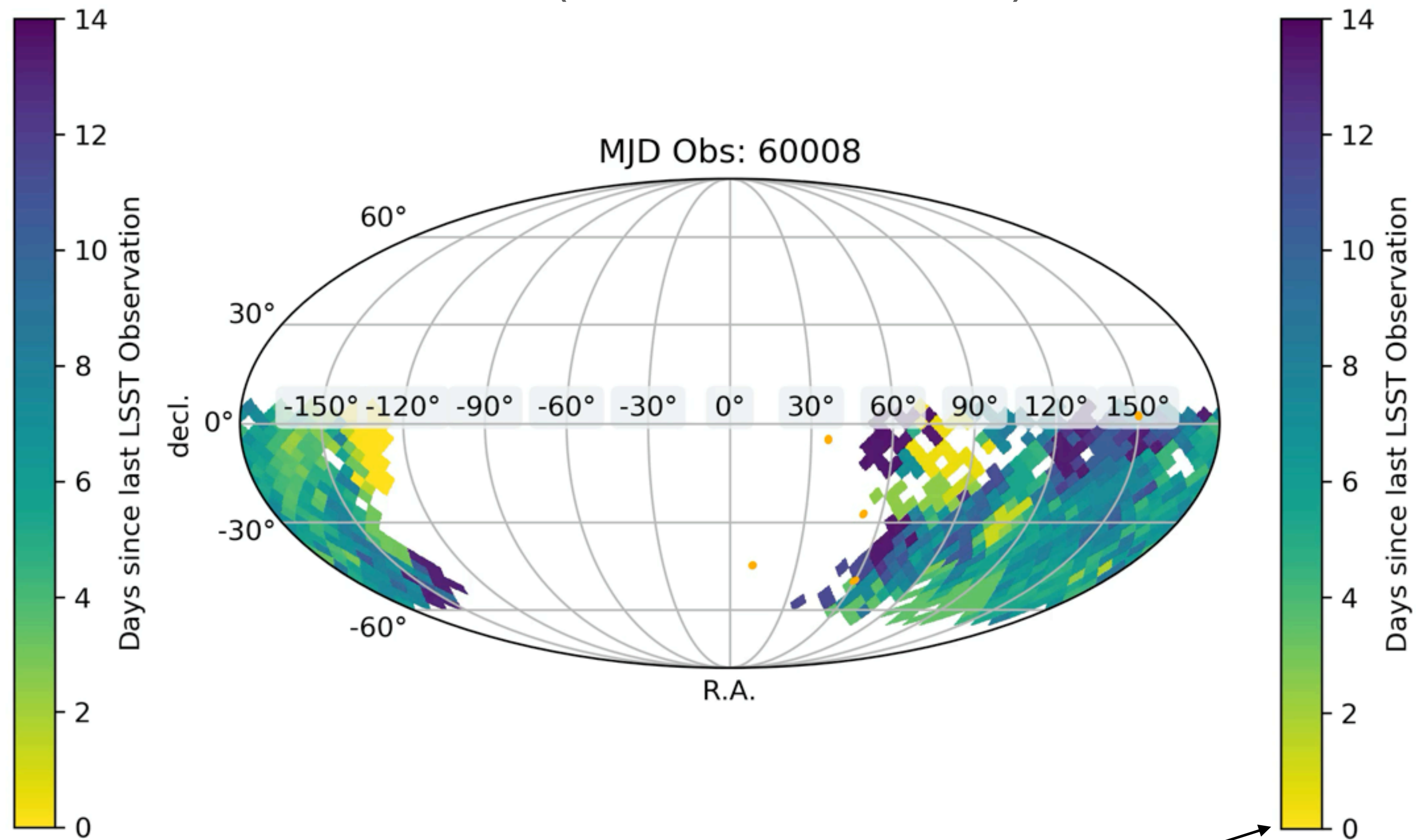
Credit: Seb Hoening



Mothra 2045 (Old simulations)



Baseline 1.7 (Latest simulations)



