The Nearby Supernova Factory

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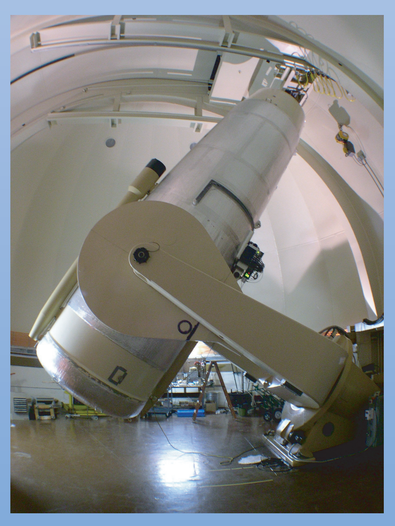
The Nearby Supernova Factory (SNFactory) will obtain and study a uniform high-quality dataset of flux-calibrated optical spectra at 10-15 epochs, starting 5-15 days before maximum light, for each of approximately 300 nearby type Ia supernovae (SNe Ia). When combined with current (SCP, HZSST, SNLS, ESSENCE) and future (SNAP, LSST) datasets of high-redshift SNe Ia, the SNFactory dataset will substantially improve the statistical measurements of the dark energy equation of state. This project will also improve our understanding of SNe Ia and their use as standardized candles.

The SNFactory targets SNe Ia in the redshift range of z approximately 0.03 to 0.10 - near enough to allow spectral observations every few days of many SNe while still distant enough to be in the smooth Hubble flow and minimize relative luminosity errors due to peculiar velocities. The SNe are found in wide-field imaging data provided by the Palomar Consortium (Yale/JPL/Caltech) and by the Near Earth Asteroid Tracking (NEAT) project at JPL, making the search unbiased with respect to host galaxy type. The identification and followup spectra will typically start within 1-3 days of the discovery epoch, using the SuperNova Integral Field Spectrograph (SNIFS) instrument which was installed on the automated University of Hawaii 2.2m telescope in April of this year. Here we present the current project status in the first weeks after the installation of SNIFS.

(artist's concept)

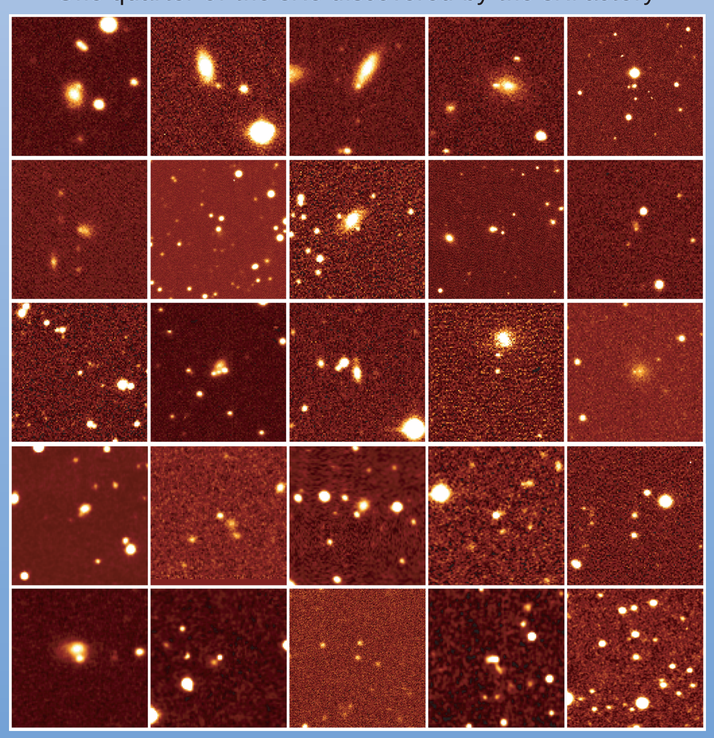
The Search:

The search for new type Ia supernovae (SNe Ia) is done with data from the NEAT (JPL) asteroid search and QUEST (Yale) groups, mainly observed with the Samuel Oschin 1.2-m telescope at Palomar. Last year the QUEST group installed a new 112 CCD camera with a 9 square degree field of view capable of both point-and-track and drift-scan imaging. The telescope is automated and can survey up to 1,000 square degrees per night. Unlike directed-galaxy SN searches, this search is unbiased with respect to host galaxy type.

