Superluminous Supernovae in LSST

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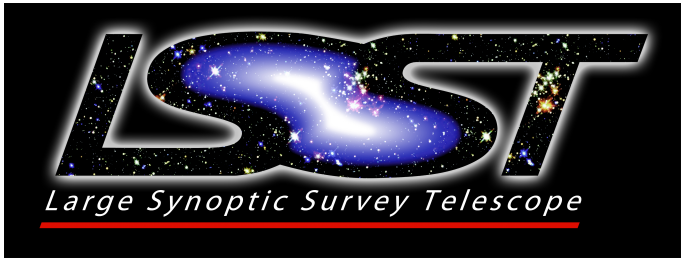
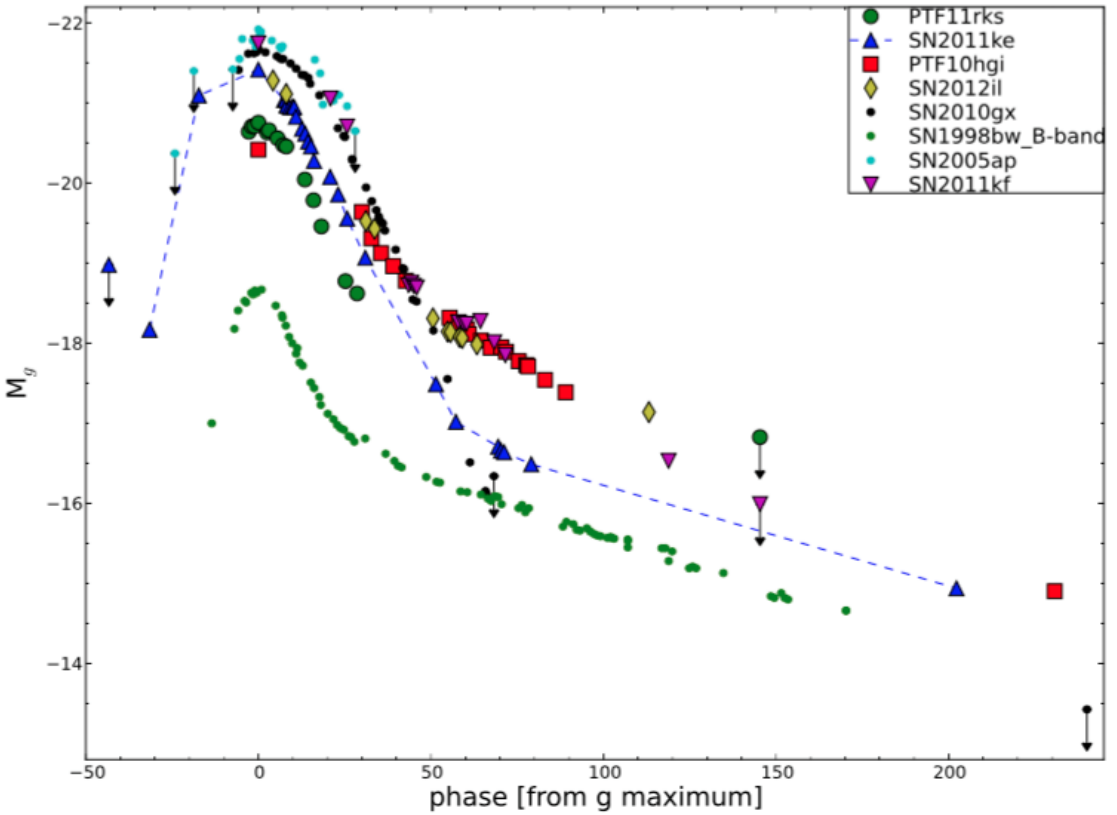


