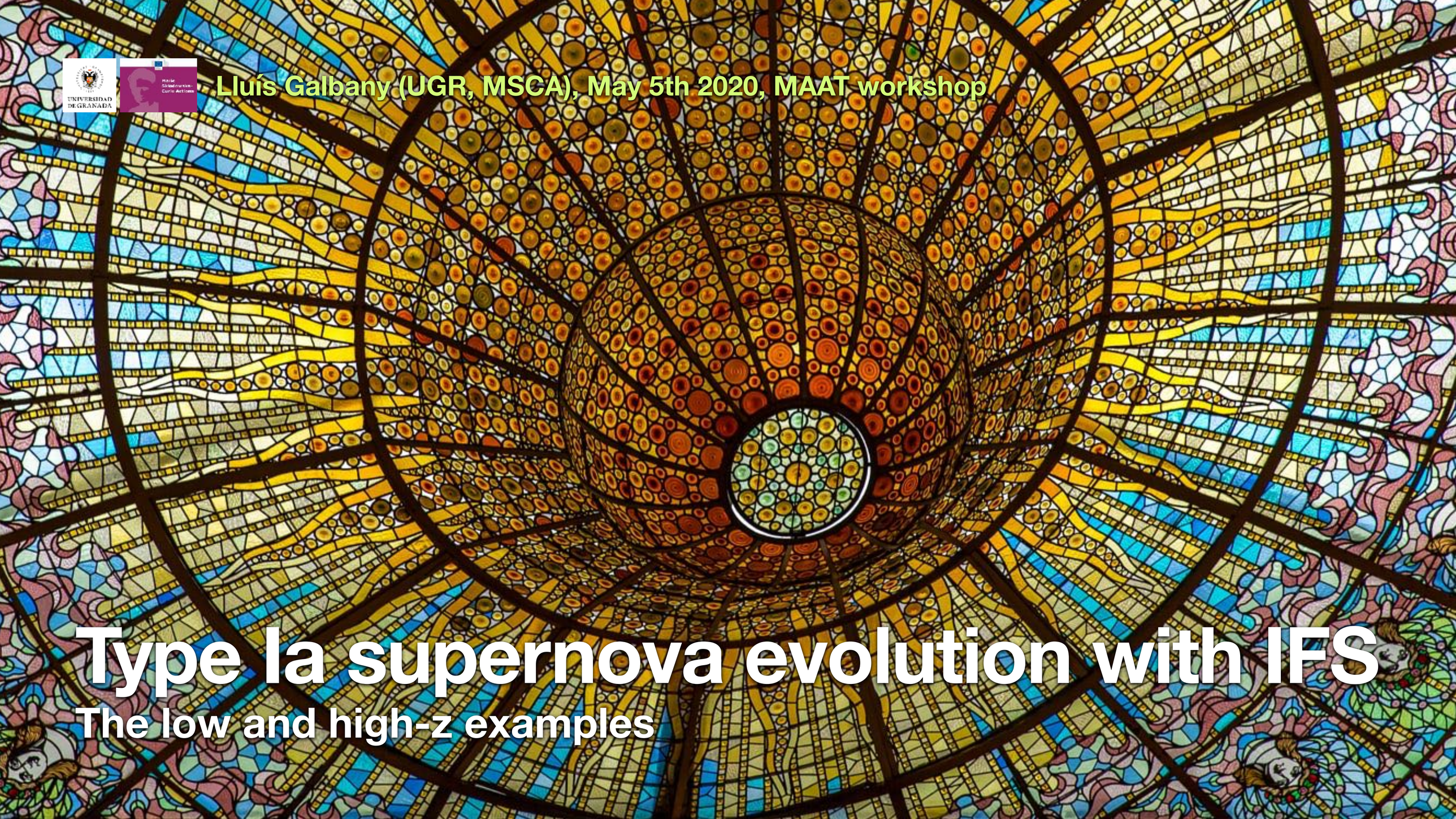
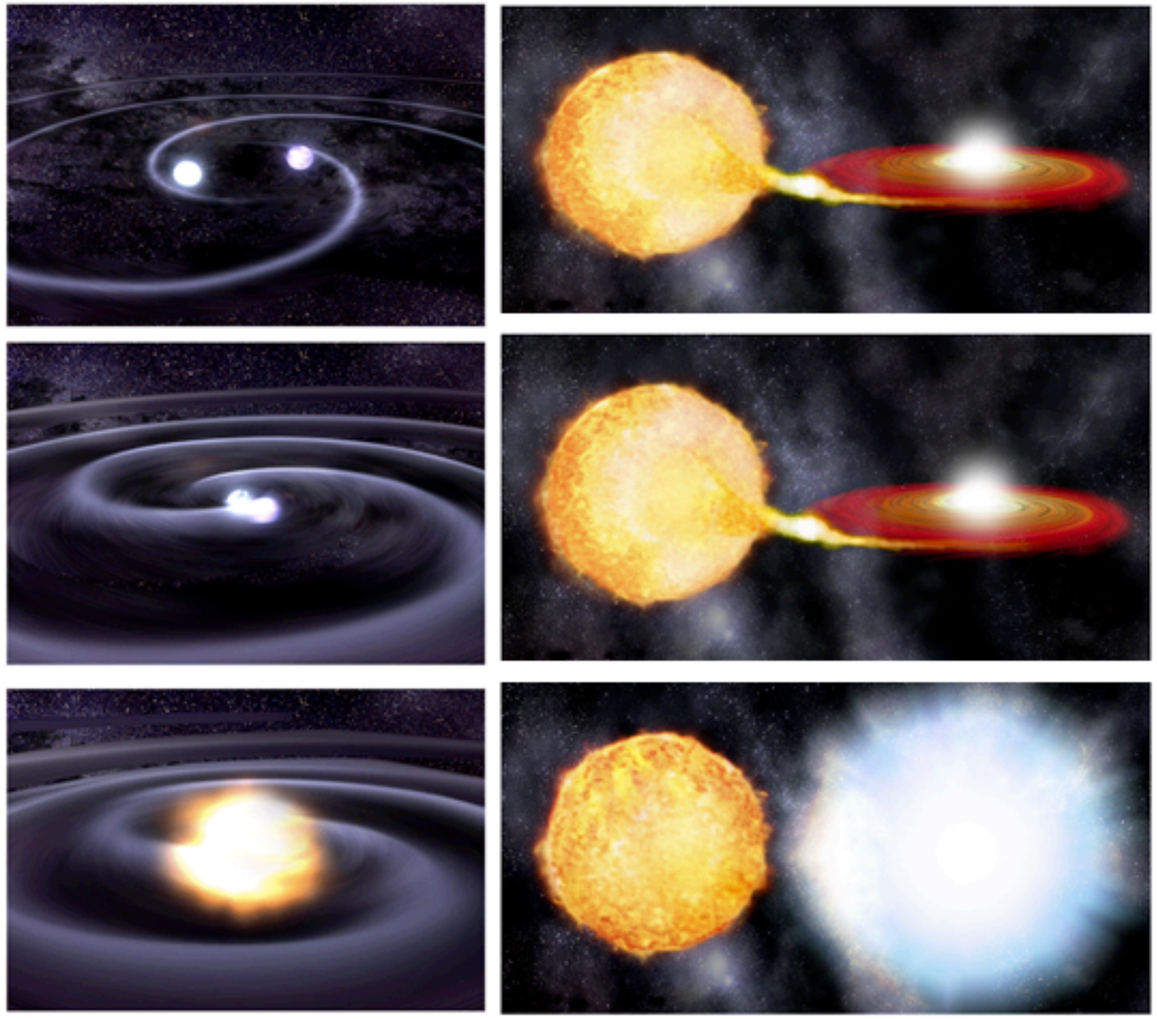


Lluís Galbany (UGR, MSCA), May 5th 2020, MAAT workshop

Type Ia supernova evolution with IFS

The low and high-z examples

Type Ia supernovae



What is exploding?

CO white dwarf (WD) in a binary system
single/double degenerate

How is it exploding?