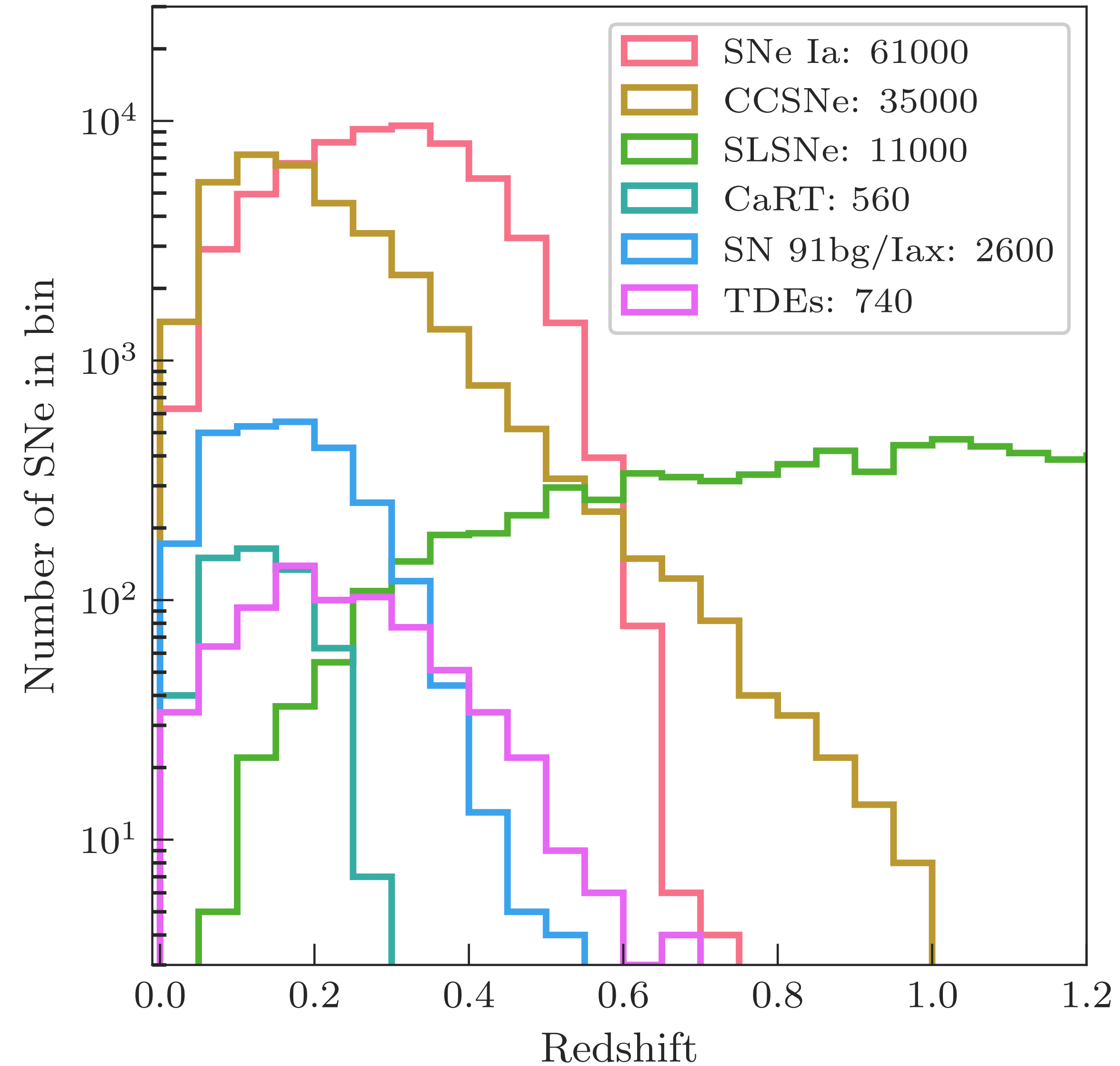
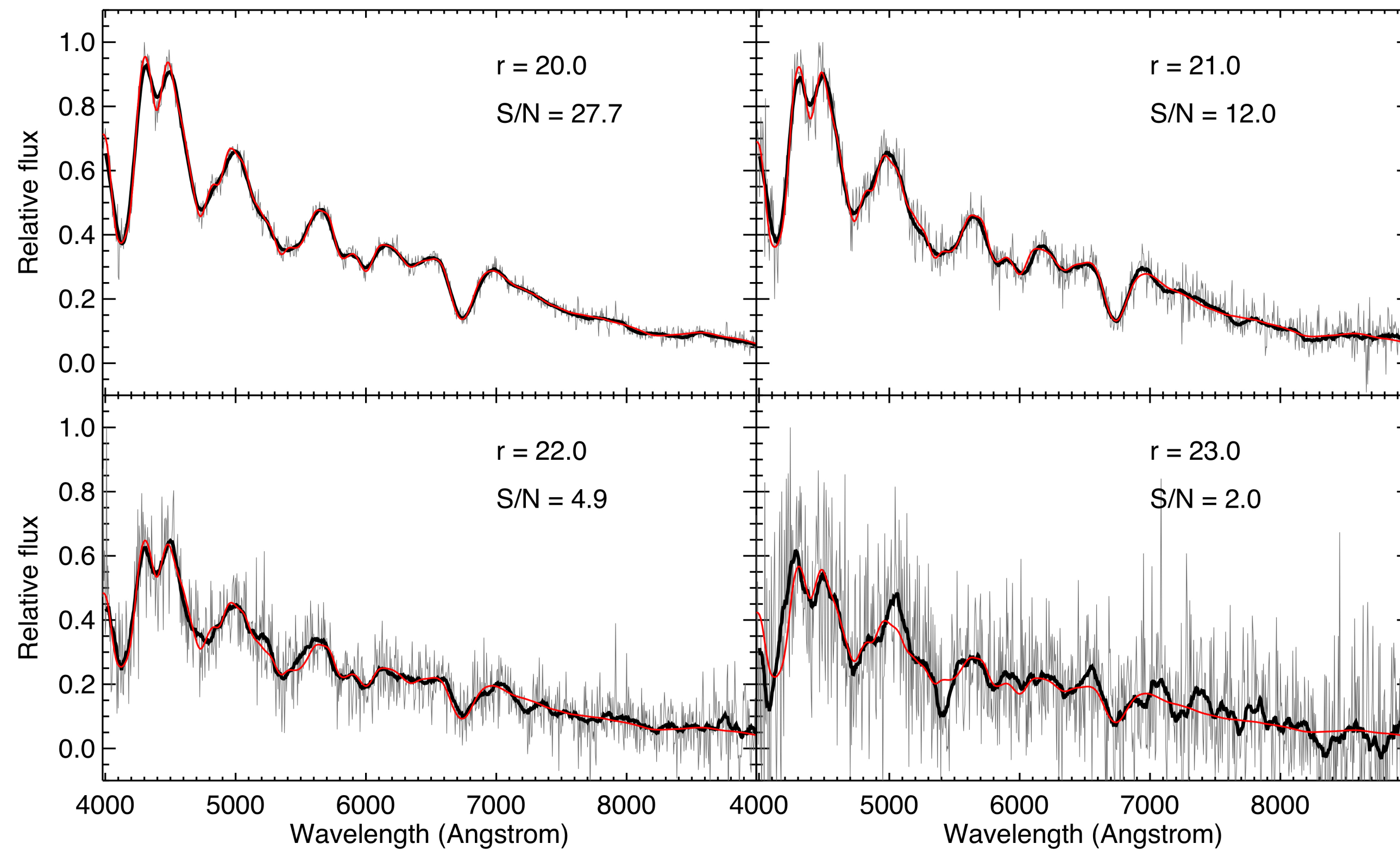
(Last i-band observation)

Results:

