SDSS-II Supernova Survey

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Presented at the "EDEN in Paris" Workshop

Dec 9, 2005

SDSS II Institutions and Supernova Collaboration

SDSS II Supernova Survey Institutional Members:
American Museum of Natural History, Astrophysical Institute Potsdam, Cambridge University, University of Chicago, Fermi National Accelerator Laboratory, Japan Participation Group, Johns Hopkins University, Joint Institute for Nuclear Astrophysics, Stanford KIPAC, Korean Scientist Group, LAMOST Los Alamos National Laboratory, Max- Planck Institute for Astrophysics/Garching New Mexico State University, Ohio State University, Princeton University US Naval Observatory, University of Washington.

SDSS Supernova Program Includes Collaborators from:
Apache Point Observatory, Space Telescope Science Institute, Penn State, Rochester Institute of Technology, South African Astronomical Observatory, University of Portsmouth, University of Texas, University of Goettingen, University of Munich

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Science

- Explore Hubble diagram in sparsely populated redshift region (<0.1 - 0.4);   goal is 200 well-measured SN1a lightcurves in 3 years.

- Complement deeper surveys.

- Study systematics of d_L from SN1a.
(with unique low-z to mid-z sample)

- u-band templates for z>1 surveys.

- Collect spectra to study K-corrections.

- Collect SN types Ib,Ic,II (and peculiar/rare).

- Measure SN rates vs. z.

Science

135 Confirmed SN1a in three months !

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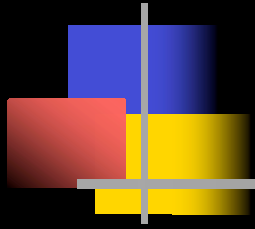
- Measure SN rates vs. z.

Overview of Survey

(Sep 1 - Nov 30, 2005, 2006, 2007)

- Alternate each night between 82N and 82S (300 sq deg coverage)
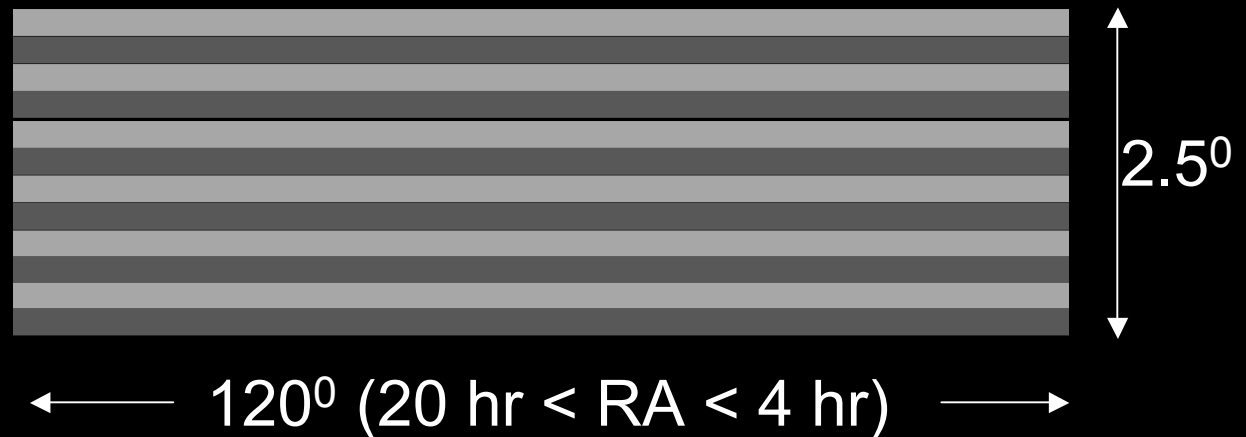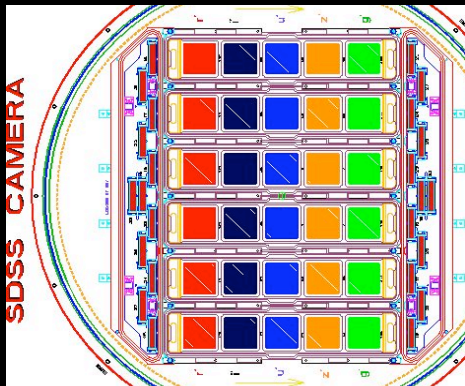- Image in drift-scan mode

30 2k x 2k CCDs, 0.4'' resolution

2.5^0

$\longleftarrow$ 120^0 (20 hr < RA < 4 hr) $\longrightarrow$
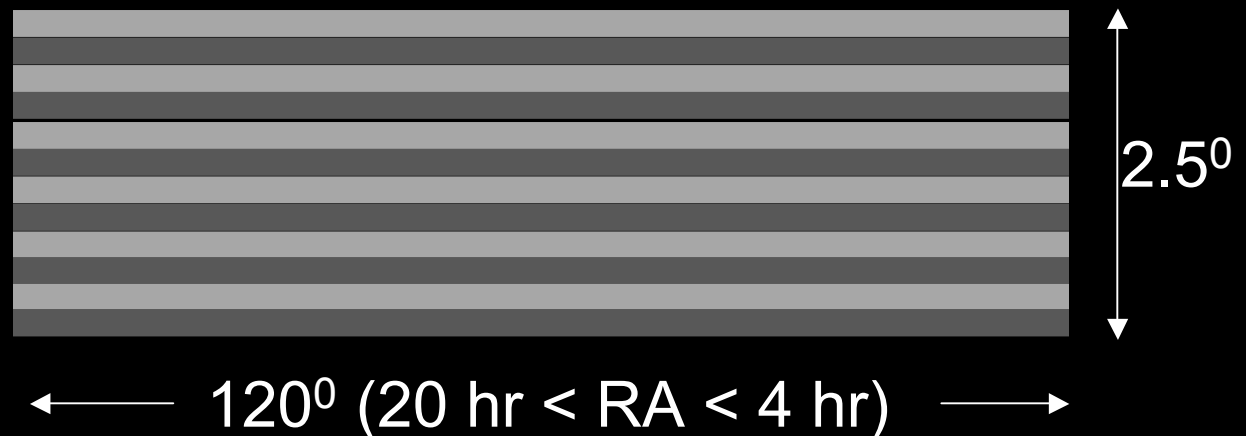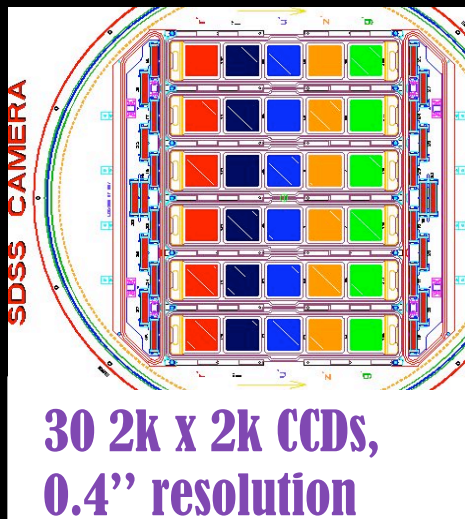
Overview of Survey