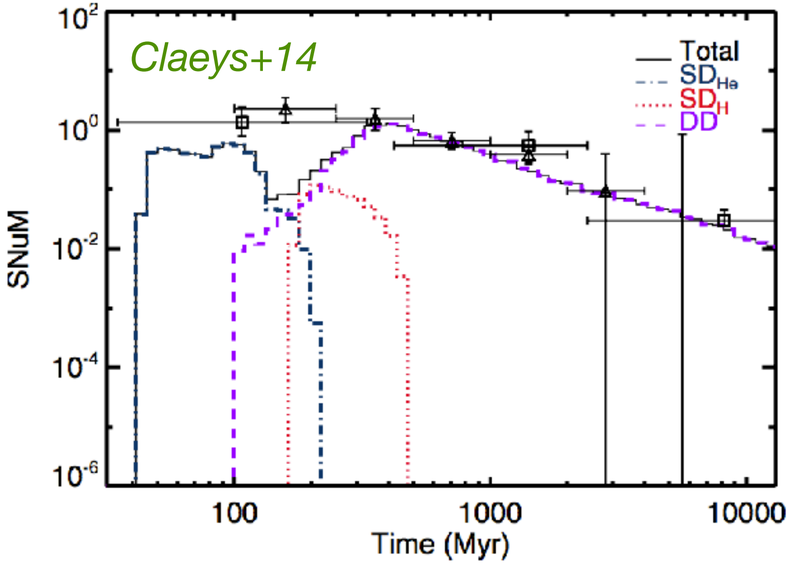
Merging/compression/He layer burn/collision
Detonation/deflagration/double-detonation
Chandrasekhar/sub-Chandrasekhar mass

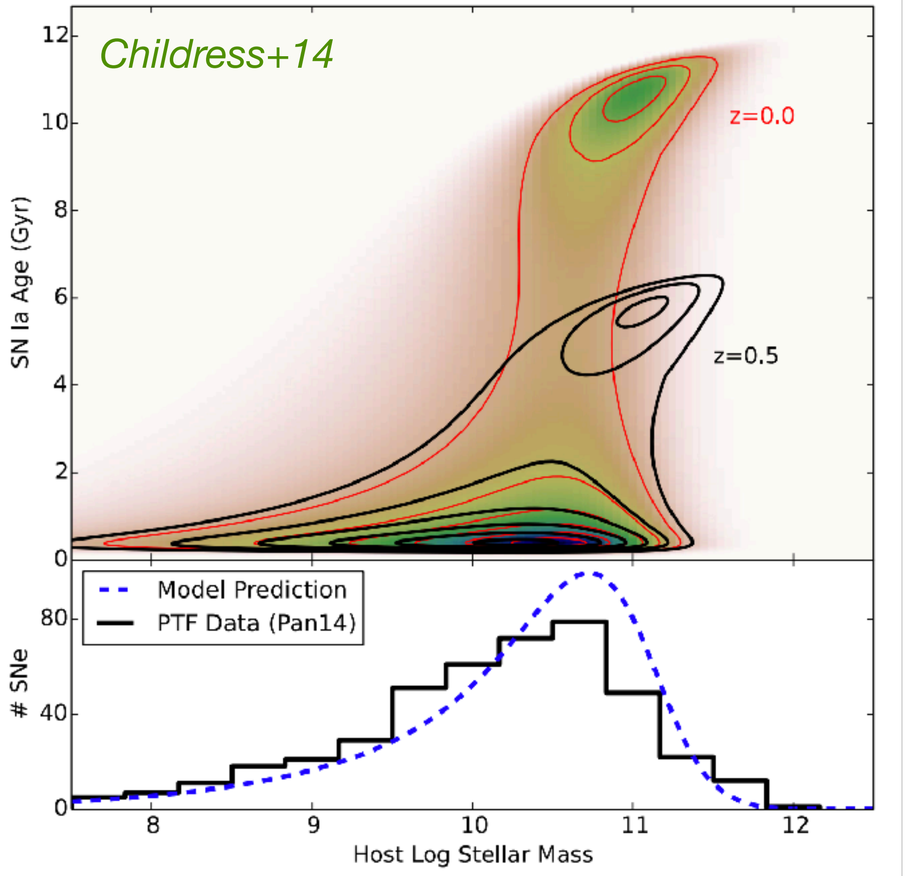
Most probably a mixture of scenarios and explosion mechanisms

Evidence for two populations?

SNIa rates and delay time distribution (DTD) models are consistent with two populations: prompt/delayed.

Continuous, though.





This is consistent with a young (~1 Gyr) and an old distinct SNIa populations.

Their ratio would evolve with redshift

SNIa cosmology

SNIa are the most precise extragalactic distance indicators (uncert. 5%)

Two empirical correlations:

peak brightness vs brightness decay

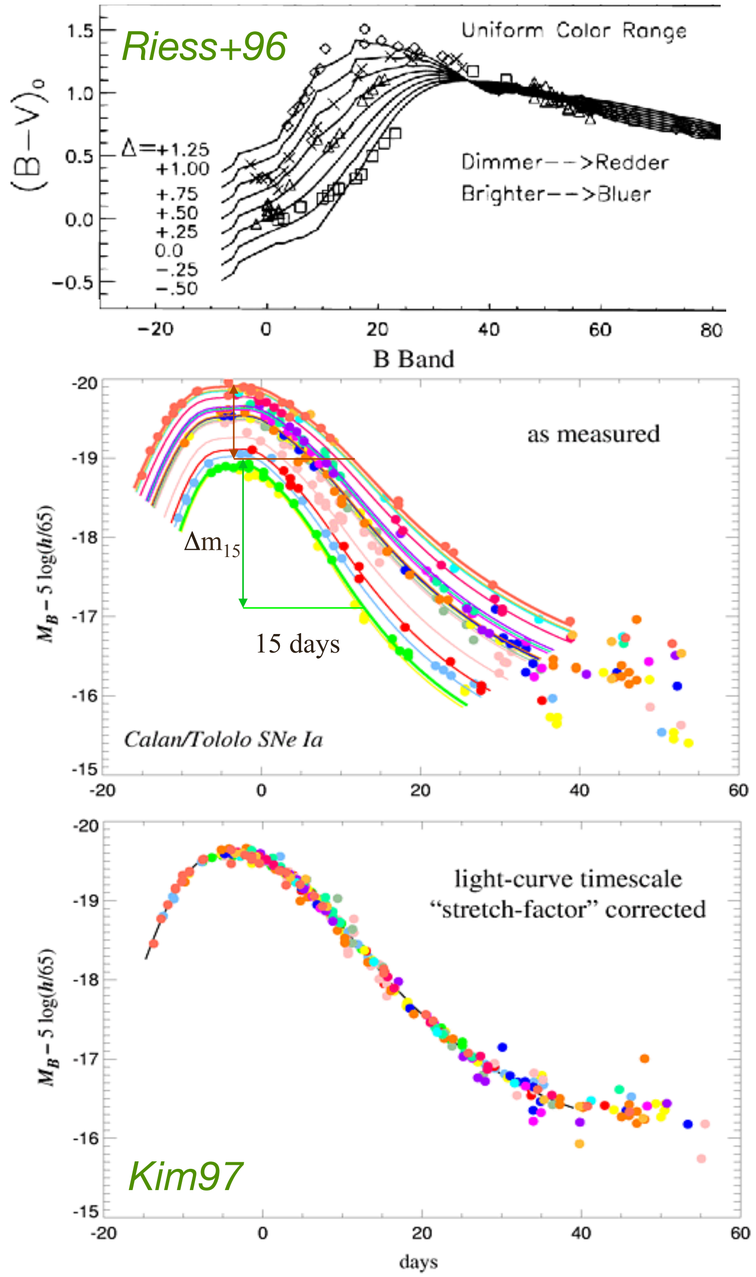
peak brightness vs color

Standardized peak brightness

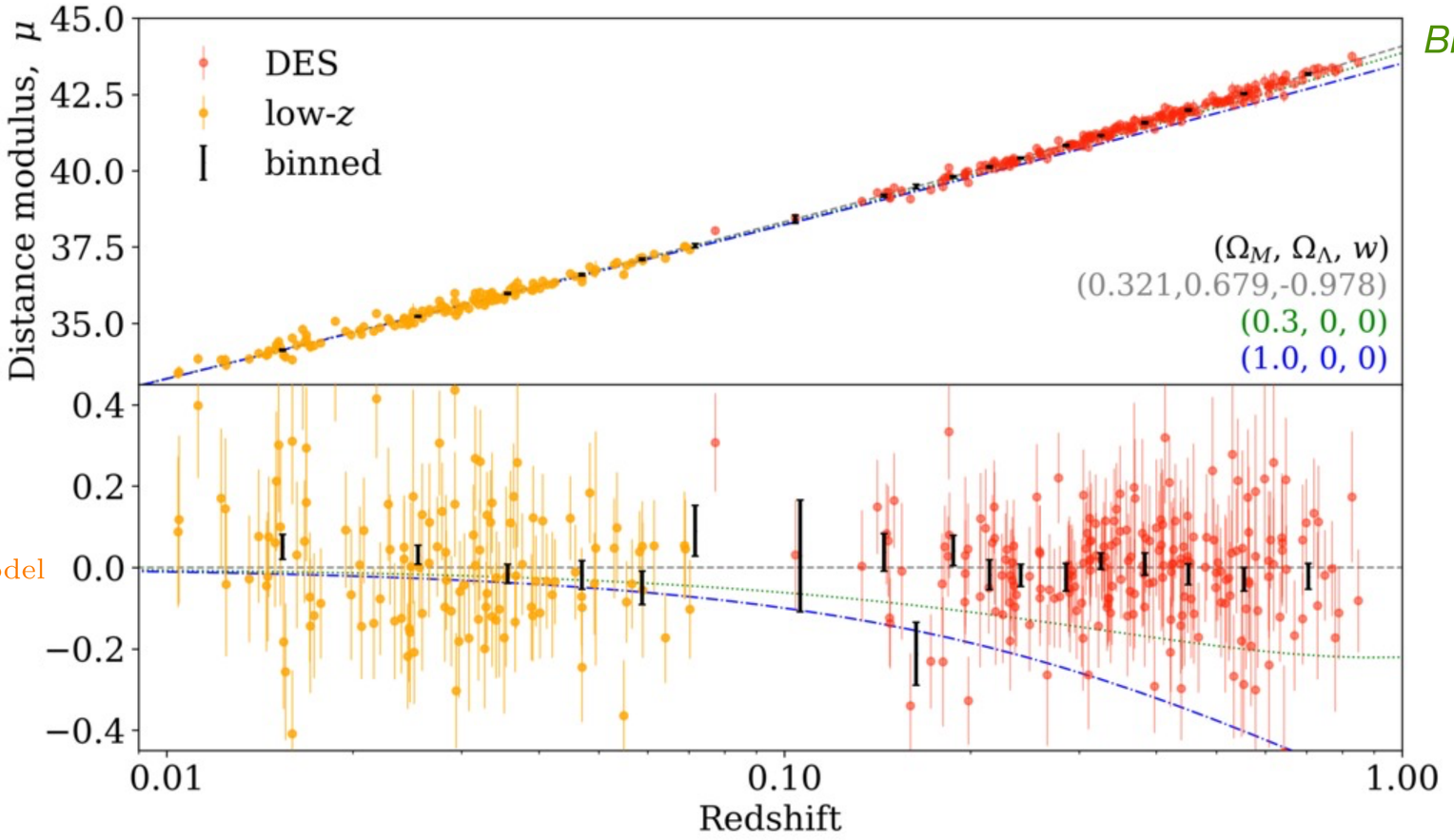
$$\mu(z)_{\rm SN} = m(z) - M = (m_{\rm obs} + \alpha x1 - \beta c - A_{\rm MW} + K_{x,y}) - M$$

$$\mu(z)_{\rm model} = 5\log_{10}(d_L/10pc)$$

$$d_L(z) = (1+z)\frac{c}{H_0}\int_0^z \frac{dz}{\sqrt{\Omega_M(1+z)^3 + \Omega_\Lambda(a+z)^{3(1+w)}}}$$



More SNIa cosmology



Brout+19

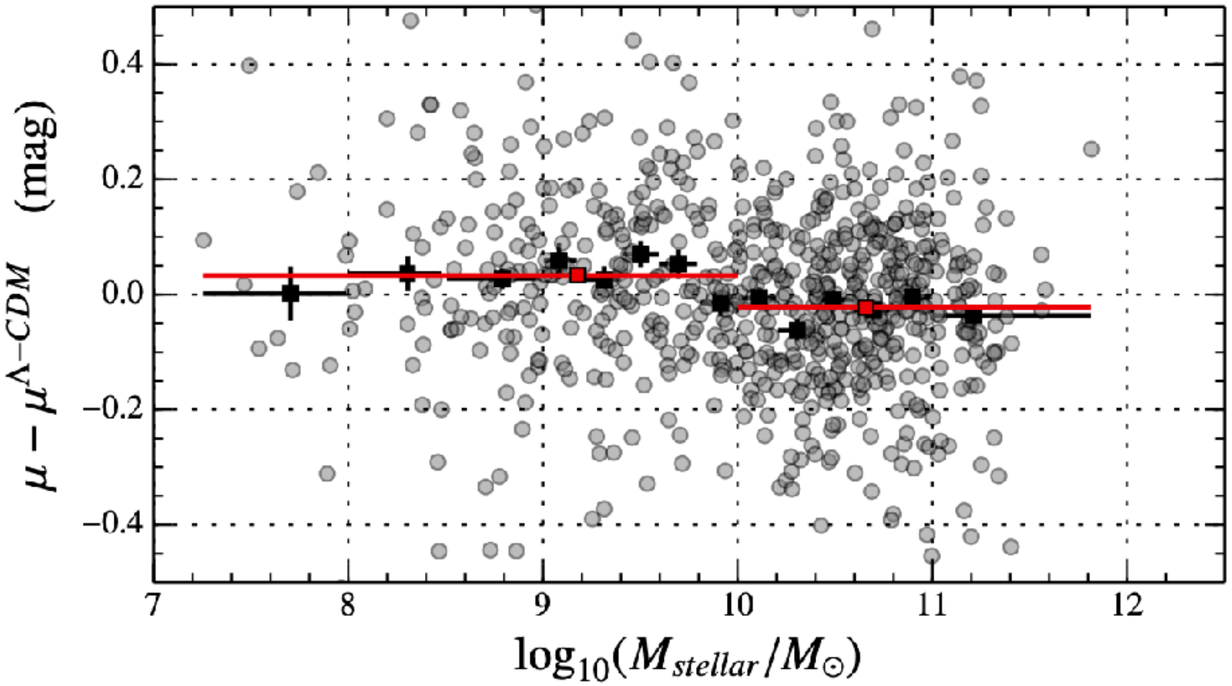
