

Status of the SuperNovae Legacy Survey

<http://www.cfht.hawaii.edu/SNLS>

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on behalf of the SNLS collaboration

- Goals
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- First preliminary results

SN Ia, $z=0.28$

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Goals of SNLS

About 5 years ago, the Supernova Cosmology Project and the High-Z Supernova team reported evidence for a non zero cosmological term using SN Ia as “calibrated” candles (see also Riess et al. 2004)

The next step is to achieve **precise measurement of the cosmological parameters Ω_m , Ω_Λ** , and to measure the equation of state of Dark Energy, $w=p/\rho$.

Measurements of **supernovae rates as a function of redshift** are also of great interest to constrain the Star Formation Rate.

These goals can be achieved by collecting sample of about a thousand of well measured high redshift supernovae (more statistic, study sub-samples ...)

Expected precision on ω_m , ω_Λ , w with SNLS and SNFactory

600 SNIa
up to $z=0.9$ (SNLS)

+200 $z \sim 0.1$ (SNFactory)

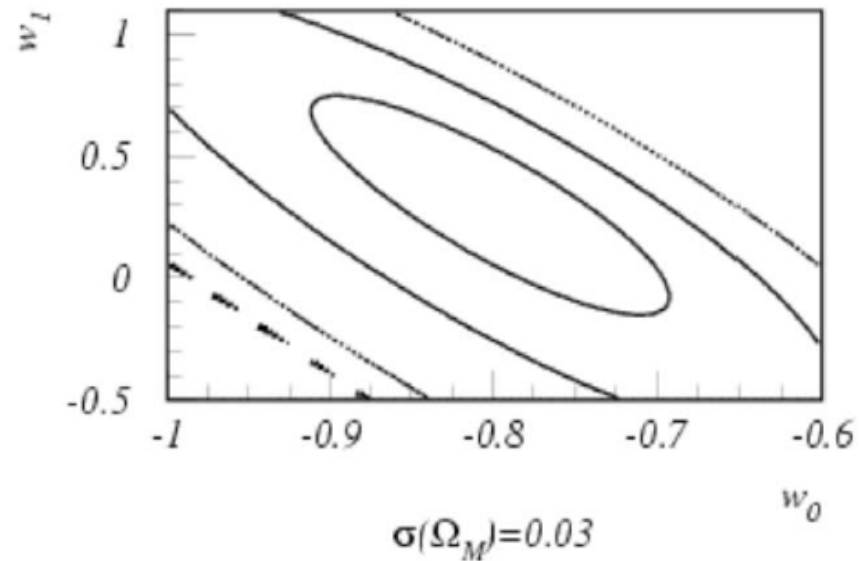
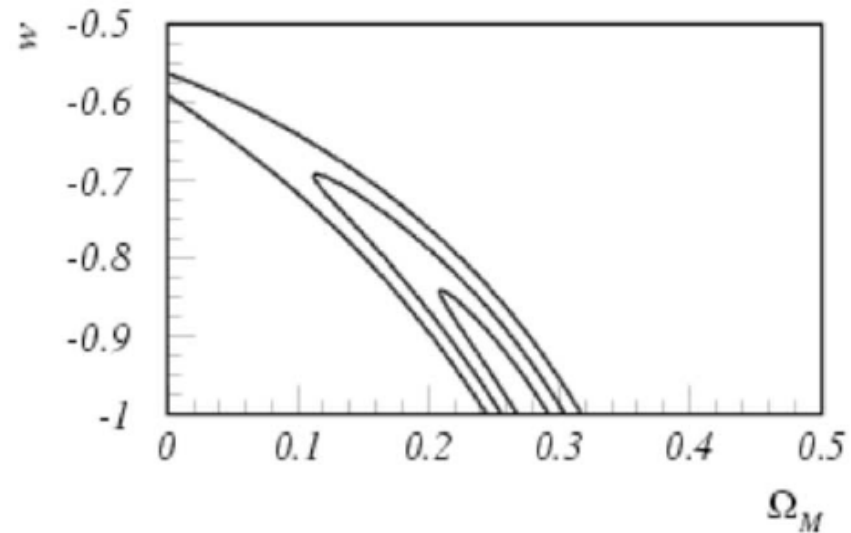
for $\omega_{\tau\tau} = 1$

with a prior on $\omega_m = 0.3 \pm 0.03$

with $(\omega_m) = 0.03$

\Rightarrow error on $w \sim 0.1$

no significant constraints on dw/dz



Means:
a “Rolling Search” Survey mode

Four fields covering one square degree each will be surveyed for 5 six months periods. They are observed every 3-4 nights in i' , r' , g' and z' .

Detection:

i' , r' are used for the real time detection based on image subtractions.

Spectroscopic Identification:

Promising candidates are observed with 8-m class telescopes.

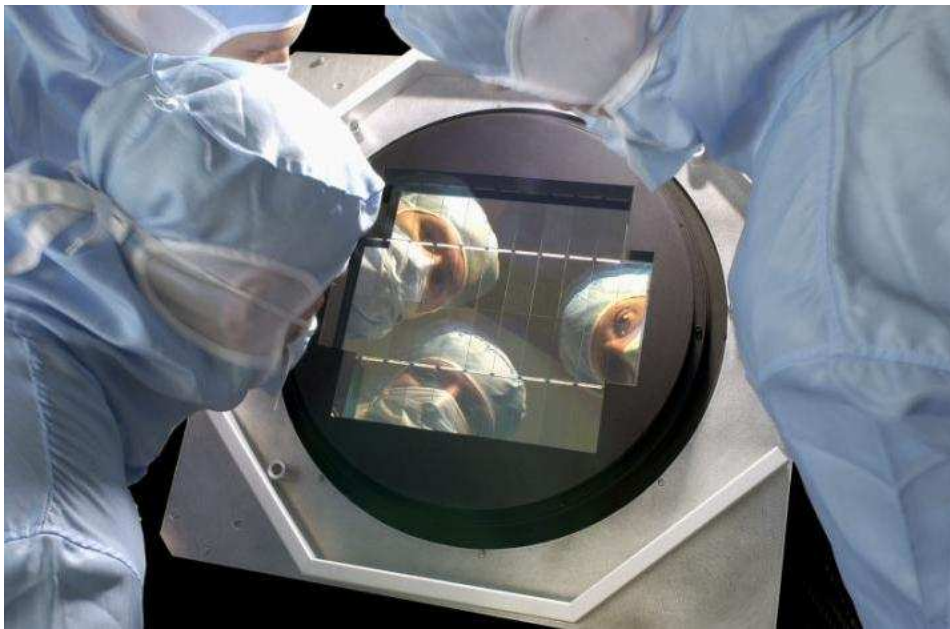
Photometric follow-up:

Immediate since we are always observing the same fields.