SLSN Astrophysics

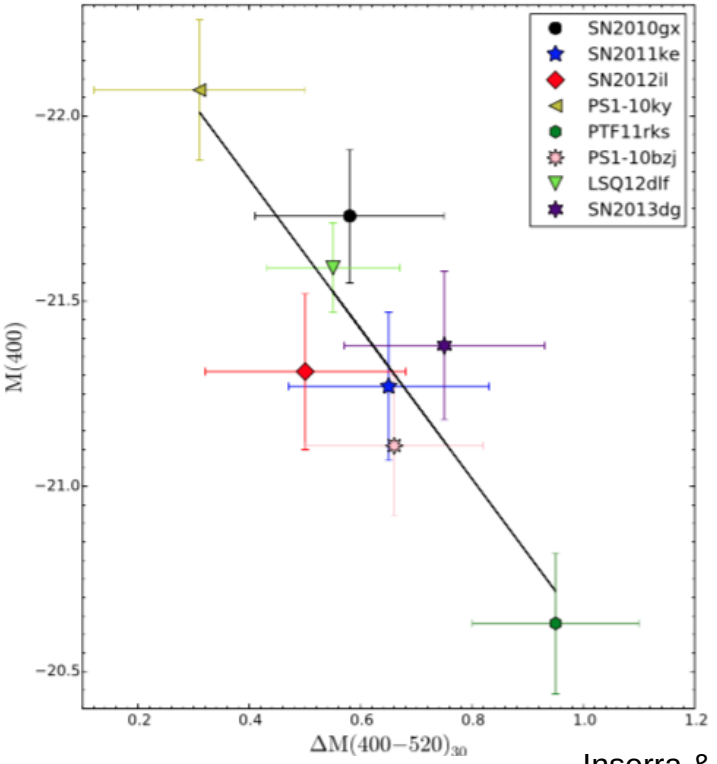
- Superluminous supernovae (SLSNe) are a new type of SN discovered only in the last decade.
- Absolute peak magnitude M < -21 (50 times brighter than Type Ia SNe).
- Long duration.
- ~50 discovered so far.
- Underlying astrophysics still in dispute, and various models have been put forward.



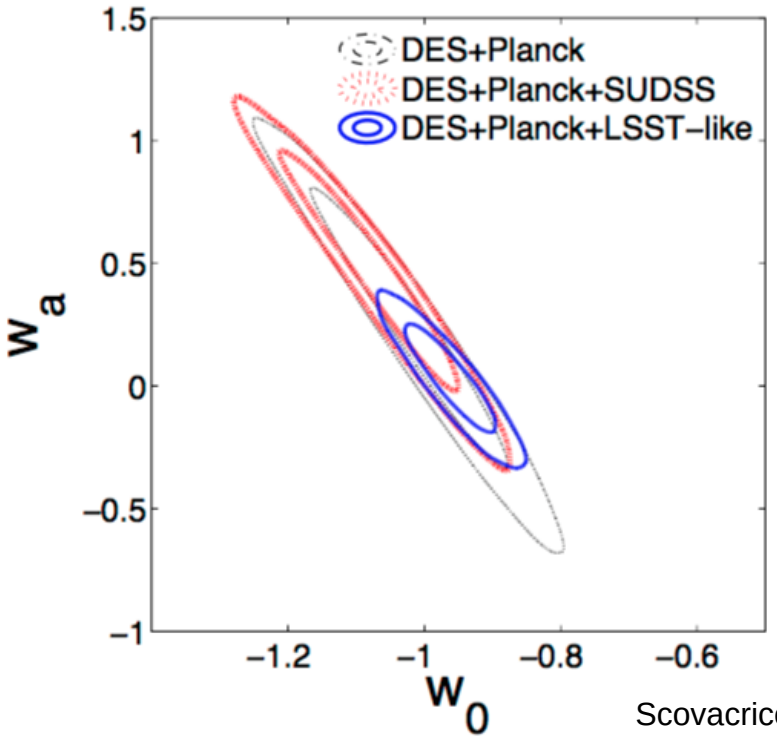
Inserra et al. 2013

SLSN Cosmology

- Inserra & Smartt (2014) use a peak magnitude – colour evolution relation to reduce the intrinsic scatter of their SLSN sample to 0.19 mags, indicating potential use as standard candles.
- Scovacricchi et al. (2015) predict cosmological constraints with 10,000 mock SLSNe from LSST combined with previous SN samples.
- For flat wCDM they find constraints on Ω_M and w of 2% and 4% for flat wCDM.
- For time varying w they find constraints of 2%, 5%, and 0.14 on Ω_M, w_0, w_a, respectively.



