



DARK ENERGY
SURVEY

Supernovae with DESpec

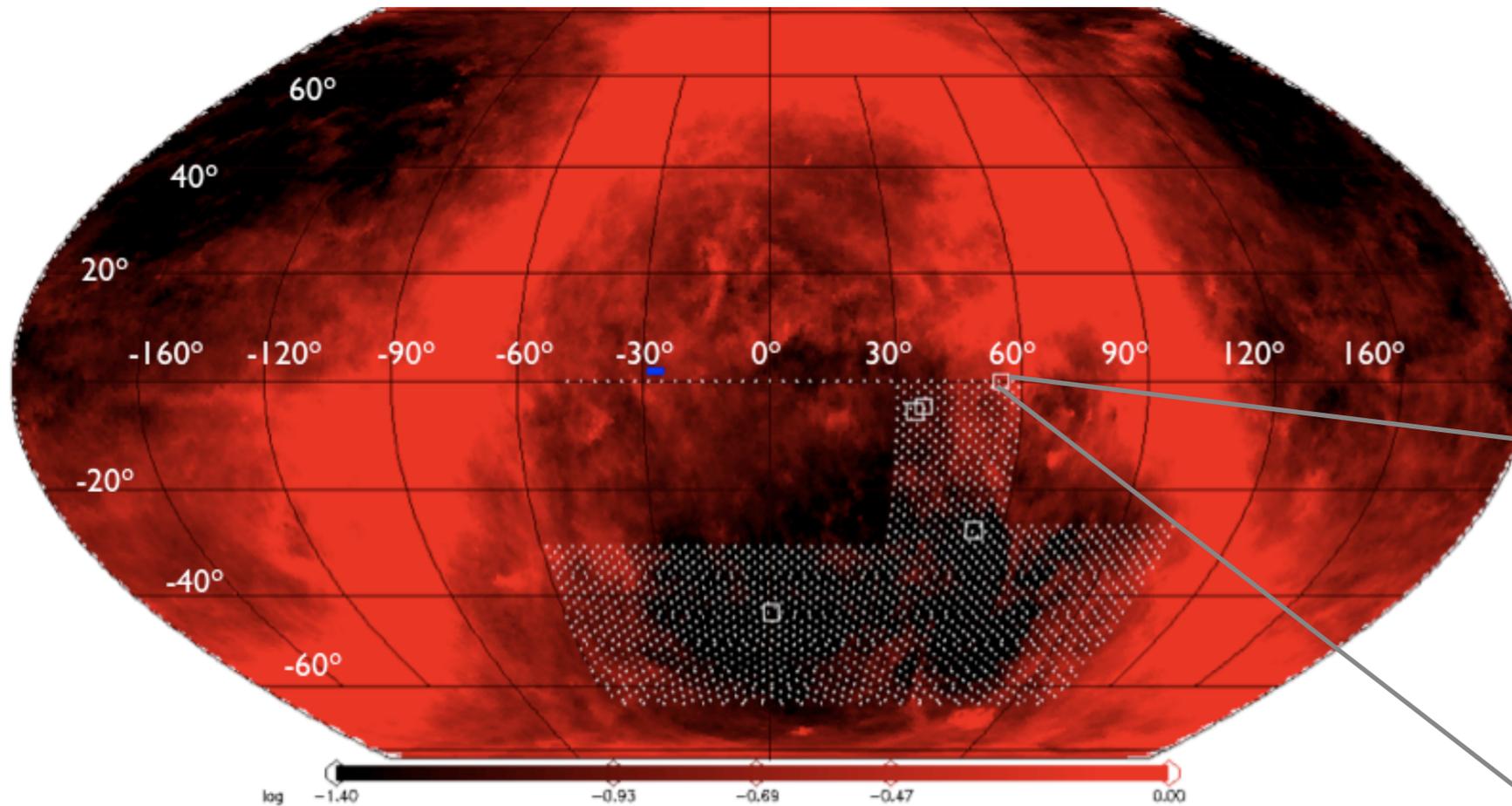
Masao Sako (Penn)

DESPEC RAS - March 7, 2011

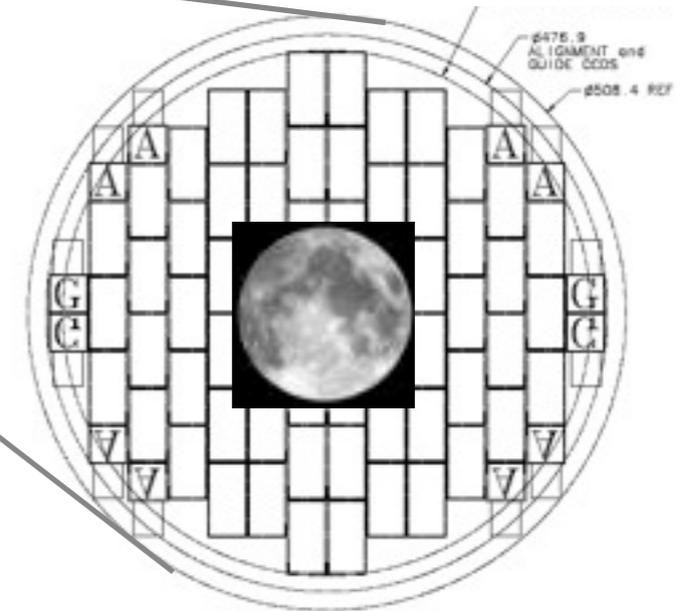


DARK ENERGY
SURVEY

DES SN Survey



Fields to overlap with existing and near-future deep imaging (e.g., CDF-S, SNLS, VIDEO) and spectroscopic surveys (DEEP2, VIPERS, VVDS, WiggleZ, GAMA I/II).



10 DES fields

Visit once every ~ 4 days.

2 deep + 8 shallow (30 deg^2)

deep: 6600 sec per visit (*griz*)

shallow: 800 sec per visit (*griz*)

good z-band efficiency ($\sim 4x$ higher than CFHT/MegaCam) and target high-z SN Ia

→ good rest-frame g-band light curves of $z \sim 1$ SN Ia.