Several hundreds of Type Ia and Type II and Ib/c supernovæ will be detected and precisely followed-up.

Detection & Photometry with MegaPrime on CFHT

We use the 1 square degree wide field imager **MegaPrime** (CFHT+CEA/DAPNIA), installed on the Canada-France-Hawaii Telescope (CFHT).



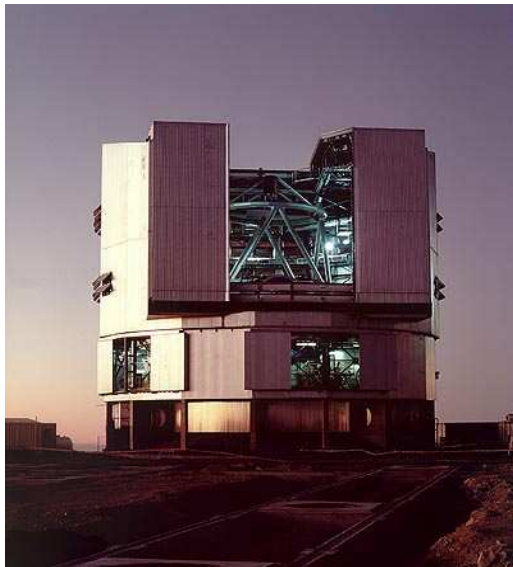
40 x (2k x 4.5k) pixels
f.o.v 1 square degree



3.6 m diameter

Spectroscopy

<u>Telescope</u>	<u>Allocated time</u>	<u>N. spectra Feb. 2004</u>
VLT	240 hours for 2 years	45
Gemini	60 h / semester (so far)	24
Keck	3 nights / year (first sem.)	31
Magellan	1 night / semester	19



SNLS Collaboration

Canada (Victoria, Toronto)

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France (IN2P3, CEA, INSU)

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Other participants

V. Arsenijevic (CENTRA, Lisbon), S. Baumont (ESO, Chile), J. Bronder (U. Oxford), S. Fabbro (CENTRA, Lisbon), I. Hook (U. Oxford), R. Knop (U. Vanderbilt), A. Mourao (CENTRA, Lisbon), S. Perlmutter (LBNL)

CFHTLS Deep survey: observation status

Four fields (=4 square degrees) are observed in MegaCam filters (u^*), g' , r' , i' , z' .

5 years at an average rate of 5.25 nights per dark period per field (5 runs per year).

Total allocated time = 202 nights ~ 1320 hours

For one field:

Filter	Expected integration time after 1 year	Limiting magnitude (AB)	Total integration time at the end of the survey	Limiting magnitude (AB)
u^*	6.5 h	27.3	33h	28.2
g'	6.5 h	27.9	33h	28.8
r'	13h	27.7	66h	28.6
i'	26.5h	27.4	132h	28.3
z'	13h	26.1	66h	27.0

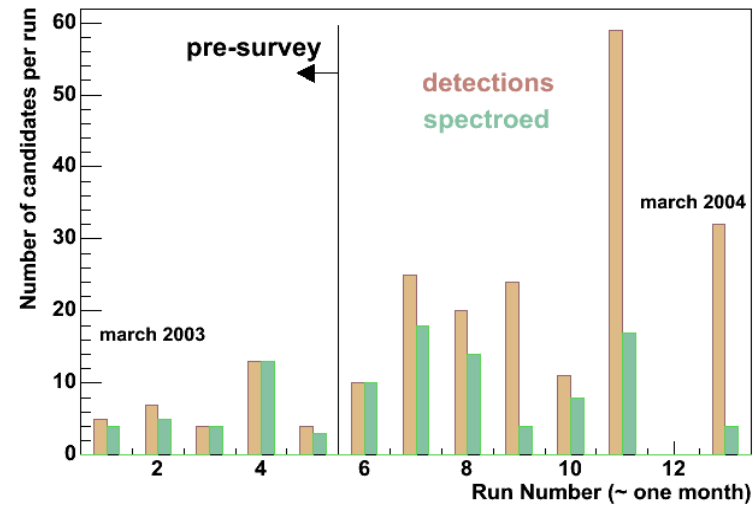
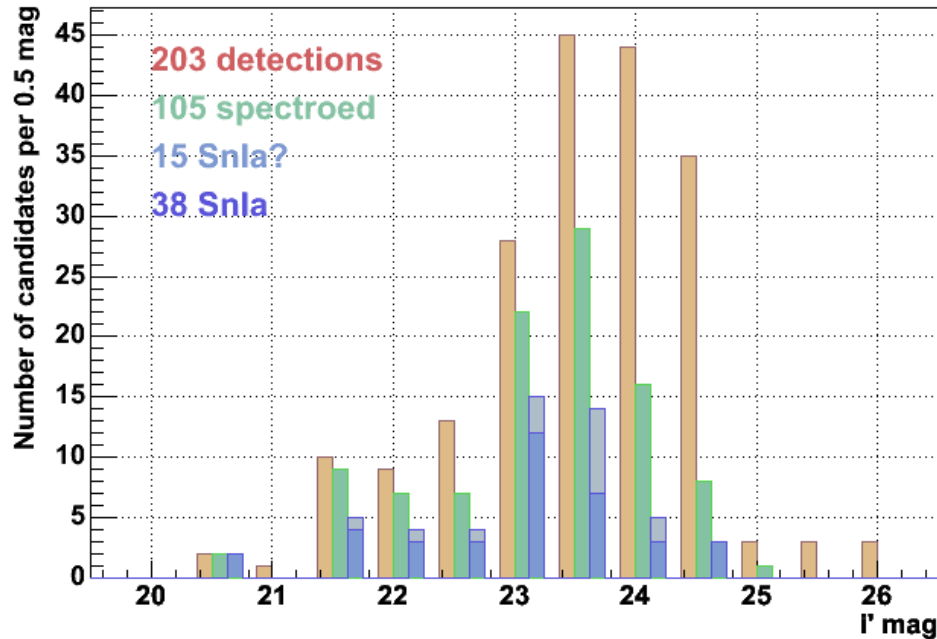
The survey started on august 2003

