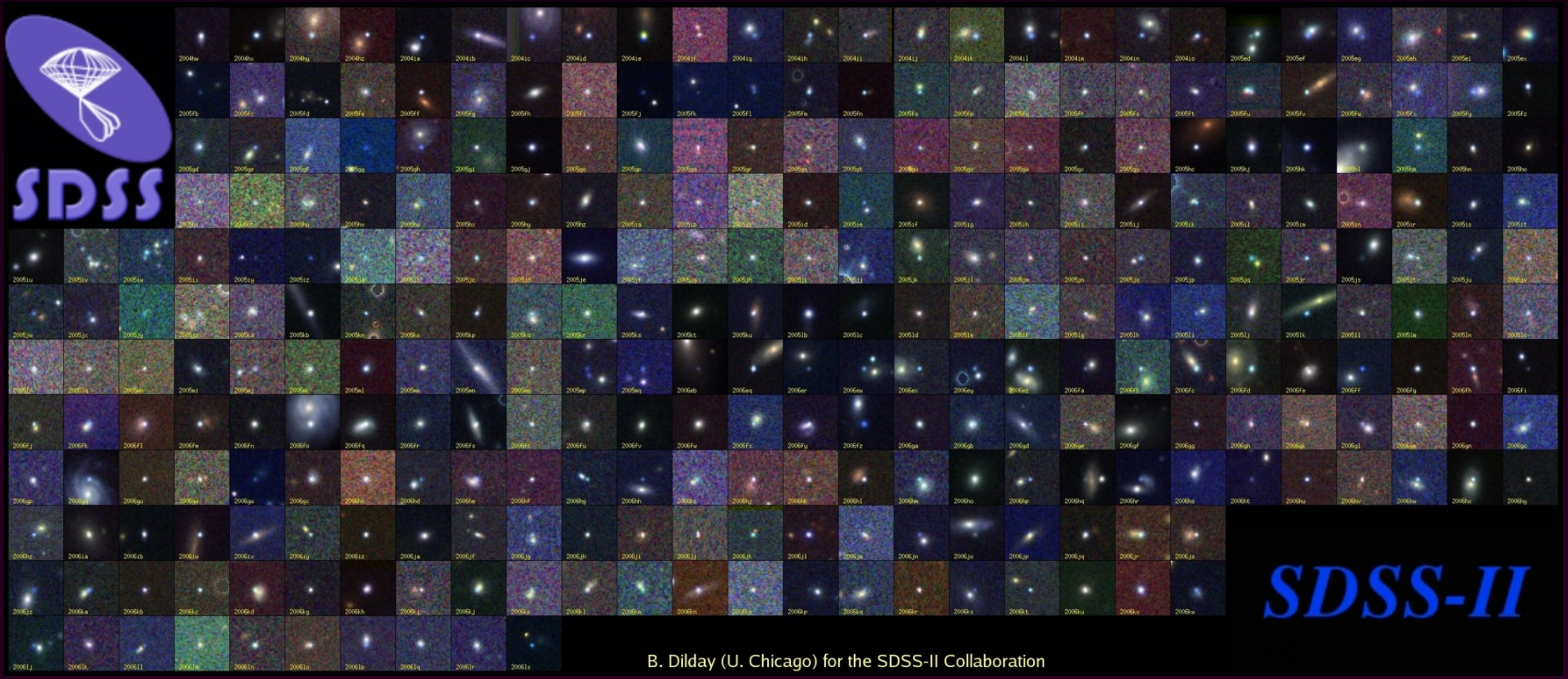
SDSS-II SN Survey

Peter Garnavich
Notre Dame

and the SDSS-II SN collaboration



KITP/UCSB April 27, 2007

SDSS-II SN Collaboration

J. Frieman

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Seoul Natl. U.	C. Choi, M. Im
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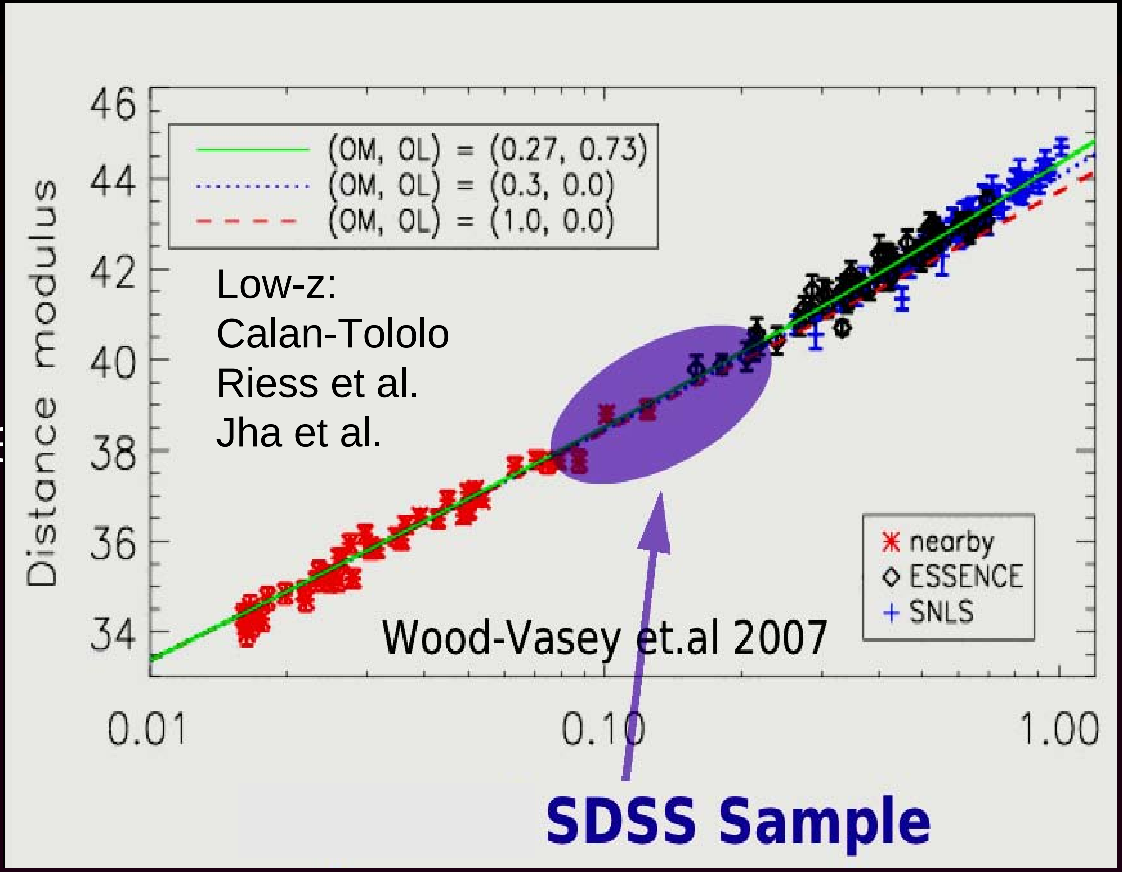
SN Ia Hubble Diagram