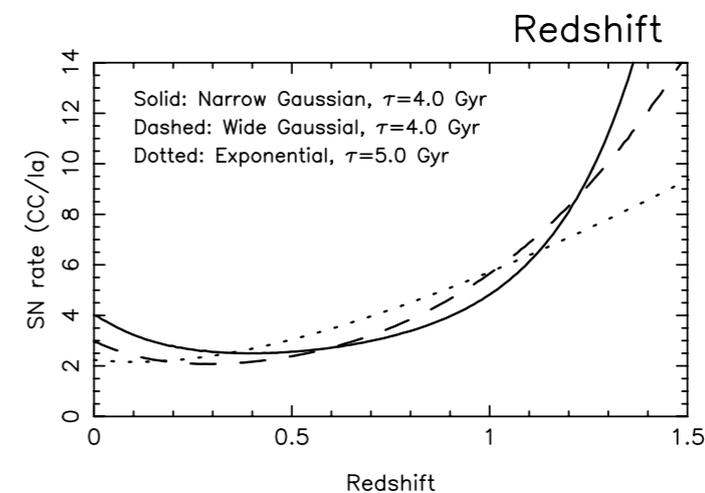
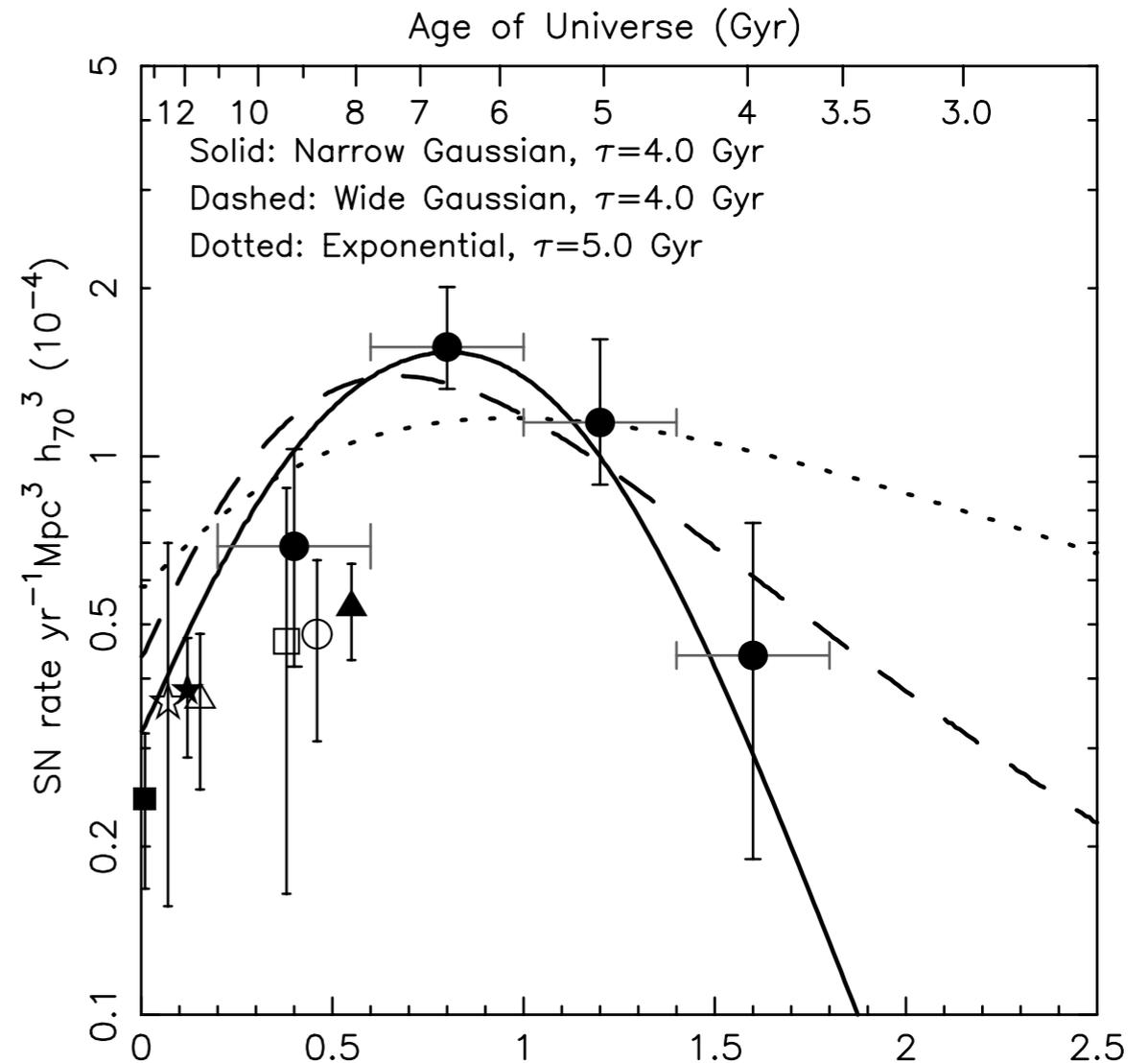


SN Rates and Numbers

DARK ENERGY
SURVEY

- ▶ ~ 0.5 SN Ia explosions per second in all-sky out to $z \sim 1$.
- ▶ \Rightarrow **10 SN Ia/deg²** within ± 5 days from peak.
- ▶ \Rightarrow **200 SN Ia/deg²** in 6 months
- ▶ $\sim 2 - 4$ CC SN for every SN Ia
- ▶ dimmer by ~ 2 mag