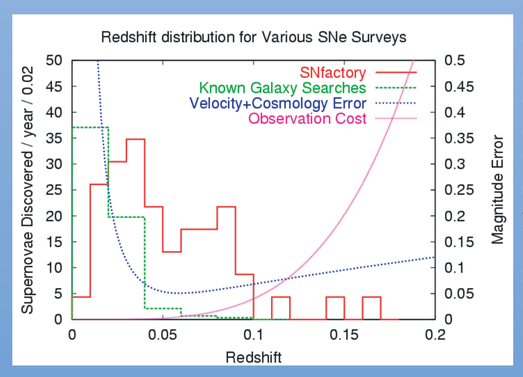


Each night ~50 GB of search data are produced and transfered from the telescope using the HPWREN wireless network. The data are archived at the 2 PB capacity High-Performance Storage System at the National Energy Research Scientific Computing center (NERSC) at LBNL. To date the SNFactory has archived over 10 TB of raw and processed data comprising 3 million images.

One quarter of the SNe discovered by the SNFactory



Every morning the SNFactory search pipeline automatically processes the previous night's new images using the NERSC Parallel Distributed Systems Facility 400-node computing cluster. Images are subtracted from previously observed template images, and routines automatically identify new SN Ia candidates among the background of variable sources. These candidates are confirmed by humans and, along with all previous observations, are stored in a database used by automatic scheduling routines to direct SNIFS spectroscopic followup observations (see below). The SNFactory searches for SNe Ia in the redshift range of 0.03 to 0.10, distant enough to be in the smooth Hubble flow (and thus minimize uncertanties due to their peculiar velocities), yet close (and thus bright) enough to allow for screening spectra of all candidates and spectra every few days (10 to 15 spectra total) for each of ~100 confirmed SNe Ia per year. Our efficiency in recovering simulated SNe Ia at z < 0.08 is over 90%.



SNIFS Commissioning on the UH 2.2m telescope:

In order to obtain spectrophotometric observations of ~300 SNe Ia, the SNFactory constructed the SuperNova Integral Field Spectrograph (SNIFS). This instrument features a dual-channel spectrograph and an imaging/guiding camera. Each spectrographic channel exploits a 15x15 microlens array to image 225 spectra across the 6"x6" field of view. The photometric camera simultaneously observes stars in the adjacent field using a custom-designed multifilter to monitor atmospheric conditions. SNIFS was installed on the UH 2.2m atop Mauna Kea in April and is currently undergoing commission.

Spectrograph

Channel	Blue	Red
Coverage	3500-5500 Å	5500–10000 Å
Spectral Resolution	2.3 Å	3.3Å
Grism	300 l/mm ($\lambda_B = 4200$ Å)	300 l/mm ($\lambda_B = 6500$ Å)
Detector	Marconi 2k × 4k	E2V-DD 2k × 4k
Calibration	He/Hg/Cd + flat	Ne/Ar/Xe + flat

Integral Field Unit

Scale	0.4″/ lens
Field of View	6″× 6″

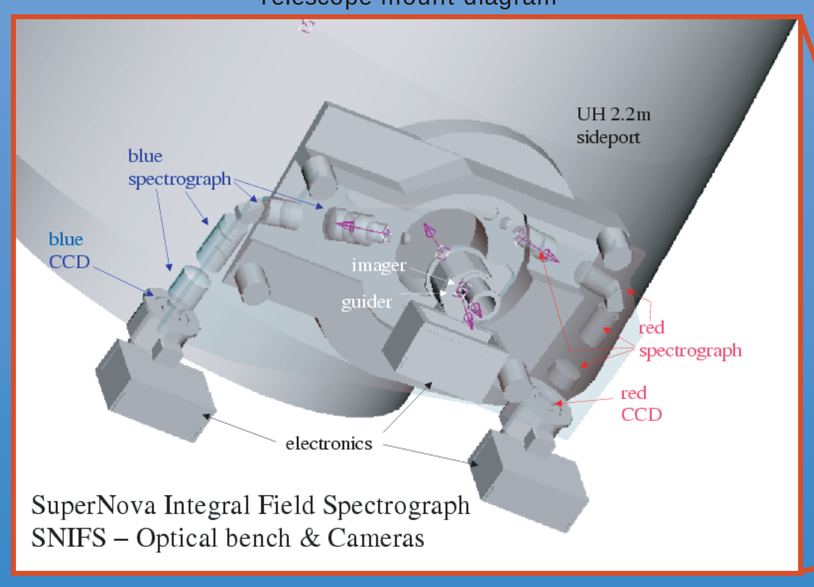
Guider/Focuser Camera (Fixed)