$HR = \mu(z)_{\rm SN} - \mu(z)_{\rm model}$

Recent (>2010) cosmological analysis found a dependence between the *Hubble residual and properties of the SN host galaxy**

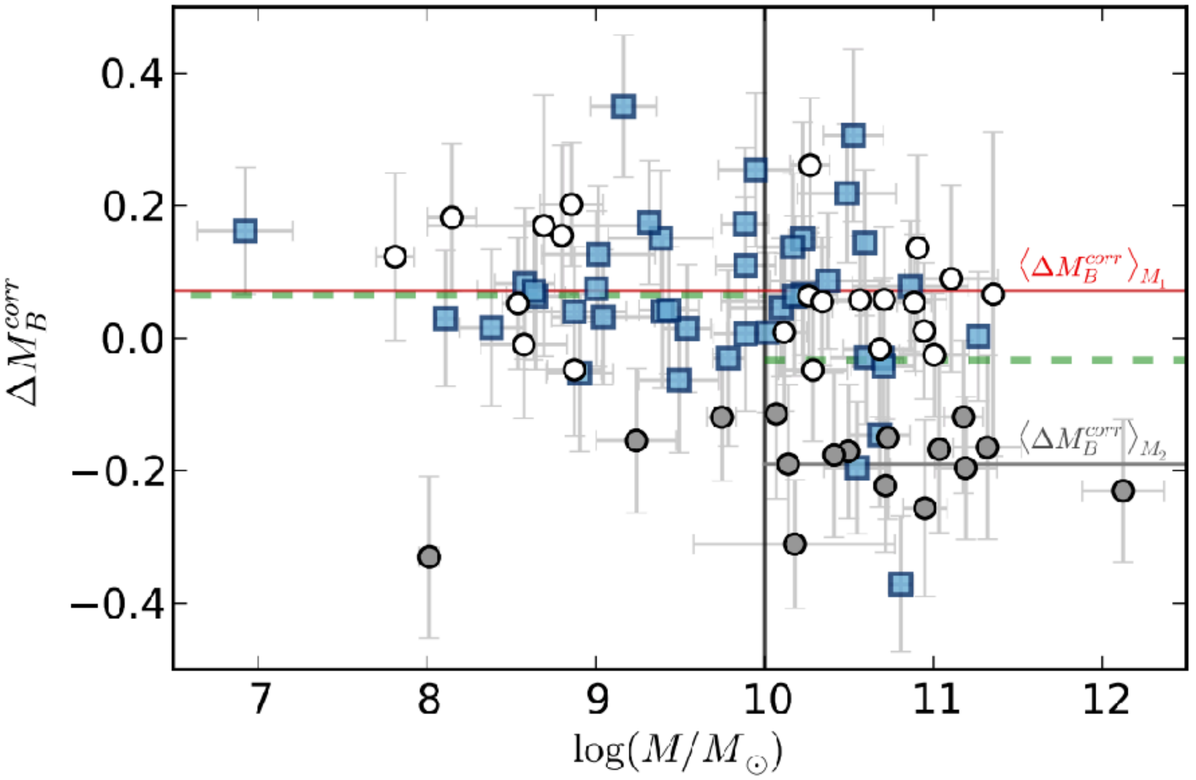
*deviation between the distance from the best cosmological model and the SN distance

SNIa environment

Sullivan+10



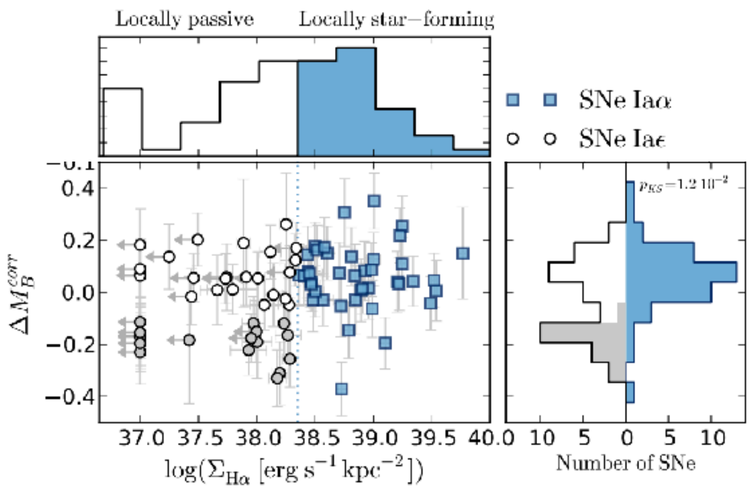
Rigualt+13



Again, all points to two different populations, one associated to young and other to old populations, that evolve with z!