- ▶ **Magnitude-limited survey gives a CC/Ia SN ratio of $\sim 0.3 - 0.5$.**



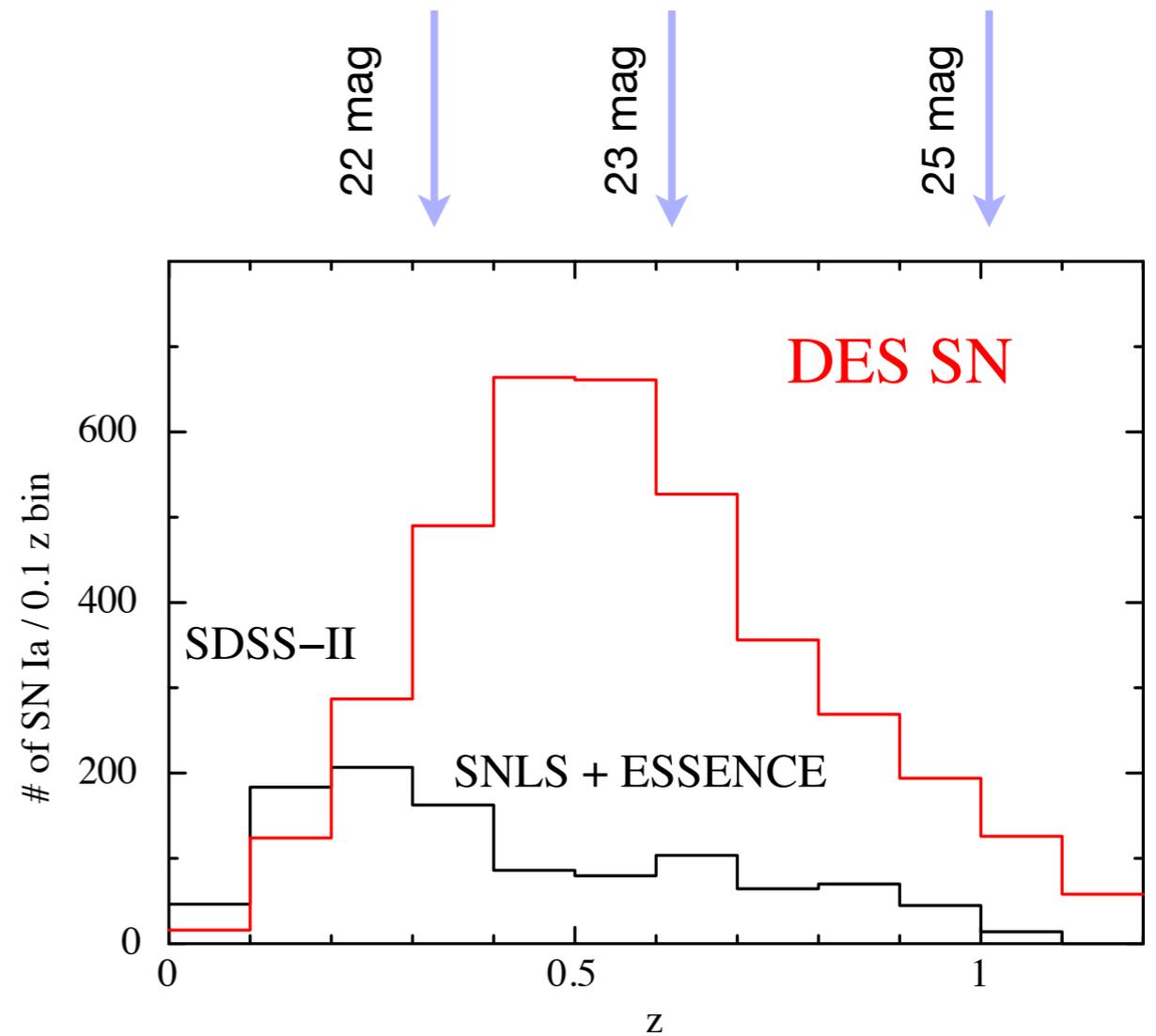
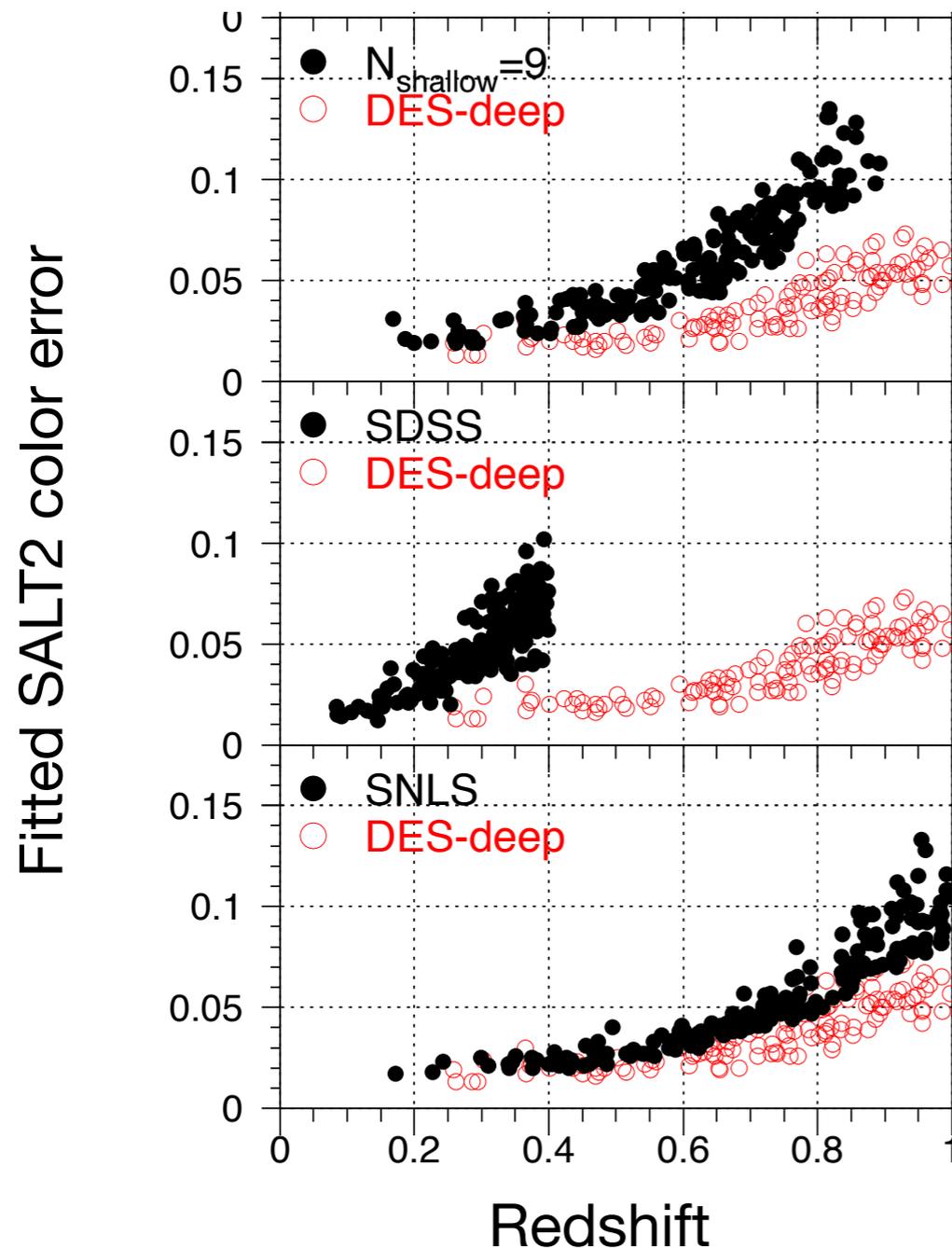
Dahlen et al.
(2004)



SN Search Strategy

DARK ENERGY SURVEY

- ▶ 6-month search and follow-up campaigns



- ▶ Will discover ~ 6000 SN Ia at $0.1 < z < 1.0$.
- ▶ **~ 3800 SN Ia** with “good” light curves