- Main goals of the SDSS SN survey:
-
- => fill in the SN Ia Hubble diagram at
- intermediate redshift, $0.1 \lesssim z \lesssim 0.3$
- => connect low-z with high-z
- => confirm concordance cosmology
- (or not!)
- => create a large, uniform sample of
  - well-studied SNIa + hosts

- Challenges
  - =>peak magnitudes $m \simeq 20\text{-}22$
  - =>need to search hundreds of deg^2



➔ SDSS 2.5m telescope + imager

http://sdssdp47.fnal.gov/sdsssn/sdsssn.html

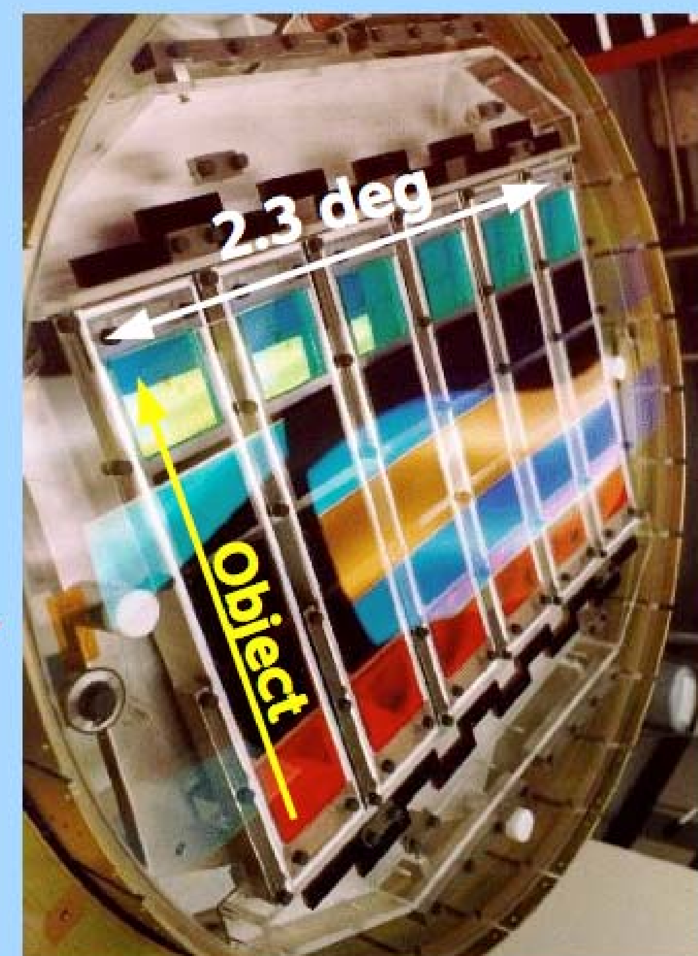
Apache Point Observatory
Southern New Mexico

2.5 m f/5 modified Ritchey-Chretien
- camera (u,g,r,i,z)
- spectrograph (640 fibers)

ARC-3.5m

NMSU-1m

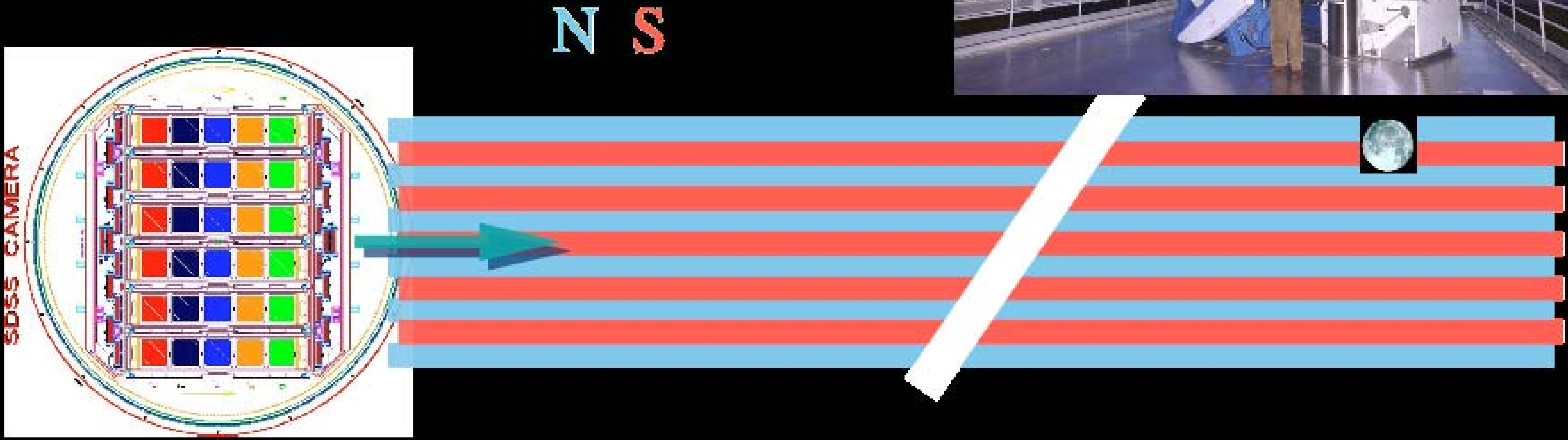
0.5m photometric telescope (PT)