(Sep 1 - Nov 30, 2005, 2006, 2007)

just finished 1st season
=> subject of this talk

- Alternate each night between 82N and 82S (300 sq deg coverage)
- Image in drift-scan mode

2.5^0

120^0 (20 hr < RA < 4 hr)
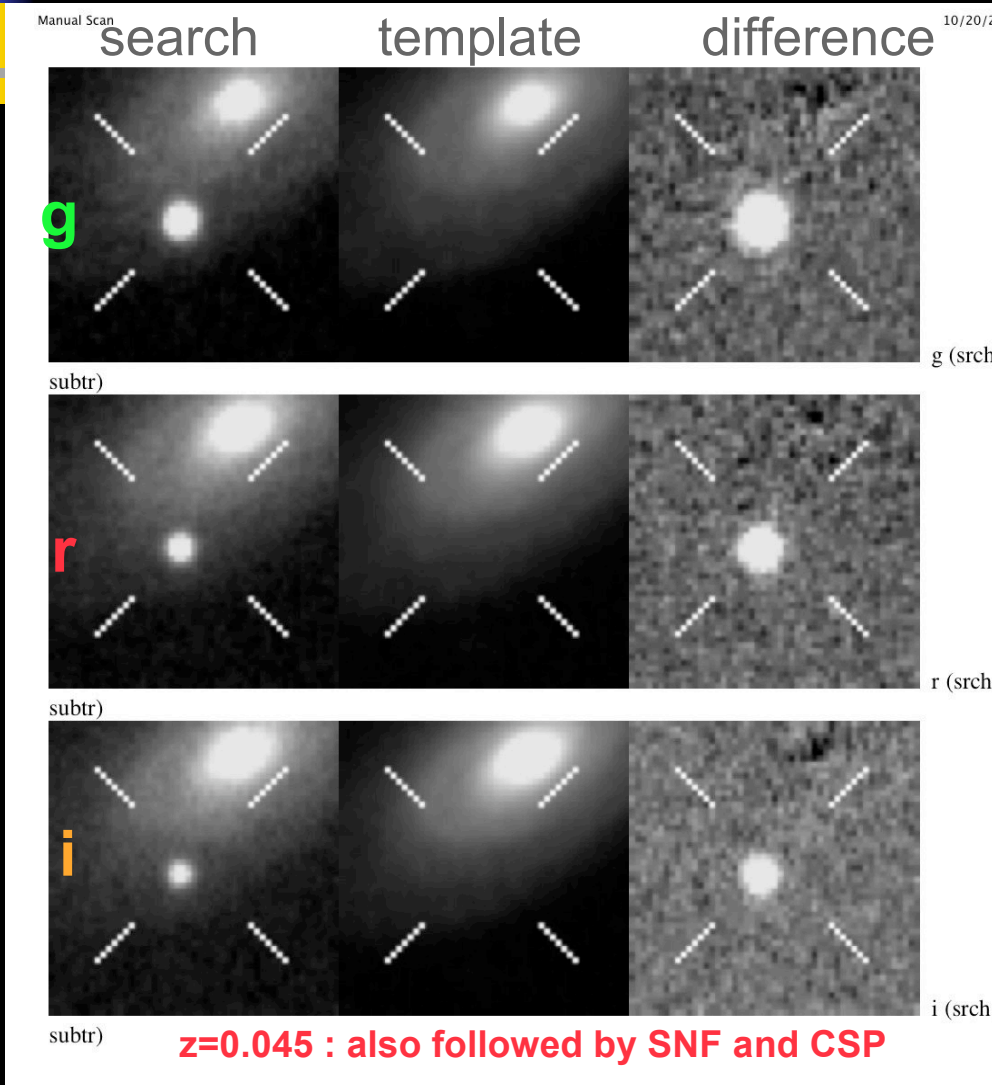
The SDSS 2.5m Telescope

- 2.5m primary

- ugriz filters

- ~ 1 minute exposures

- Location: Apache Point Observatory in New Mexico (3000 m altitude)

- DA was upgraded in summer 2005 (includes data → disk   instead of tape)

- Substantial non-SDSS resources (later in talk)

Data Reduction for Survey

- Data are reduced and image-subtracted at APO using ten dual-CPU servers with 8 Tb disk space.

- Subtractions in g,r,i

- Full night processed in < 20 hrs

- Results copied to FNAL for human scanning

- u,z 'forced photometry' done next day on SN candidates found in scanning gri

    (apply u-g cut to distiguish Type I, II)