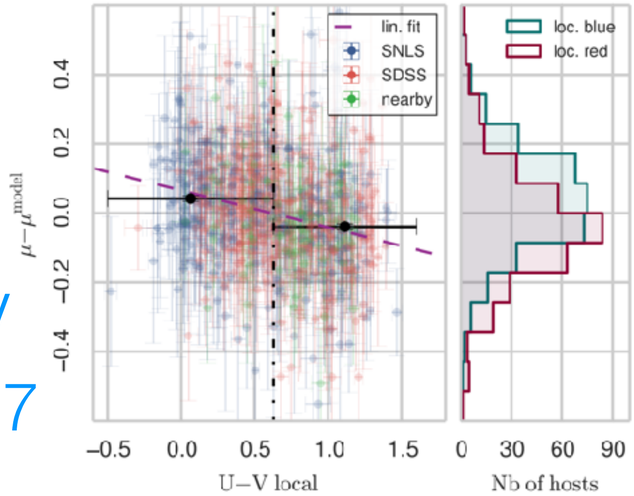
But mass should be just a proxy for another other parameter…

Local SNIa environment



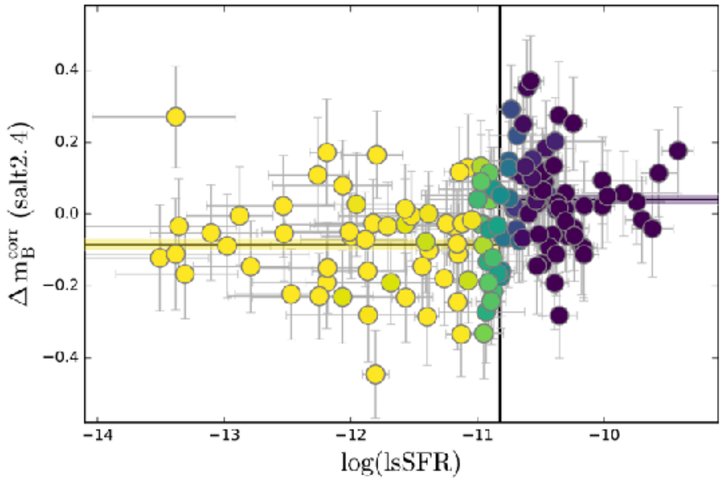
Rigault et al. 2013

SFR



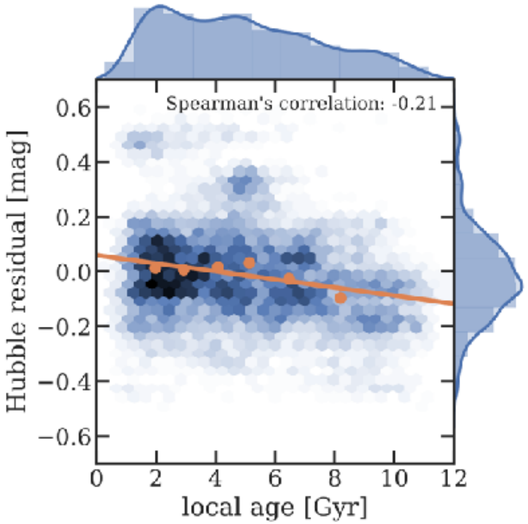
U-V

Roman et al. 2017



Rigault et al. 2018

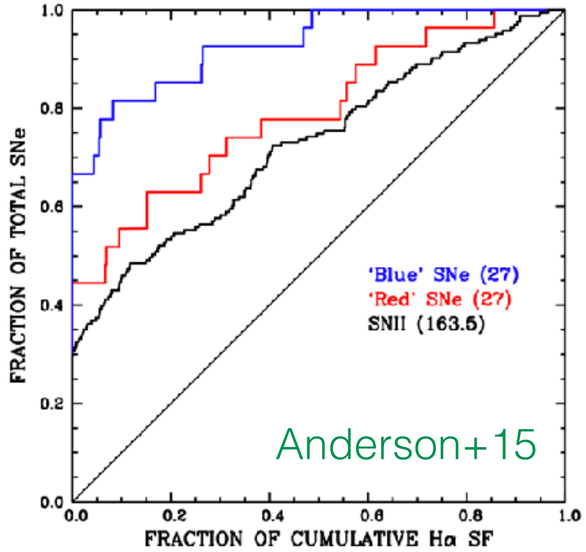
lsSFR



Age

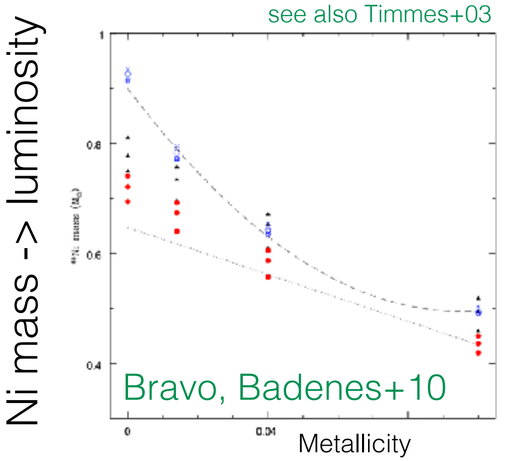
Rose et al 2019

(Non-cosmological) local SNIa environment

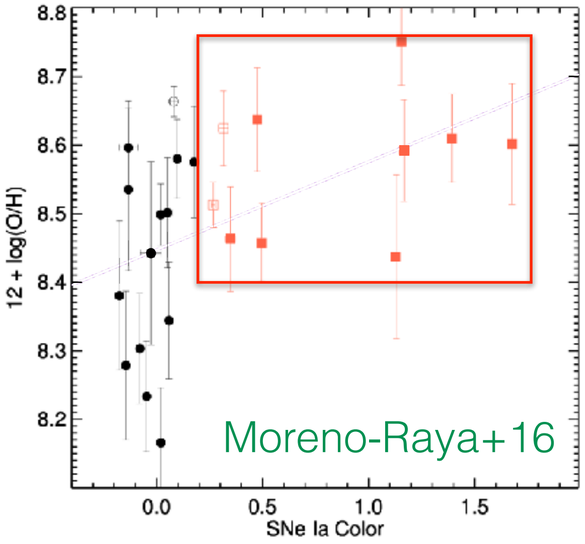


Redder SNIa more associated to HII regions And found more centrally within hosts