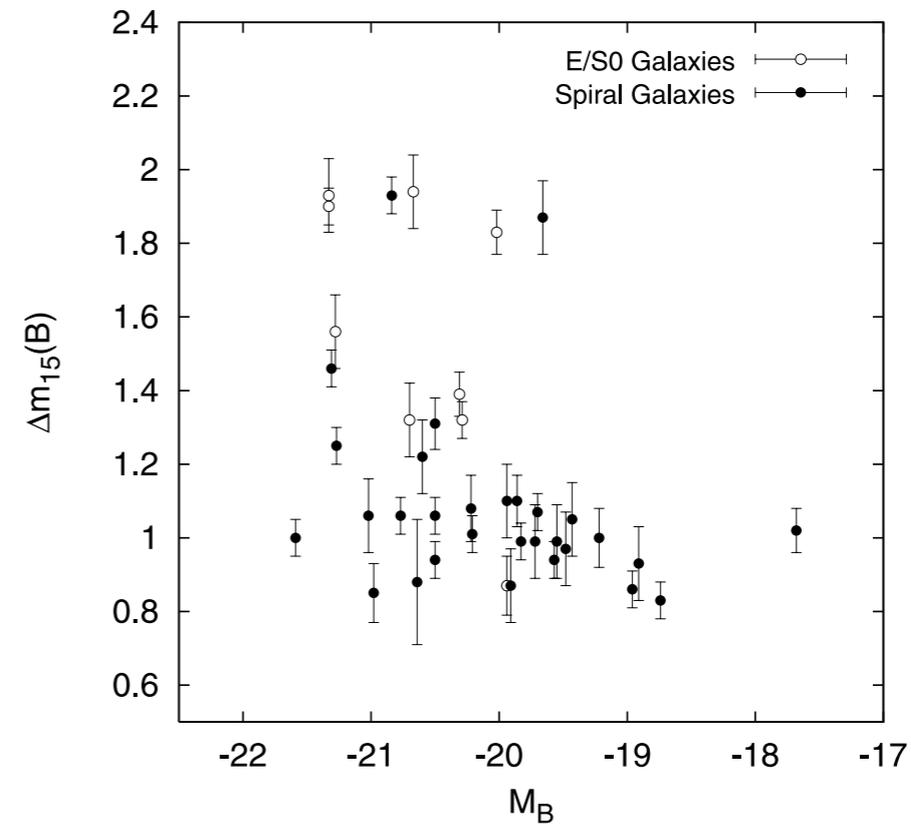


Host Galaxy Follow Up

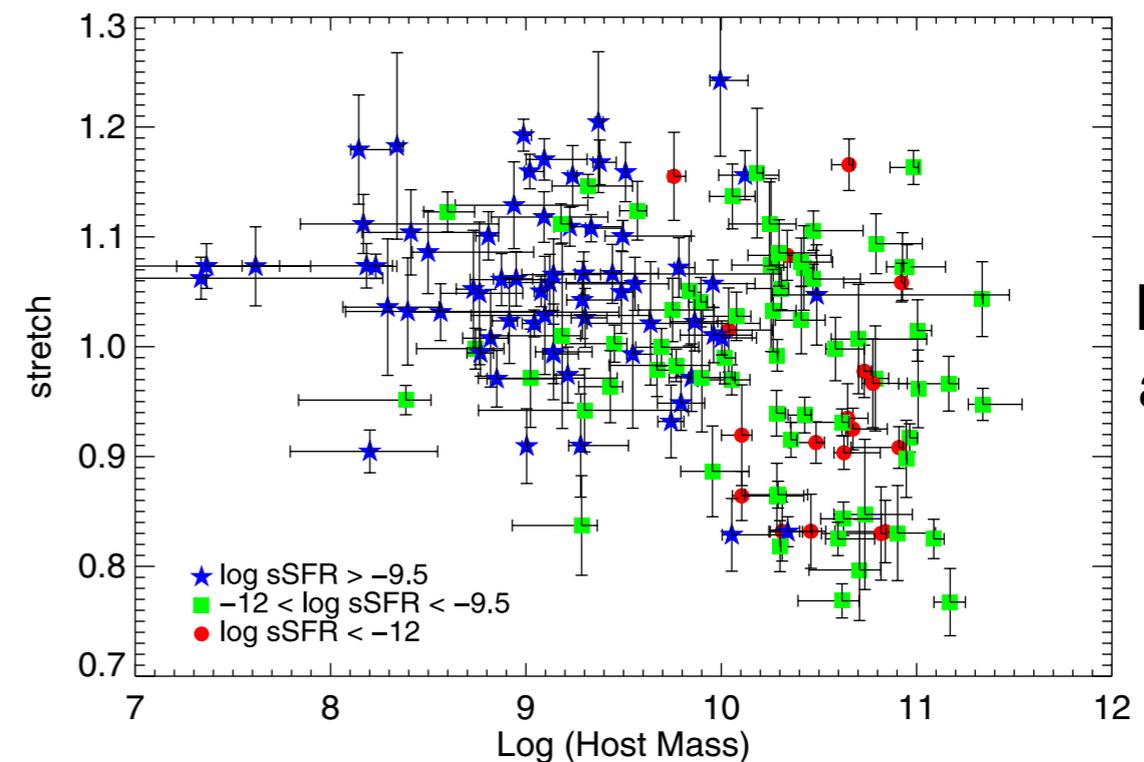
DARK ENERGY
SURVEY

▶ Spectroscopy of SN candidate host galaxies

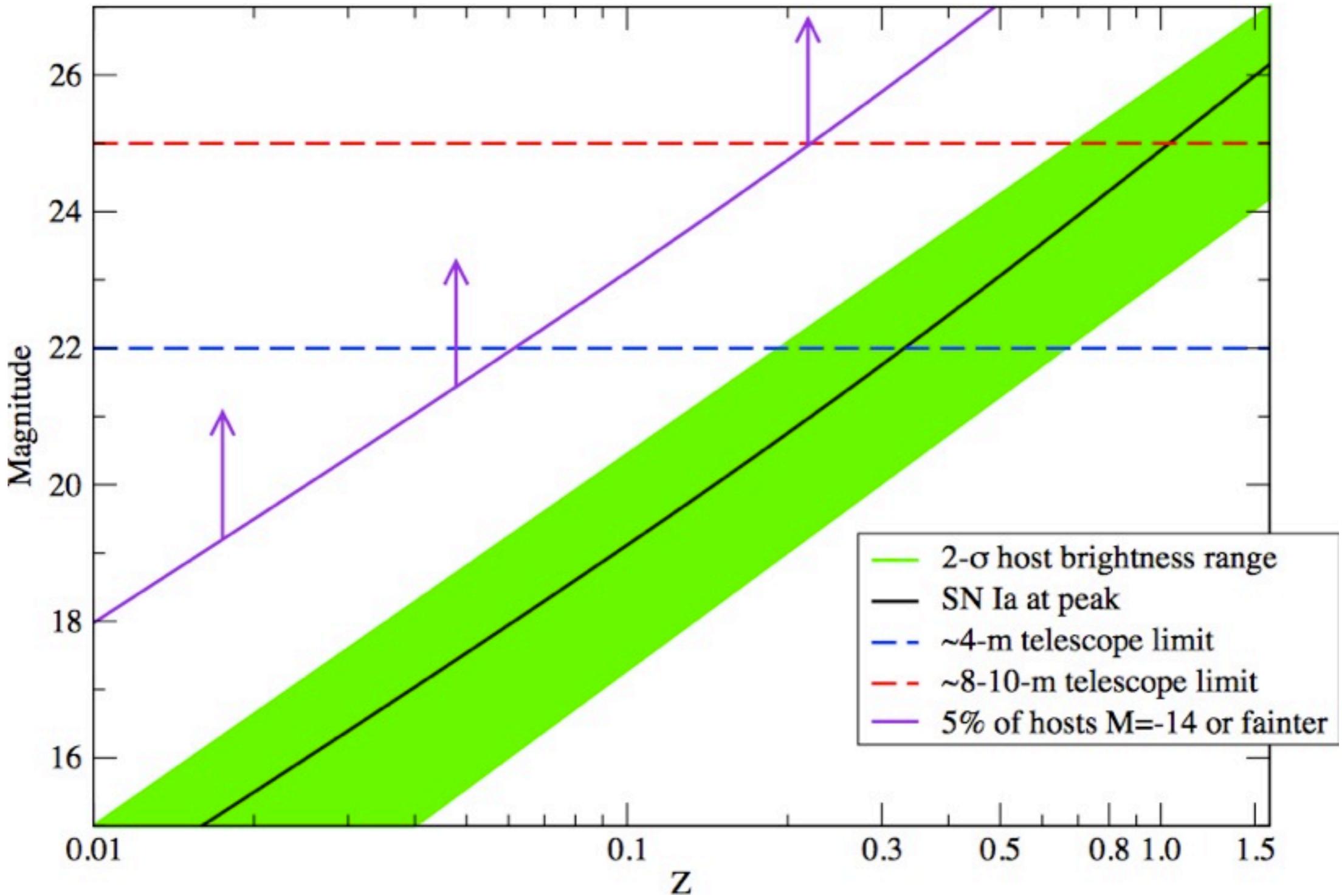
- ▶ 10000+ targets from DES SN
 - ▶ DES main survey - will the light curves be useful?