Validated observations before February 2004: 85 hours

(6.5 % of allocated time for the survey)

SNLS Real Time Analysis

Detection statistics



38 clearly identified SNIa + 15 that need photometric confirmation

Detections @ CFHT up to $i' \sim 25.5$

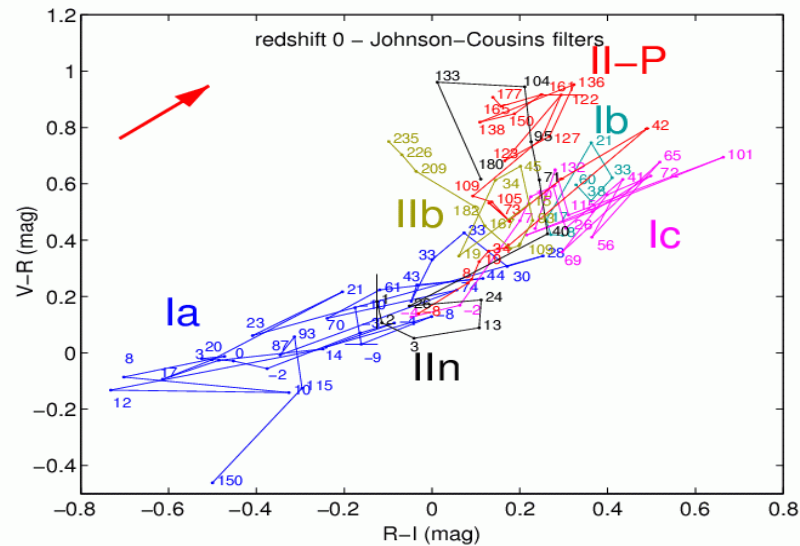
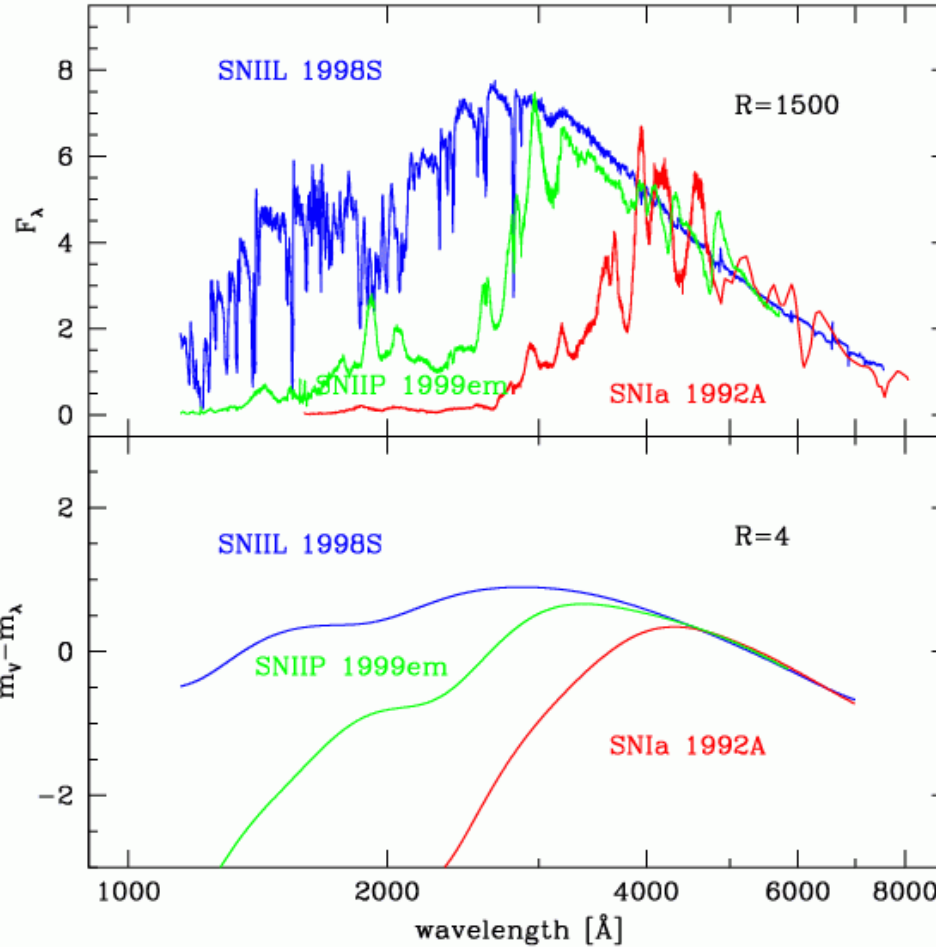
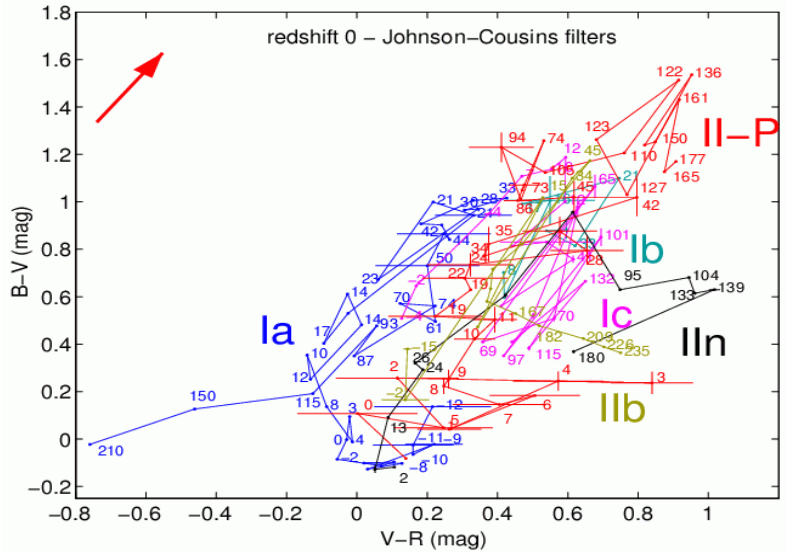
Spectroscopic Identification limited to $i' \sim 24.5$

