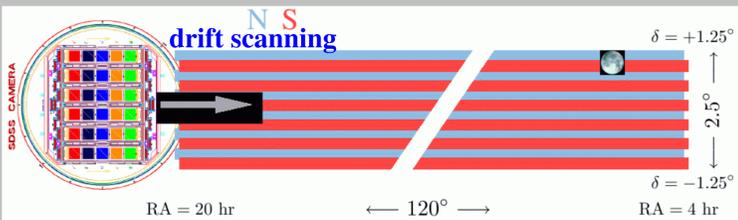


Object Classification and Photometric Supernova Typing in the SDSS-II SN Survey

Ben Dilday, University of Chicago
& SDSS-II collaboration

I. Object Detection

Repeat Imaging of SDSS stripe-82 (N/S)
- 162 sq deg/per night



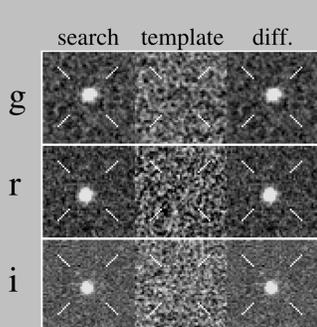
Difference Imaging

- ~85 Gb sdss gri imaging per full night
- reduced in ~20 hrs with 20 CPU compute cluster @ APO

~ 5000-10000
'objects' per full
night

Initial Object Filtering

- require match in 2 bands to 0.8"; removes cosmic rays, noise
- veto known variables



vetoed as moving if g-band
detection is >0.8 arcsec and <3.2
arcsec from r/i detection

215 sec

72 sec

drift scanning mode
fixes time between
observations

FAST MOVER

~ 2000-5000
objects after initial
filtering

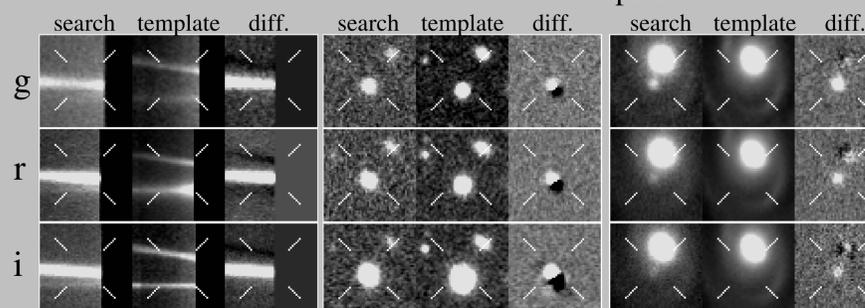
II. Scanning

humans inspect and classify
objects

2005: scan everything
2006: scan bright first epochs,
2nd+ epochs; autoscanning

Year	Objects Scanned	SN Candidates	Confirmed Ias	Scans per SN
2005	190020	11385	129	1473.02
2006	14441	3694	193	74.82

Examples



ARTIFACT

DIPOLE

SN CANDIDATE

Autoscanner

Towards automated object classification

METHODOLOGY:

- use 2005 object attributes + human evaluations as training set
- for new data, search for training objects nearby in observable space
- if region is overdense with e.g. asteroids --> classify as asteroid

CLASSES & OBSERVABLE SPACE:

- asteroids --> (gri magnitudes, offset between filters, angle of apparent motion)
- artifacts --> (extendedness, chi-square fit to PSF, signal-to-noise)
- dipoles --> (negative flux, negative/positive flux ratio)
- variables --> (detection in a previous year)

asteroids/variables vetoed in 2006.

Remaining objects evaluated by human.

In principle can be used to improve
confidence in single-epoch SN discovery
(early spectroscopy, rapid alerts to
community, short-time scale transients).

Majority of moving objects detected by
SDSS-II are not cataloged.

New orbits being cataloged by A. Becker, B.
Dilday, J. Kubica, A. Puckett, A. Rose with
the MPC

NEW FOR 2006

~ 150 - 300
objects per night
for human
scanning
after autoscanning

III. Photometric Typing

- fit light-curve to SN models
- vary A_v , redshift, time of peak, decline rate (for SNe Ia)
- use host galaxy photo-z as a prior (if available)
- Ia: stretch-model; spectral templates from P. Nugent
- Ib/c, II: catalog of light-curves from P. Nugent and SUSPECT database (<http://bruford.nhn.ou.edu/~suspect/index1.html>)
- compare chi-squared values

Spectroscopy

Forced Photometry

YEAR	Ia	Ia (probable)	Other SNe
2005	129	16	18
2006	193	15	26

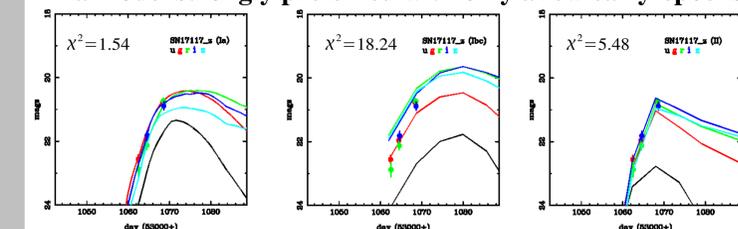
- difference imaging/photometry for
- pre-discovery epochs
- (u,z)-band
- u-band helps distinguish type Ia/II

High efficiency for selecting
Ias

Example

2006qm @ z=0.14

Ia model strongly preferred with only a few early-epochs



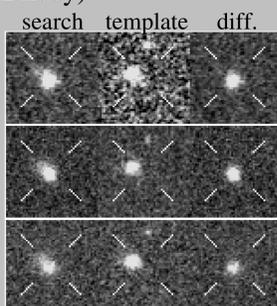
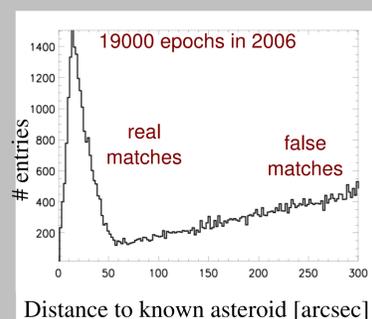
Ia

Ib/c

II

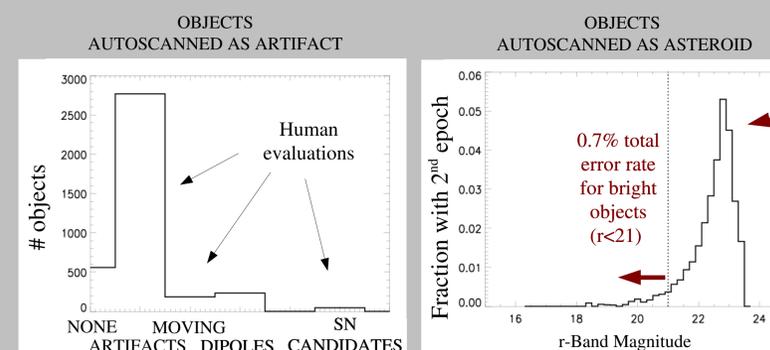
Tracking known asteroids

orbital elements from Harvard Minor Planet Center database¹
+ ephemeris code (B. Dilday)



Minor Planet
(10966)van der Huch

Autoscanner performance in 2006



Astrometric error at
faint mags causes
increased
classification error