

The Nearby Supernova Factory

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Transient Universe 2006

The Collaboration

Lawrence Berkeley National Lab / UC Berkeley / SSL

Laboratoire de Physique Nucleaire et de Haute Energies de Paris

Institut de Physique Nucleaire de Lyon

Centre de Recherche Astronomy de Lyon

Kavli Institute for Cosmological Physics - University of Chicago

Yale University - Baltay group

Partners

QUEST II Collaboration

Caltech/Palomar Observatory

Near Earth Asteroid Tracking - JPL/CIT

High Performance Research & Education Network

University of Hawaii

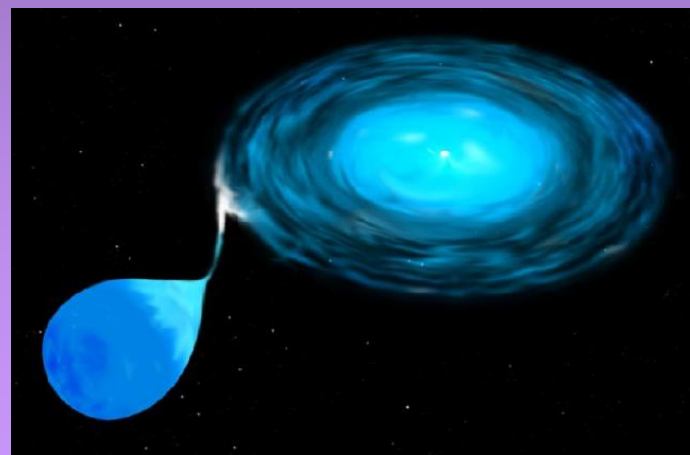
Gordon & Betty Moore Foundation

Energy Sciences Network

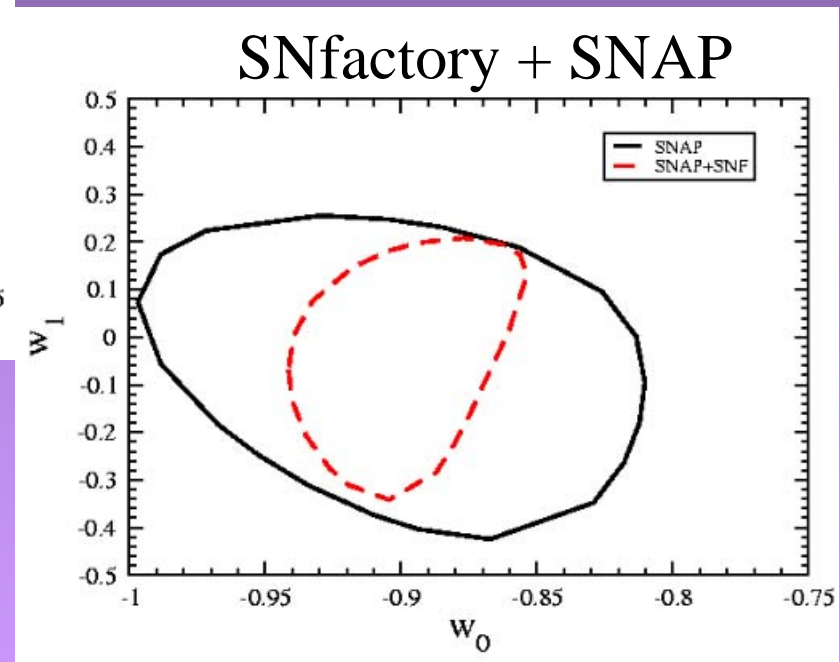
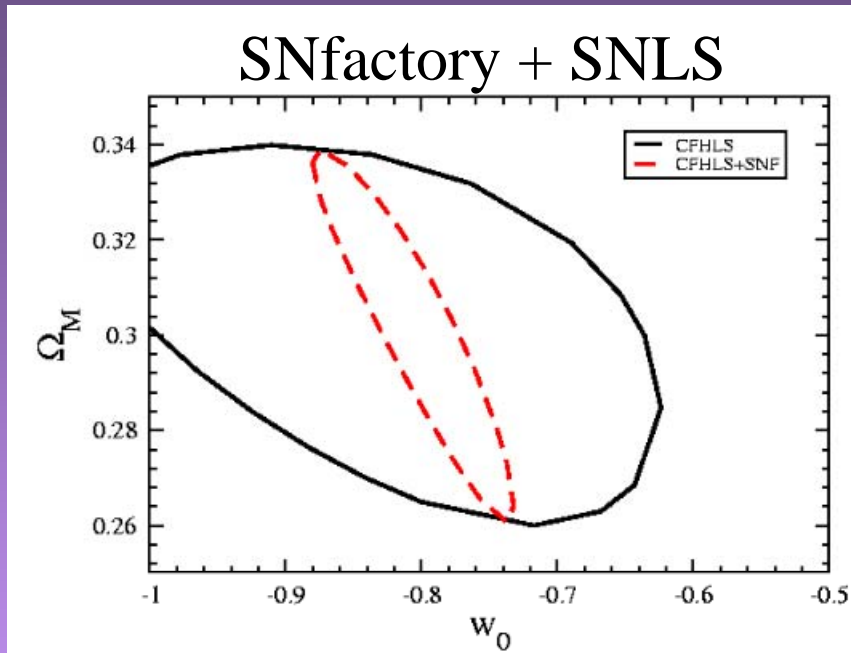
National Education & Research Science Computing