Inserra & Smartt 2014



Scovacricchi et al. 2015

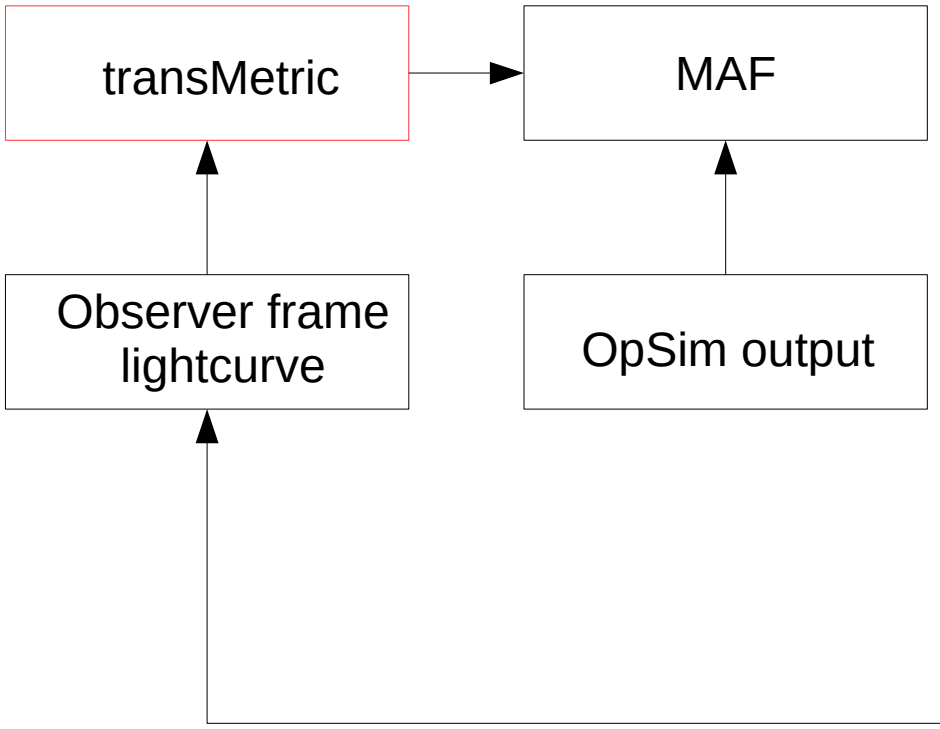
Toward the redshift distribution

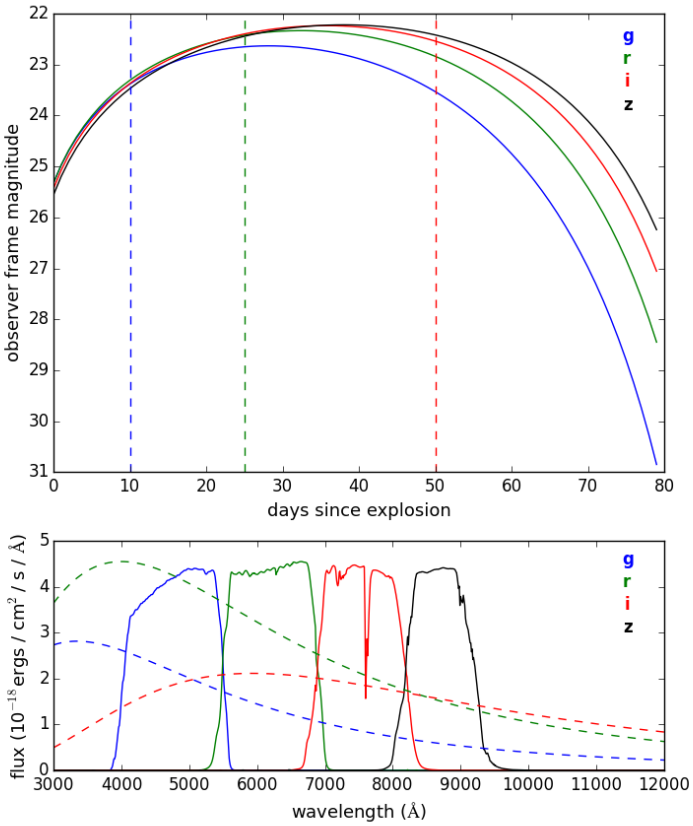
$$N(z) = \sum_{\epsilon=0}^{1} \epsilon(z) V(z,\epsilon) R(z) T$$

