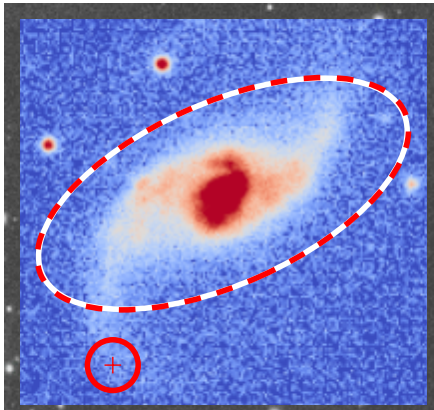

Environmental dependence of supernova light-curves

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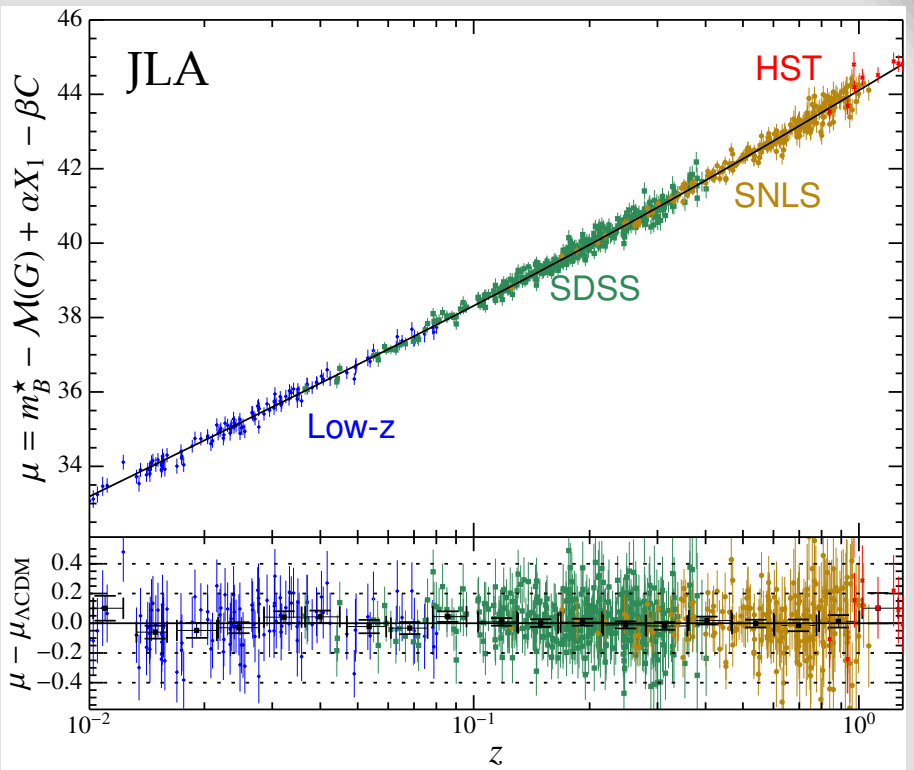
Cosmology with type Ia supernovæ

- Historical probe of dark energy
- Traces expansion history
  - luminosity distance-redshift relation
- « Standard » candles
- Going further in the standardisation
  - environment

Betoule et al. (2014)