- ▶ host redshifts, SFR, gas-phase metallicity (S/N~10).
- ▶ stellar population age, metallicities (S/N~50).
- ▶ reduce Hubble scatter.
- ▶ 5 - 10% contamination from non-Ia.
- ▶ cannot identify spectroscopically peculiar types.



Gallagher
et al.
(2005)

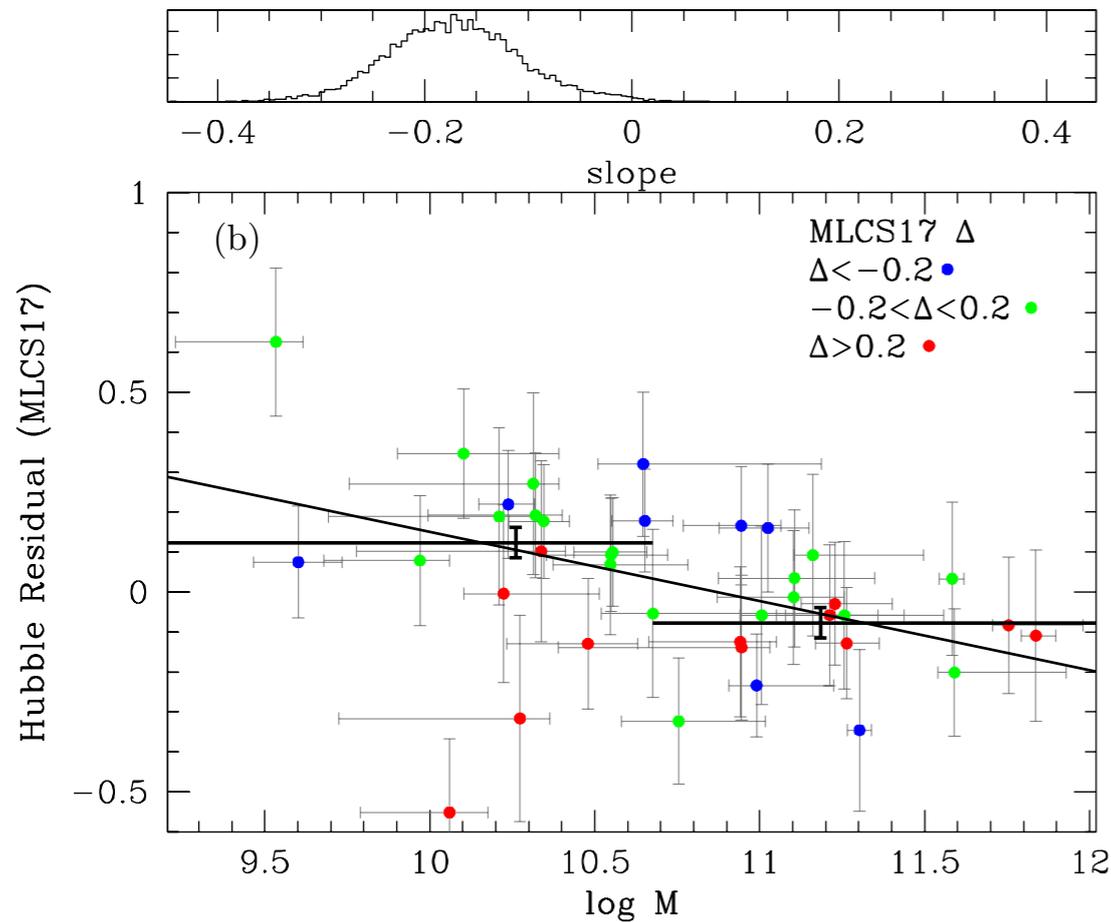


Howell et
al. (2009)