u	g	r	i	z
22.0	22.2	22.2	21.3	20.5

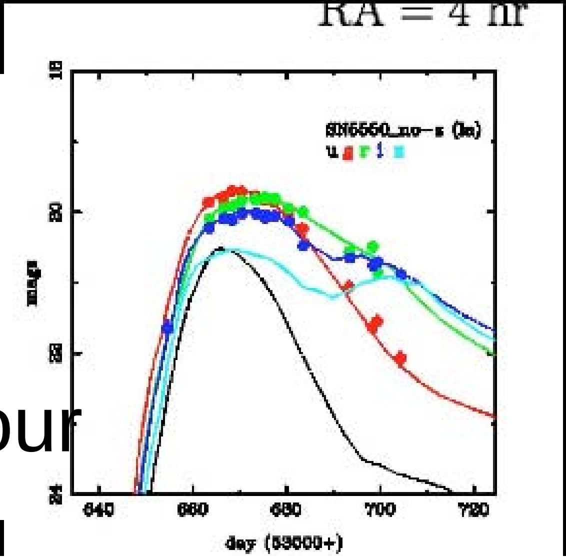
56 sec to cross a chip

SNe Survey

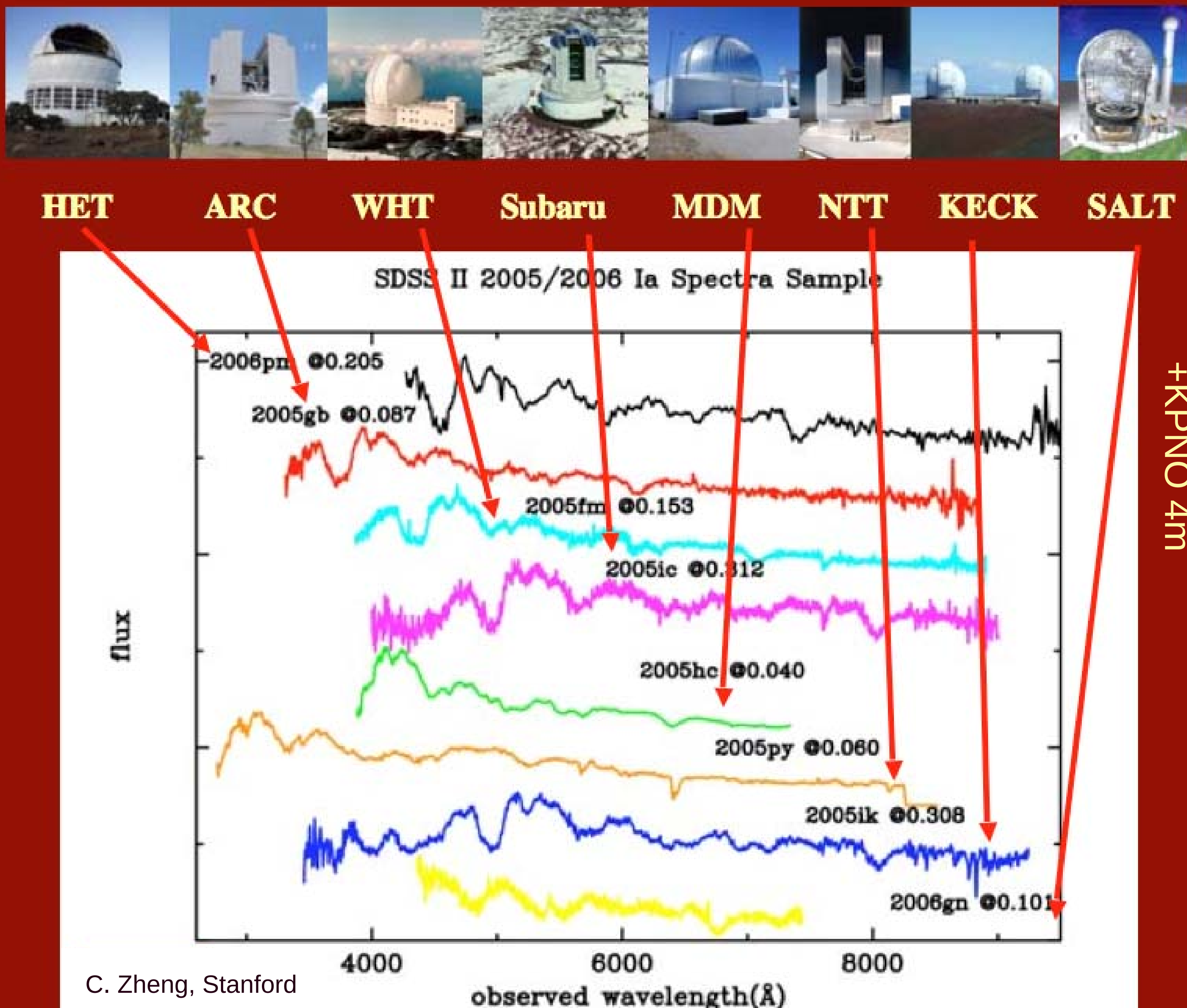


Drift scanning is very efficient: no readout time or filter changes.

SDSS scans at 20 square degrees/hour



SDSS SN Spectroscopy



After Two Full Innings…

Scans processed at APO during the day including template subtraction and initial residual identification.

Template is created from ~10 good seeing scans taken before 2004.

Hand-scan (humans) within
24 hours:

bad subtractions (dipoles)
asteroids (slow moving)
ghosts near bright stars

Number of bad candidates greatly reduced in 2006=> color filter on asteroids and wait for two epoch

	2005	2006
nights on 2.5m	59	60
runs	73	90
objects scanned	190,020	14,441
SN candidates	11,385	3694
confirmed SN Ia	**129**	**193**
probable SN Ia	**16**	**15**
SN Ia host z	**80**	**0**

improved "junk" filter; trained with 2005 data.

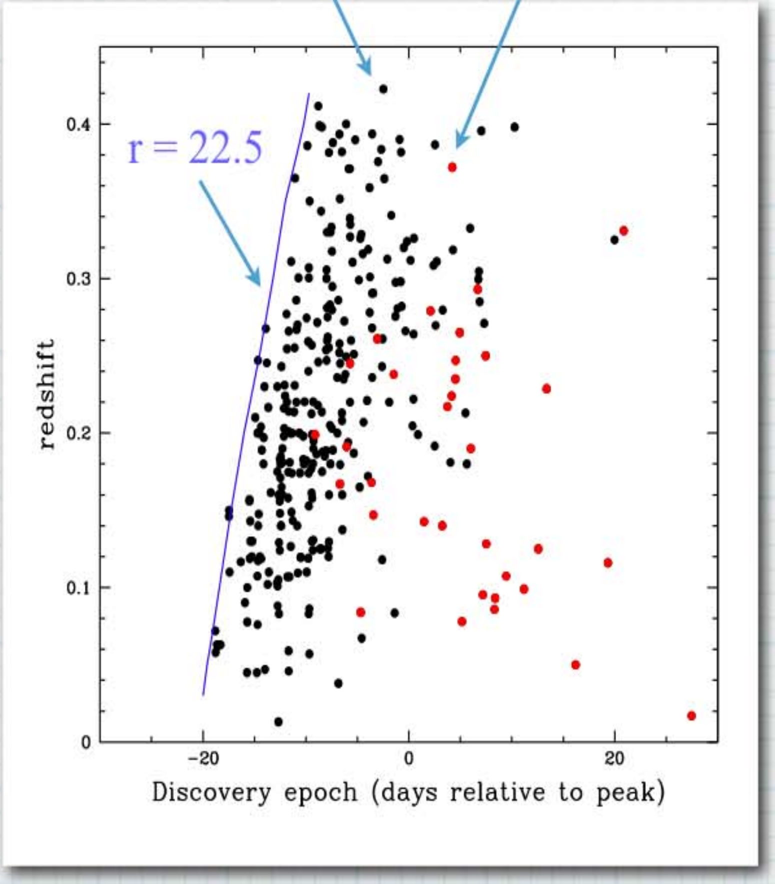
322 SN Ia in two seasons!