Results: 70-90,000 live SN spectra

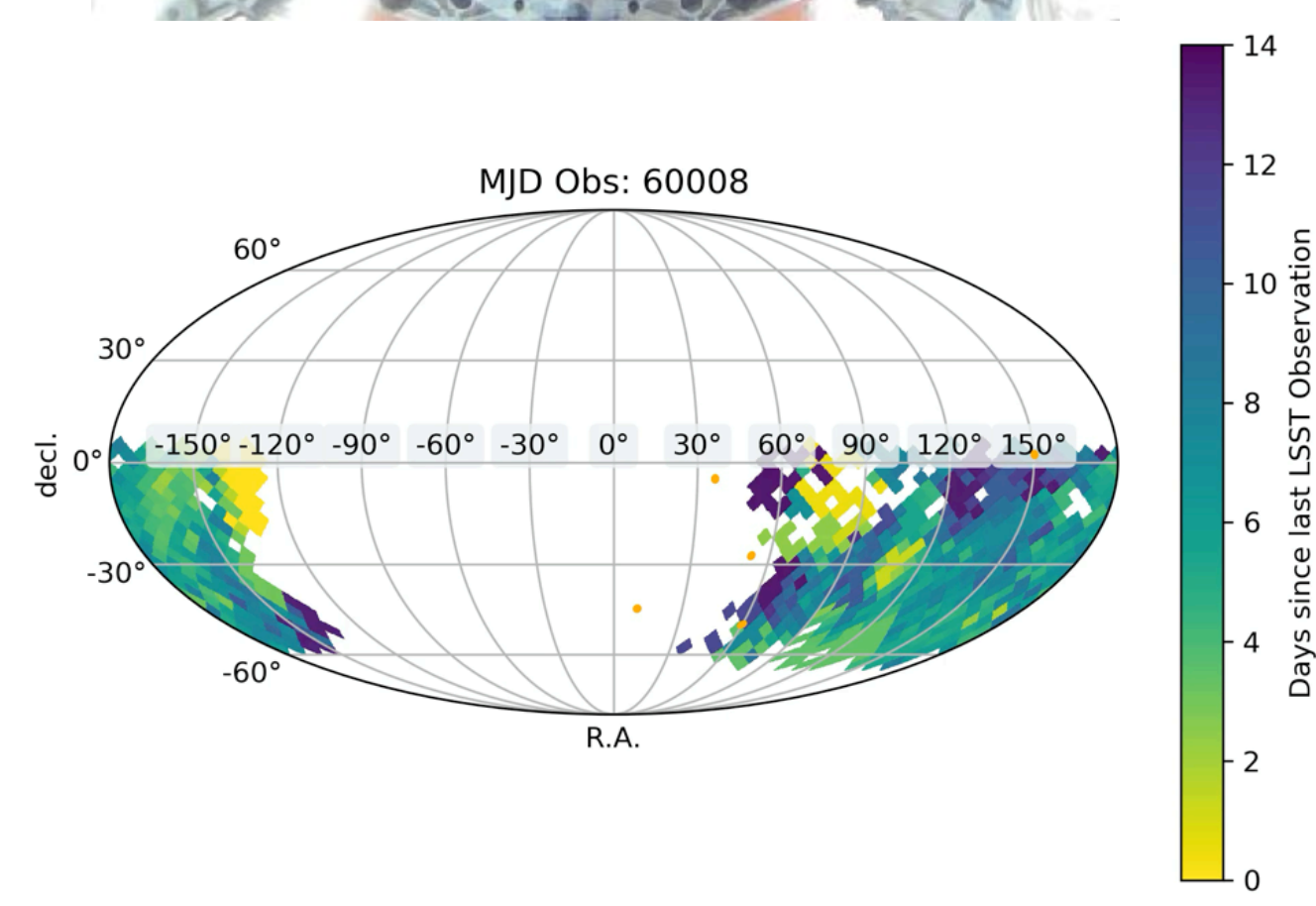
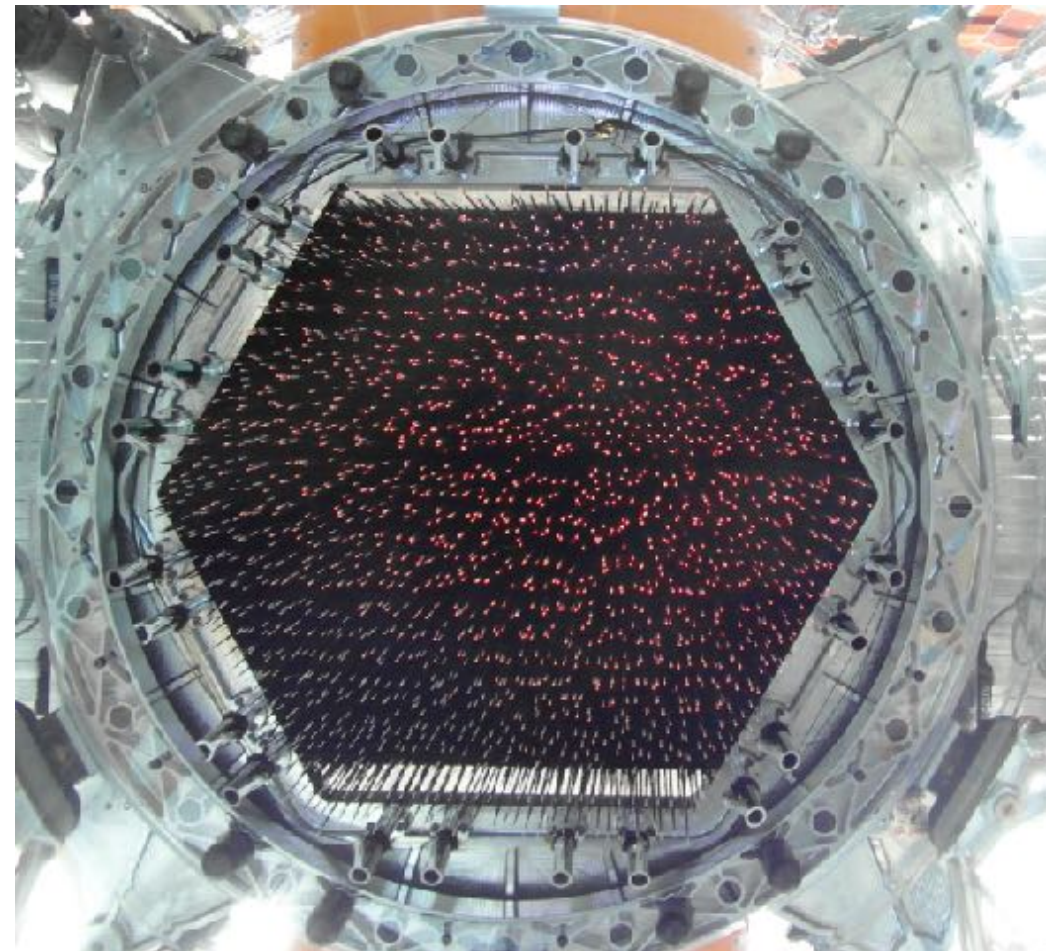
>50,000 host galaxy spectra

