The Nearby Supernova Factory

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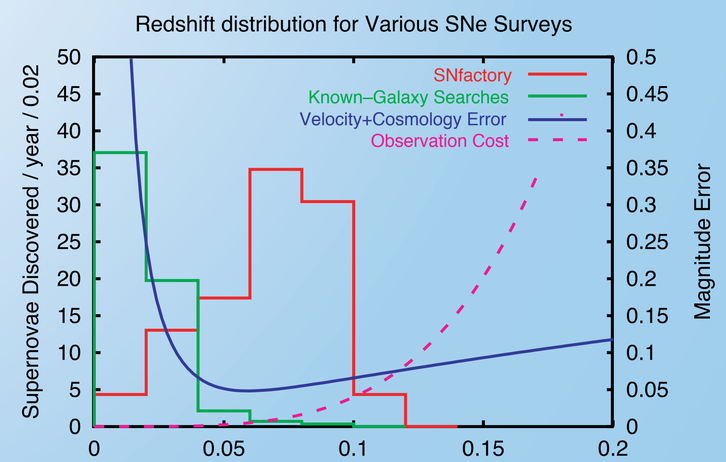
Automated Discovery and Observation of Nearby Supernovae

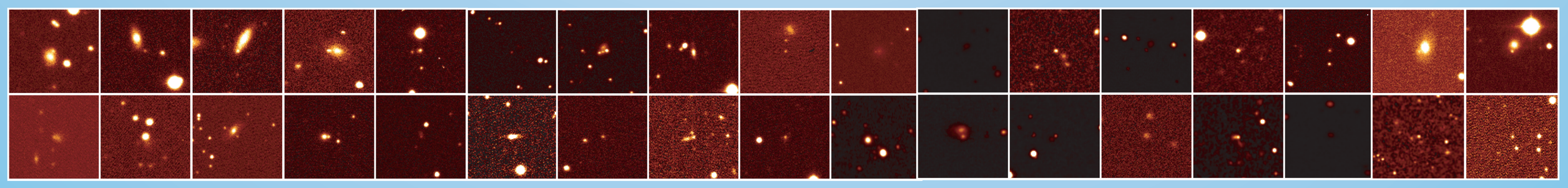
Goals: Improve measurements of □ and *w* by anchoring the low-redshift portion of the SNe Ia Hubble diagram and refining SNe Ia as cosmological distance indicators.

Methods: Discovery and lightcurve spectrophotometry of 300 nearby Hubble flow SNe Ia.

Results: To date, 34 SNe discovered in prototype search:
18 Type Ia, 2 Type Ib/c, 7 Type II, 7 untyped
More than any other first-year effort



The SNfactory will find and study 100 Type Ia supernovae per year in the nearby Hubble-flow (z=0.03–0.08). This is the ideal balance between peculiar velocities and cosmological uncertainty. The SNfactory histogram shown here is scaled from actual 2002 discoveries to 100 SNe/year.

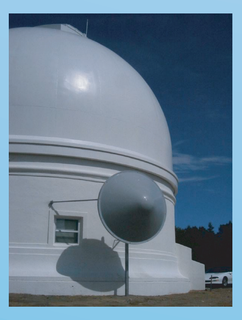


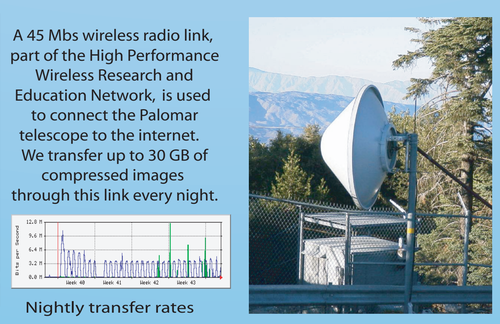
Searching

NEAT Search Facilities

Site:	Haleakala	Palomar I	Palomar II
Aperture:	1.2m	1.2m	1.2m
Nights/Month:	18 dark/gray	18 dark/gray	9 dark/gray
Imager Format:	4k × 4k	3 × 4k × 4k	112 × 2.4k × 0.6k
Imager Scale:	1.33″/pixel	1.01″/pixel	0.87″/pixel
Field of View:	1.5°×1.5°	1.1°×3.4°	2.3°×4.0°
Filters:	open	open	open
Exposures:	3×20 sec	3×60 sec	TBD
Readout:	20 sec	20 sec	40 sec
Nightly Coverage:	300□°	500□°	(1000 □°)
Start:	Mar 2000	Apr 2001	~Feb 2003
Data (compressed):	12 Gbyte/night	40 Gbyte/night	(80 Gbyte/night)

Two search telescopes used by the Near-Earth Tracking Project (JPL, NASA) provide the data for our supernova search. Automated and equipped with wide-field cameras, they cover approximately 500 square degrees per night with a roughly ten day cycle. A new camera, expected to come online in spring 2003, will be able to double the rate of sky coverage. As shown in the figure below, NEAT has covered some 20,000 square degrees of sky.