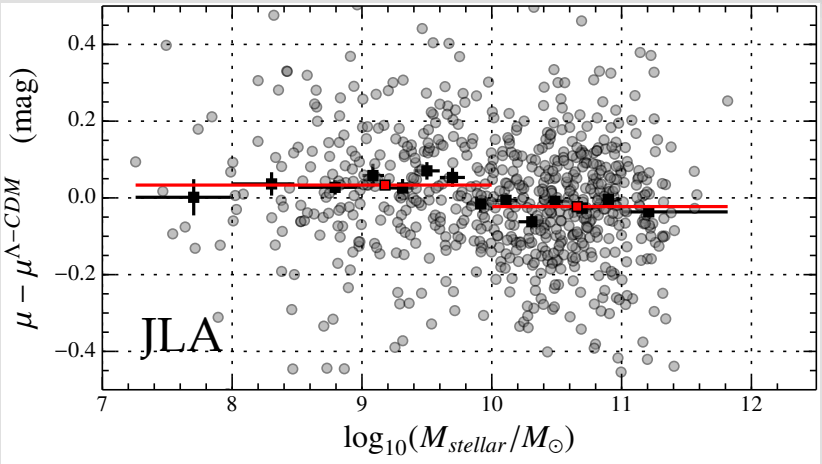


$$d_L(z) = (1+z)\frac{c}{H_0}\int dz \left(\Omega_m(1+z)^3 + \Omega_x \exp\left(\int_0^z dz' 3\frac{1+w(z')}{1+z'}\right)\right)^{-1/2}$$

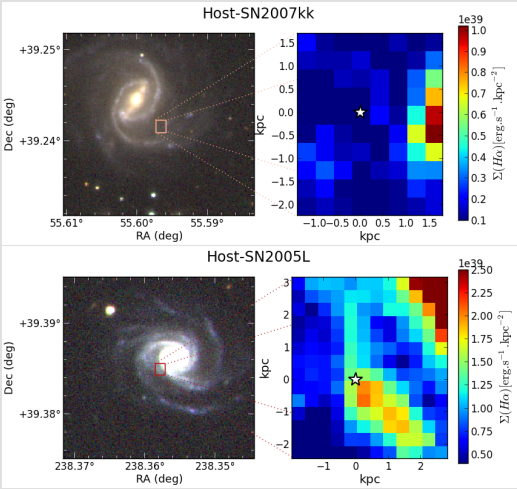
Cosmology with type Ia supernovæ

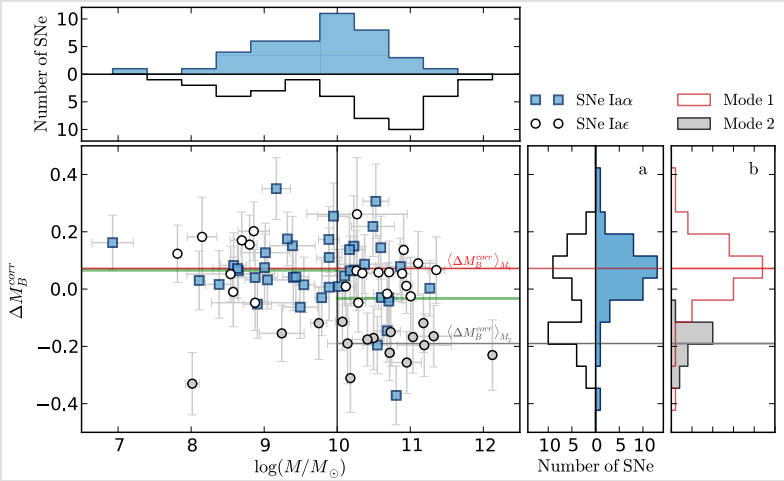
- Joint Light-Curve Analysis (JLA):
  - improved calibration accuracy
  - 0.15 mag remaining dispersion
- Correlations between supernova brightness and environment:
  - host stellar mass (JLA)
  - local Hα for low-z SNIa

Betoule et al. (2014)