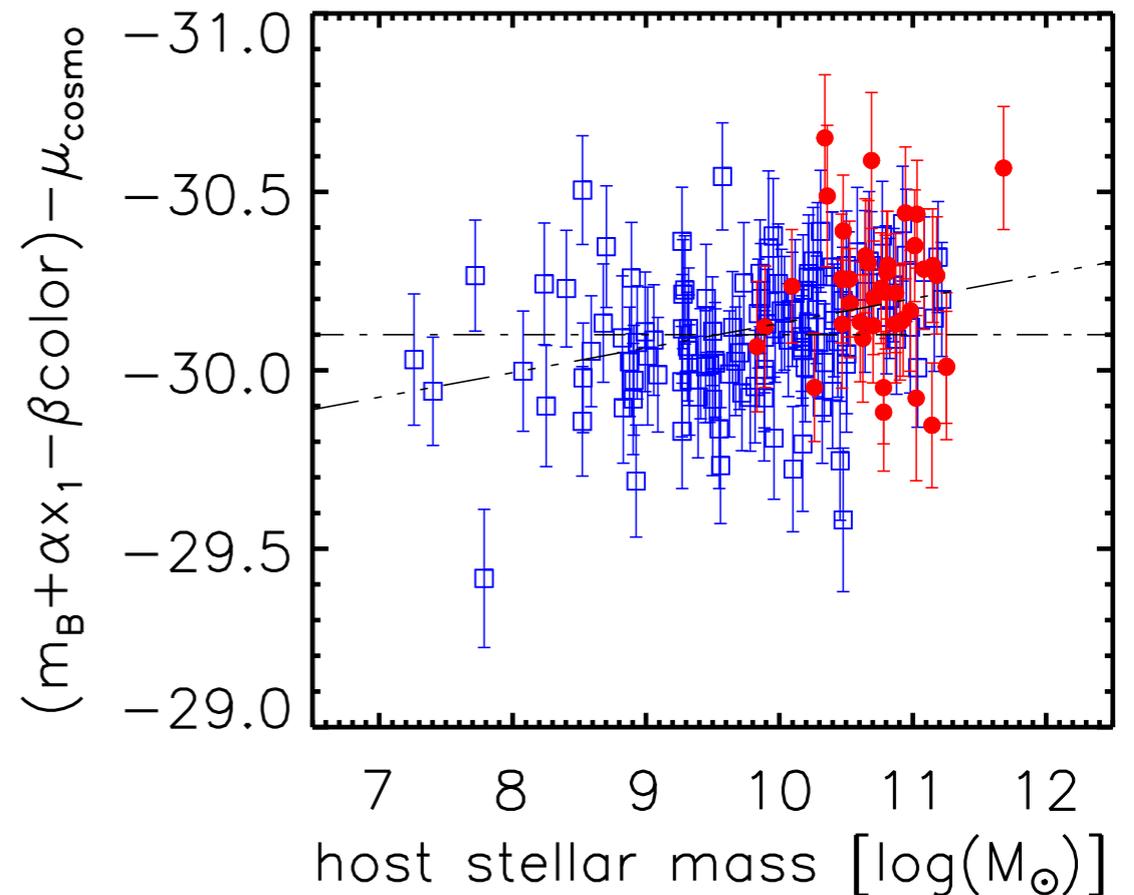
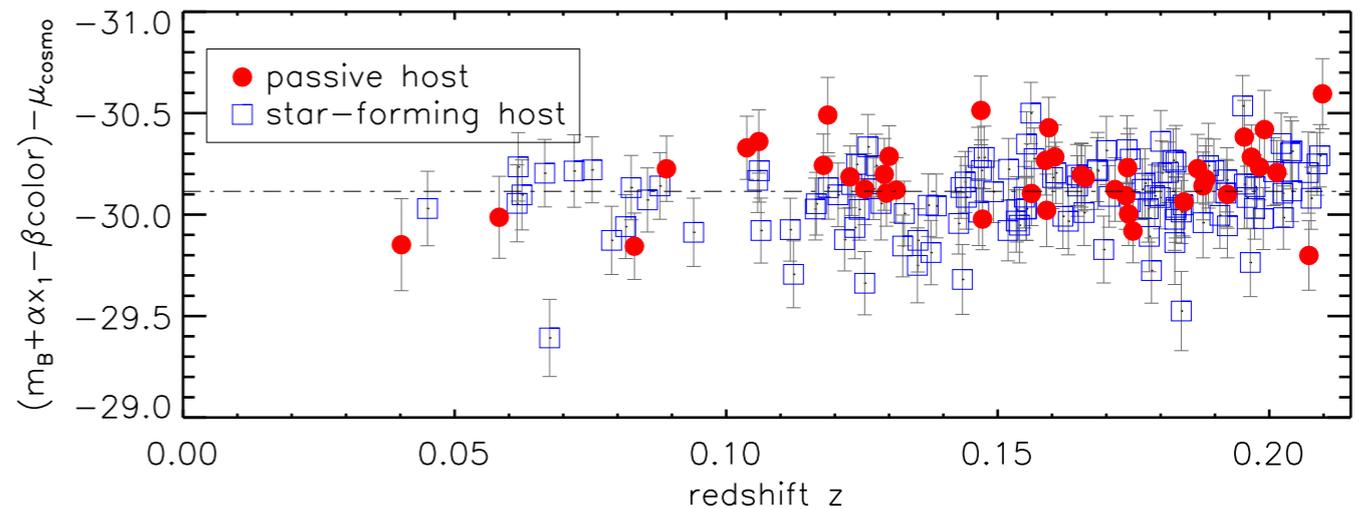
SN Ia Host Galaxy Brightness

Low-z SN Ia (Kelly et al. 2010)



also seen in SNLS & low-z
(Sullivan et al. 2010)