>700 AGN observed at a 14 day cadence



Future Lasair integration

LSST + 4MOST Simulations



Future Lasair integration

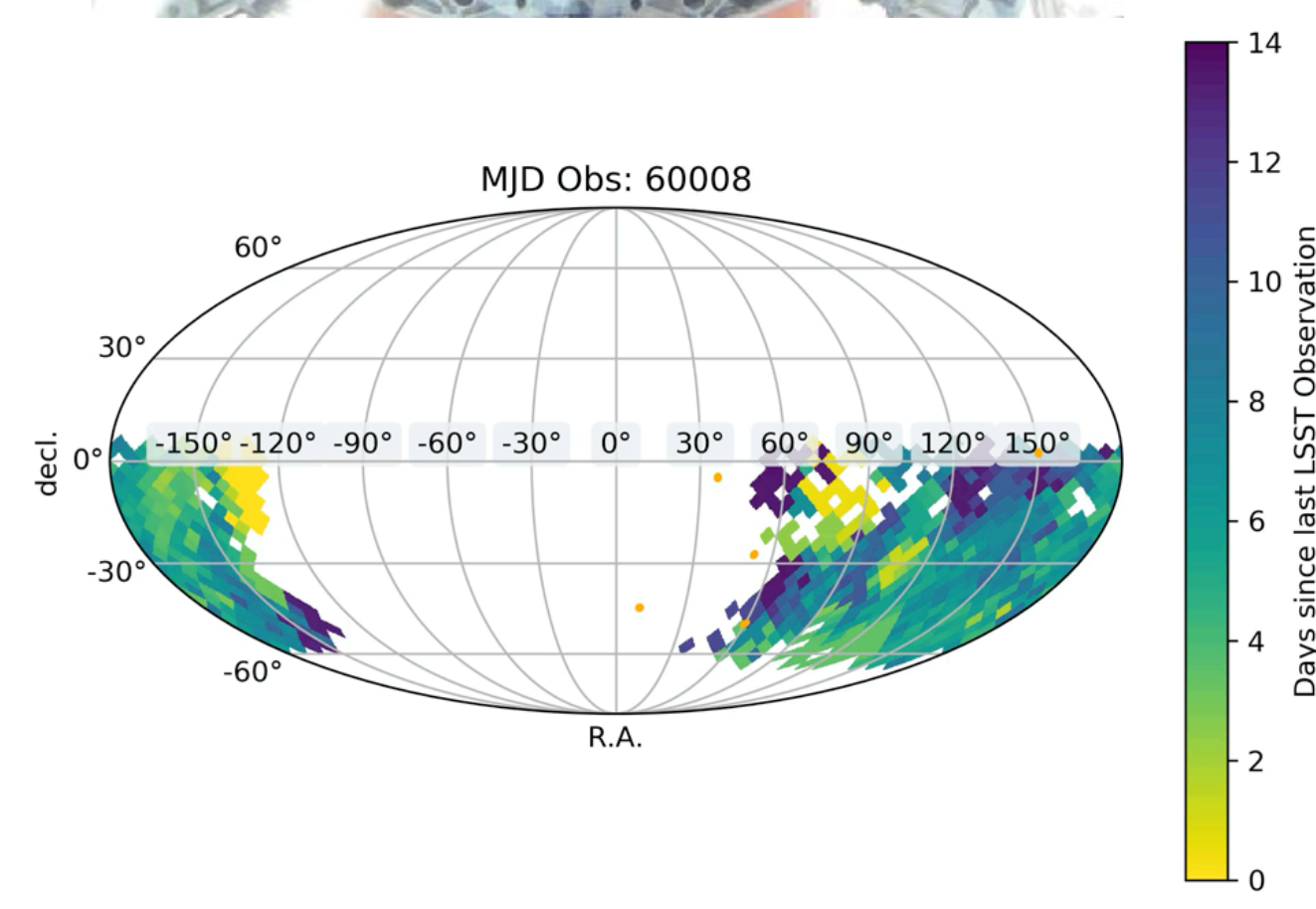
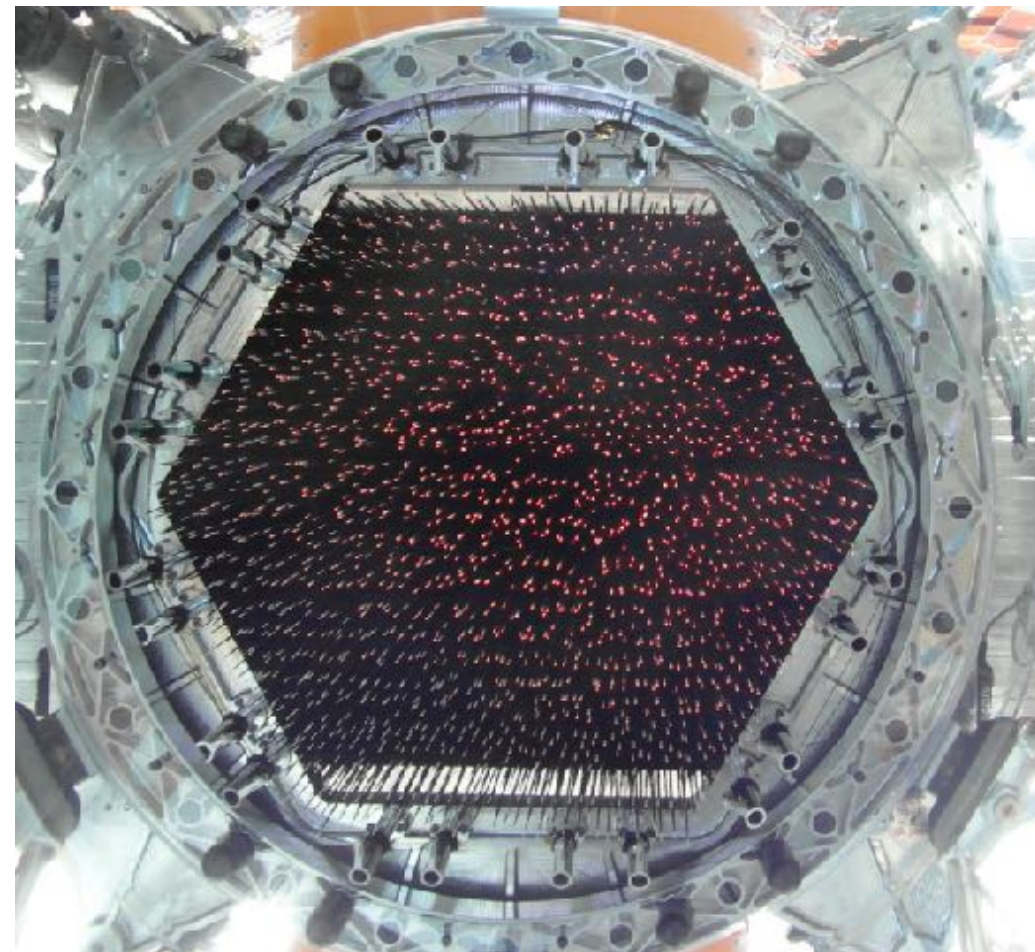
LSST Transient Discovery