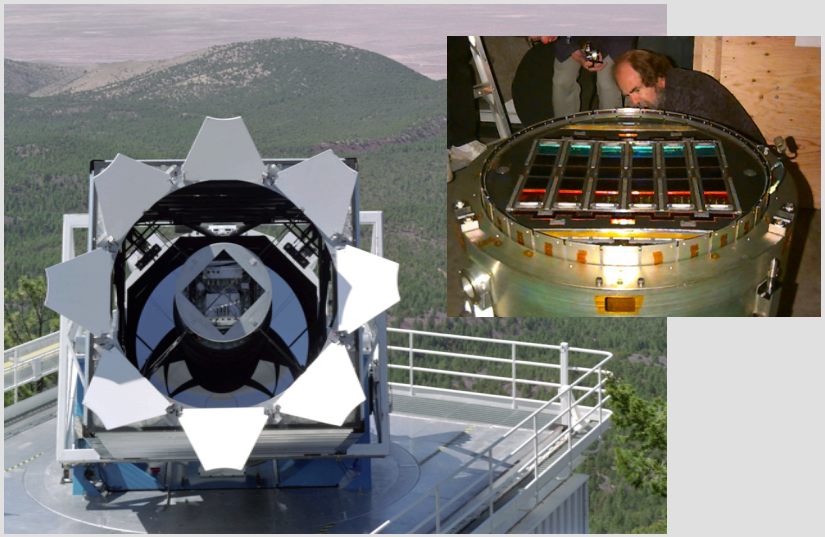
Rigault et al. 2013

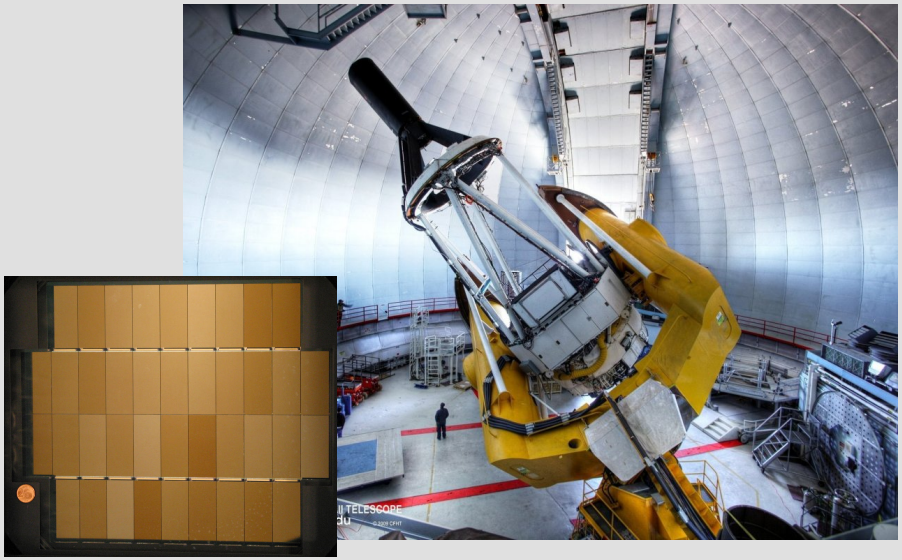




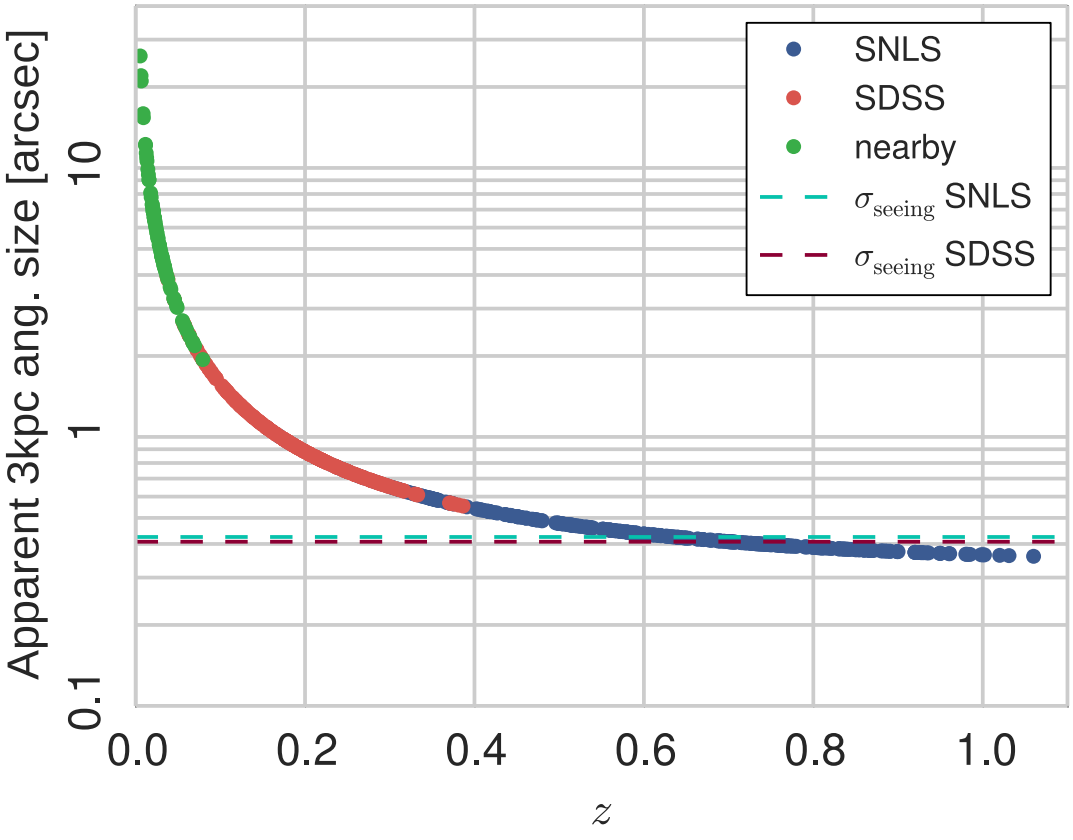
The SNLS-5 years sample

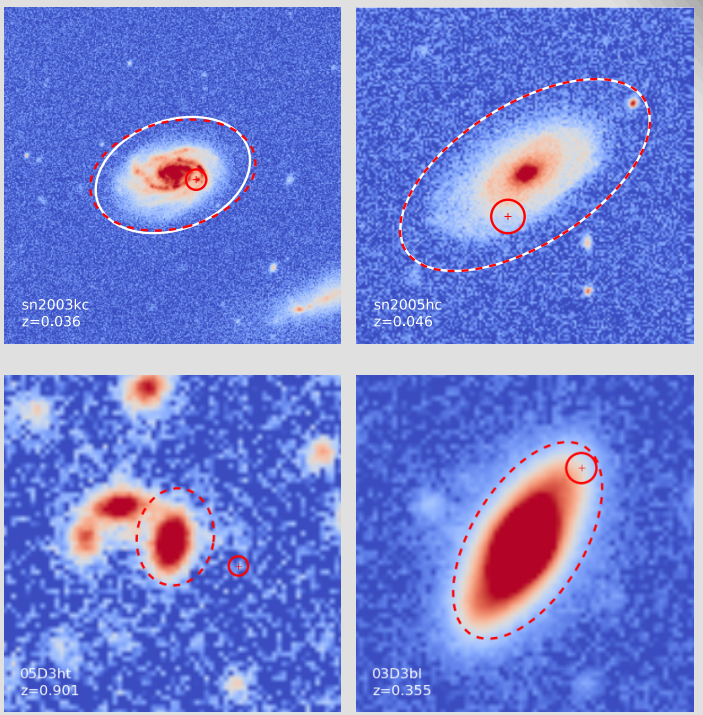
	SN	Host photometry	Reference	Filters/Instrument
CSP	19	7	SDSS footprint, SIMBAD	$ugriz$/SDSS & JHK/2MASS
CfAIII	84	55	SDSS footprint, SIMBAD	$ugriz$/SDSS & JHK/2MASS
CfAIV	53	34	SDSS footprint, SIMBAD	$ugriz$/SDSS & JHK/2MASS
SDSS	441	389	Sako et al. 2014	$ugriz$/SDSS
SNLS	397	397	Hardin et al. 2017 (in prep.)	$ugriz$/MegaCam
Total	994	882	–	–