Expect ~500 spec confirmed total in 3 years

> 50% of 2005 frames are ***not*** survey quality.

2005 & 2006 Seasons Detect transients to r=22.5

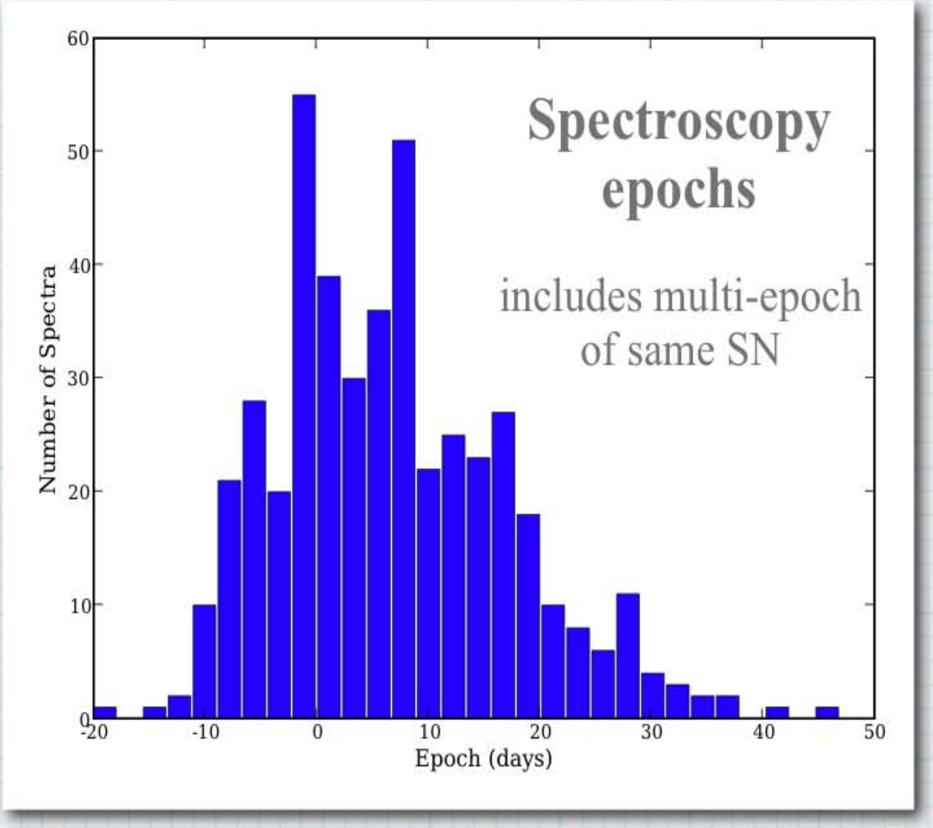
peaked after Sept. 7   peaked before Sept. 7



J. Frieman

> 85% of SN Ia discovered before maximum light

Follow-up spectrum usually obtained after **~2 - 4 epochs** (~90% confirmation efficiency for SN Ia).

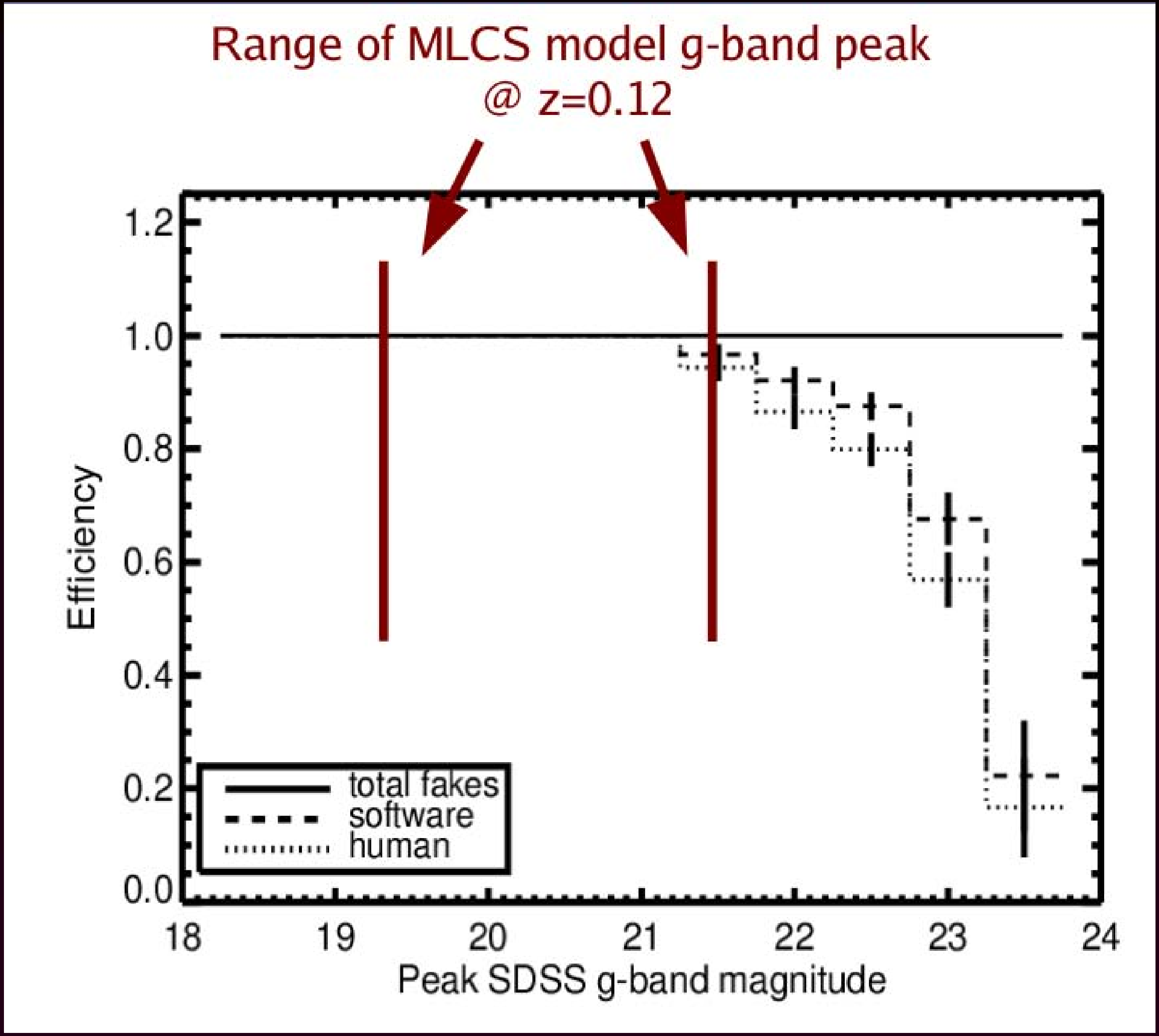


A. Becker

also attempted **20 single-epoch** candidates (**15** SNe, **1** galaxy, **2** noise, **2** asteroids)