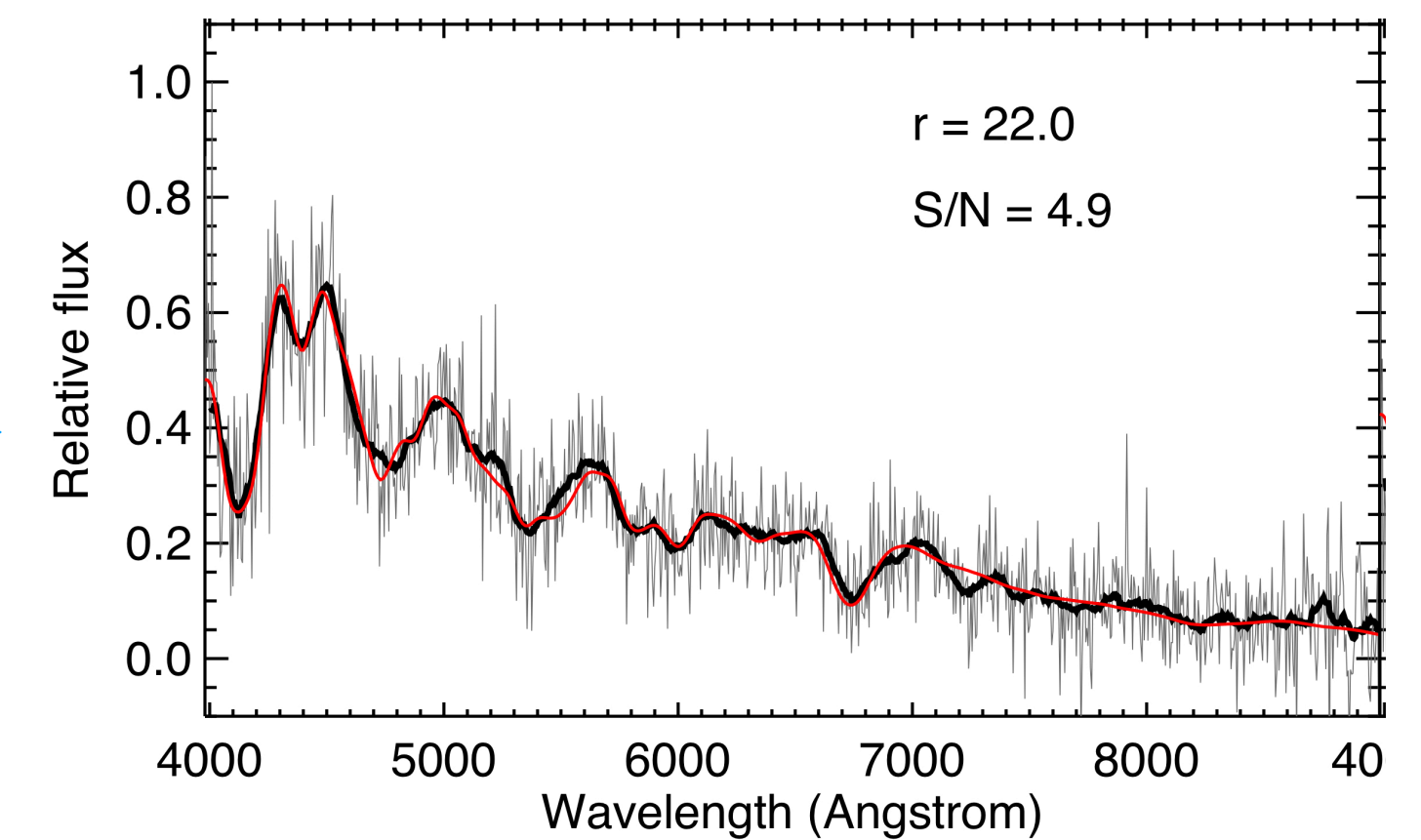
UK Transient Brokers



4MOST Observations



Transient Classification



Data dissemination

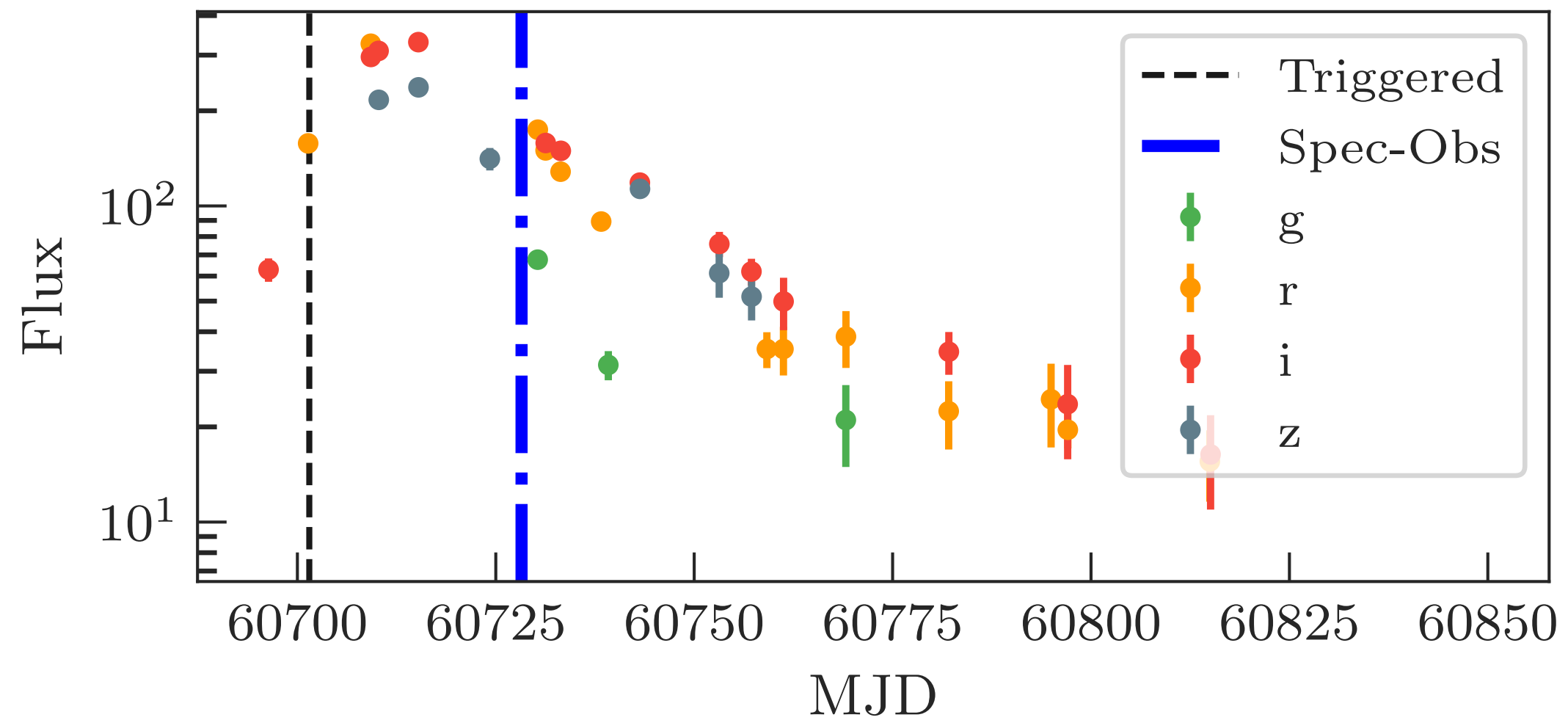
Lasair



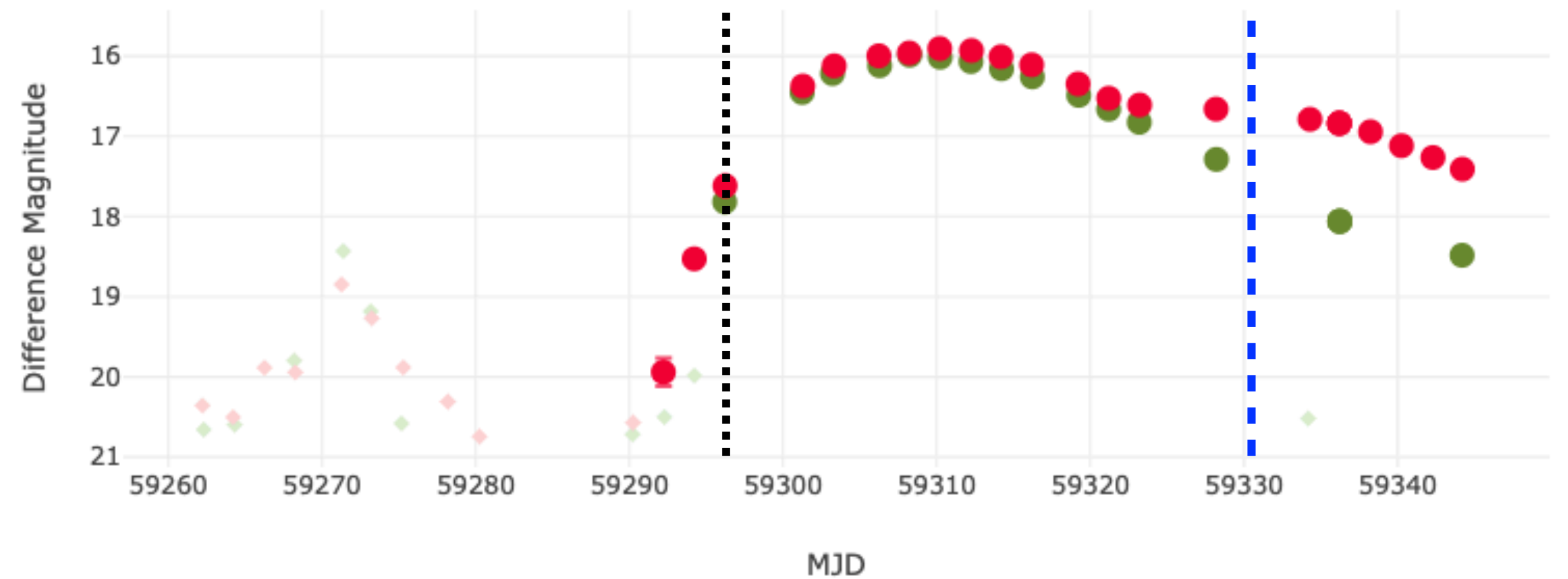
Lasair

Port simulated target selection to Lasair

Baseline 1.7



Object ZTF21aapyiku



Discussion points with Lasair:

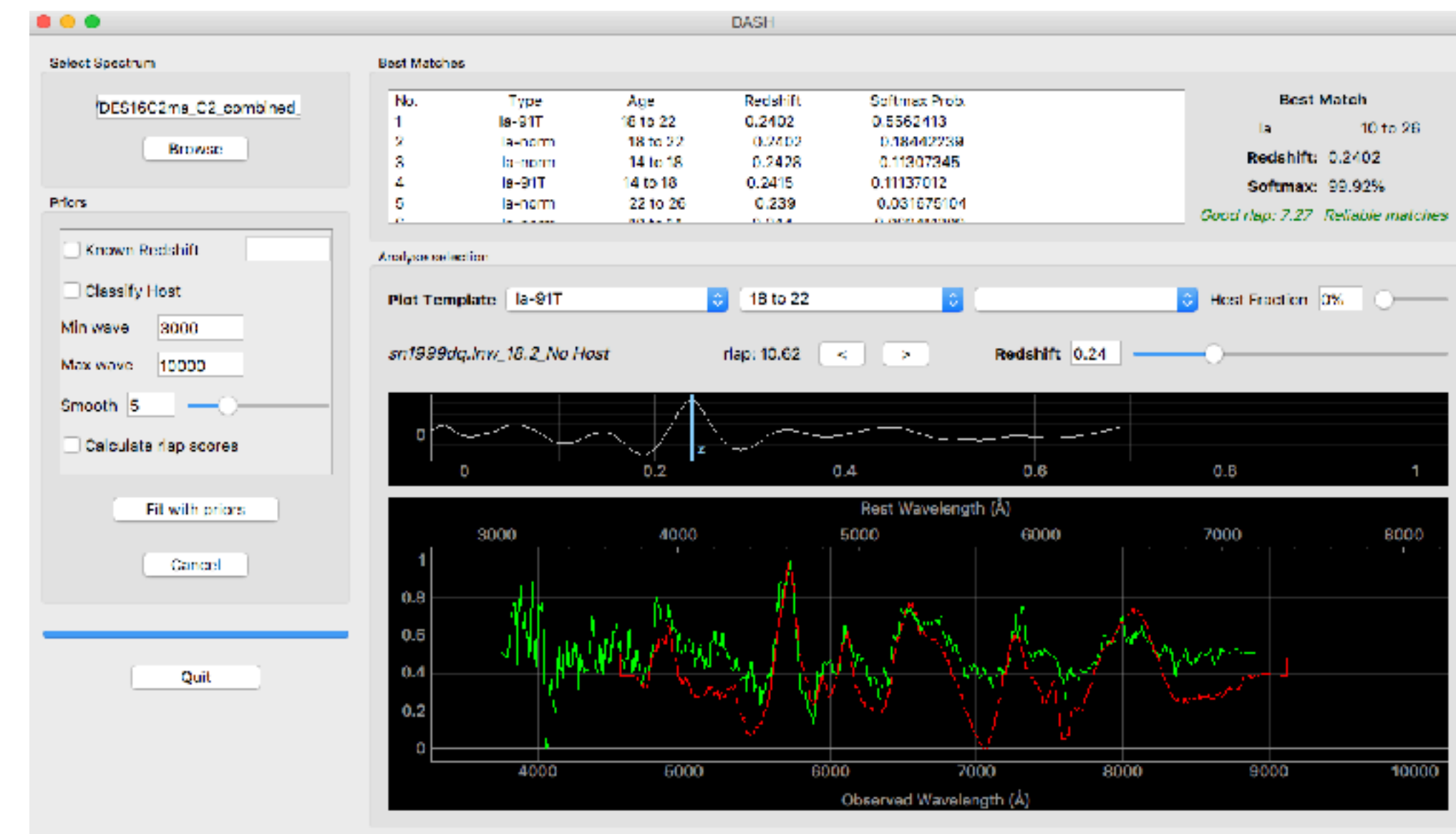
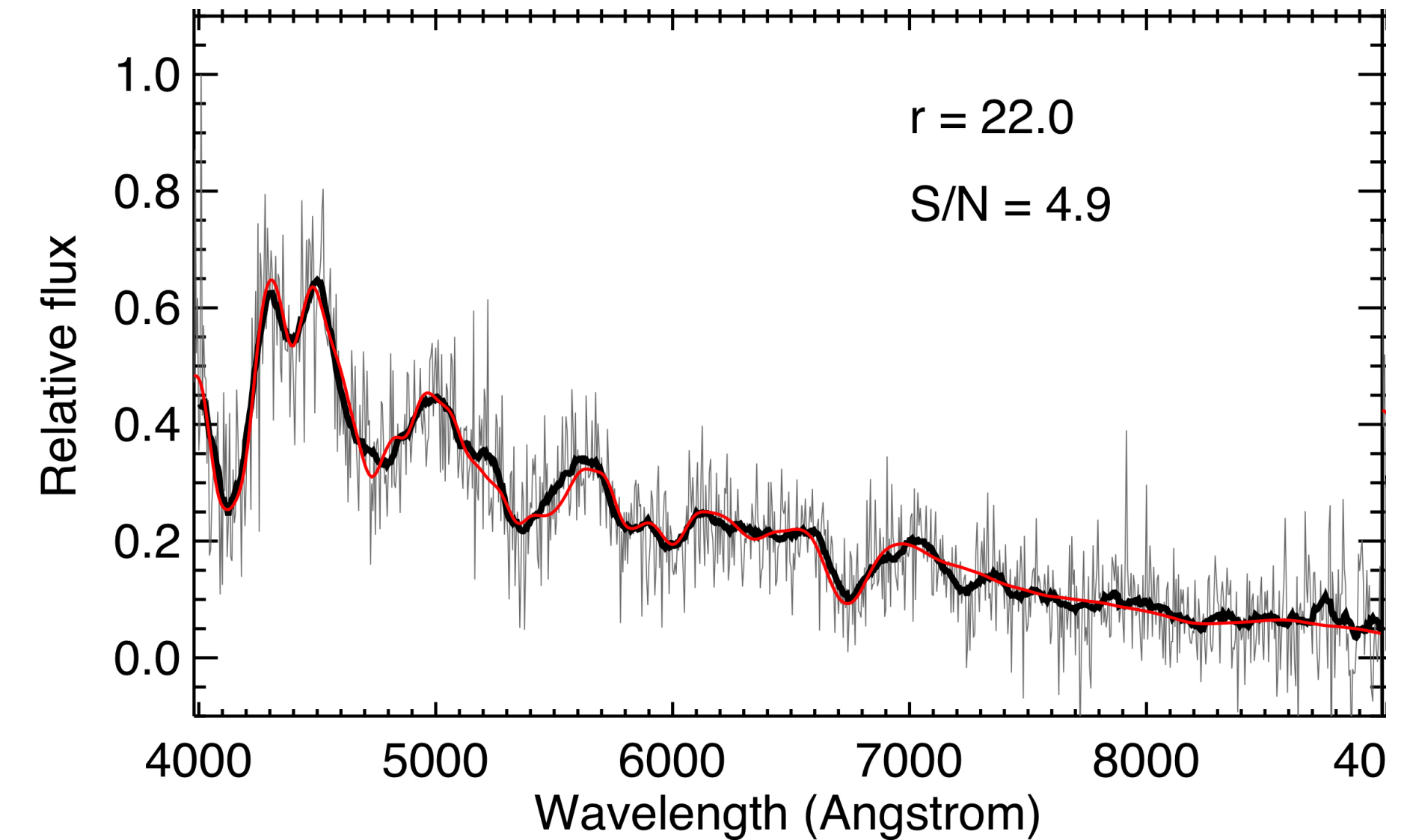
Automated target selection algorithms in Lasair

Target tracking

- Updating the 4MOST observing instructions as object evolves
- After object fades away need to automatically pull it from the 4MOST queue

Automated target classification

- Spectra require classification
 - Is it a type Ia supernova, type II etc etc
- DASH classifier for supernova spectra
 - Type, phase, redshift, host
- Galaxy pipeline separately developed within 4MOST