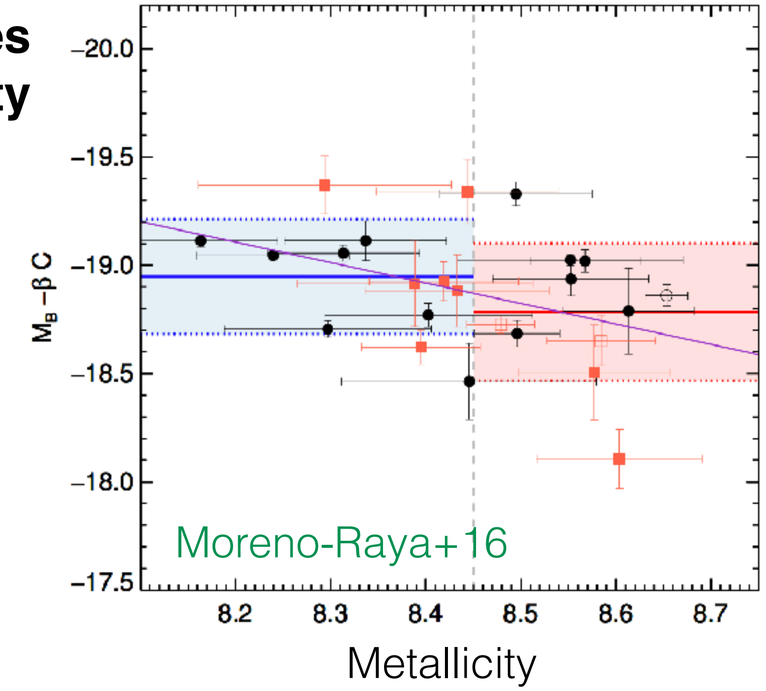
see also Timmes+03



Color corrected magnitudes depend on local metallicity

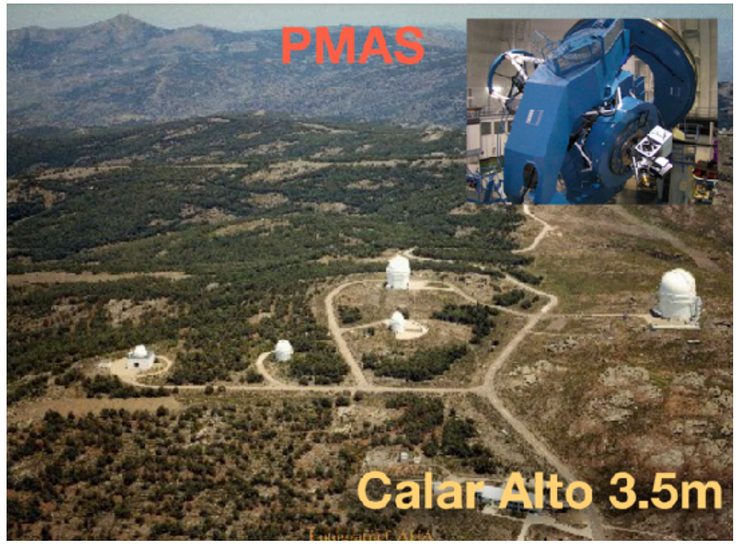


Red SNe in metal-rich environments



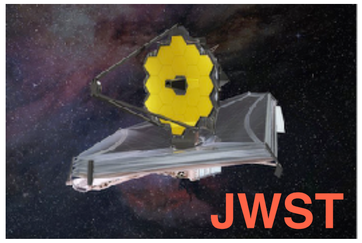
IFS SNIa local environment

In 2015, we started an effort to compile a large set of SN host galaxies observed with IFS to study local correlations

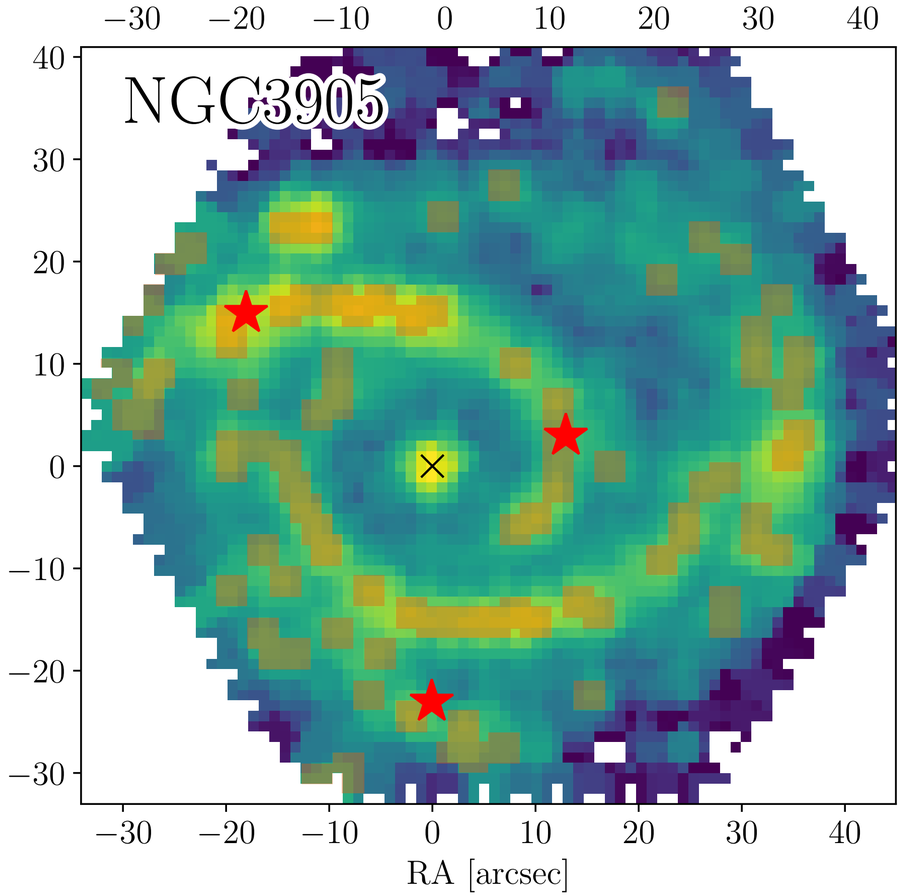


Completed for optical IFS at low z (z < 0.2)

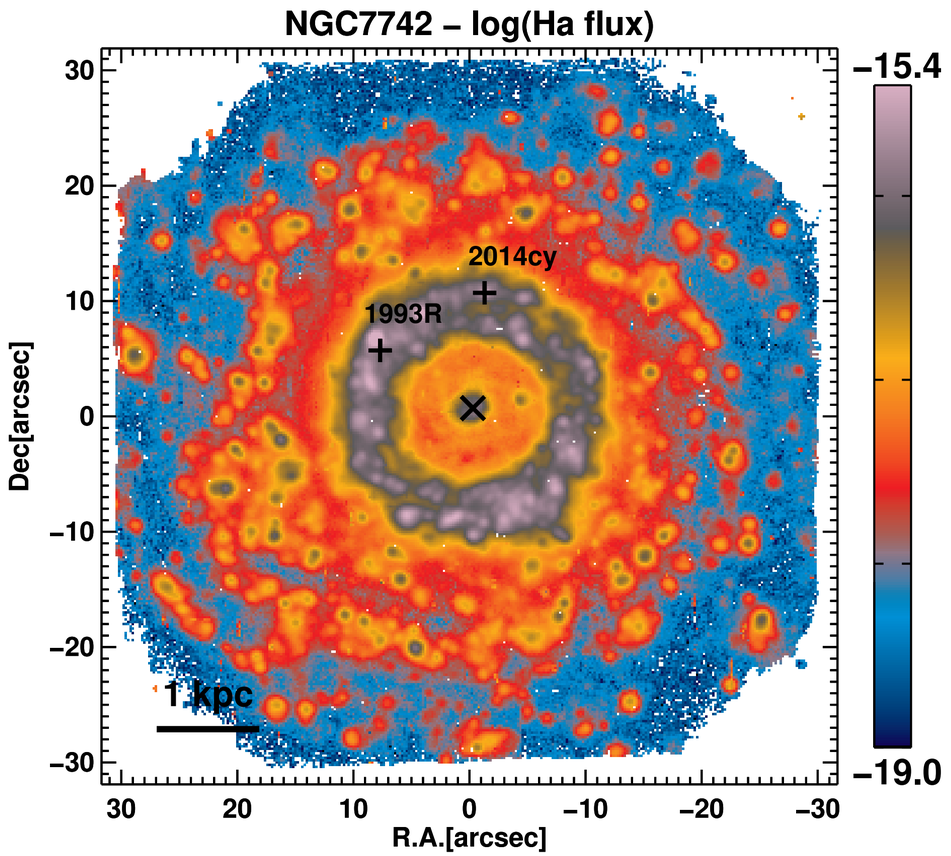
Ongoing for NIR IFS at high z (z > 0.5)