Some of the SNIa that were not spectroed will be later identified from their lightcurve and color

SN Ia photometric identification with colors

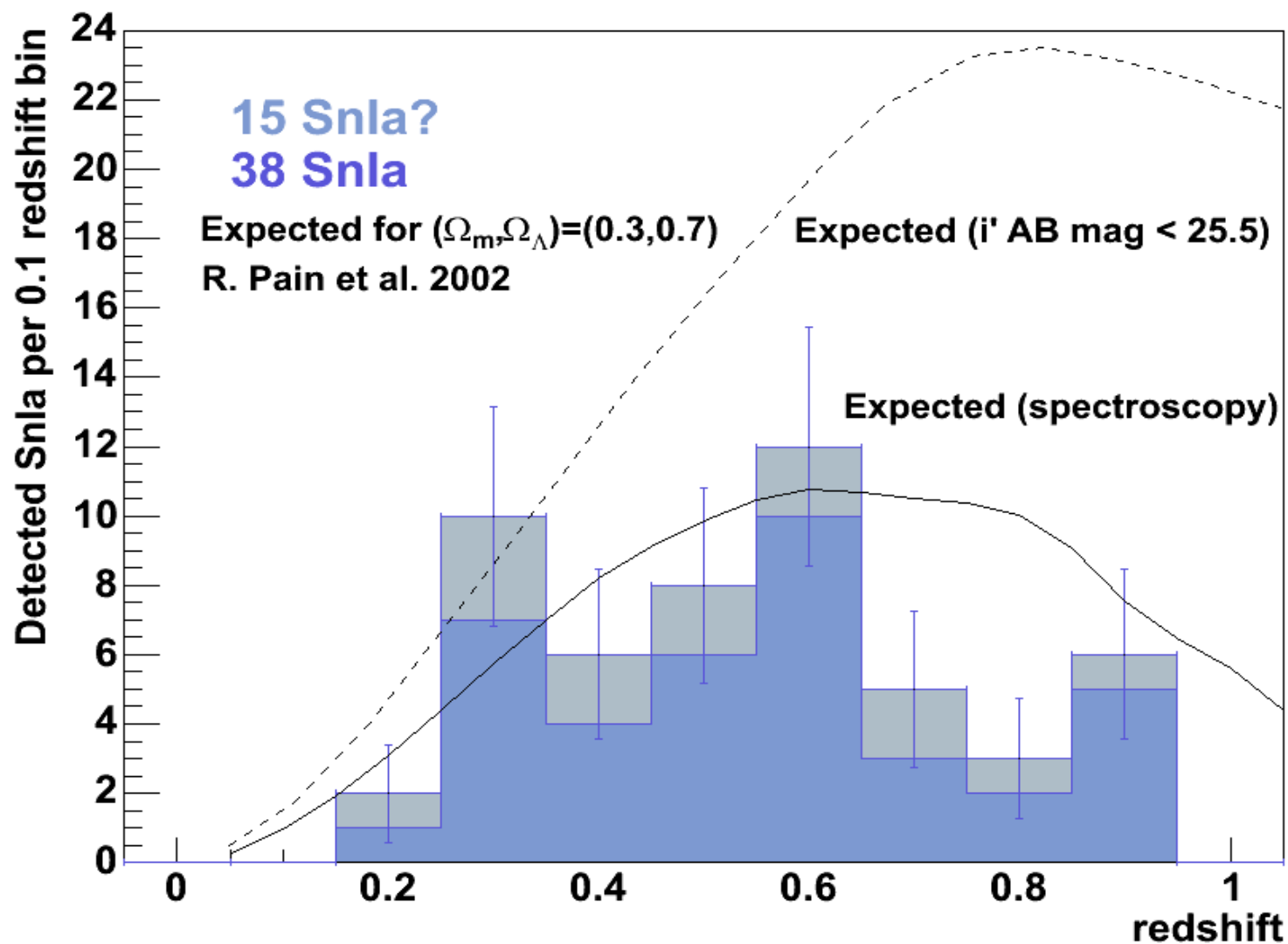
Poznanski, 2003 : color LCs

Riess, 2003: lack of UV for SNIa



SNLS Real Time Analysis

PRELIMINARY Redshift distribution

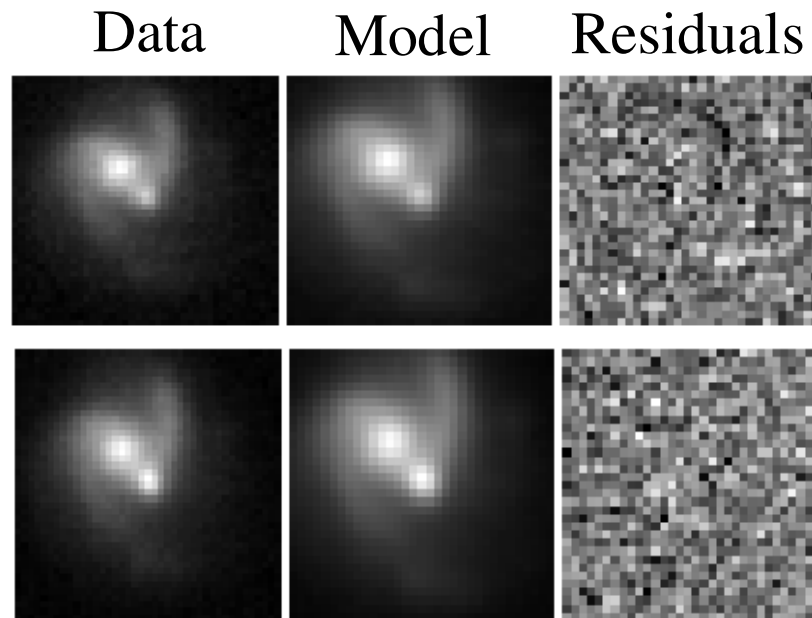


Follow-up Lightcurve Photometry Simultaneous Fit

$$I(x, y) = \text{Flux} \times [\text{Kernel} \otimes \text{PSF}_{\text{best}}](x - x_{sn}, y - y_{sn}) \\ + [\text{Kernel} \otimes \text{Galaxy}_{\text{best}}](x, y) + \text{Sky}$$