Scan Example

Manual Scan
search   template   difference 10/20/

g

subtr)   g (srch

r

subtr)   r (srch

i

subtr)   i (srch

z=0.045 : also followed by SNF and CSP

To appear on scan-page requires the difference image for at least two filters to have sig/noise > 3 and to be within 0.6'' .
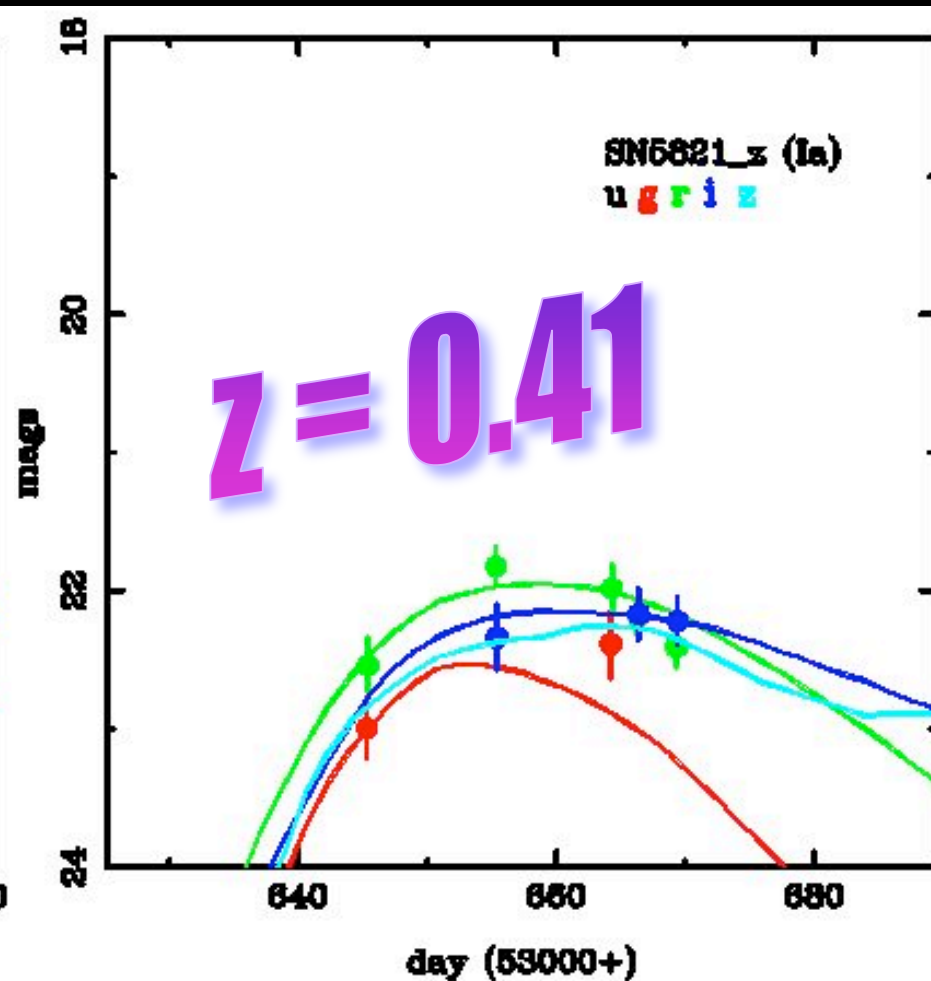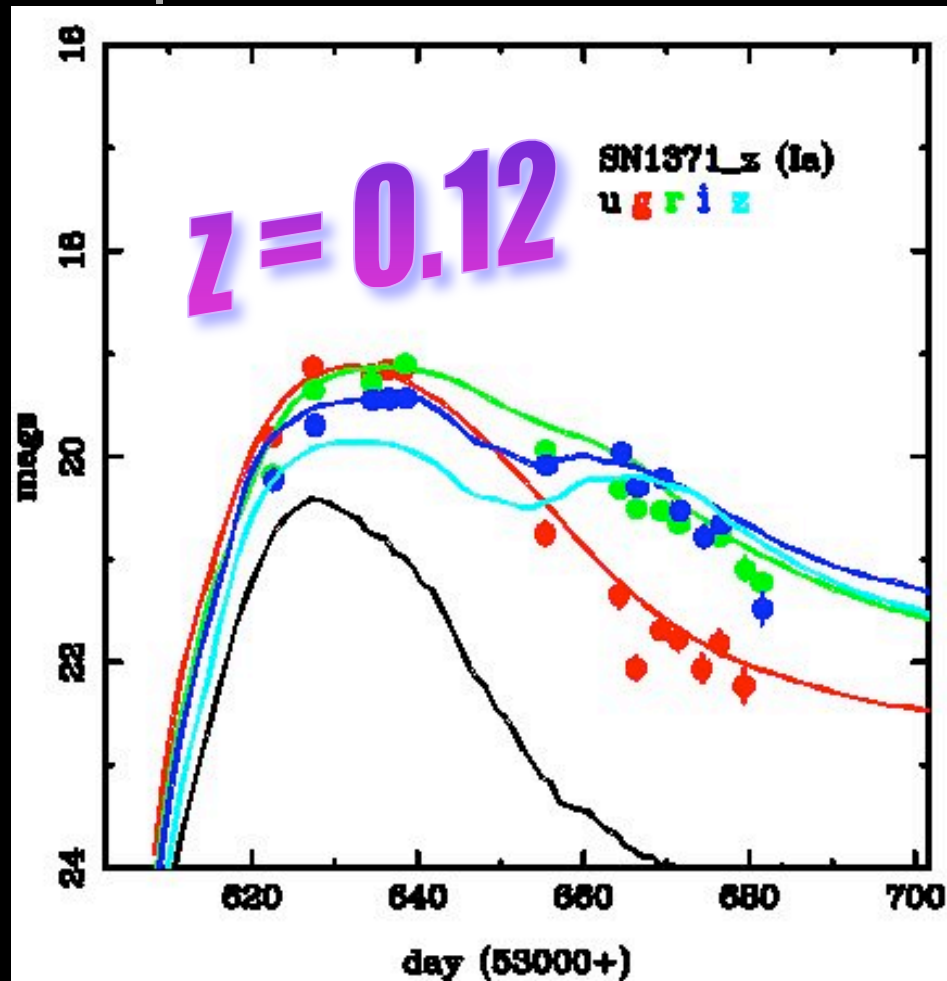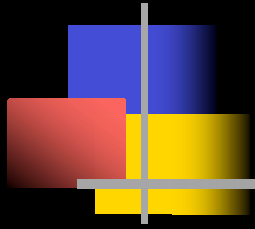
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Lightcurve Fits