Scale	0.14″/pixel
Field of View	4.7′× 9.4′
Detector	E2V 2k × 4k
Filters	none

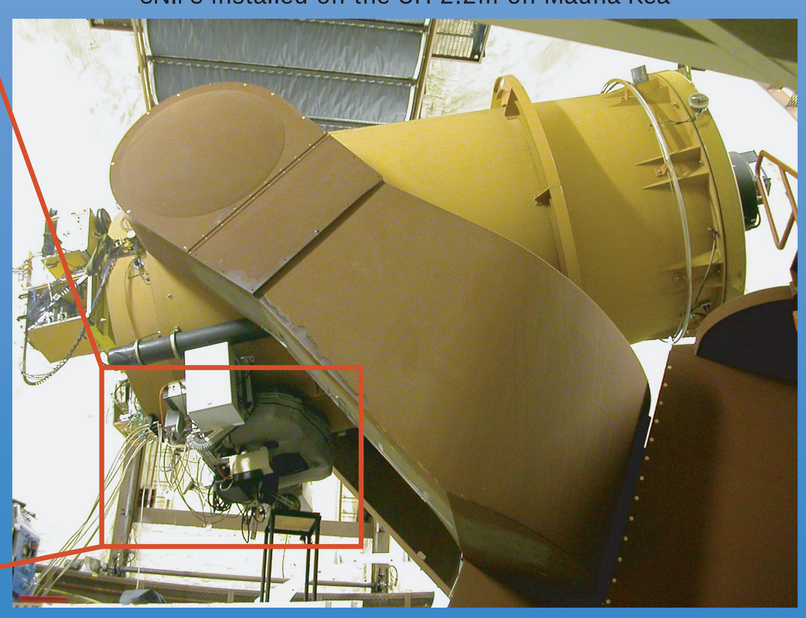
Auxiliary Camera

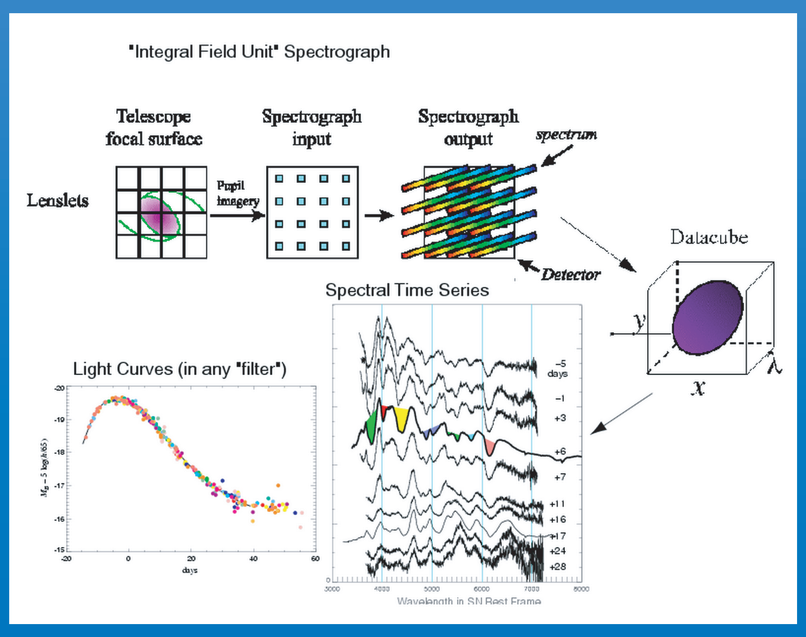
Scale	0.14″/pixel
Field of View	4.7′× 9.4′
Detector	E2V 2k × 4k
Filters	UBVRIZ + extinction monitor

