Distance to M101 from SN 2011fe

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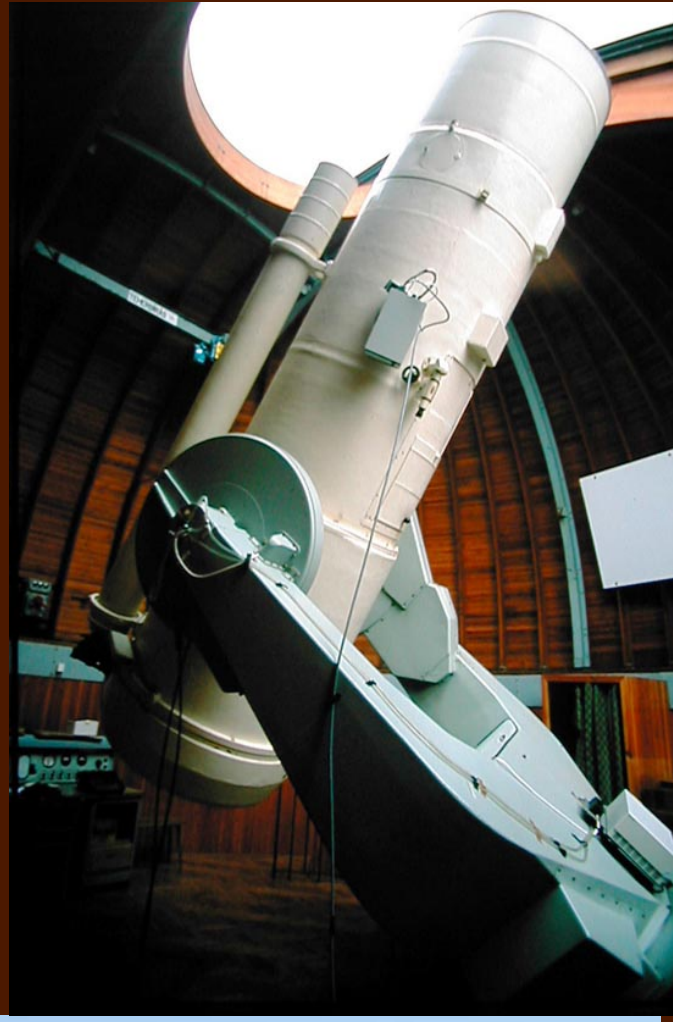
Image by K. Sarneczky, 2011.08.25. Konkoly Observatory, Hungary