$$R(t) = R_0 + \frac{dR}{dt}$$

$$T(t) = T_0 - \frac{dT}{dt}$$

Howell et al. 2013





Toward the redshift distribution

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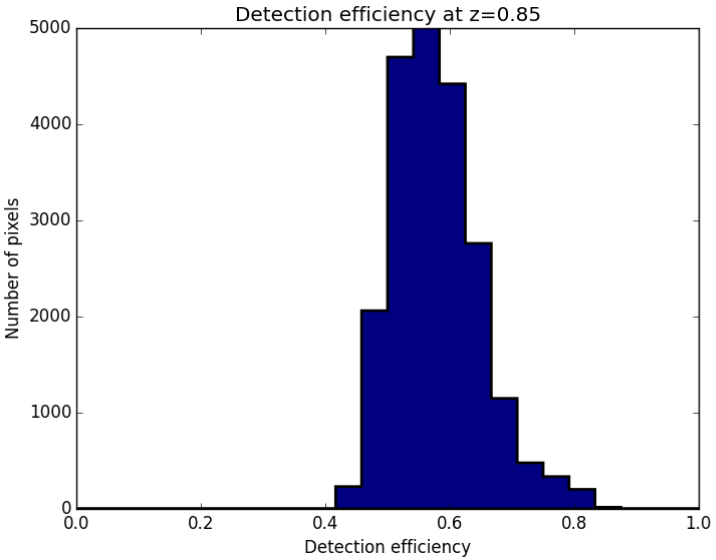
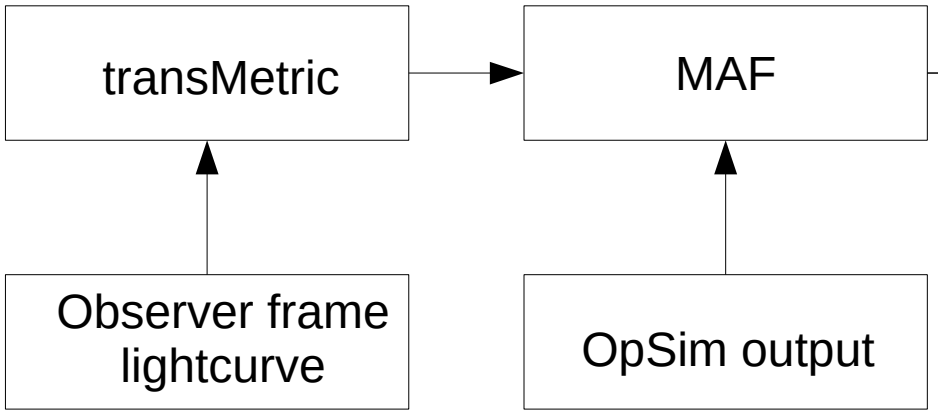
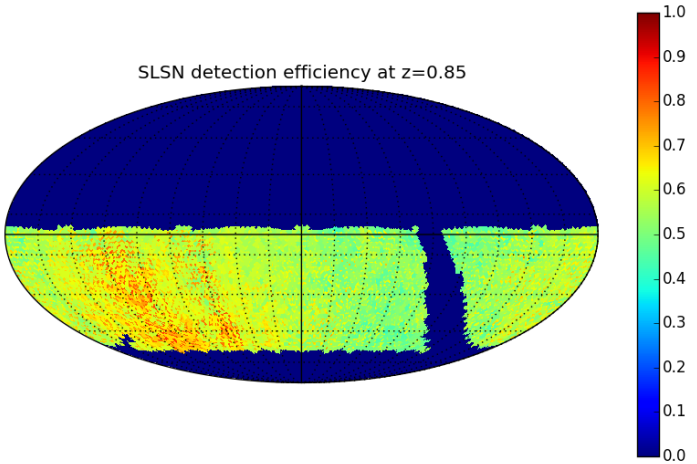