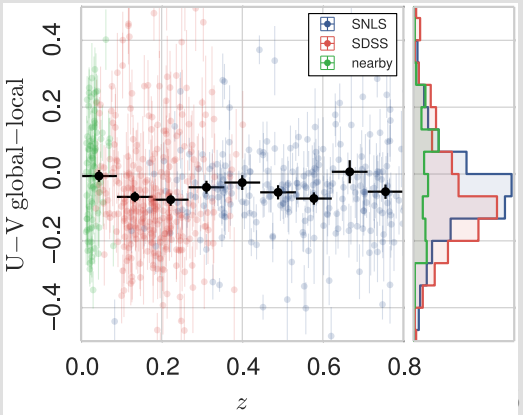




Local environment at ALL redshifts





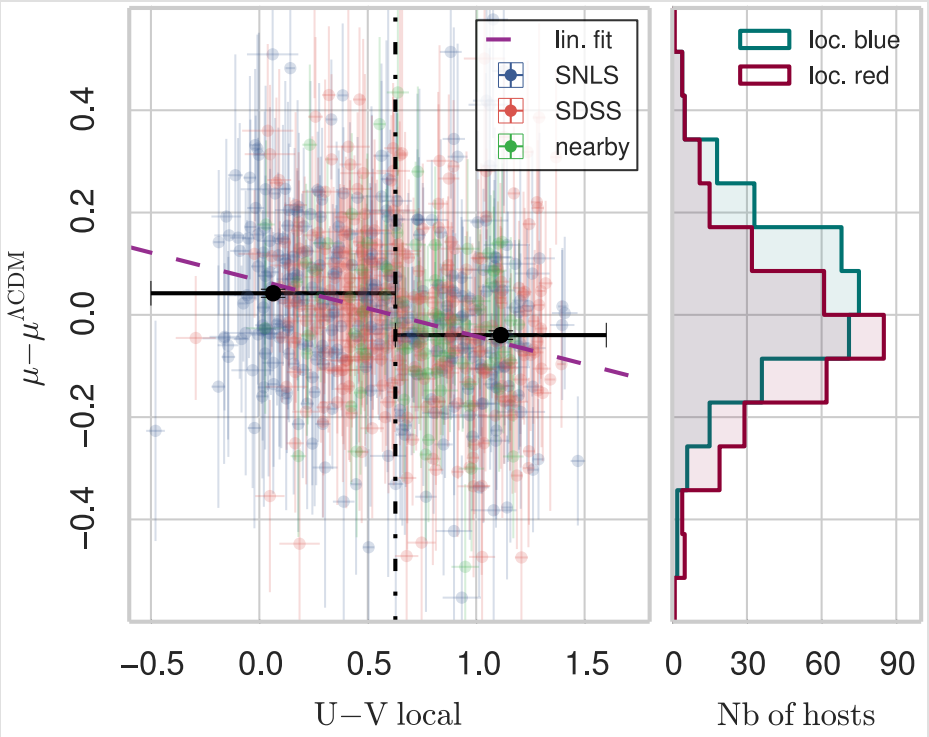


- Local and global photometry of 882 host galaxies of SNIa at ALL redshifts
- 3 kpc local radius
- rest-frame U-V colors by interpolating fluxes

Local environment at ALL redshifts

- Local color as a third standardization parameter
- 7σ significance of the magnitude step
  - more significant than other variables (host stellar mass, galaxy color)
  - valid for different redshift ranges

ΔM_B = – 0.091 ± 0.013 mag



Roman et al. (2017, in prep.)

Conclusions

- First analysis of local environment of Type Ia supernovae at all redshifts and for a large sample
- Local color correlates more to Hubble diagram residuals than host stellar mass, host color
- Strong hint that luminosity variations can be reduced
- Type Ia supernovæ can become a major cosmological probe again: dark energy, expansion rate

w, H_0