BVRI photometry

Konkoly Observatory
Piszkesteto Station, Hungary

60/90 cm Schmidt telescope
Apogee Alta U16 CCD
Bessell filters

37 nights between Aug.25 - Nov.06.
calibrated via Landolt fields

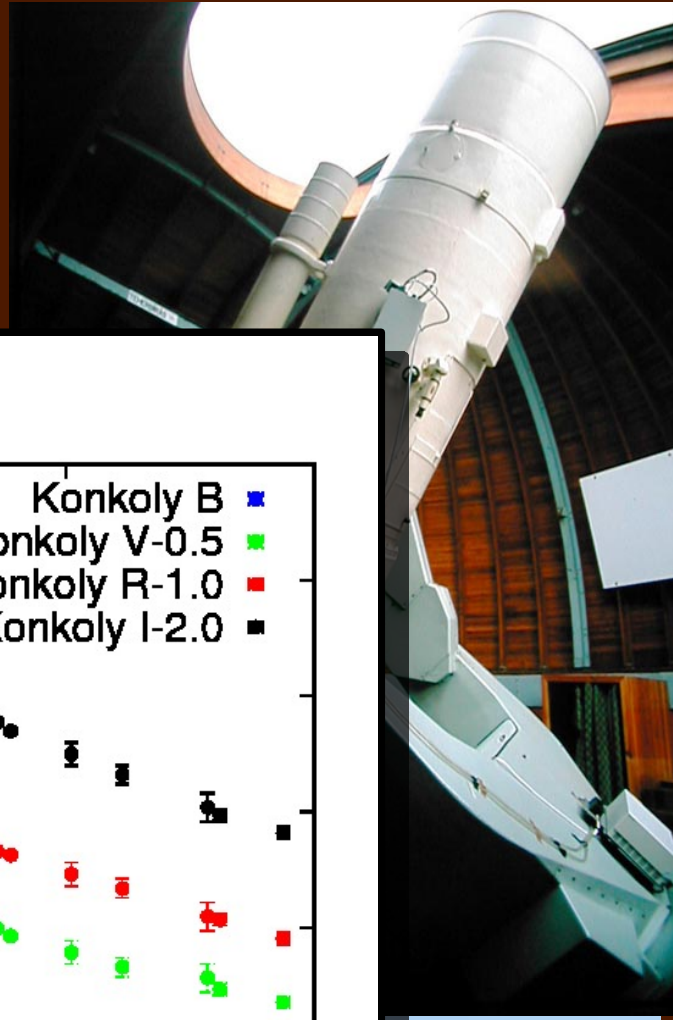


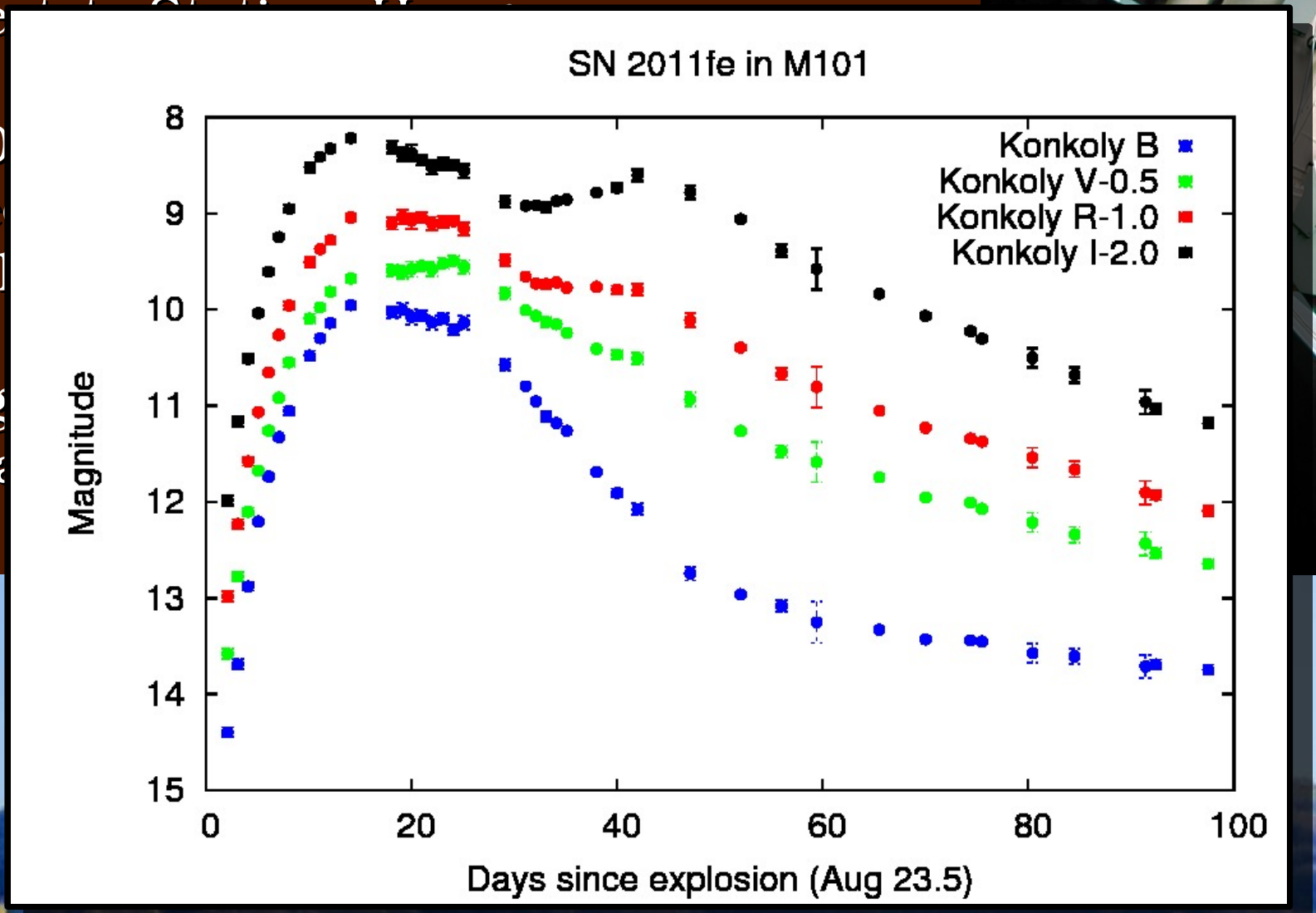