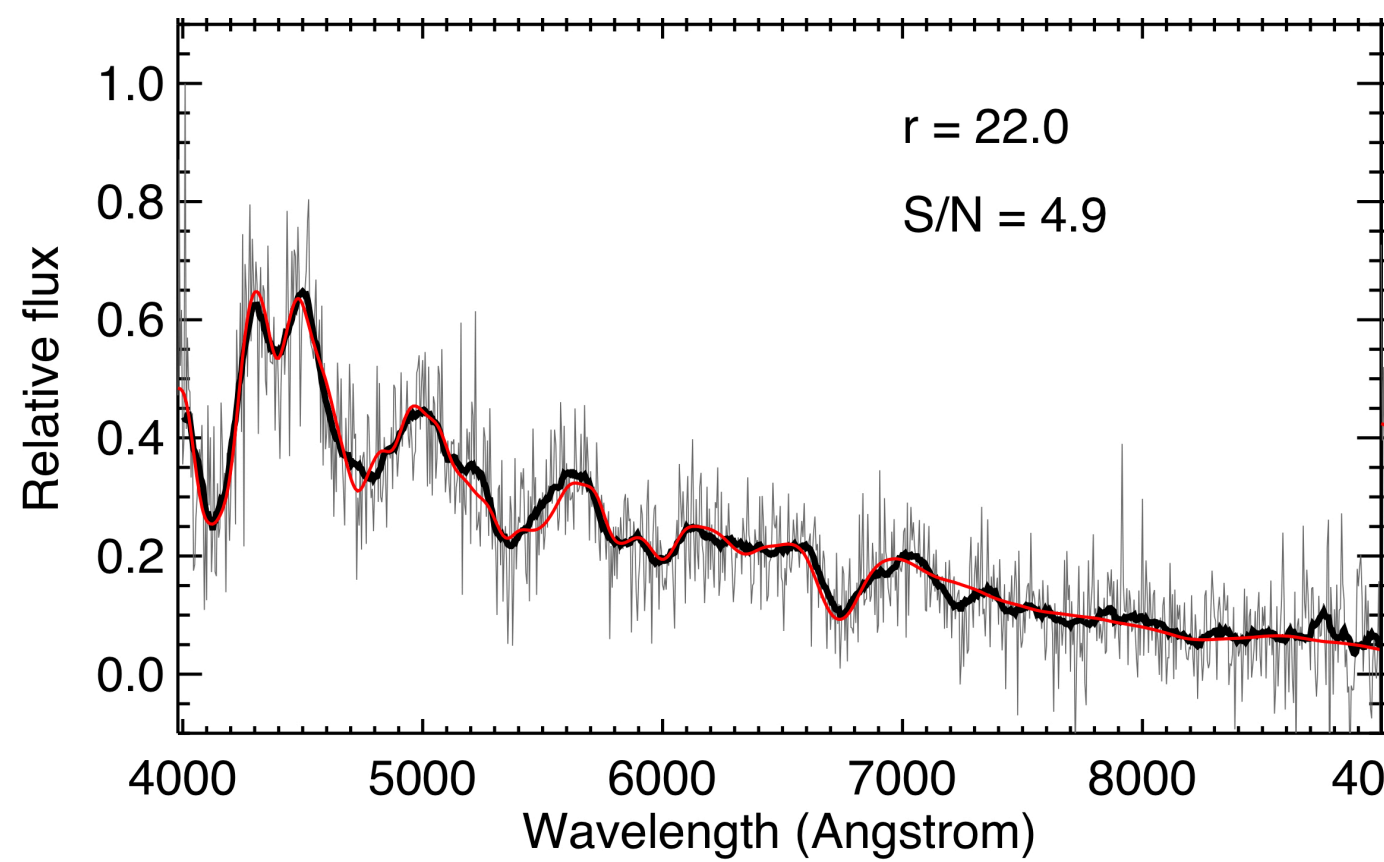


Results in Lasair

Need a repository for spectra meta-data:

- Signal-to-noise
- Data of observation
- SN classification
- Redshift
- Etc etc

Transient Classification



Lasair

ZTF21aaxsct

Logged in as cfrohmaier (Logout)

Object ZTF21aapyiku

Difference Magnitude

Relative flux

$r = 22.0$
 $S/N = 4.9$

- Object has 40 candidates, at mean position:
 - (RA, Dec) = (132.209438, 29.870506)
 - (RA, Dec) = (08:48:50.265, 29:52:13.823)
 - (galactic_lon, galactic_lat) = (194.668000, 37.255426)
 - (ecliptic_lon, ecliptic_lat) = (126.497289, 11.621919)
- Classified as SN at distance 8.00 arcsec.
- The transient is possibly associated with UGC 4467; an $r=14.15$ mag galaxy found in the NED_D/PS1/LASR catalogues. It's located 1.20 N, 8.06 W (3.5 Kpc) from the galaxy centre. A host distance of 89.3 Mpc ($z=0.20$) implies a transient $M = -14.82$ mag.
- Information on this webpage also available as JSON.
- Galactic Extinction
- Conesearch Links (at 5 arcsec): [Simbad](#) | [NED](#) | [Transient Name Server](#) | [ZTF DR1](#)

Comments

Lasair 2021-03-23 10:00:00 In TNS as SN2021gtp (0.1 arcsec separation from ZTF coordinates), discovered (MJD Bot 08:19:59.000 59292.00) by ZTF. Classified as a SN II. At a redshift $z = 0.0202$.

Crossmatches

rank	ID	Catalog	Type	Separation	r-mag	g-mag	photoZ
1	UGC04611	NED_D/PS1/LASR	galaxy	8.00	14.147100448608398	14.628399848937988	None
2	1237661126152093910	SDSS	galaxy	4.14	14.8916	16.1622	0.07186

Data dissemination

Lasair



AladinLite

Control the base layer here:

PanSTARRS

Candidates (To sort, click the column headings)

MJD	UTC	Filter	magpsf	candidate	Image(target, ref, diff)
59344.199	2021-05-10 04:46:48	r	17.410 ± 0.041	t 1590199161015015019	
59344.185	2021-05-10 04:26:45	g	18.484 ± 0.074	t 1590185241015015012	