Each SN scan-tag gets a mult-band lightcurve fit to Ia, Ibc, II: crucial for selecting objects for spectro follow up
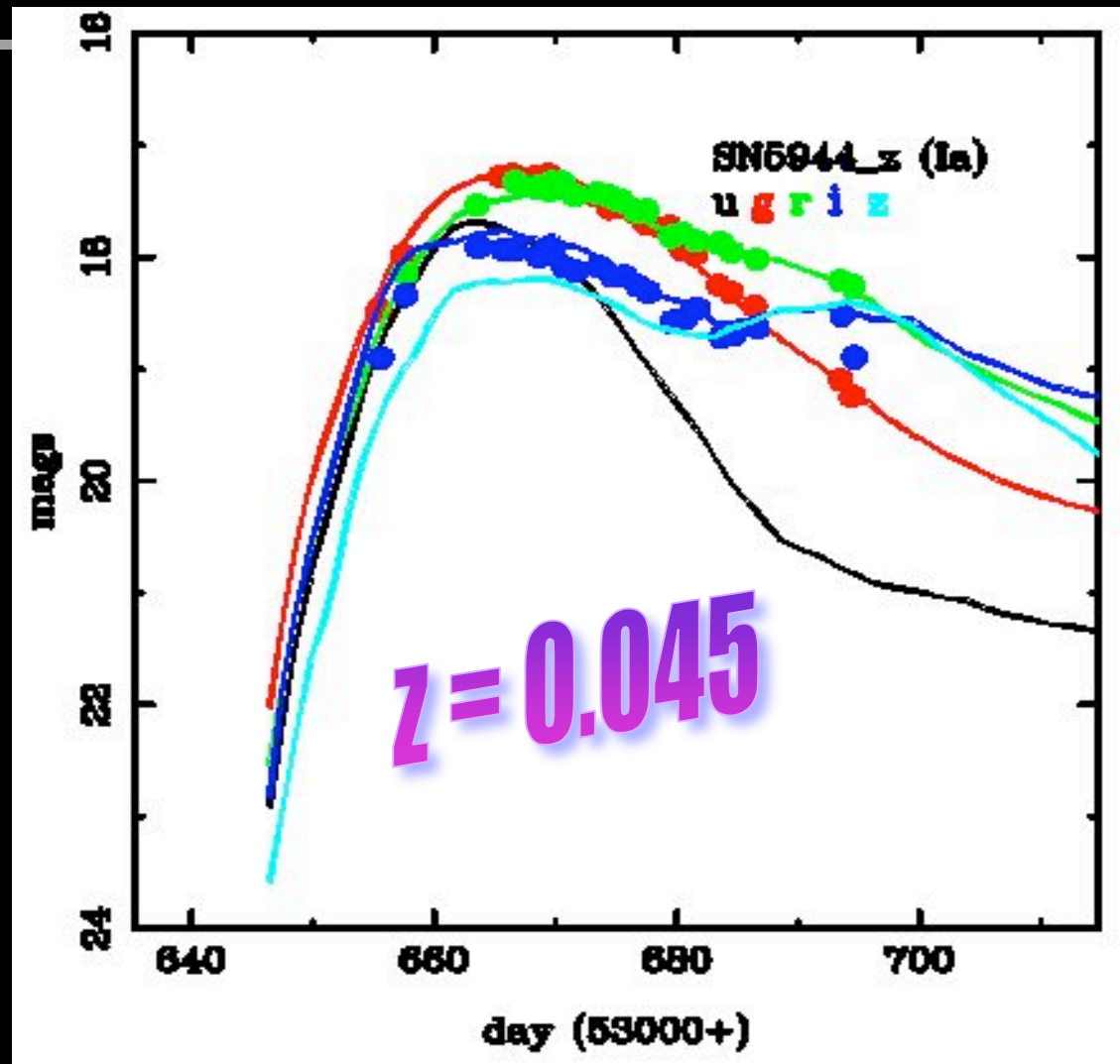
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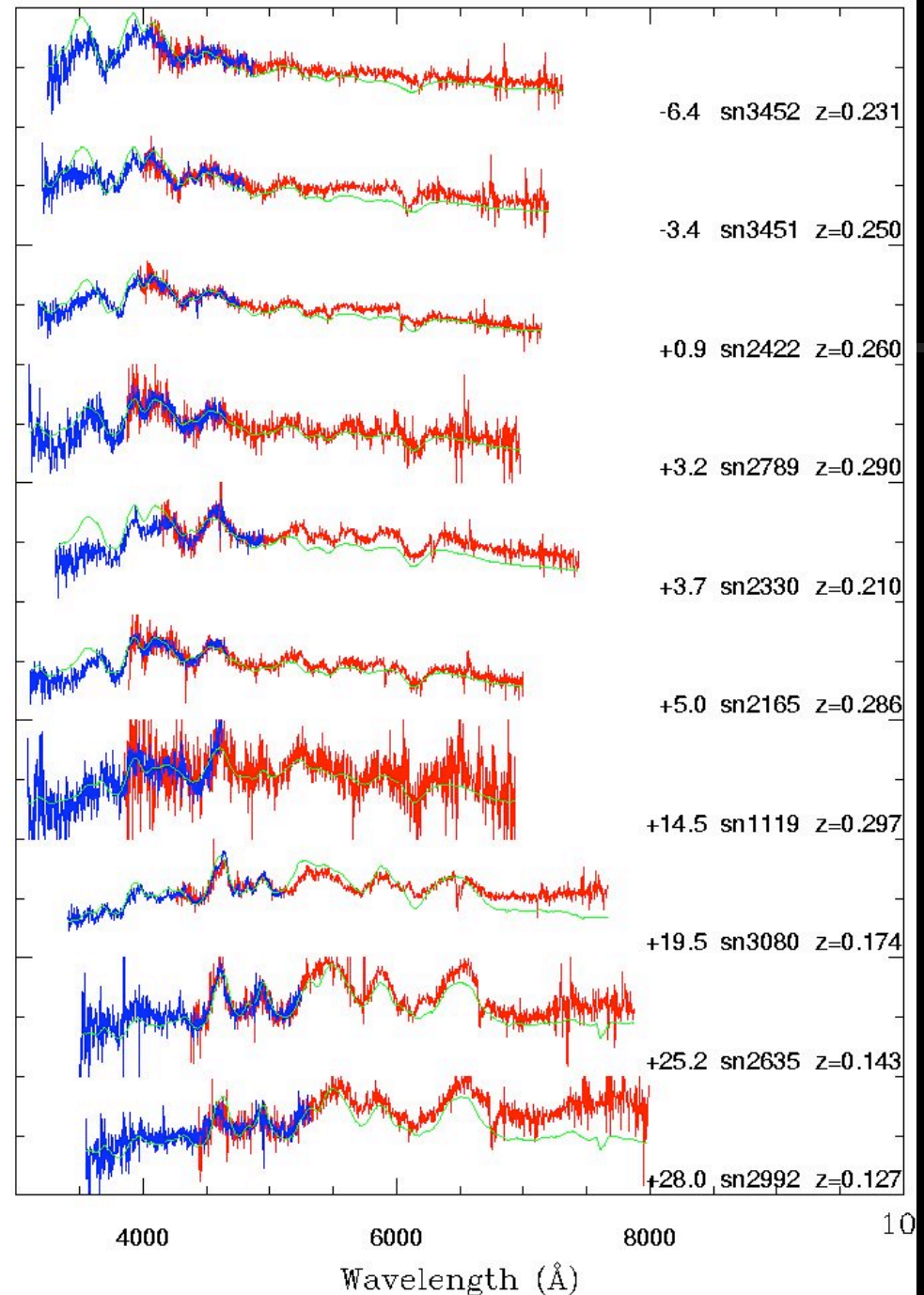
Follow-up
spectra
from
HET,
Subaru,
WHT,
ARC 3.5m,
MDM,
Keck

2005 Data Overview (no cuts)

off the mark by Mark Parisi
www.offthemark.com
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MarkParisi@aol.com