BVRI photometry

Konkoly Observatory
Piszke

60/90
Apoge
Bessel

37 nig
calibra





Why SN 2011fe ?

- spectrum looks like "normal" (not peculiar) Ia
- z = 0.0008 ==> K-correction negligible
- A_V (total) ~ 0.08 mag

==> reddening-related problems minimal

- host galaxy (M101) has independent distances from Cepheids

SN 2011fe is the Ia that we were waiting for!

MLCS2k2 analysis

$$m_X(t) = M_X(t) + p_X(t)\Delta + q_X(t)\Delta^2 + 5\log(H_0/65) + \mu_0 + A_X$$

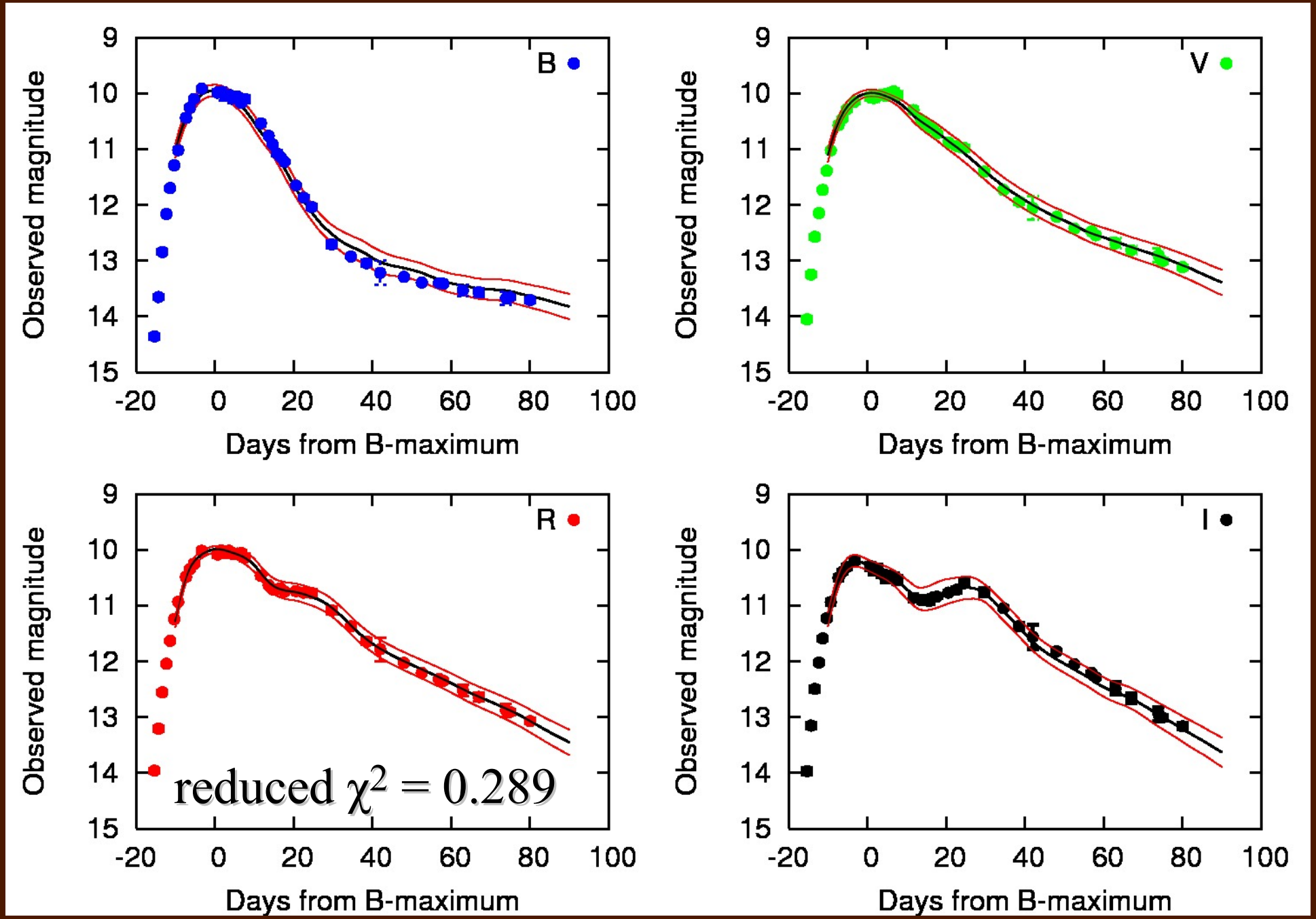
(Jha, Riess & Kirshner, 2007)