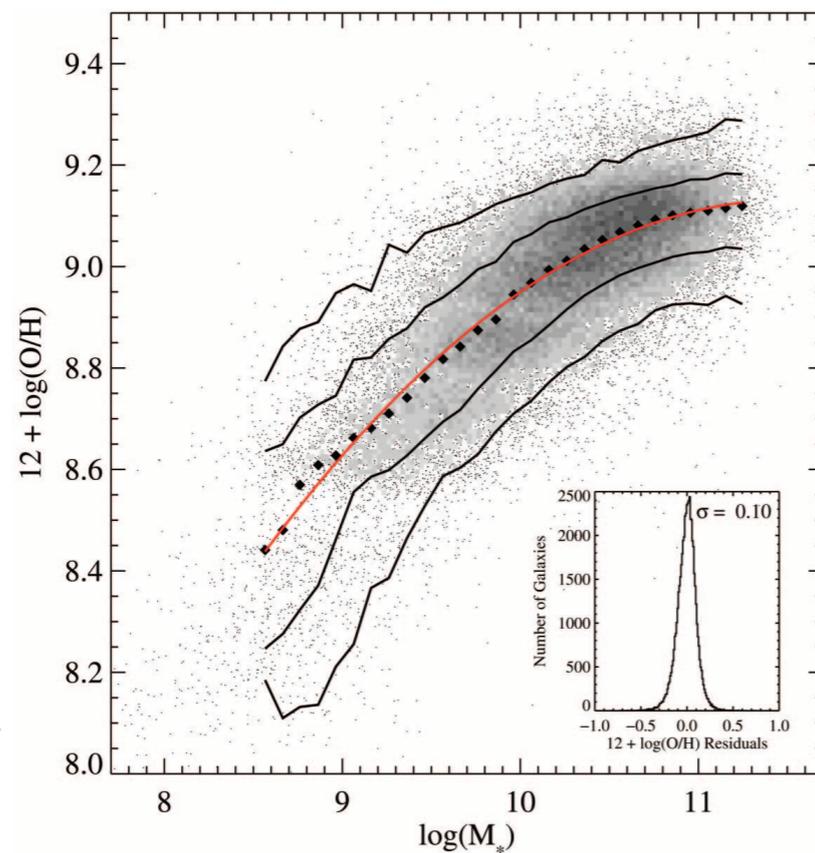
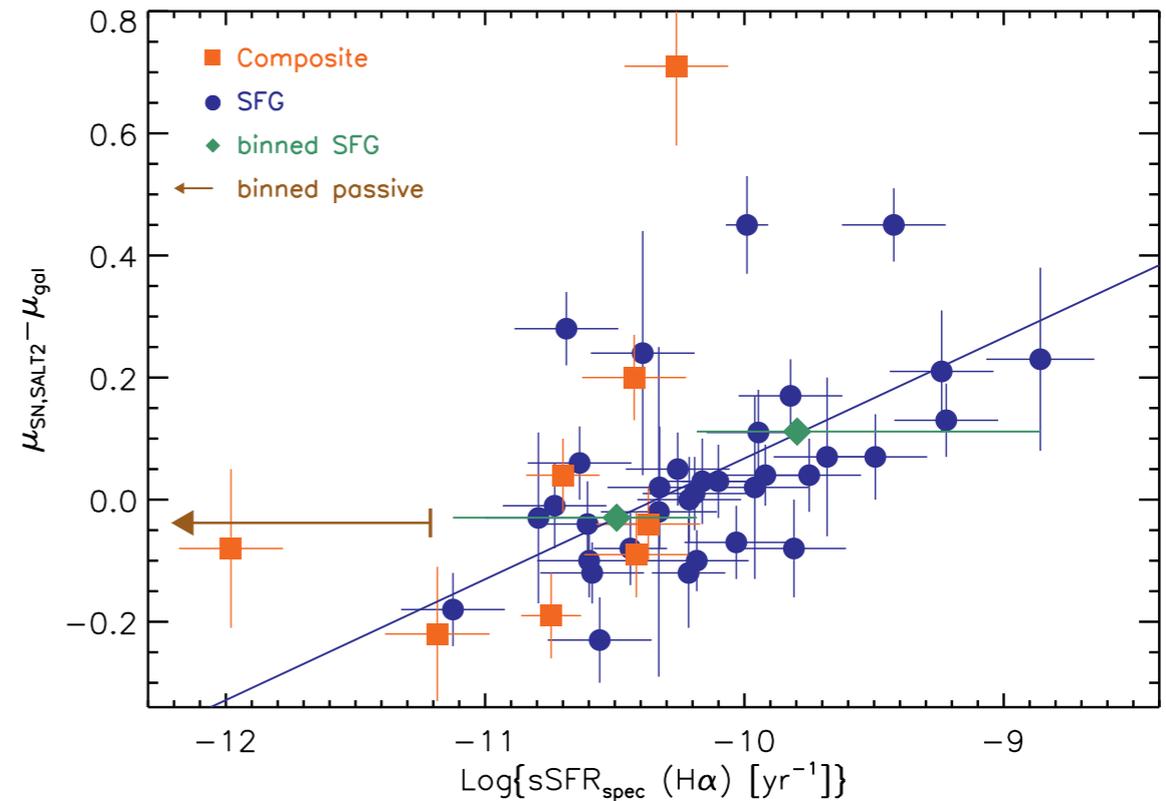
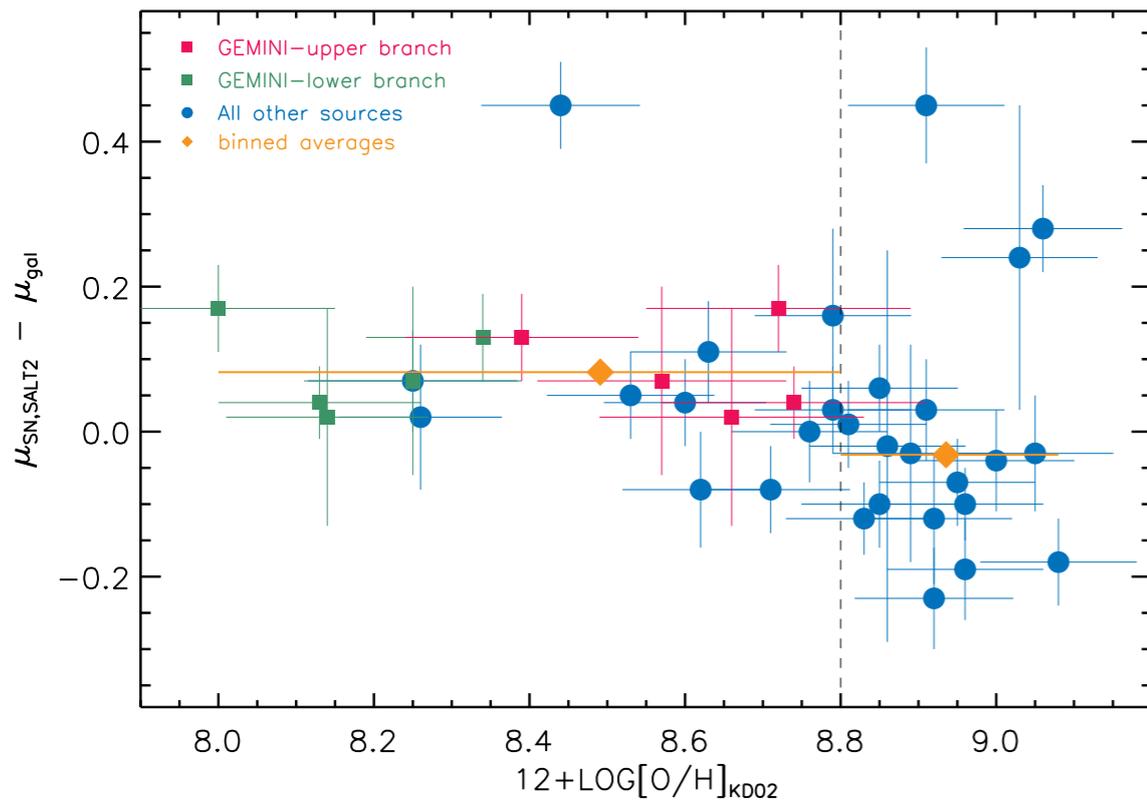
SDSS-II SN Ia (Lampeitl et al. 2010)