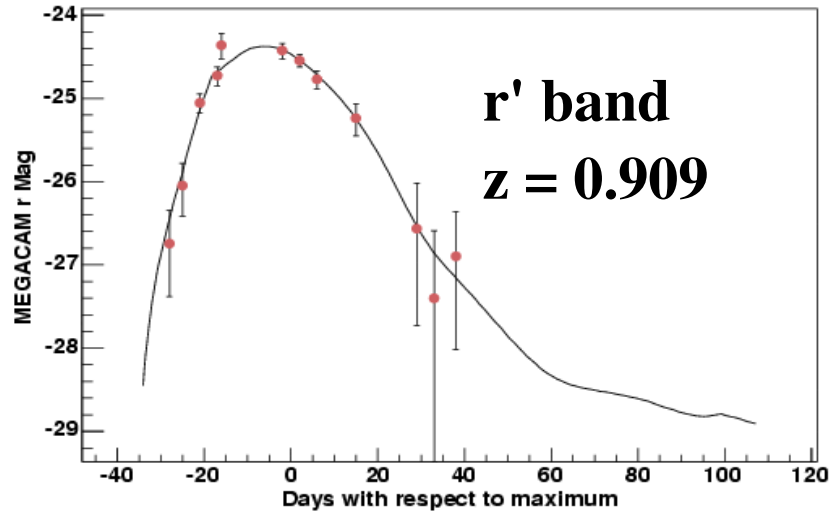
- Fit galaxy(i,j) on a stamp
- Can fit constant background
- Sn flux using PSF obtained with daophot
- Fit accurate Sn position

Kernels fitted on all images are used.

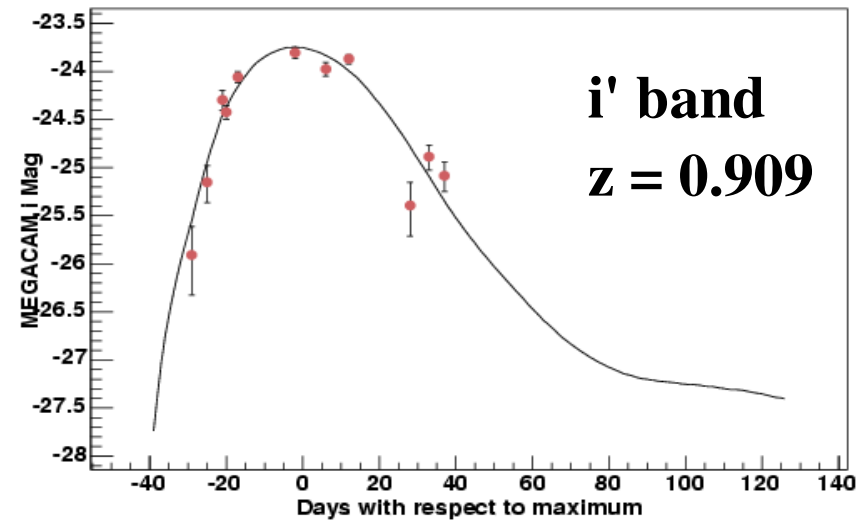


PRELIMINARY Light curves in MegaCam r',i' bands

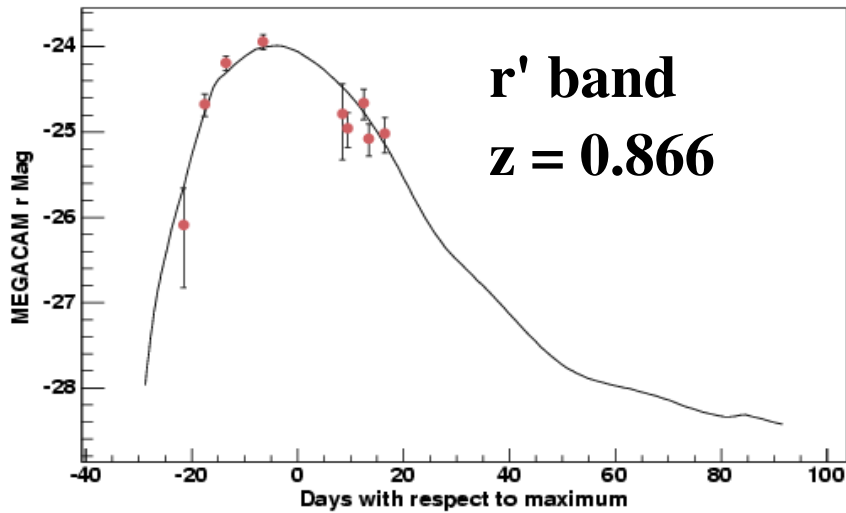
Simultaneous fit for Lightcurve of R6D4-10 @ $z = 0.909$



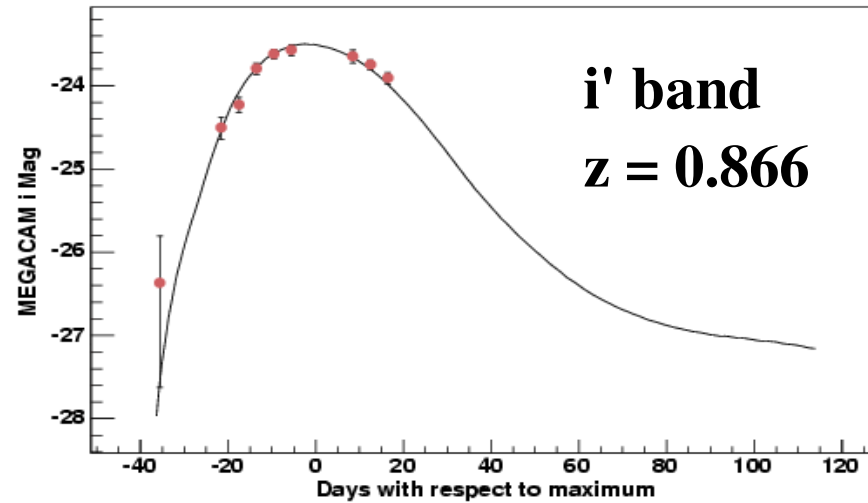
Simultaneous fit for Lightcurve of R6D4-10 @ $z = 0.909$