assumptions:
R_V = 3.1 (Galactic reddening law)
H_0 = 73 km/s/Mpc (from HST Key Project)

Fitting results:

A_V(host) = 0.05 ± 0.01 mag --> low reddening
Δ = -0.01 ± 0.08 --> fiducial Ia
μ_0 = 29.21 ± 0.07 mag --> D = 6.95 Mpc

MLCS2k2 analysis

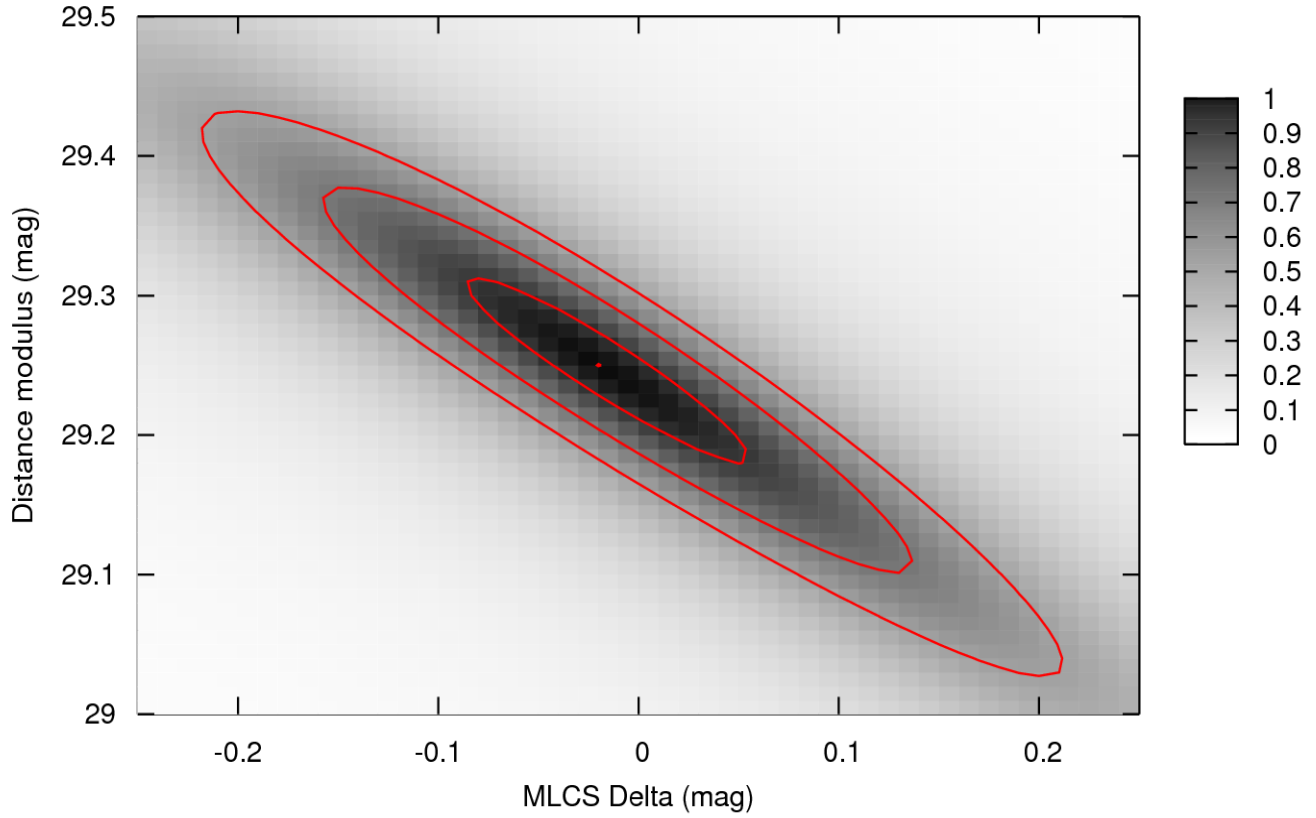


MLCS2k2 analysis

Uncertainties:
(10% $\Delta\chi^2$ change):

$\delta\Delta = \pm 0.08$ mag
$\delta\mu = \pm 0.07$ mag

Δ and μ are
strongly correlated



SALT2 analysis

fitting parameters: m_B^* , M_0 , x_1 , C

calibrations for the distance modulus:

$$\mu = m_B^* - M_0 + \alpha \cdot x_1 - \beta \cdot C$$

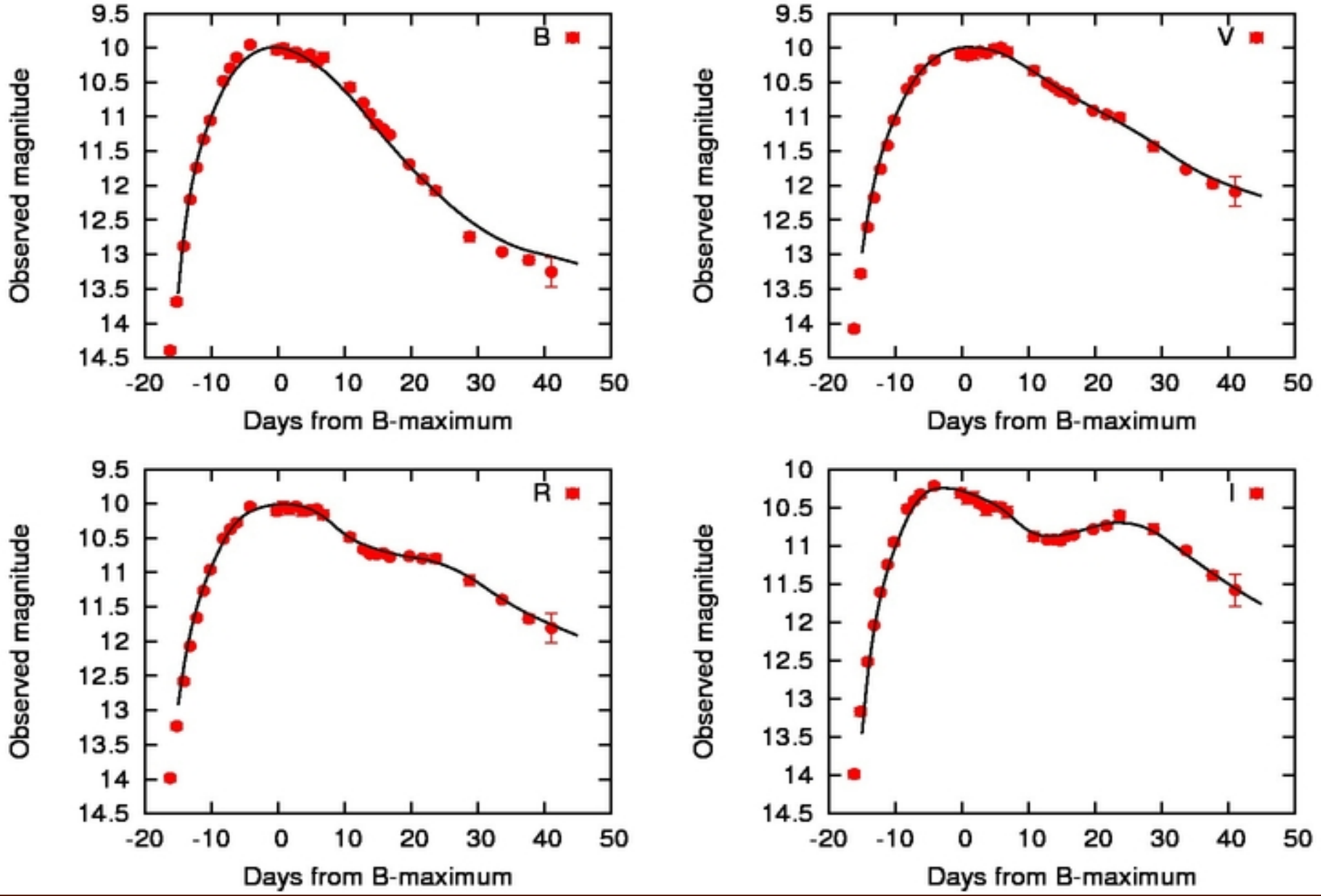
Kessler et al. ApJS 185, 32 (2009)
assuming FwCDM cosmology