Efficiency of Finding Fakes

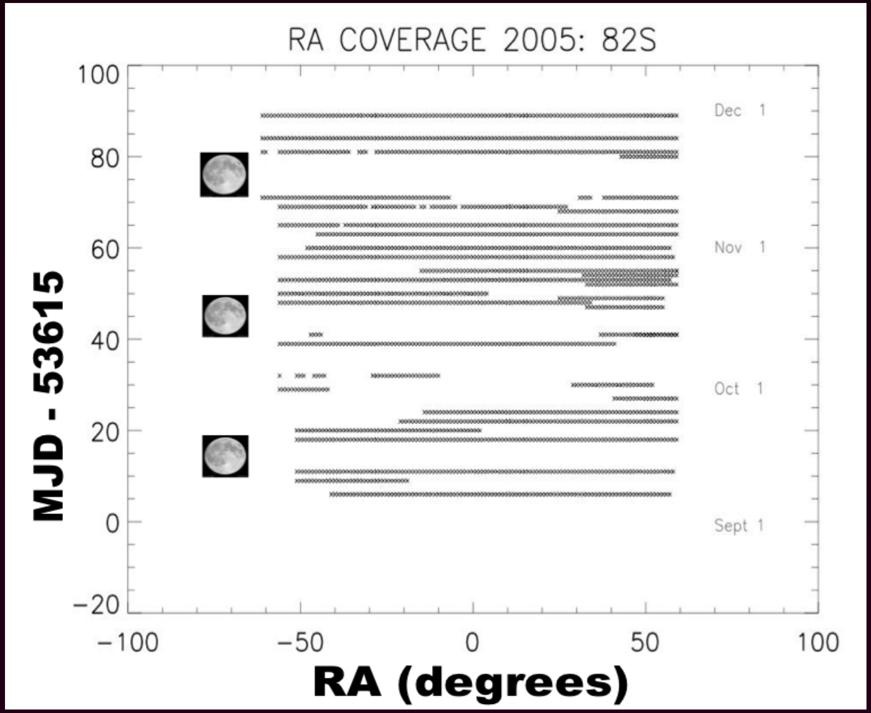
100% at g<21.3 50% at g=23.3 (includes fakes in host core