Low-z SNIa host galaxies

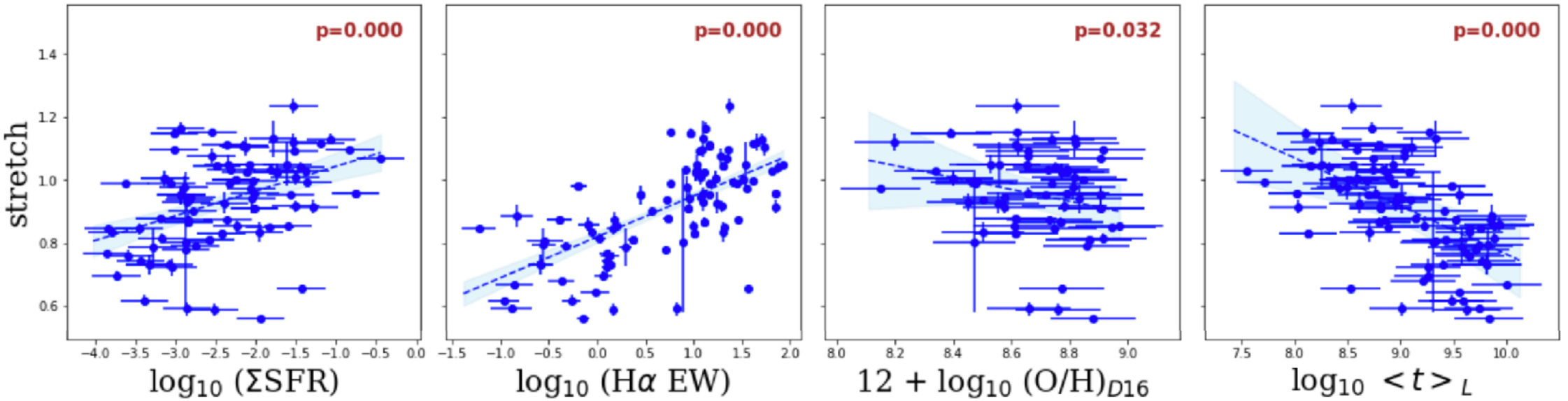


PISCO, *LG et al. 2018*



AMUSING, *LG et al. 2016*

IFS SNIa local environment

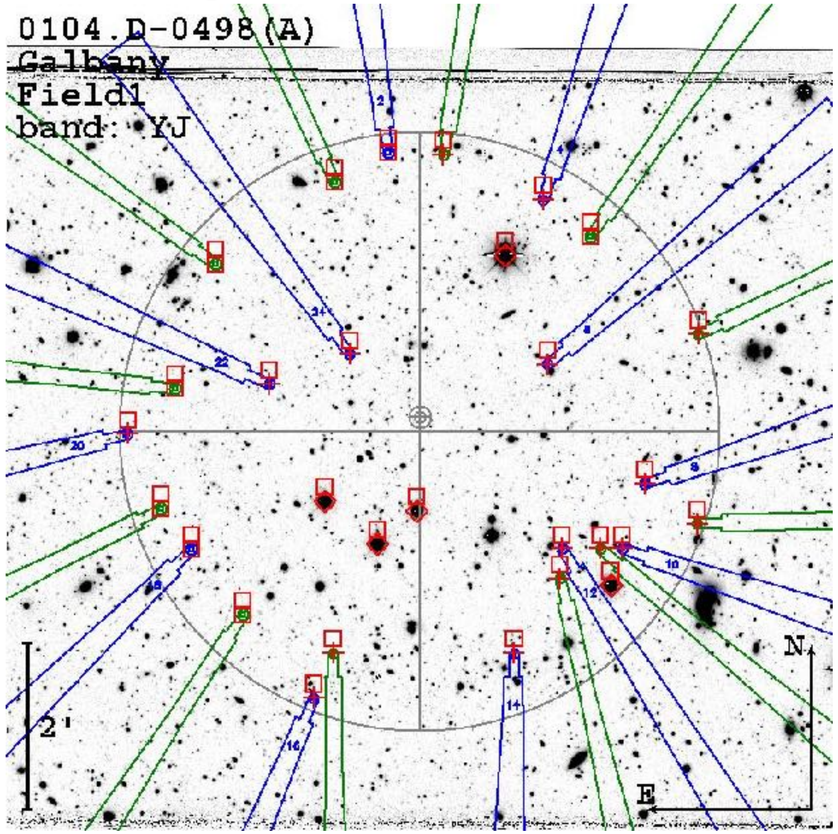


All PISCO (PMAS) SNIa

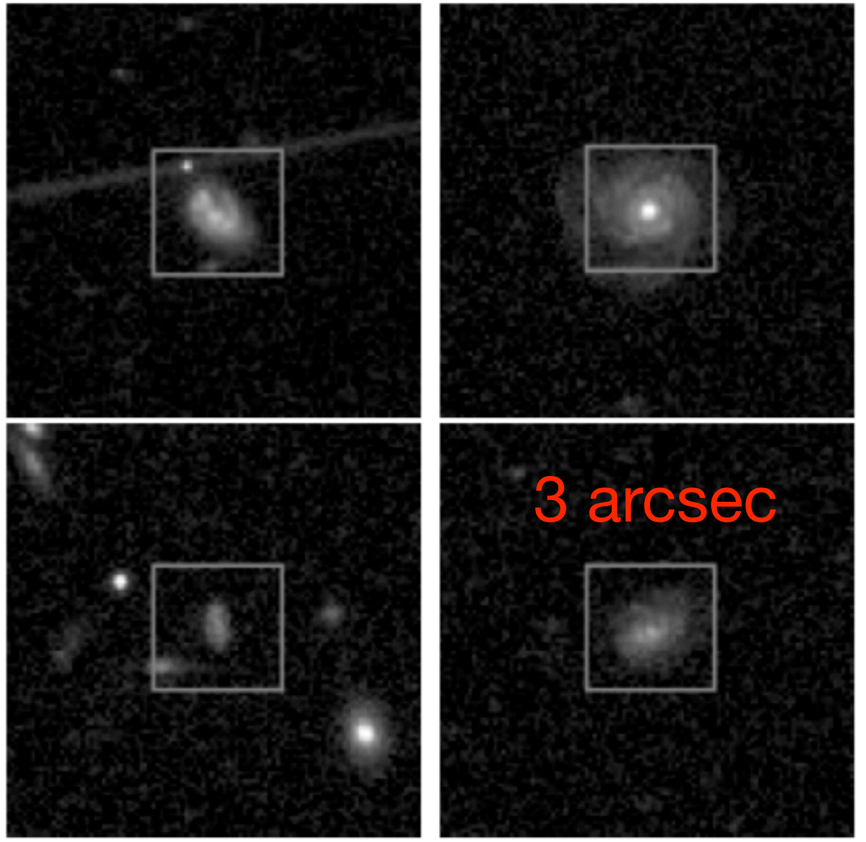
Ongoing analysis of all CSP I-II sample

High-z SNIa host galaxies

DES galaxies 0.5 < z< 1.0



SNLS galaxies 0.5 < z< 1.0



KMOS

JWST

IFS survey of SNIa host galaxies

Low z (z<0.2): Hα in the optical, galaxies resolved with small telescopes

High-z (>0.5): Hα in the NIR

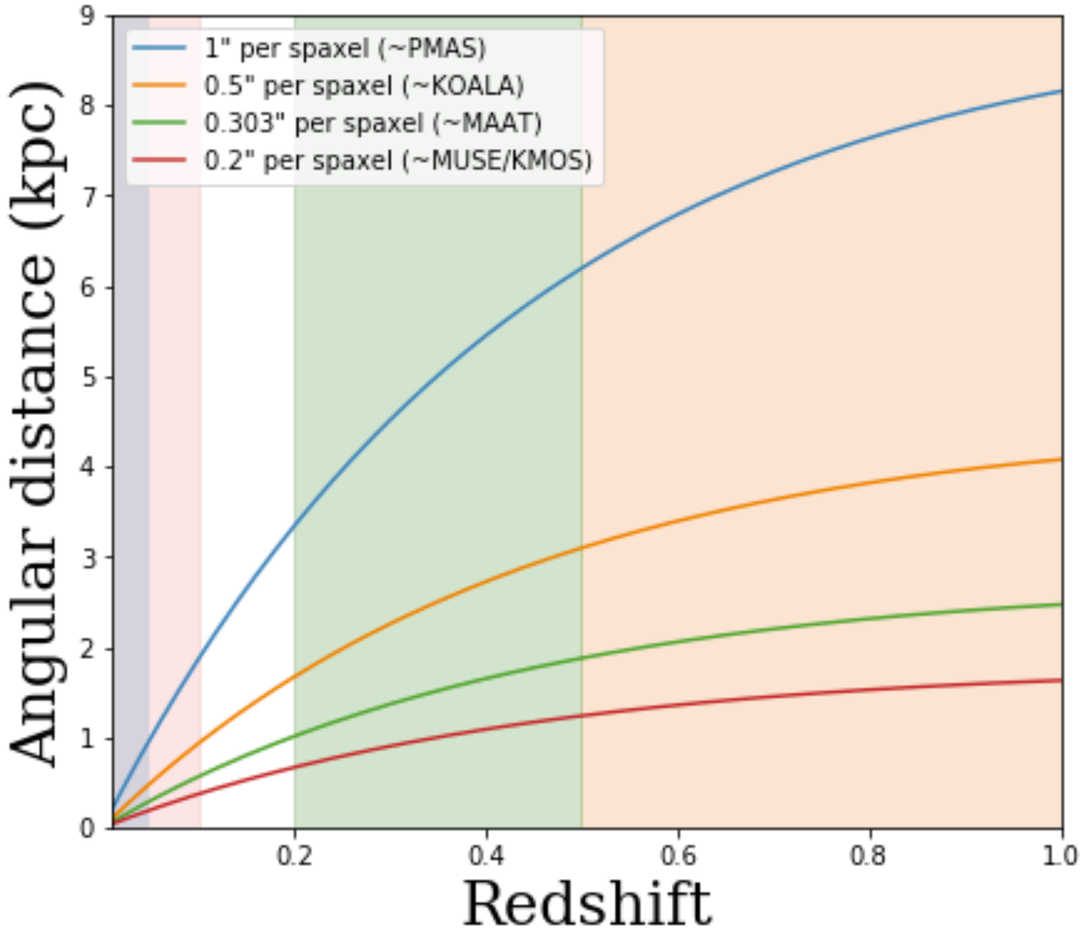
IFS survey of SNIa host galaxies

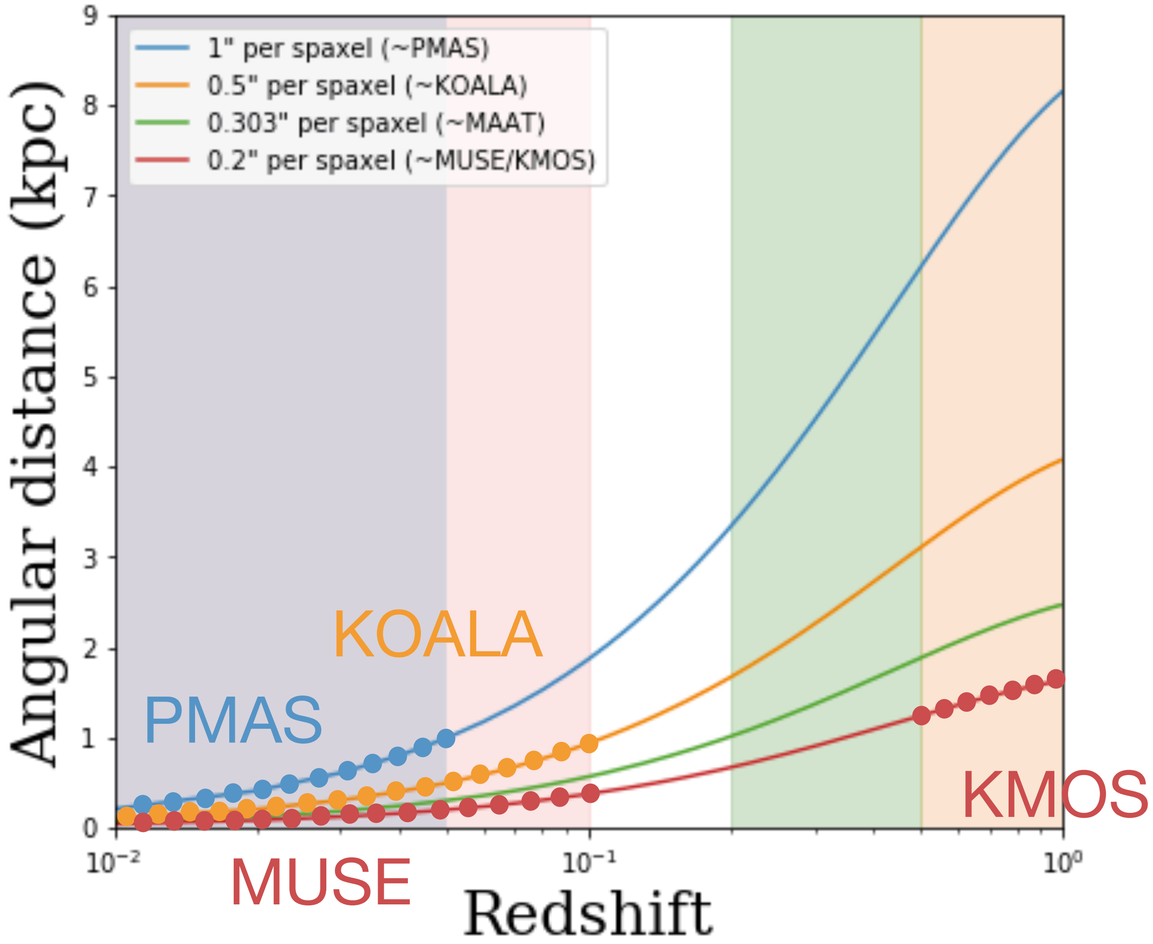
Low z (z<0.2): Hα in the optical, galaxies resolved with small telescopes

int-z (0.2<z<0.5): Hα in the optical (7800-9850A) at z~0.5. Need of large telescope to resolve structure of galaxies.