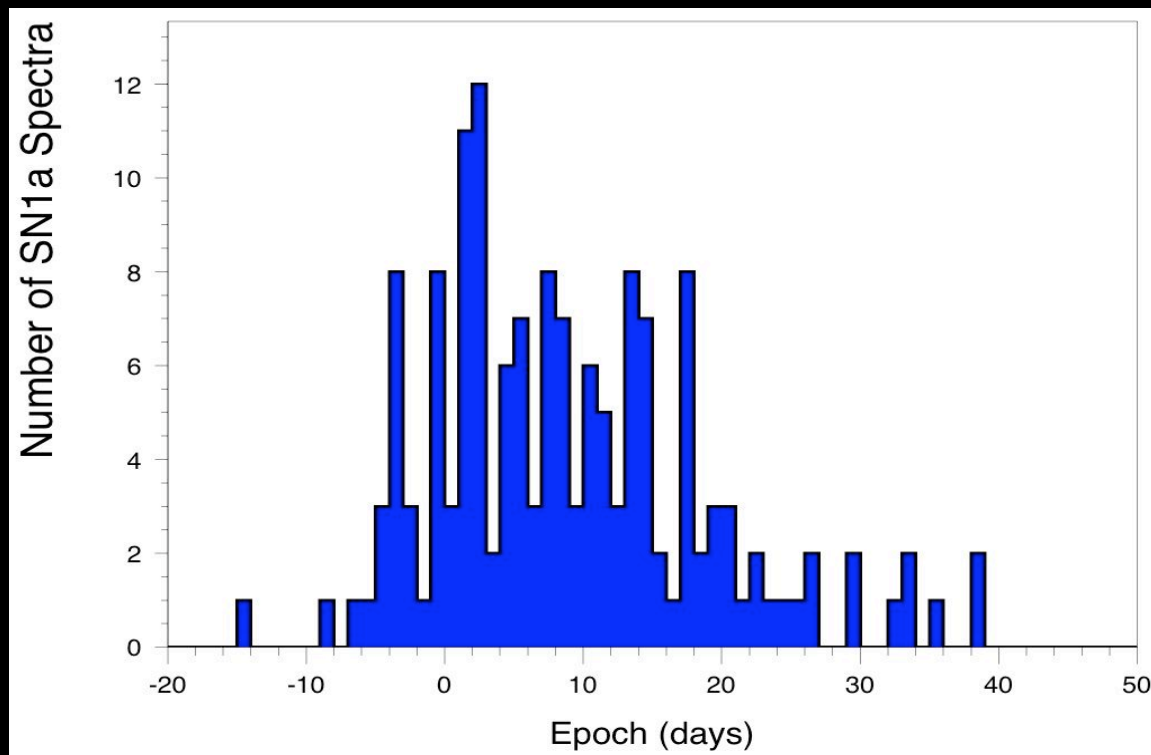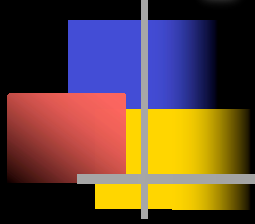| Objects scanned by humans	165,000 (~4000 / night)
SN tags (candidates)	26,000 (12,000)
reasonable SN lightcurve fit	~ 300
Spectrum taken	190 objects
Confirmed SN Ia	135 (117 with pre-max image)
Confirmed SN other	3 Ib, 3 Ic, 10 II

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2005 Imaging Overview