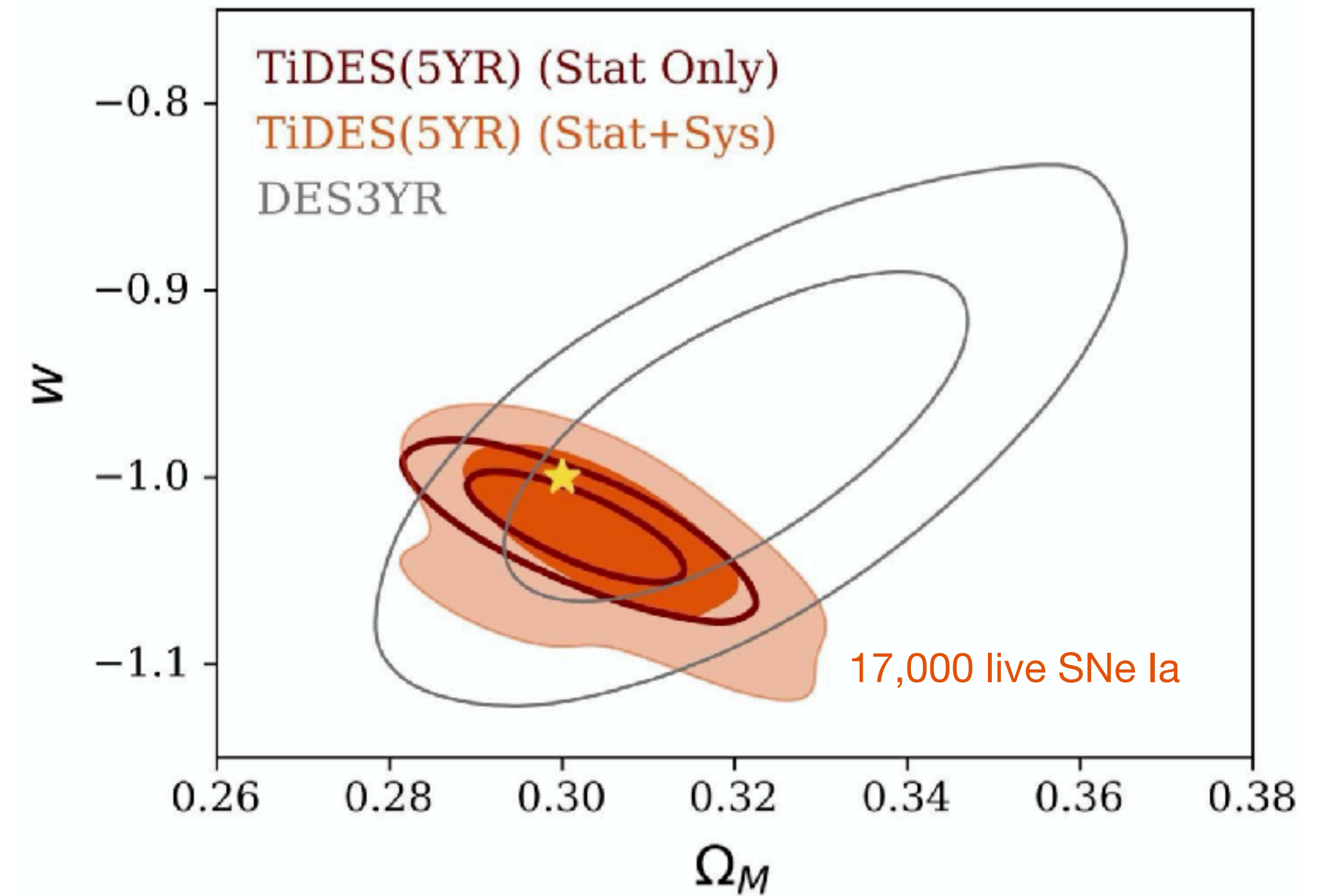
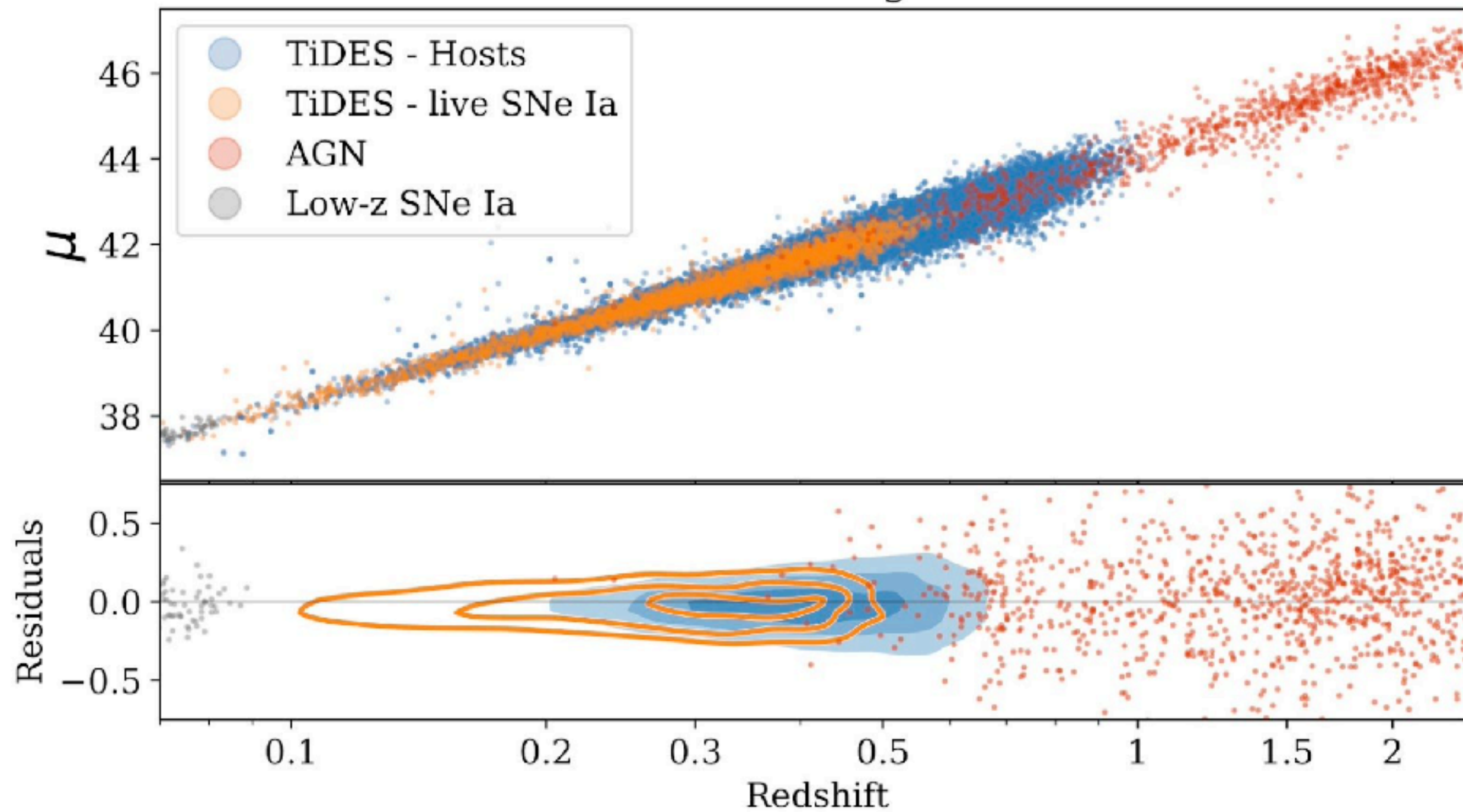
Number of TNS 5 year public spectra database of transients: ~7,900

Number of TiDES transients and host galaxy spectra in 5-year lifetime: >100,000

Cosmology

Largest cosmological sample of SNe Ia ever

Hubble Diagram



~17,000 cosmologically useful SNe Ia spectroscopically confirmed
~50,000 host galaxy redshifts
~700 AGN to $z=2.5$

Assuming Planck-priors and ~70,000 spectroscopic redshifts (live SNe + hosts)

$$w < 2\%$$

Questions



Mark Sullivan (PI)
David Alexander, Pierre Antilogus, Sebastien Bongard, Jon Carrick,
Thomas Collett, Tamara Davis, Jamie Dumayne, Richard Ellis, Poshak
Gandhi, Or Graur, Sebastian Hoenig, Isobel Hook, Peter Jonker, Rubina
Kotak, Kate Maguire, Kaisey Mandel, Richard McMahon, Daniel
Muthukrishna, Brooke Simmons, Stephen Smartt, Elizabeth Swann