Simultaneous fit for Lightcurve of R7D1-11 @ $z = 0.866$

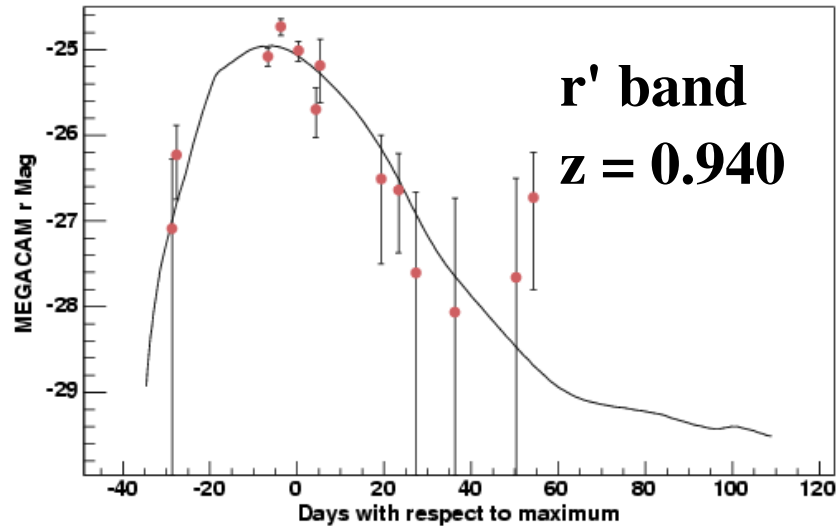


Simultaneous fit for Lightcurve of R7D1-11 @ $z = 0.866$

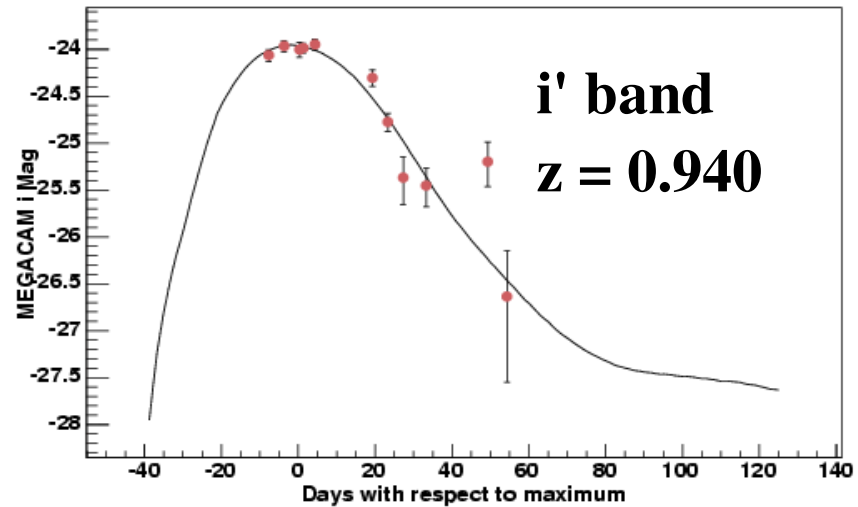


More PRELIMINARY Light curves (g', r', i', z') ...

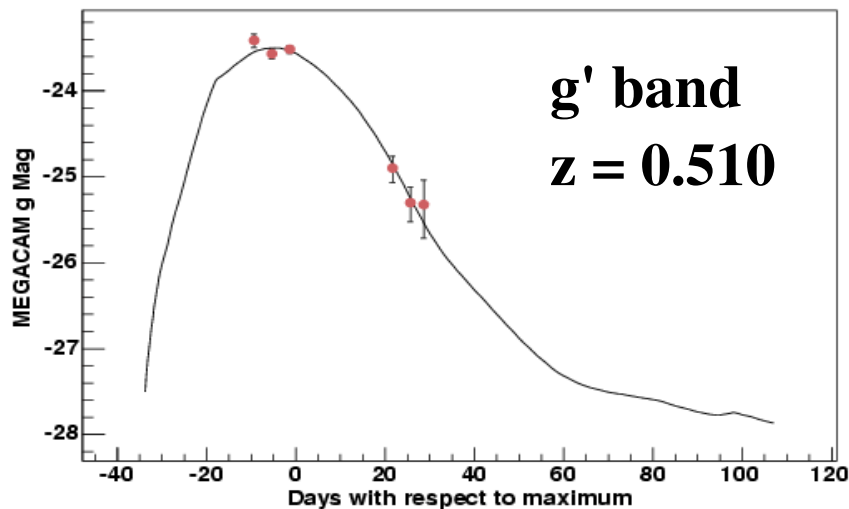
Simultaneous fit for Lightcurve of R6D4-9 @ $z = 0.94$



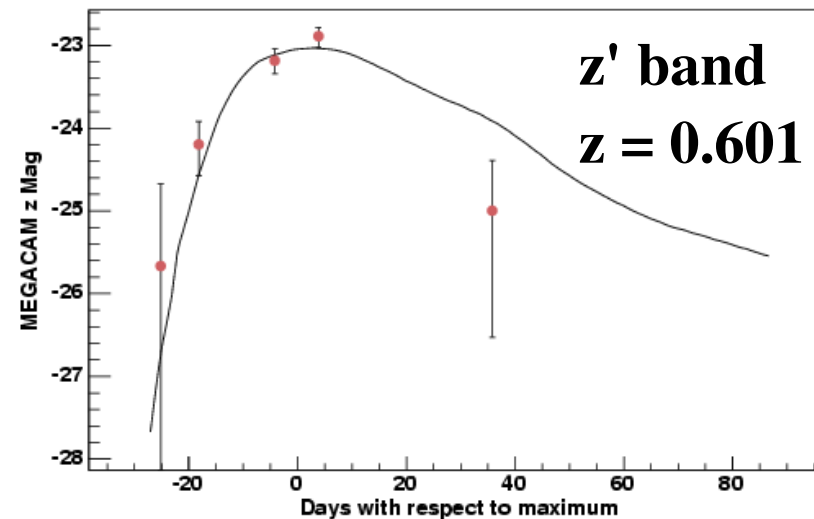
Simultaneous fit for Lightcurve of R6D4-9 @ $z = 0.94$