- 1370 SN1a images with 2.5m
  => ~10 epochs per SN lightcurve.

- ~200 SNe images with non-2.5m to cover bad weather, faint epochs (mag >22) and post-season follow-up: UH88, NMSU 1m, MDM and occasional ARC3.5, VATT, LT, WIYN

2005 Spectra Overview

- ~ 200 total SN spectra:
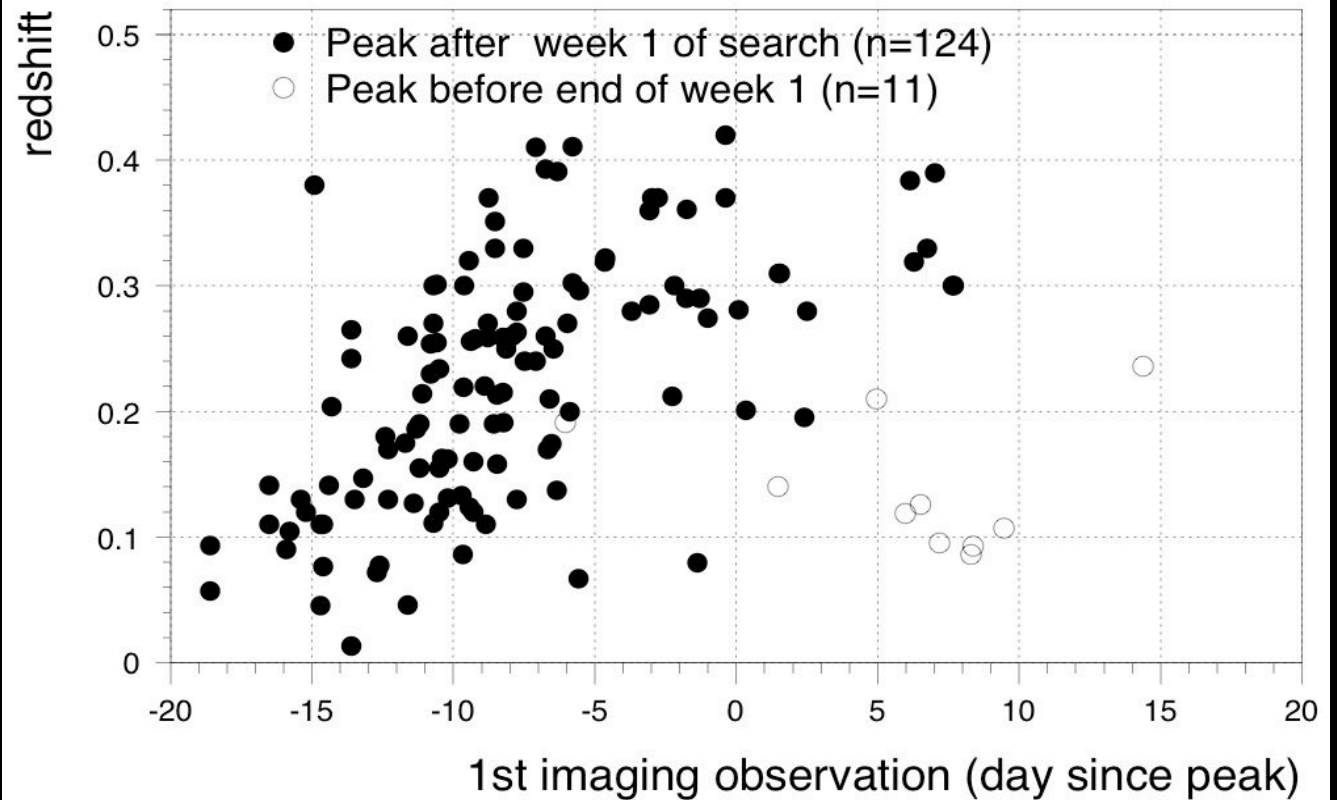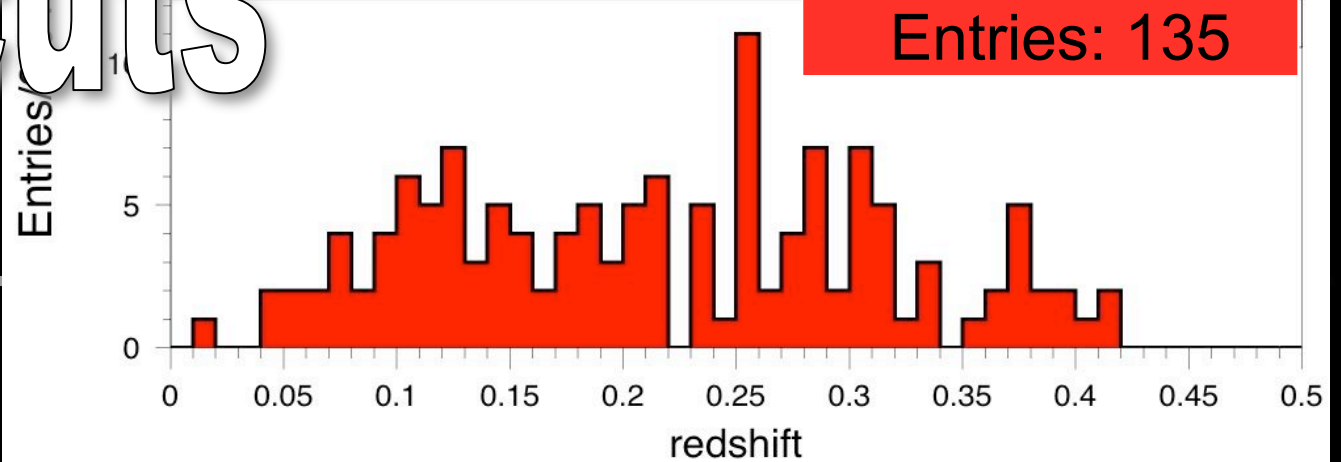HET, Subaru, WHT, ARC 3.5m, MDM, Keck