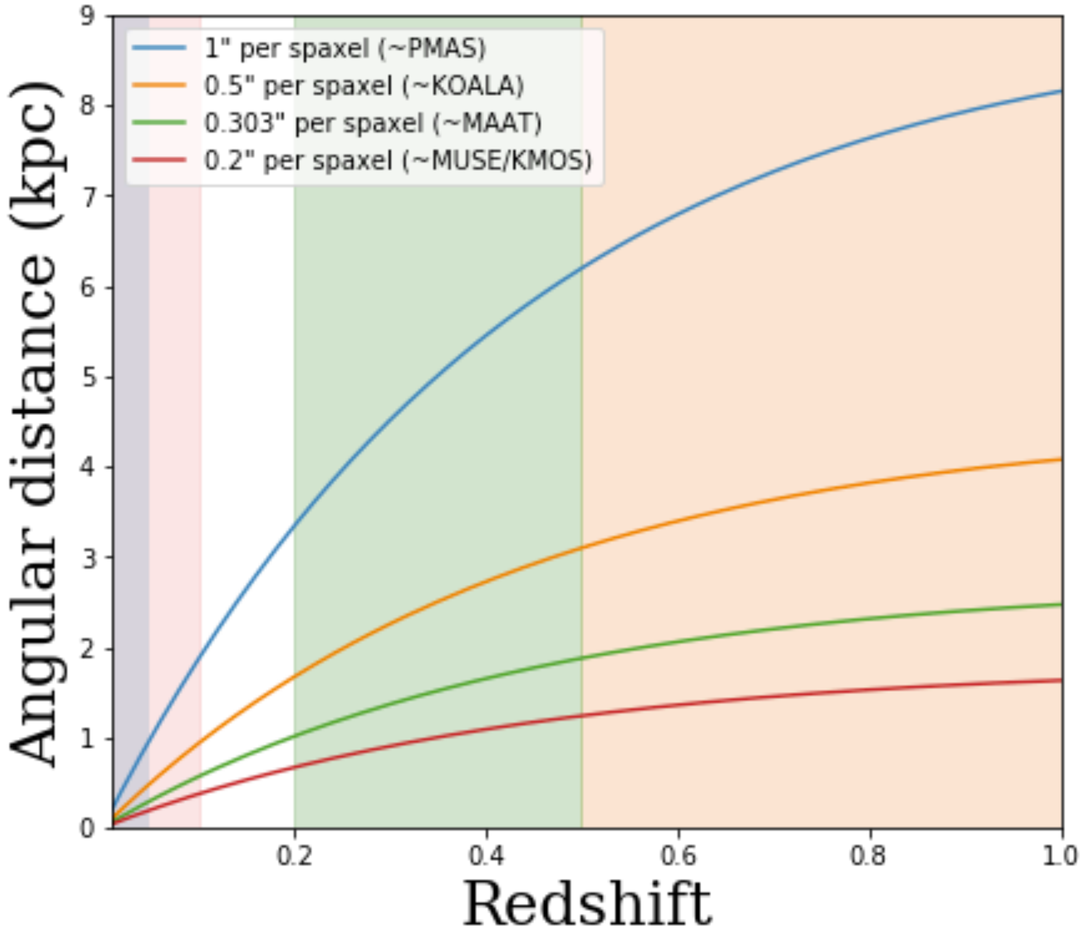
High-z (>0.5): Hα in the NIR

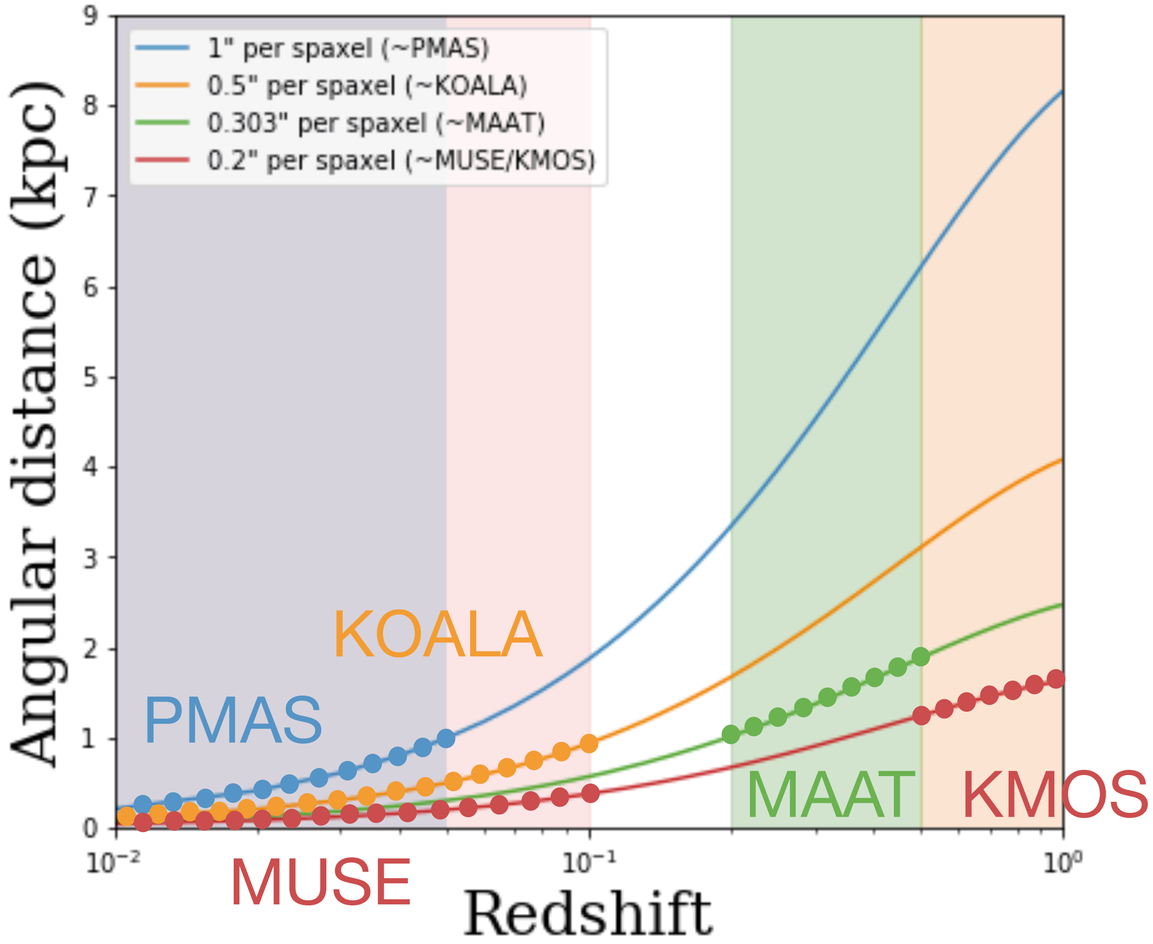
Resolution obtained with a fixed element over z





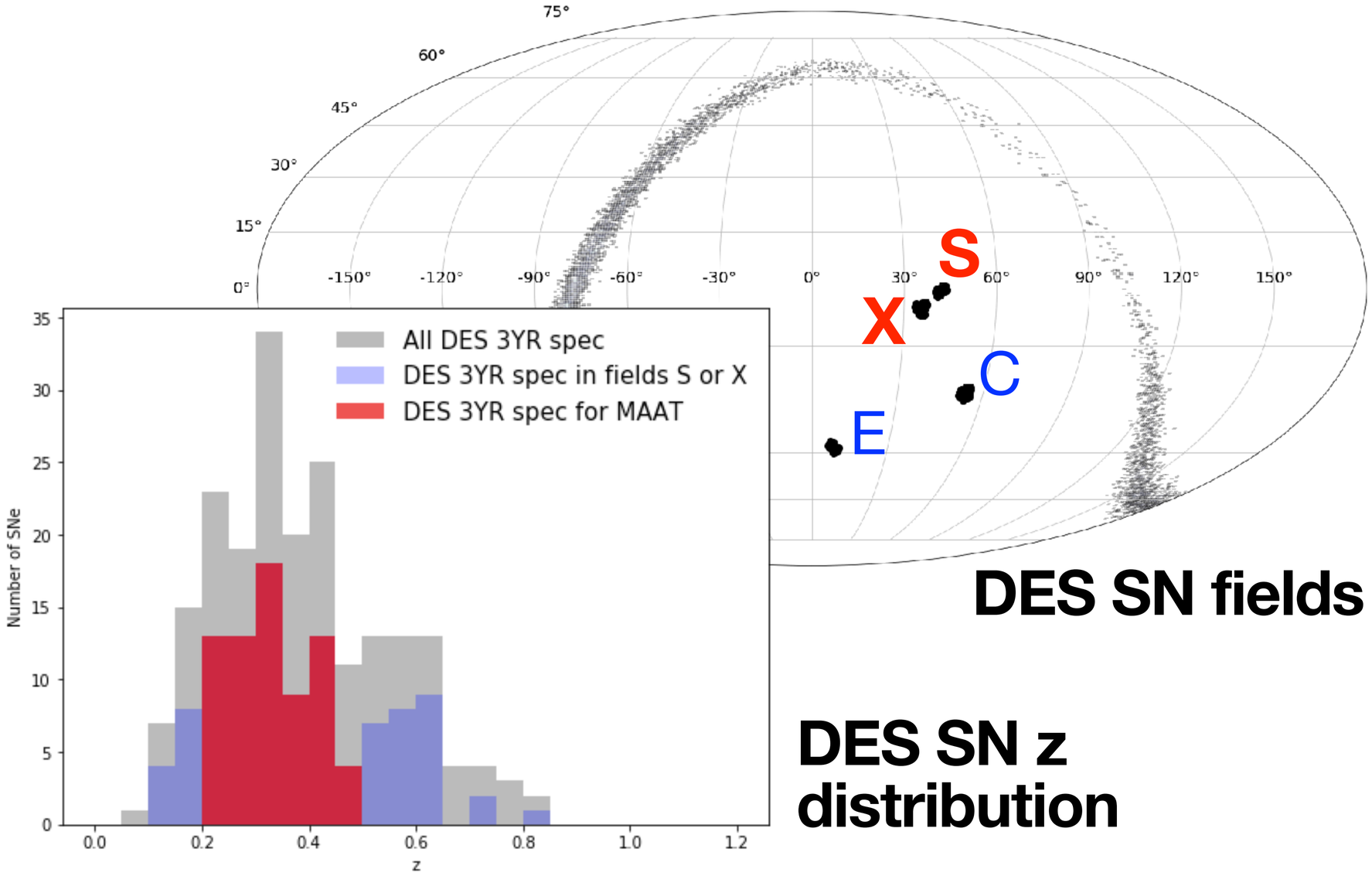
Resolution obtained with a fixed element over z





Proposal: MAat Sn HOsts (MASHO?)

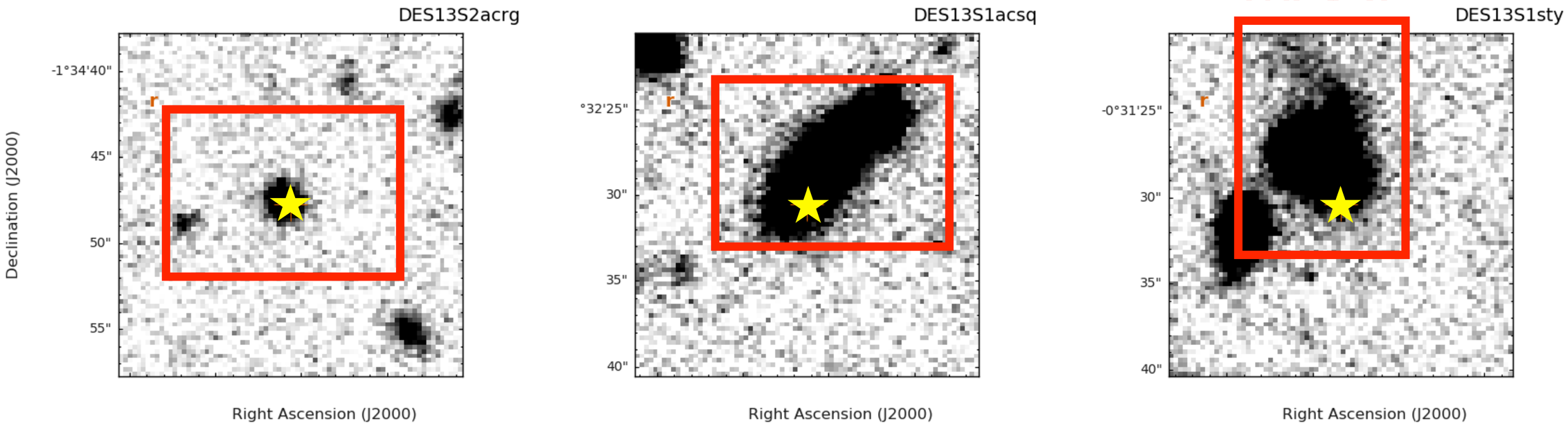
- 70 DES SNIa
- 0.2 < z < 0.5
- In fields S/X
- Sep-Dec (4months)
- 1h/obj. ➜ 70h



DES SN fields

DES SN z distribution

DES hosts 0.2 < z< 0.5



z=0.2919

z=0.3125

z=0.4259

Summary

- IFS has already proved to be a powerful technique for putting constraints on SNIa (+other transients!) environments
- Low and high-z samples are covered by current instrumentation
- MAAT is an excellent option for the int-z range