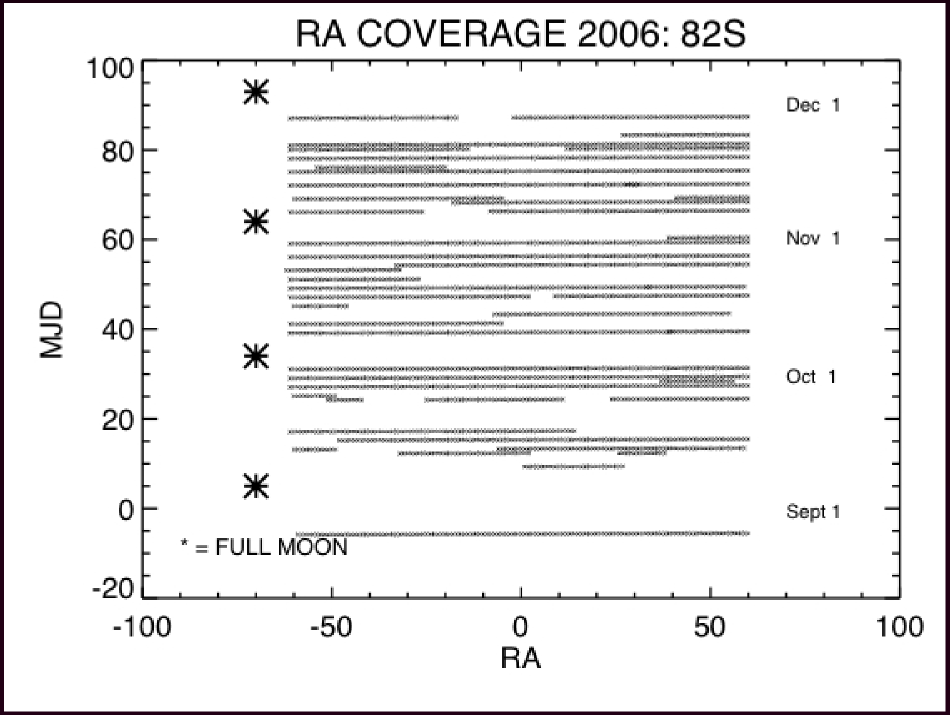


Ben Dilday

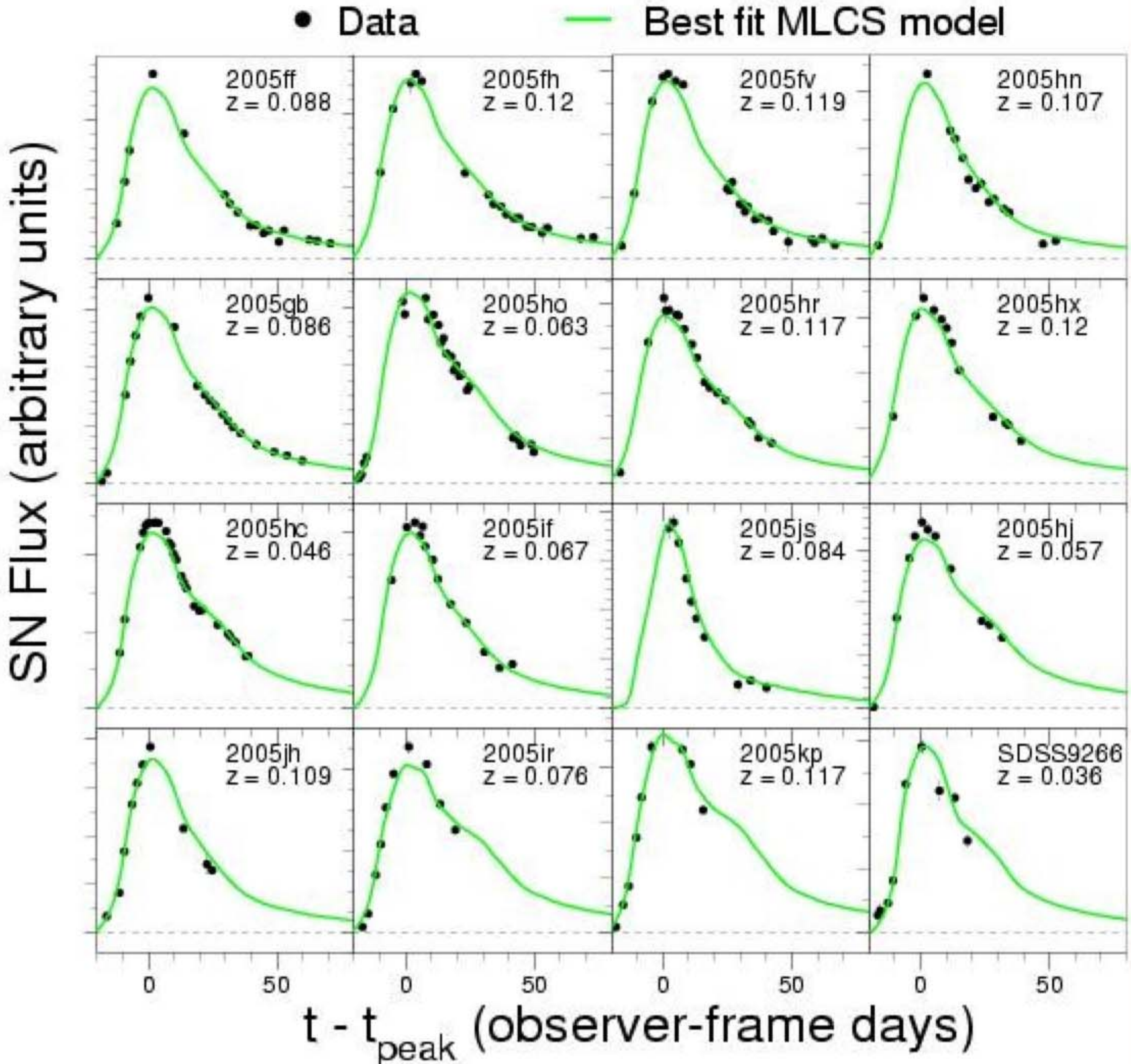
SDSS SN Search Properties

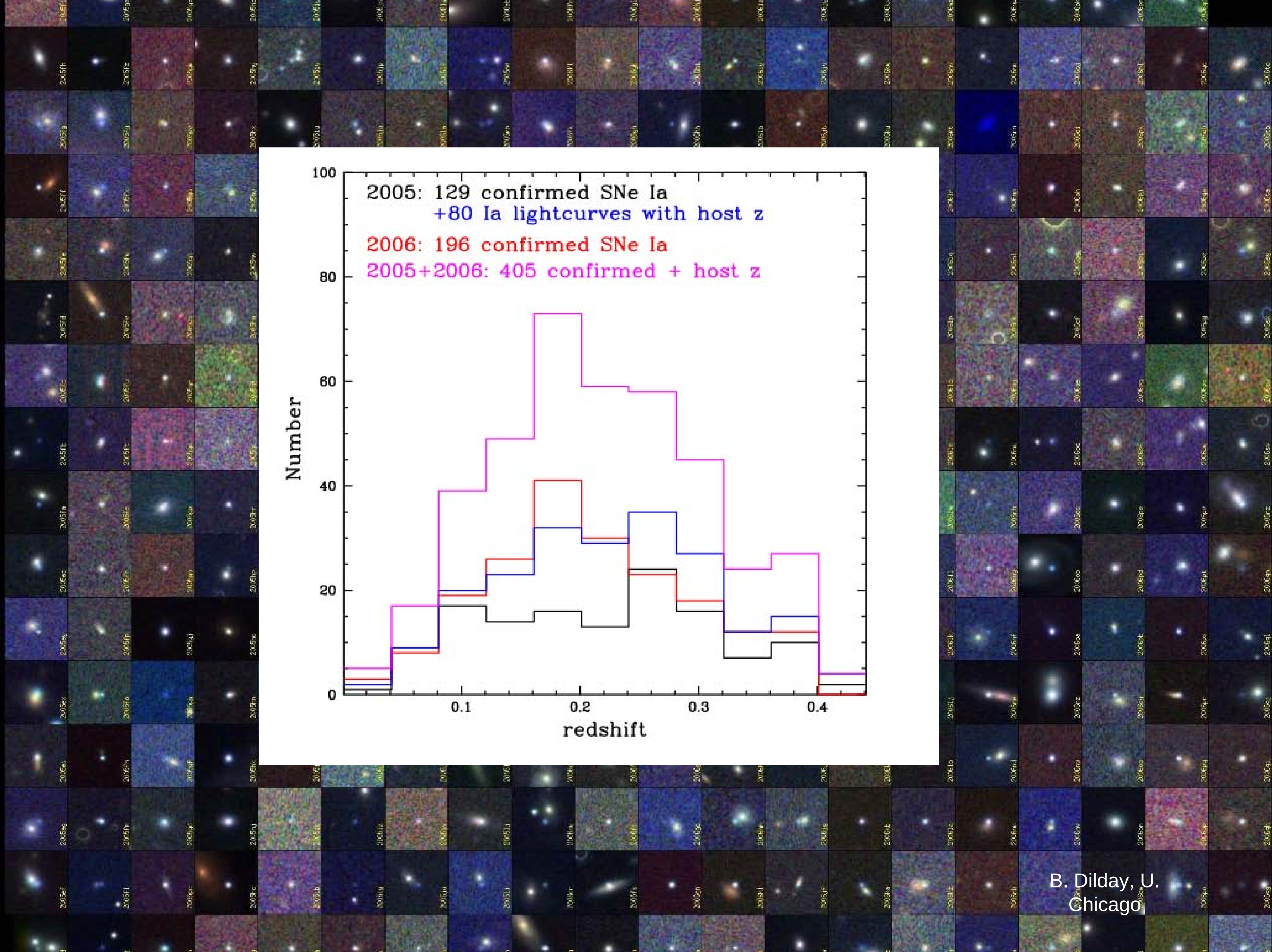
- 3 months/year for 3 years (two down, one to go)
- Pointless/democratic (volume) search
- 280 square degrees search area (stripe 82N + 82S)
- cadence: every other day
- ugriz simultaneously - but u and z only useful for bright Sne
- Excellent photometric calibration using SDSS natural system
- transient detection at r=22.5 mag
- galactic latitude > 30 deg
- image scale 0.4 arcsec/pix