No cuts

First imaging epoch vs. redshift

(2005 sample)

SDSS Confirmed SN Ia

Entries: 135

Entries/ — redshift

Peak after week 1 of search (n=124)
Peak before end of week 1 (n=11)

redshift
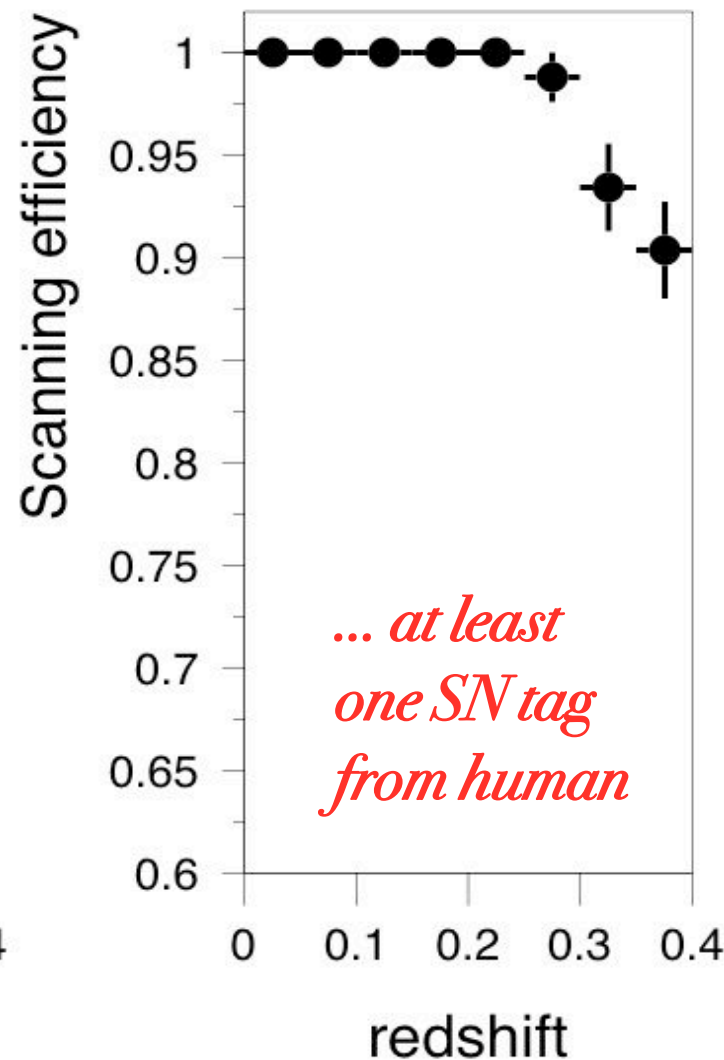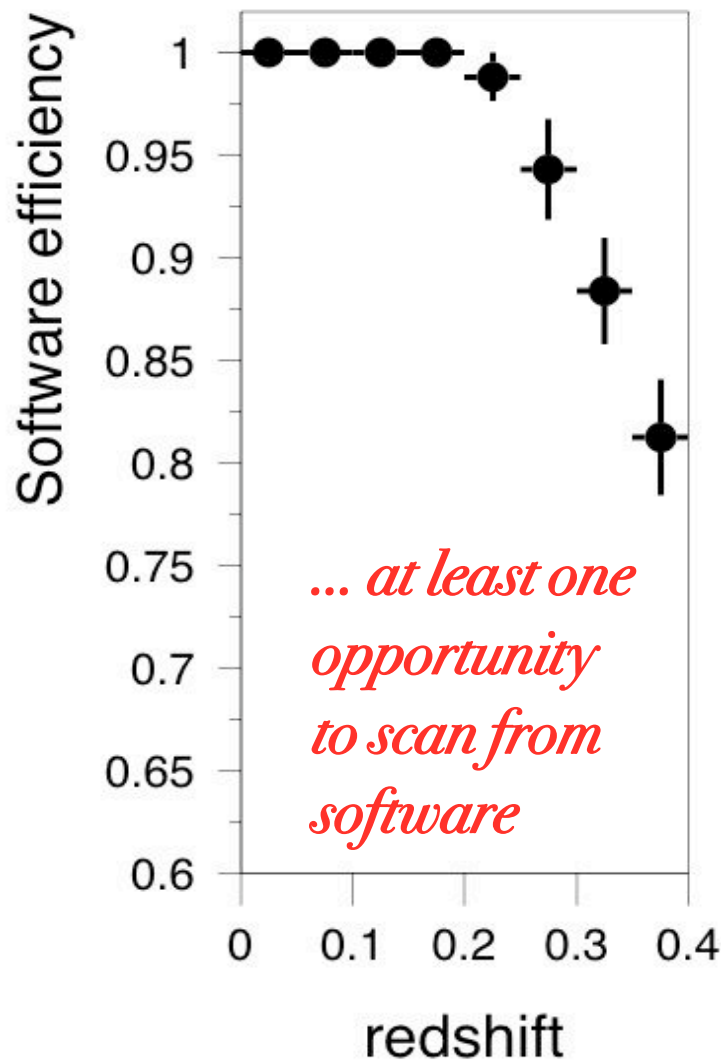
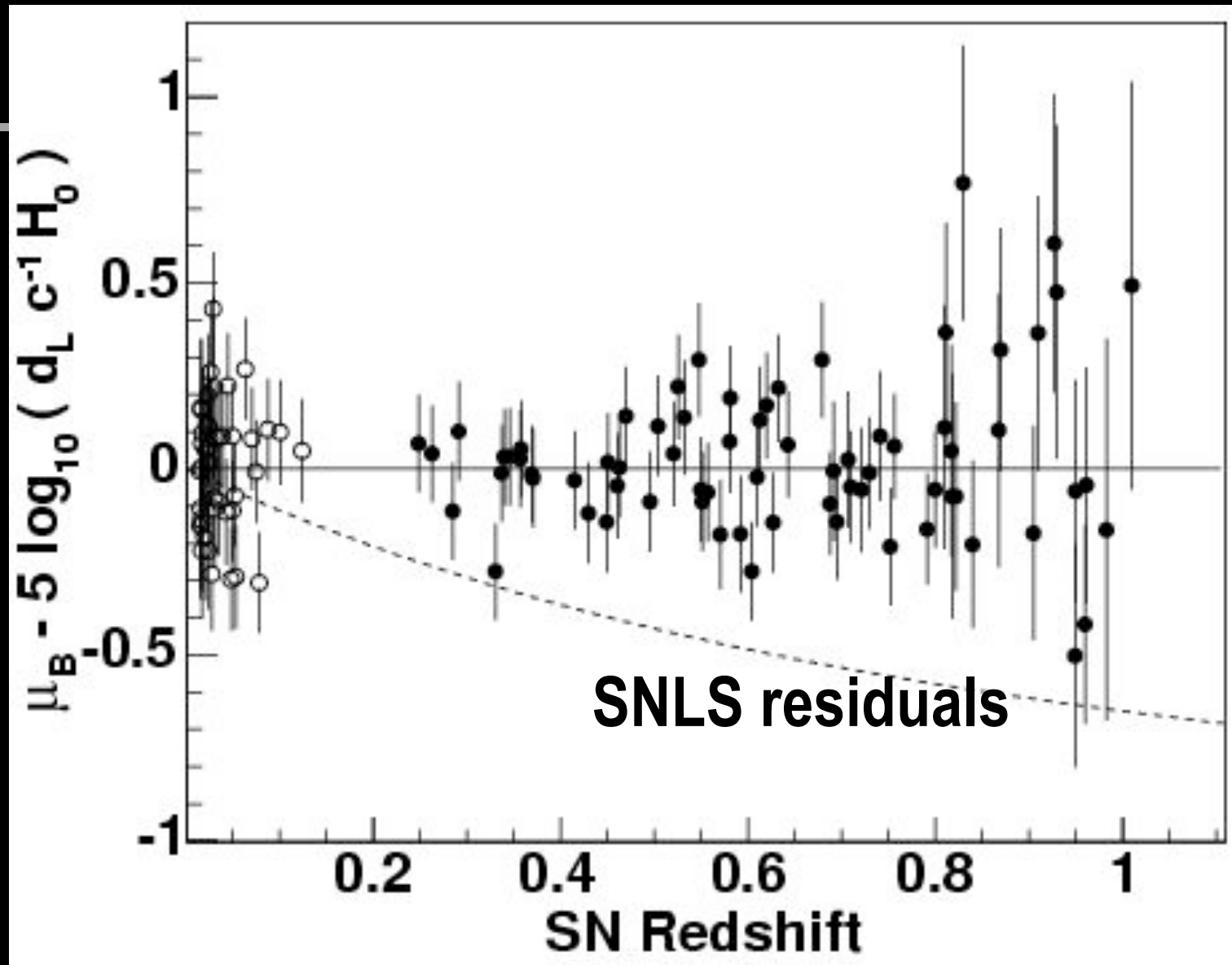1st imaging observation (day since peak)

Fakes

- Fake SNe are inserted into data to track efficiency of software pipelines and human scanning.

- Needed to measure SN rates.

- Keeps scanners alert.