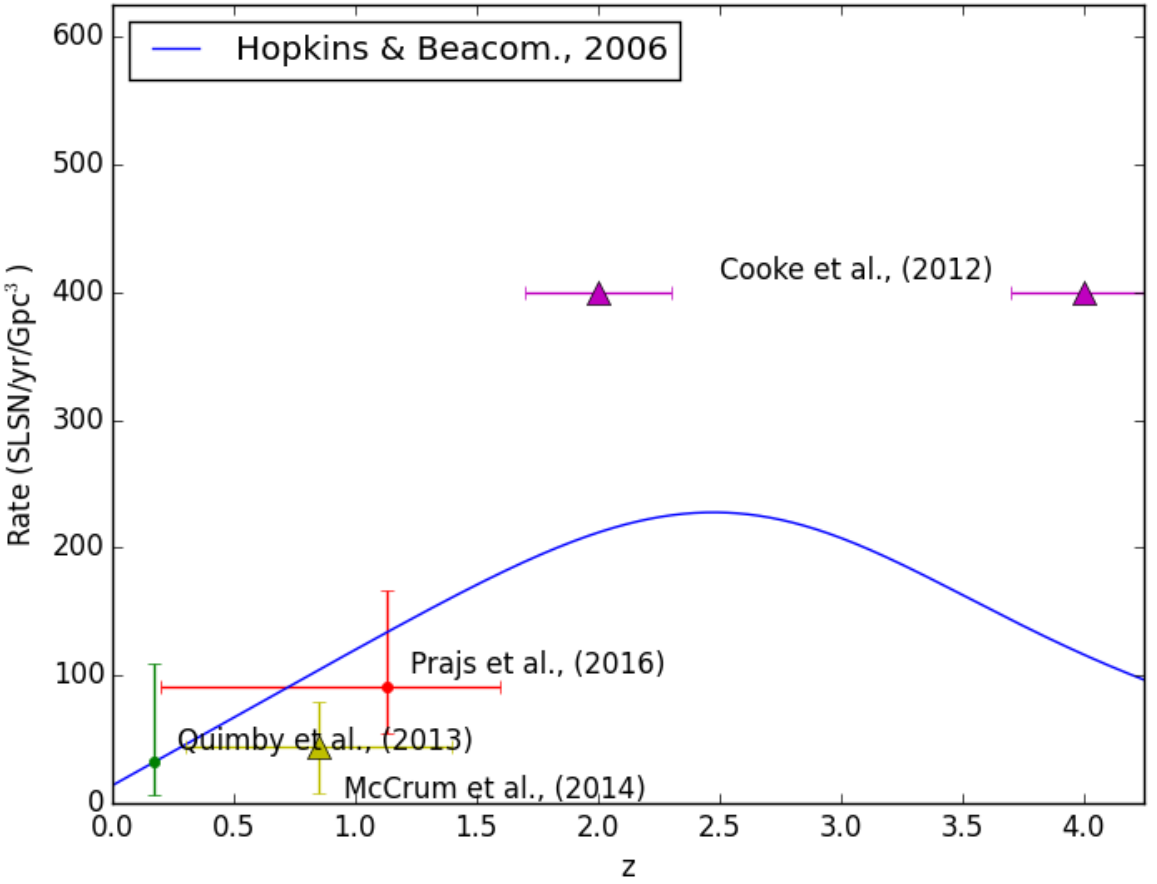




Toward the redshift distribution

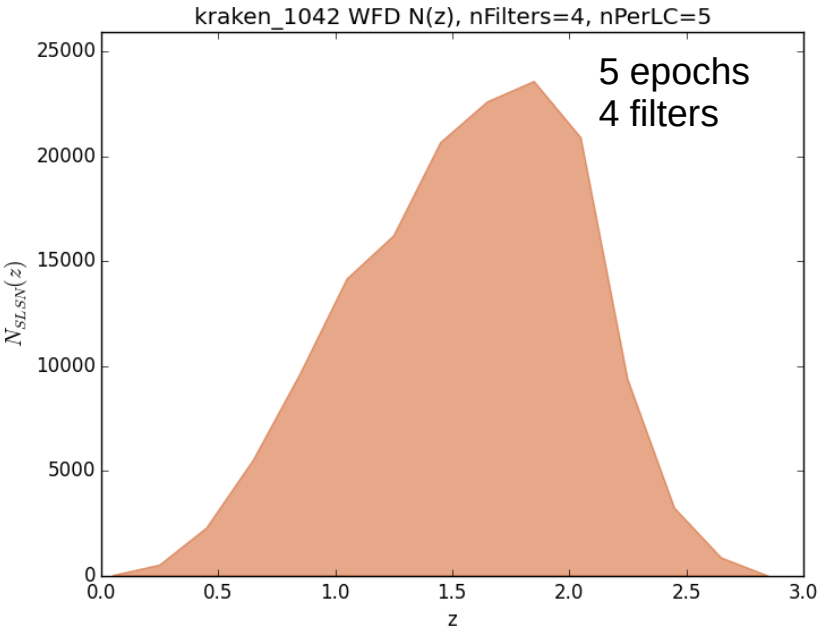
$$N(z) = \sum_{\epsilon=0}^{1} \epsilon(z) V(z, \epsilon) R(z) T$$

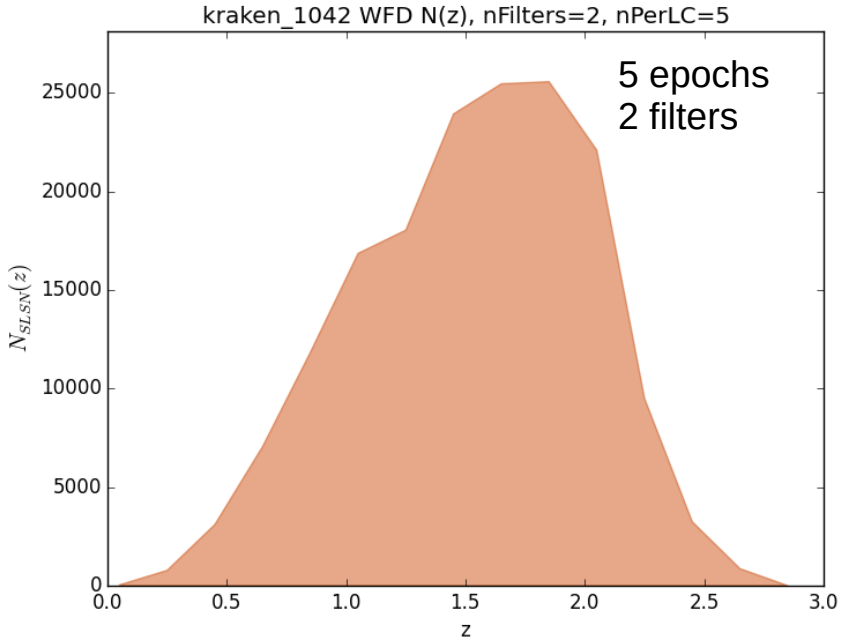
- Rate assumed to follow normalized star formation history as SLSNe come from high mass stars.
- Large source of uncertainty at $z > 2$, low metallicity implies more SLSNe than we might expect.
- More measurements needed at $z > 2$ to better constrain high z SLSN rate.