Telescope mount diagram

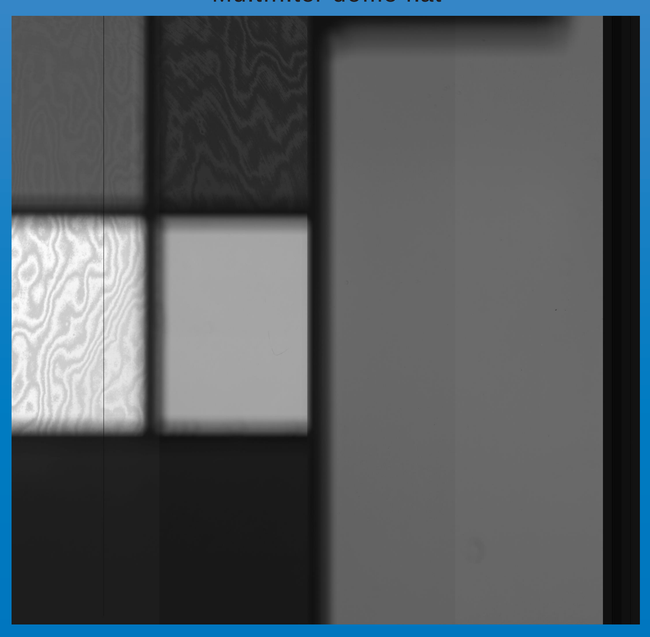


SNIFS installed on the UH 2.2m on Mauna Kea

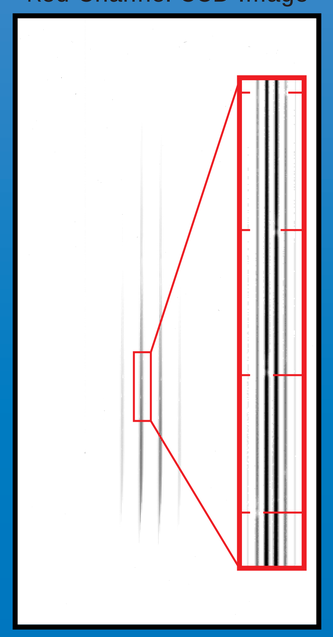




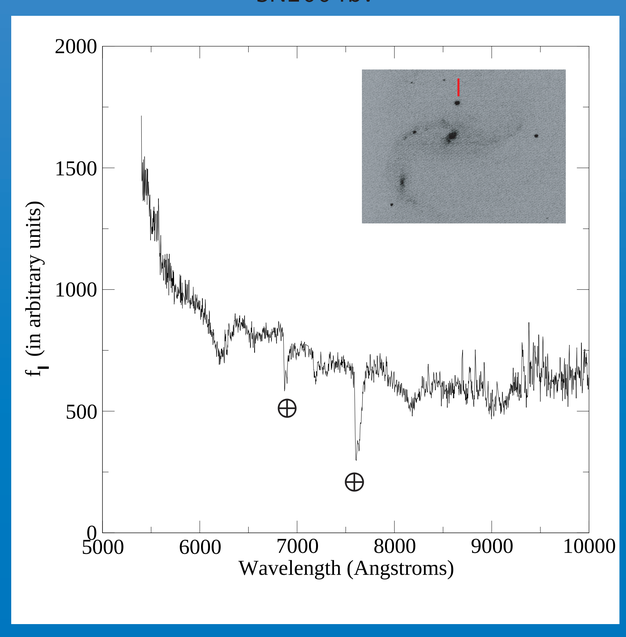
Multifilter dome flat



Red Channel CCD Image



SN2004bv



For more information on the SNFactory, contact Greg Aldering (GAldering@LBL.gov) or Brian Lee (BCLee@LBL.gov) or visit out webpage at http://snfactory.lbl.gov/