- Still no spectrum requested for a fake !!!
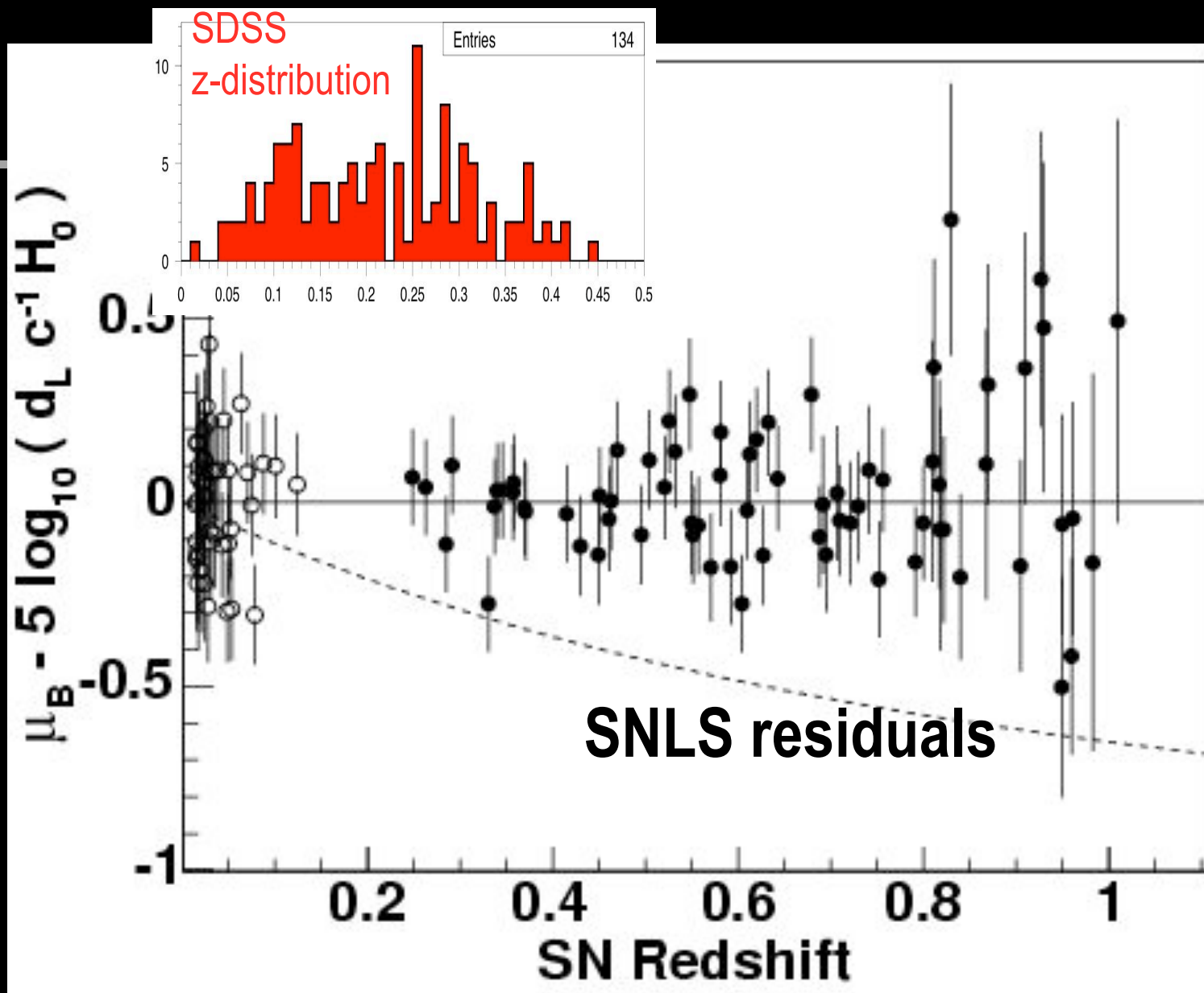
Efficiency for Fake Supernova

... at least one opportunity to scan from software

... at least one SN tag from human

... obtained spectrum after lightcurve fit/selection (in progress)

Potential for Combining SN Programs

SNLS residuals

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Potential for Combining SN Programs

SDSS z-distribution

30-40 low z (1 of 3 years)

Entries 134

SNLS residuals

45 non-SNLS SNe at low z
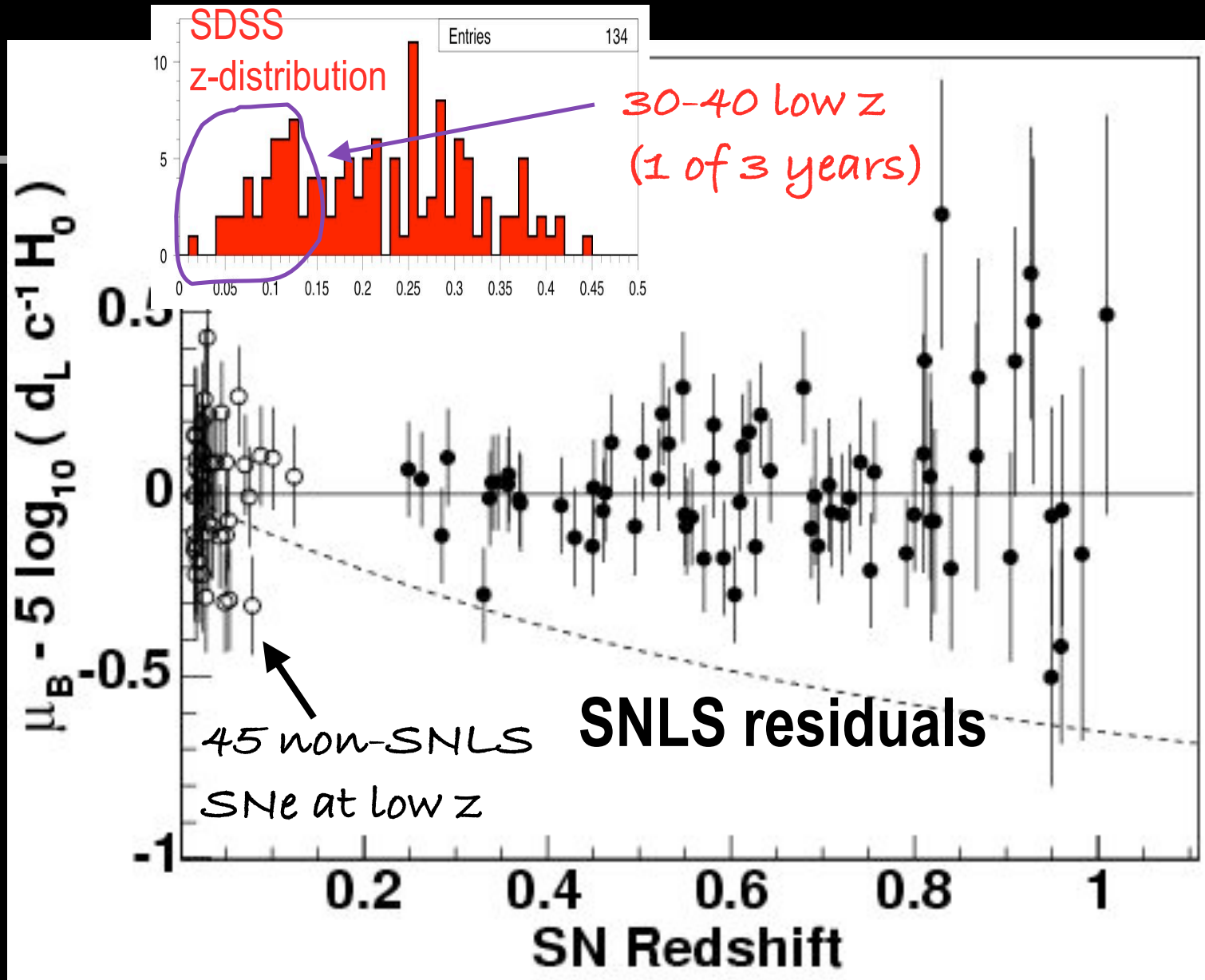
Summary

- Encouraging SN1a yield in 1st year
- Next year plans include:
  - ✿ reduce human scanning
  - ✿ increased follow-up resources
  - ✿ in-situ measure of lightcurve selection eff
  - ✿ improve cross-calibration between SDSS 2.5m and other telescopes/programs