Simultaneous fit for Lightcurve of R7D1-3 @ $z = 0.51$

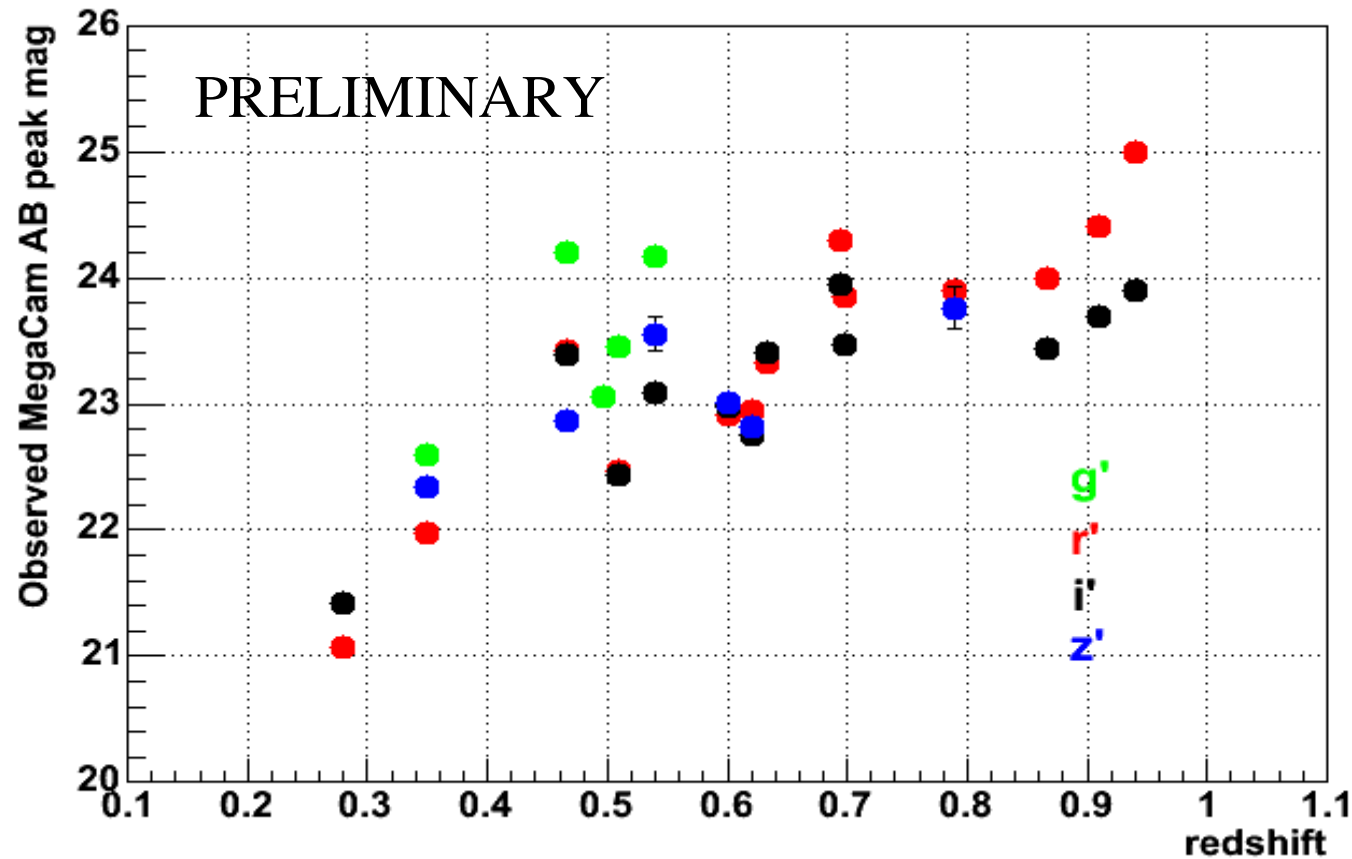


Simultaneous fit for Lightcurve of R7D4-7 @ $z = 0.601$



MegaCam Magnitudes versus redshift

Sub-sample of identified SNIa using data of 3 dark runs



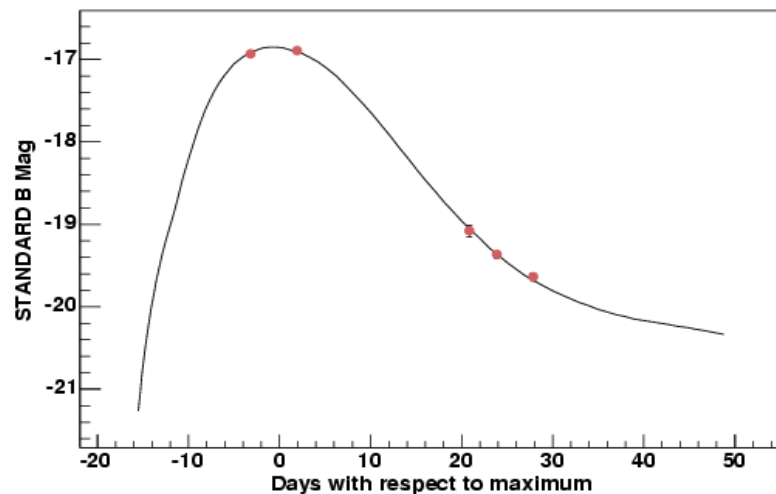
narrow statistic errors ~ 0.05 mag @ $z \sim 0.9$
(no systematic included)