r-band Gallery of Low-Z Lightcurves

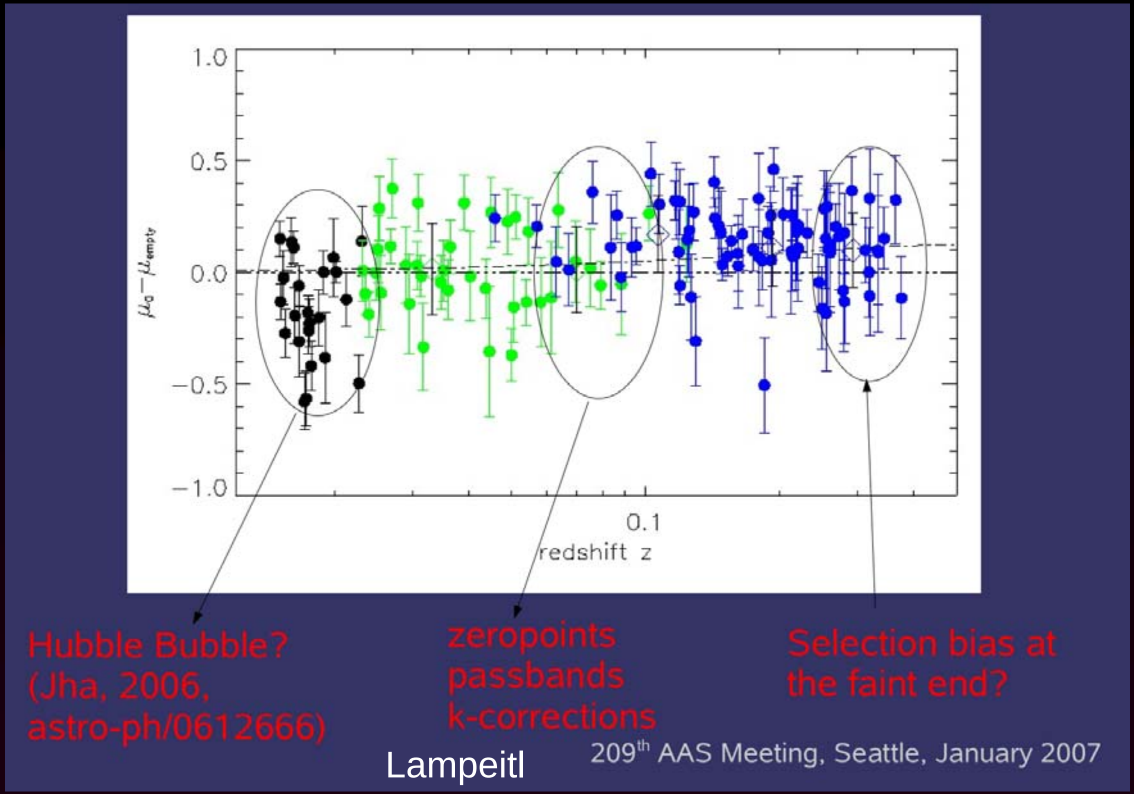


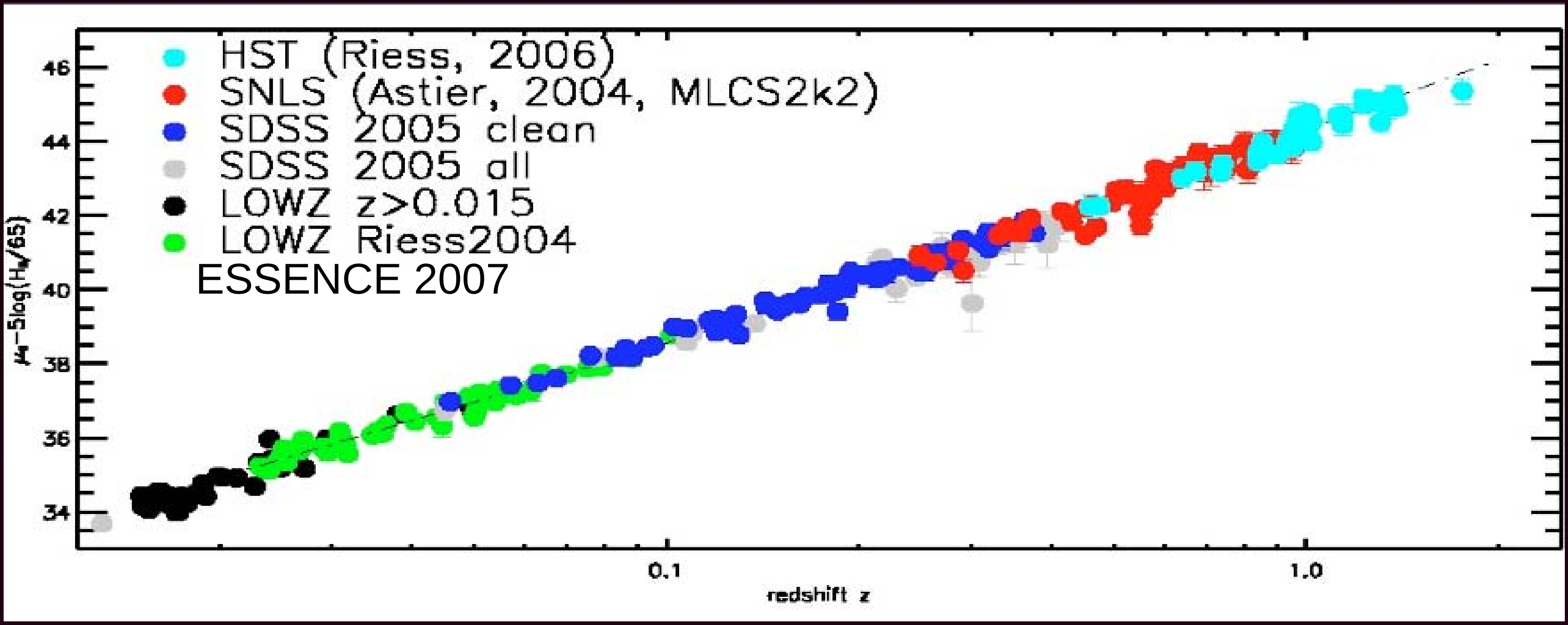


2005: 129 confirmed SNe Ia
+80 Ia lightcurves with host z
2006: 196 confirmed SNe Ia
2005+2006: 405 confirmed + host z
Number
redshift
0
20
40
60
80
100
0.1
0.2
0.3
0.4
B. Dilday, U. Chicago

SDSS SN Hubble diagram
from fall 2005 data
129 SN Ia in all, 74 “clean”
SN Ia for cosmology
(cuts on number of epochs and
epochs around maximum)