SN vs Host Properties

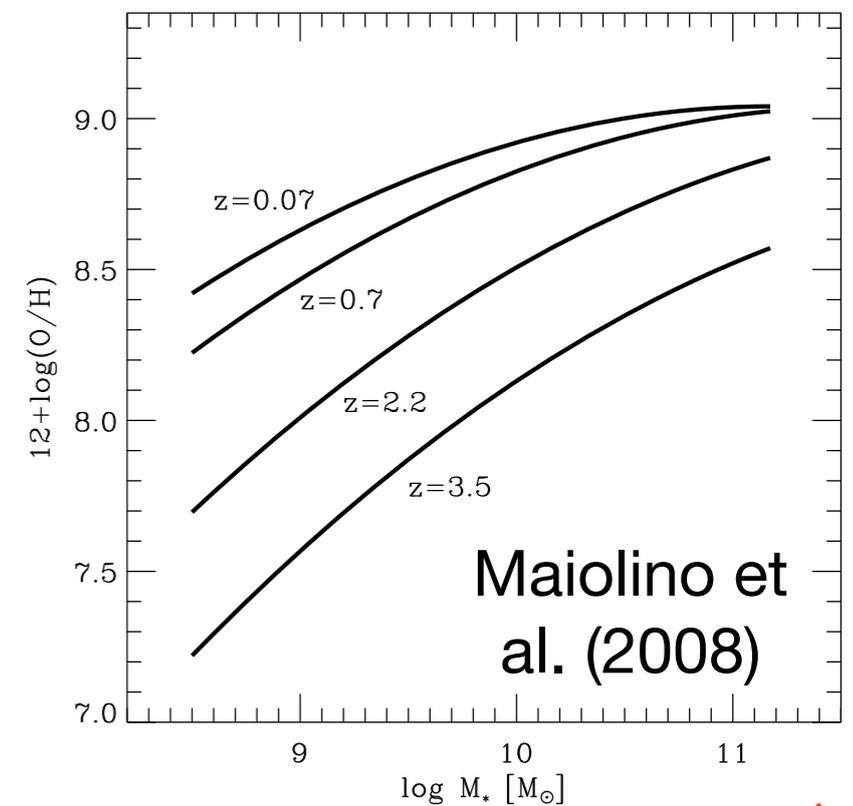


SDSS-II SN Survey $z < 0.15$ (D'Andrea et al. 2011)



SDSS galaxies $z \sim 0.1$
(Tremonti et al. 2005)

Galaxy mass evolves
with redshift. mass-
metallicity relation
also evolves with
redshift...



Maiolino et al. (2008)

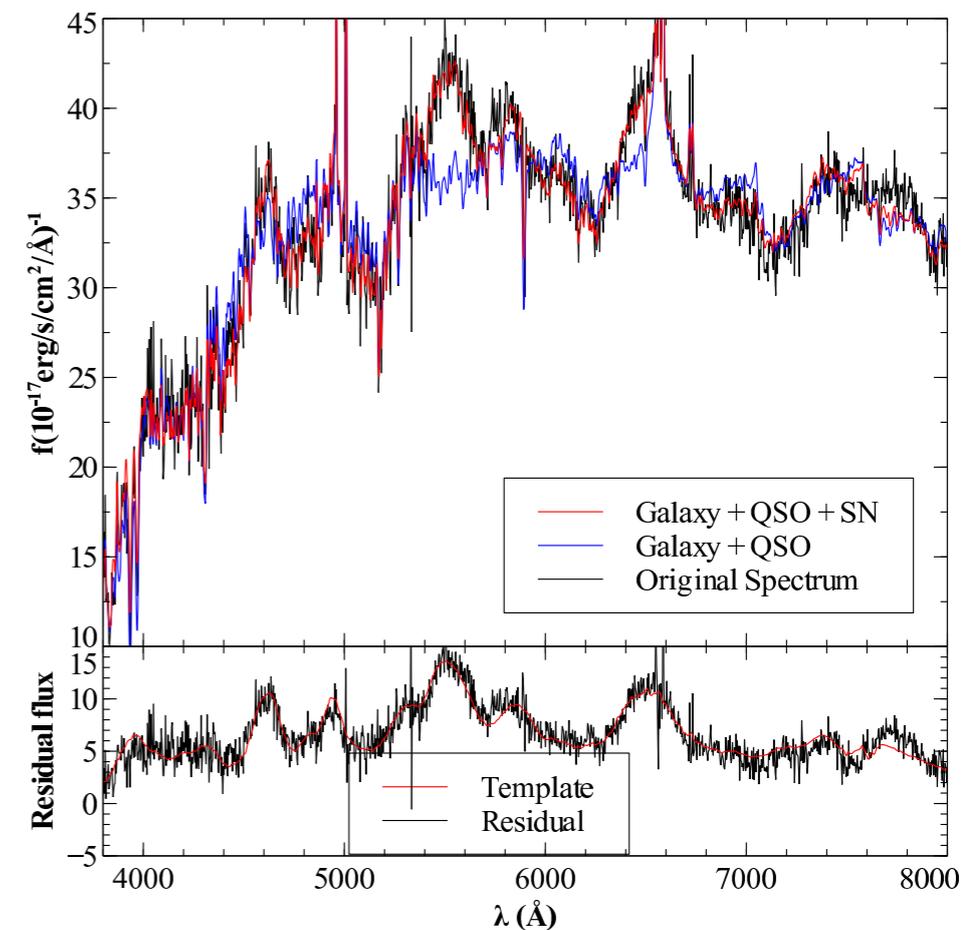




Possible Ancillary Program

▶ Spectroscopy of active SN

- ▶ serendipitous - e.g., Krughoff et al. (2010) found 52 SN Ia in ~350,000 SDSS galaxy spectra (1/6000).
- ▶ ~1500 SN Ia near peak in 10M galaxy spectra (more due to larger fiber fraction).
- ▶ target - need imaging survey (e.g., DES+, LSST).
- ▶ ~30+ SN Ia candidates near peak in every 3 deg².



Summary

- ▶ DESpec can:
 - ▶ measure SN host galaxy spectra of 30%+ of DES SN.
 - ▶ provide redshifts, star-formation rates, gas-phase metallicities and possibly age and metallicities of stellar population.
 - ▶ majority of SN galaxies too faint for 4m spectroscopy
 - ▶ (look at numbers in Main Survey)
- ▶ perform follow-up spectroscopy of ongoing SN surveys (use ~1% of fibers).