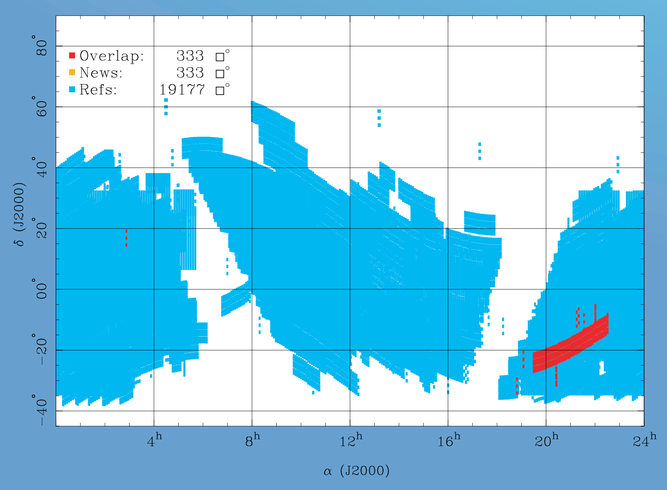


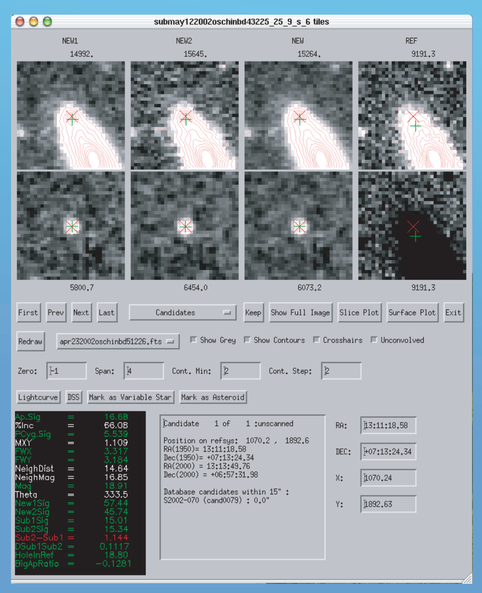
A 45 Mbs wireless radio link, part of the High Performance Wireless Research and Education Network, is used to connect the Palomar telescope to the internet. We transfer up to 30 GB of compressed images through this link every night.

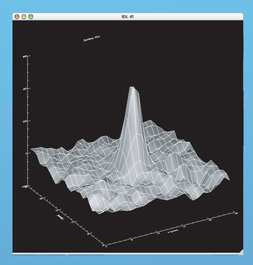
Nightly transfer rates

Images are transferred from the Palomar 48" and Haleakala 1.2 m telescopes every night and archived at the High-Performance Storage System (2 petabyte capacity) at the National Energy Research Scientific Computing center at Berkeley Lab. Every morning they are processed and subtracted by the Parallel Distributed Systems Facility 390 node computing cluster. An automated candidate identification system scores objects in the subtraction and submits the interesting ones for further analysis. To date we have archived six Tbytes (compressed) and processed a quarter-million images in our search for supernovae.

Palomar NEAT Overlap: New = 08/08/2002; Gap = 0–1000 Days



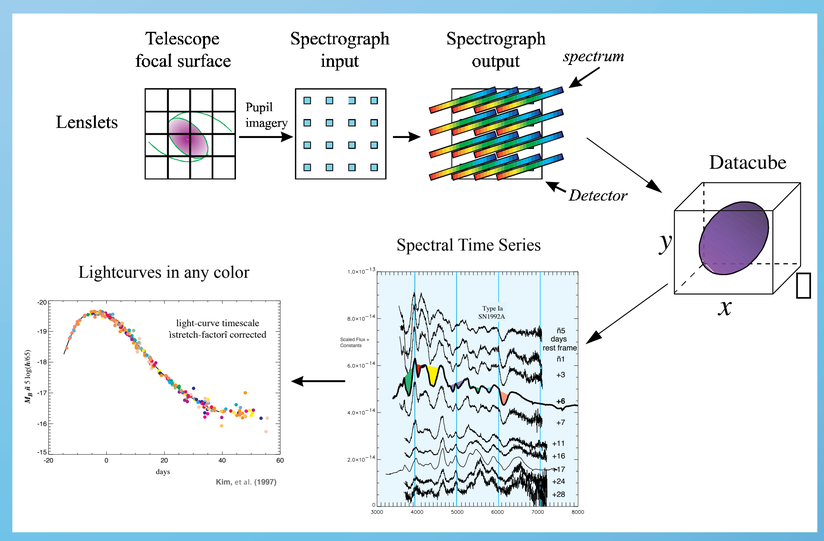




SN 2002cx

Interesting objects are flagged by the computer and manually scanned by a team of undergraduates. Improvements in image subtraction and automated candidate screening will reduce the current 10--20% manual scanning to a long-term goal of < 1%.

Follow-Up Lightcurve Spectrophotometry



A special instrument, SNIFS, is being built to specifically study these supernovae. 225 lenselets, covering a 6"x6" region, will allow each supernova and its host galaxy to be studied simultaneously in spectrophotometric detail. SNIFS will be mounted and operational on the UH 2.2-m telescope in the summer of 2003.

SuperNova Integral Field SpectrographSpecifications

Integral Field Unit

Scale	0.4″/lens
Field of View	6″ × 6″

Spectrograph

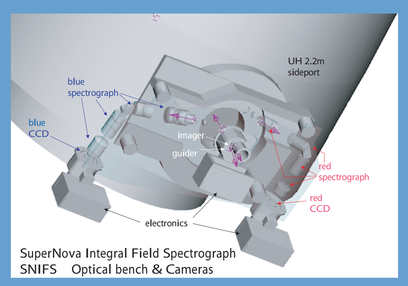
Channel	Blue	Red
Coverage	3500–5500Å	5500–10000Å
Spectral Resolution	2.3Å	3.3Å
Grism	300 l/mm $\lambda_B = 4200$Å	300 l/mm $\lambda_B = 6500$Å
Detector	Marconi 2k × 4k	LBNL 2k × 4k
Calibration	He/Hg/Cd + flat	Ne/Ar/Xe + flat

Guider/Focuser Camera (Fixed)

Scale	0.14″/pixel
Field of View	4.7′ × 9.4′
Detector	LBNL 2k × 4k
Filters	none

Auxiliary Camera

Scale	0.14″/pixel
Field of View	4.7′ × 9.4′
Detector	LBNL 2k × 4k
Filters	U,B,V,R,I,Z,extinction monitor



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