$$\mu = m_B' - M_0 + \alpha \cdot (s' - 1) - \beta \cdot C'$$

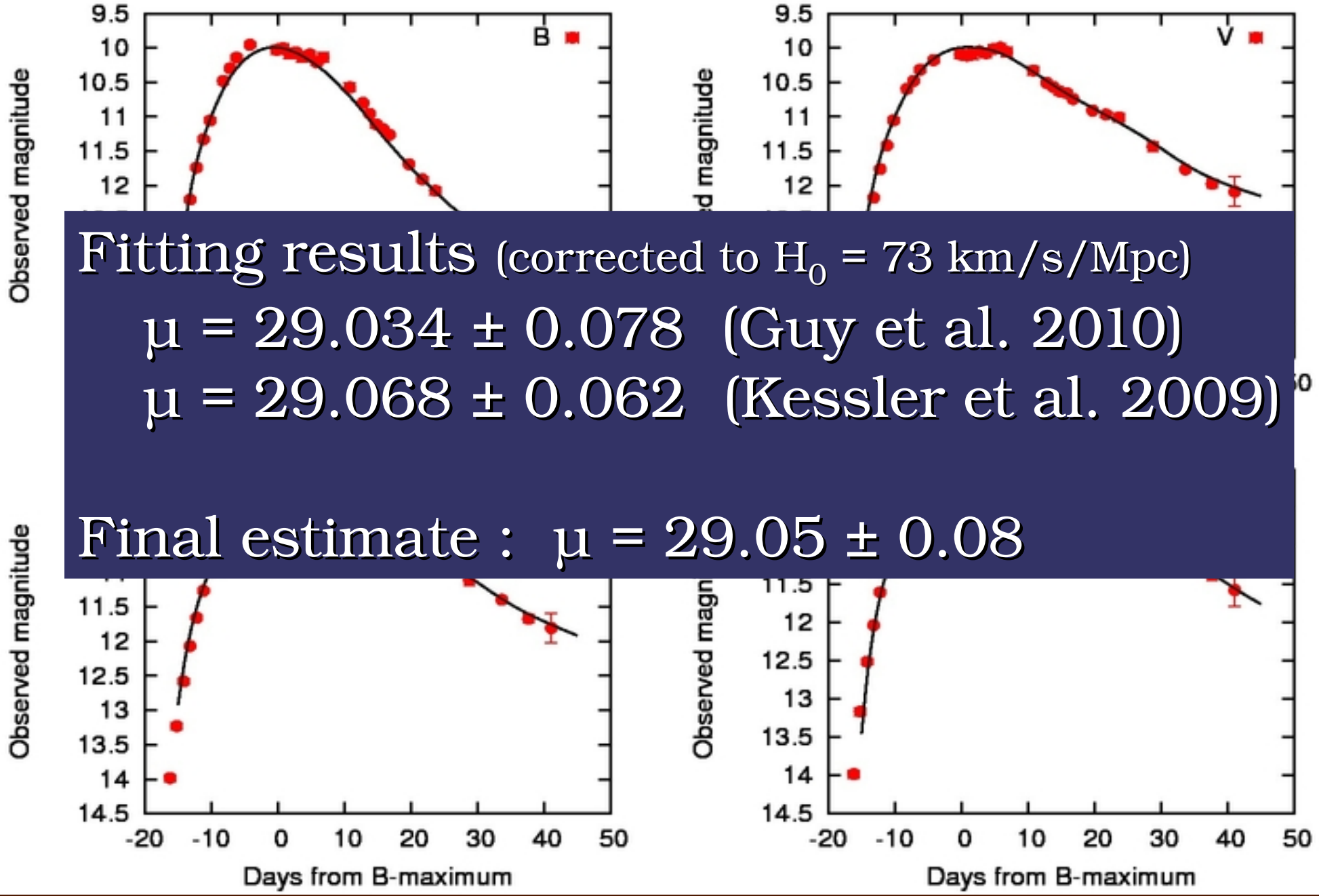
Guy et al. A&A 523, 7 (2010)
assuming H_0 = 70 km/s/Mpc

m_B' , s' , C' are linear combinations of m_B^* , x_1 and C

SALT2 analysis



SALT2 analysis



Fitting results (corrected to H_0 = 73 km/s/Mpc)

μ = 29.034 ± 0.078 (Guy et al. 2010)

μ = 29.068 ± 0.062 (Kessler et al. 2009)

Final estimate : μ = 29.05 ± 0.08

M101 distance moduli

Method	μ	δμ	Reference
MLCS2k2	29.21	0.07	this work
SALT2	29.05	0.08	this work
Tully-Fisher	29.20	0.50	Pierce, ApJ 430, 53 (1994)
EPM	29.35	0.40	Schmidt et al. ApJ 432, 42 (1994)
Cepheids	29.13	0.11	Freedman et al. ApJ 553, 47
Cepheids	29.06	0.11	Newman et al. ApJ 553, 562
Cepheids	29.04	0.05	Shappee & Stanek, ApJ 733, 124 (2011)
TRGB	29.05	0.06	Shappee & Stanek, ApJ 733, 124 (2011)

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