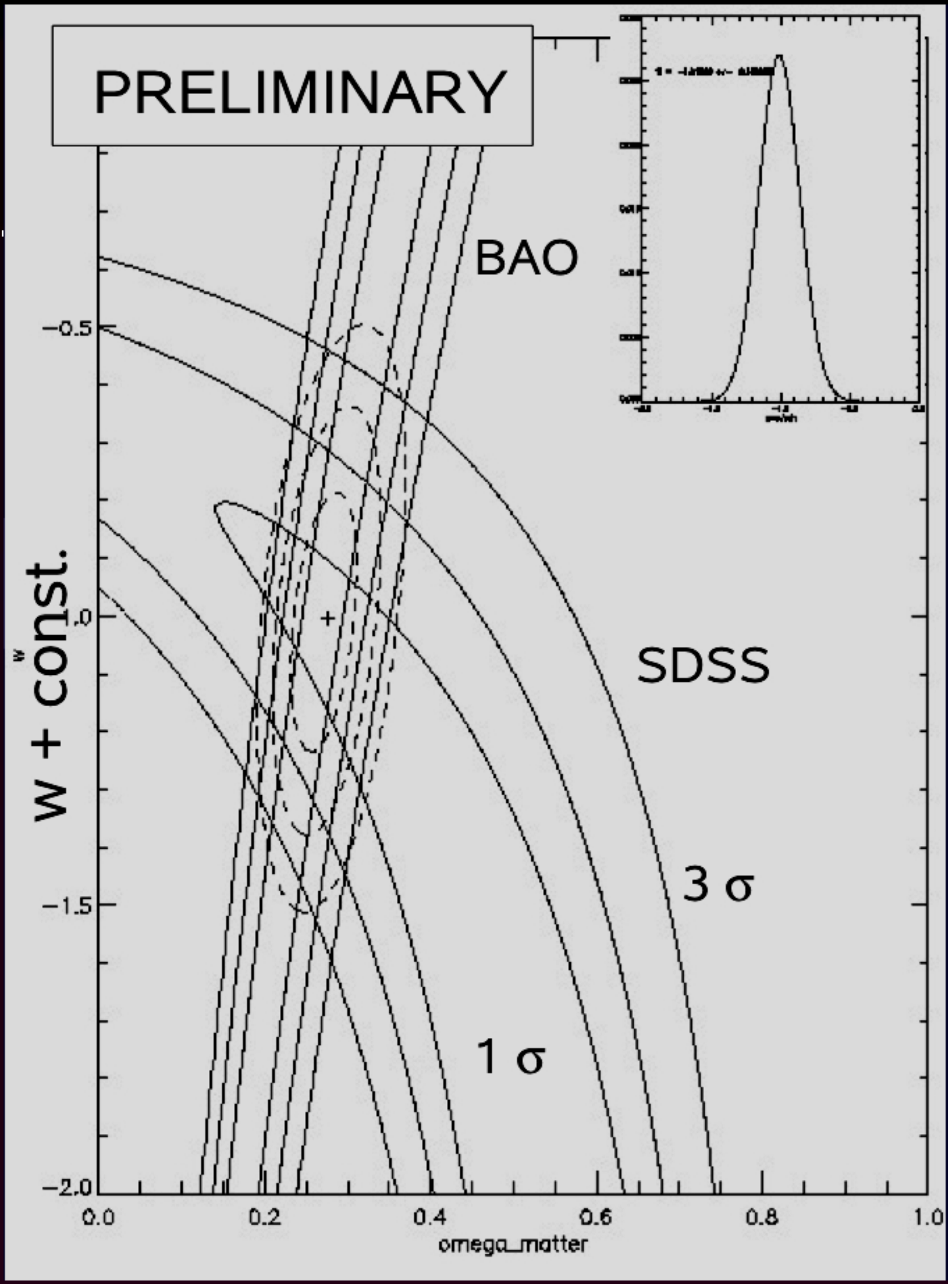
for the first time we have a
continuous expansion history
measured from SN to z > 1





SDSS SN Survey Status

- Preparing initial year papers on cosmology, rates, photometry, hosts…
- Extensive simulations to check for systematics
- Developing a new light curve fitting program - MLCS-like with flux fitting
- Simulate other surveys (SNLS, ESSENCE, Higher-Z) to check their systematics and make uniform Hubble diagram
- Preparing for final season in the fall



Dark Energy Survey - DES

The Dark Energy Survey♣

T. Abbott[1], G. Aldering[2], J. Annis[3], M. Barlow[4], C. Bebek[2], B. Bigelow[5], C. Beldica[6], R. Bernstein[5], S. Bridle[4], R. Brunner[7], J. Carlstrom[8,9], M. Campbell[10], F. Castander[11], C. Cunha[8,9], H. T. Diehl[3], S. Dodelson[3,8], P. Doel[4], G. Efstathiou[12], J. Estrada[3], A. Evrard[10], E. Fernández[13], B. Flaugher[3], P. Fosalba[11], J. Frieman[3,8,9], E. Gaztañaga[11], D. Gerdes[10], M. Gladders[8,14], W. Hu[8,9], D. Huterer[8,9], B. Jain[15], I. Karliner[16], S. Kent[3,8], O. Lahav[4], M. Levi[2], M. Lima[8,9], H. Lin[3], P. Limon[3], M. Martínez[13], T. McKay[10], R. McMahon[12], K. W. Merritt[3], C. Miller[1], J. Miralda-Escude[11], J. Mohr[7,16], R. Nichol[17], H. Oyaizu[8,9], J. Peacock[18], J. Peoples[3], S. Perlmutter[2], R. Plante[6], P. Ricker[16], N. Roe[2], V. Scarpine[3], M. Schubnell[10], M. Selen[16], E. Sheldon[8,9], C. Smith[1], A. Stebbins[3], C. Stoughton[3], N. Suntzeff[1],W. Sutherland[12], M. Takada[19], G. Tarle[10], M. Tecchio[10], J. Thaler[16], D. Tucker[3], S. Viti[4], A. Walker[1], R. Wechsler[8,9] , J. Weller[3,4], W. Wester[3]

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DES Outline

- Improved CTIO 4m
- 5000 square deg South Gal. Cap
- New camera with 3 sqr deg FOV
- griz filters
- Supernova search/ weak lensing cluster abundance/ clustering
- Observations begin 2009
- 5 year survey (525 nights total)

Blanco CTIO 4m

Baseline DES Supernova Survey

- 10% of time for SN search (~50 nights/5 yrs)
- SNIa 0.25<z<0.75 200s r, 400s i, 400s z
- 40 sqr deg SN search
- cadence: 3 days in r, 6 days in i/z
- 2000 SNIa in 5 years
- Limited spectroscopic follow-up
- redshifts from SN light curves and host colors

DECam

Median seeing: 0.65” site

0.9” delivered