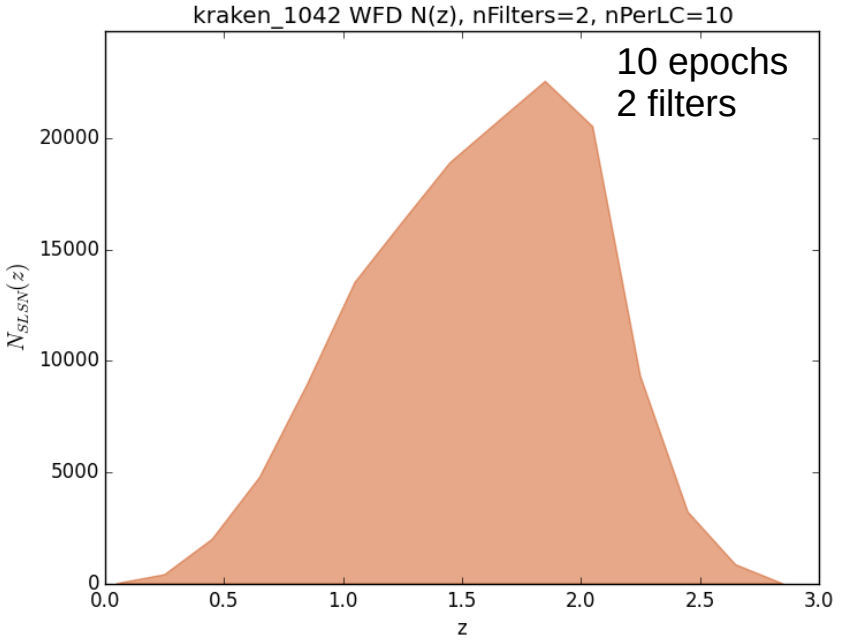


N(z) dependence on detection criteria

- We test the sensitivity of our *N(z)* to the number of epochs and number of filters we require for a detection.
- We find greater sensitivity to the number of epochs than to the number of filters.
- For epochs < 15 , filters < 5 , we find at least 100,000 SLSNe in LSST.