Comparison with nearby data

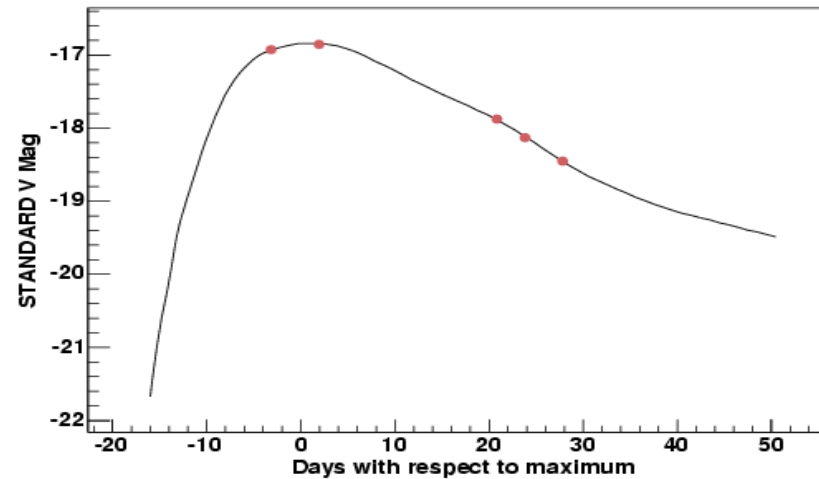
Recette:

- * assume one cosmology : $\omega_m = 0.3$ $\omega_\lambda = 0.7$
- * use Jha thesis SNIa (B_J, V_C)
- * Fit them with template spectrum: get color correction to spectrum, and stretch.
- * Redshift template spectrum and integrate in MegaCam response function.

Simultaneous fit for Lightcurve of 1999cc @ $z = 0.031328$

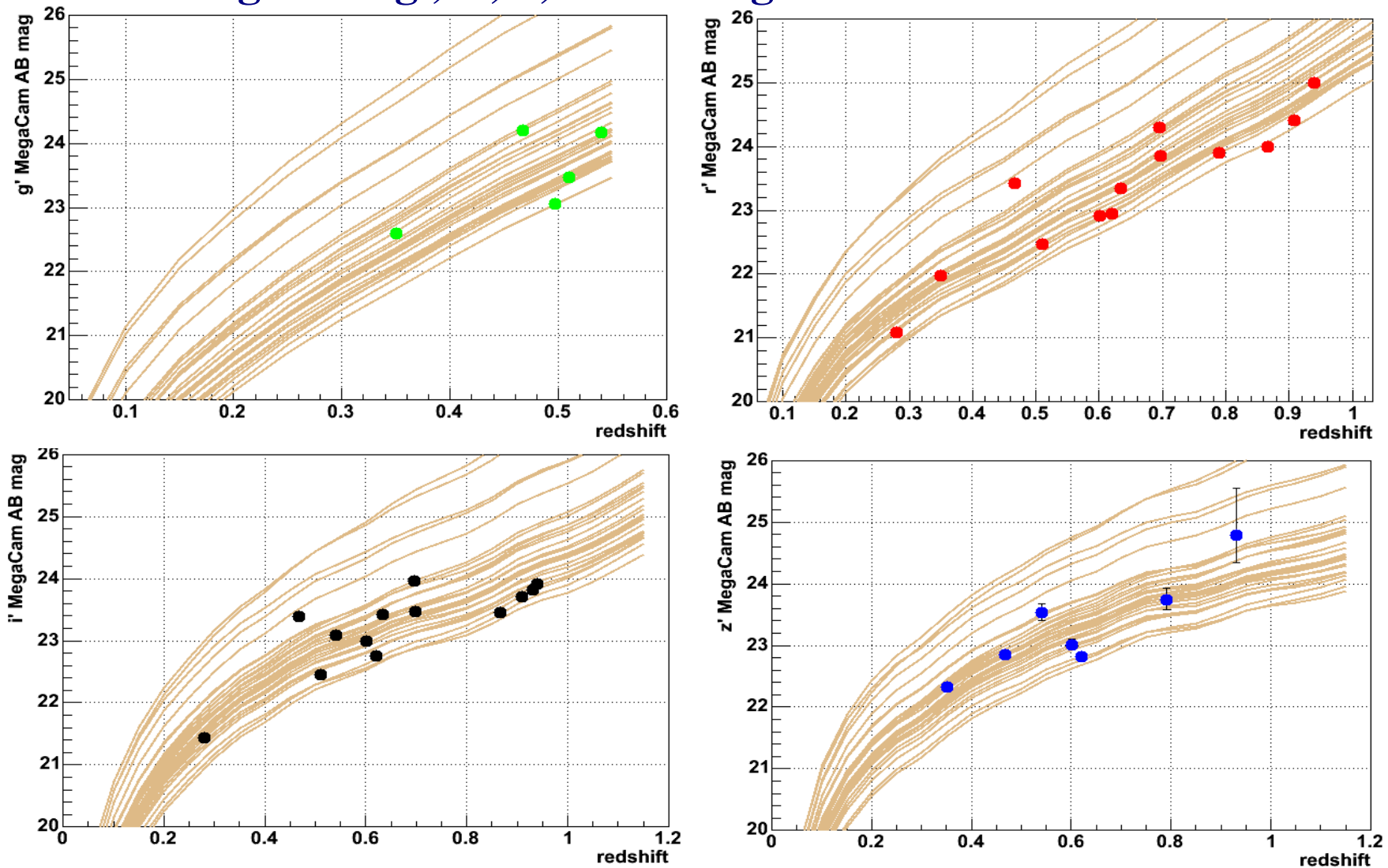


Simultaneous fit for Lightcurve of 1999cc @ $z = 0.031328$



PRELIMINARY

MegaCam g', r', i', z' AB magnitude versus redshift



● SNLS SNIa

— Synthetic magnitudes using fitted nearby SNIa Light curves (B,V)

Conclusions

- As of Feb. 2004, 38 spectroscopically identified SNIa
- Many others could be identified with photometry:
unbiased sample up to redshift ~ 0.8
- Currently two online independent detection pipelines
(french/canadian) that give similar results.
- Full photometric analysis of a sub-sample of SNIa give
promising lightcurves (good sampling and resolution) in 4 bands.

- Currently working on improving detection pipeline, automated off-
line photometry, light curve fitting ...

Hopefully many more SNIa will be detected in the coming years