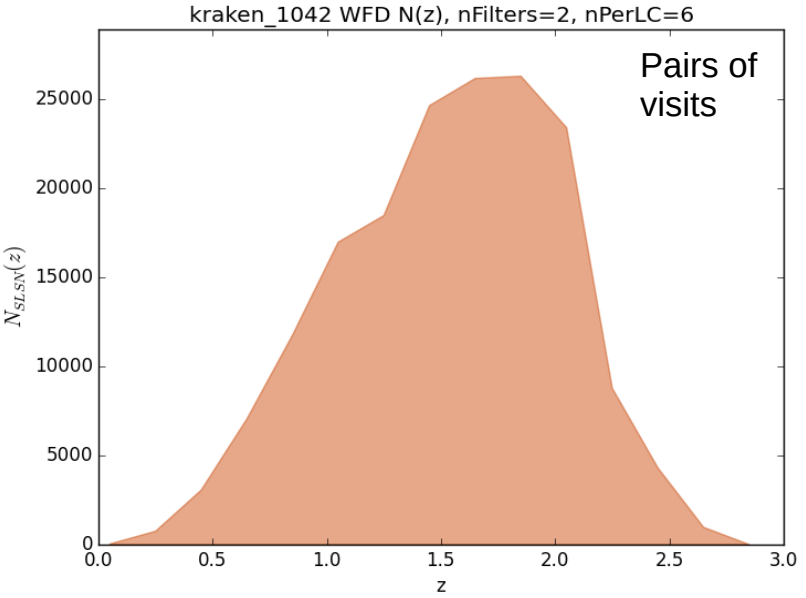


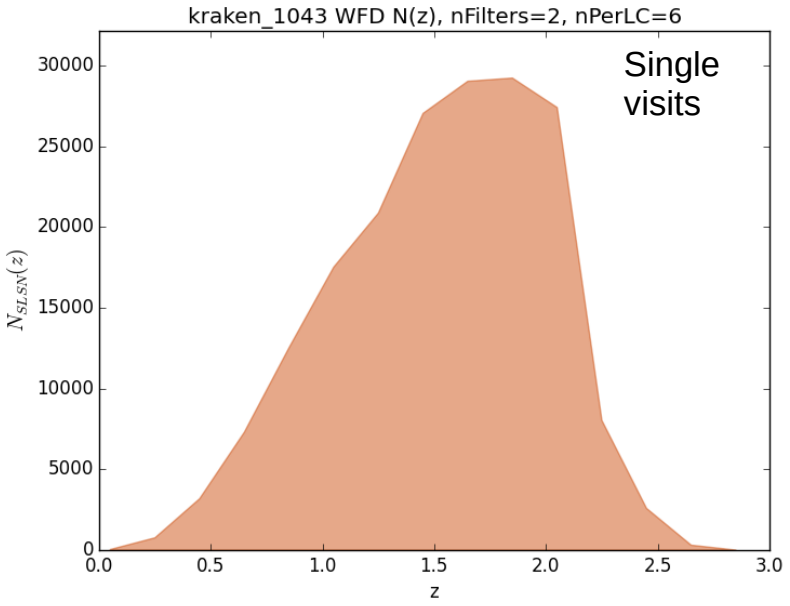


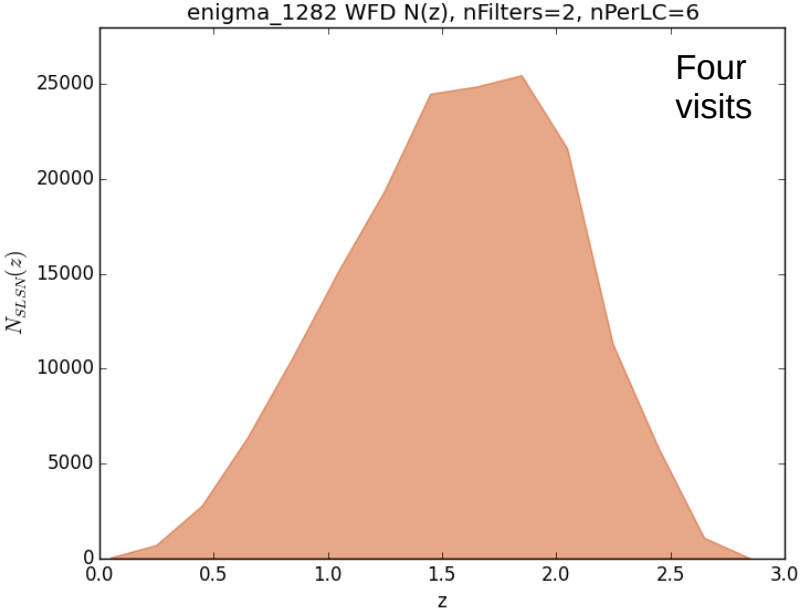


N(z) dependence on cadence proposal

- A key parameter in the LSST survey strategy is the number of fast revisits (separated by ~1hr) we require.
- We test how this parameter affects the SLSN *N(z)*.
- Little difference is found whether we require single visits, pairs of visits, or four visits per pointing.







Future work

- Better constrain where the detected epochs lie on the lightcurve in transMetric. (e.g. specify points +30 days from peak)
- Sample from a realistic SLSN luminosity function, to be built from 17 DES SLSNe.
- Predict cosmological constraints using our realistic *N(z)*, as an update to our work in Scovacricchi et al. (2015)
- Questions?