SNfactory Science Goals

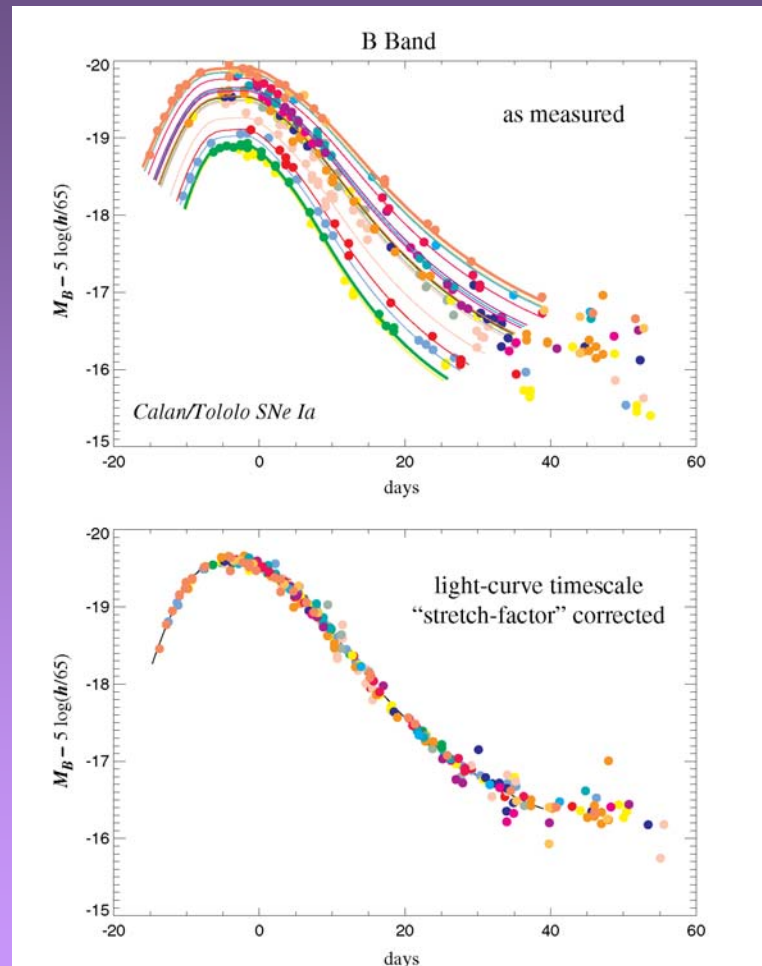
- **Improve statistical constraints on dark energy**
 - 2x improvement for SNLS, Essence, SNAP
- **Improve systematics uncertainties on dark energy**
 - Better calibration of SN properties
 - Span wide range of physical & empirical parameters
 - Constrain SN physics
- **300 Type Ia SNe**
 - in the *nearby smooth Hubble flow*
 - with many-epoch *spectrophotometry*



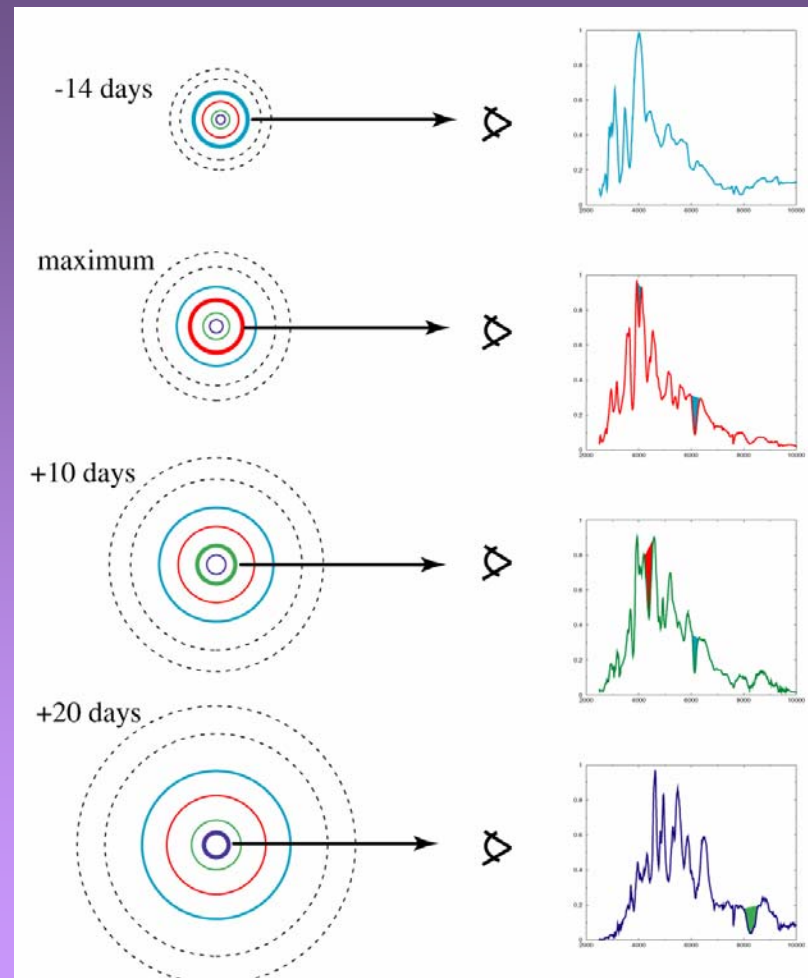
Cosmological Constraints from SNfactory



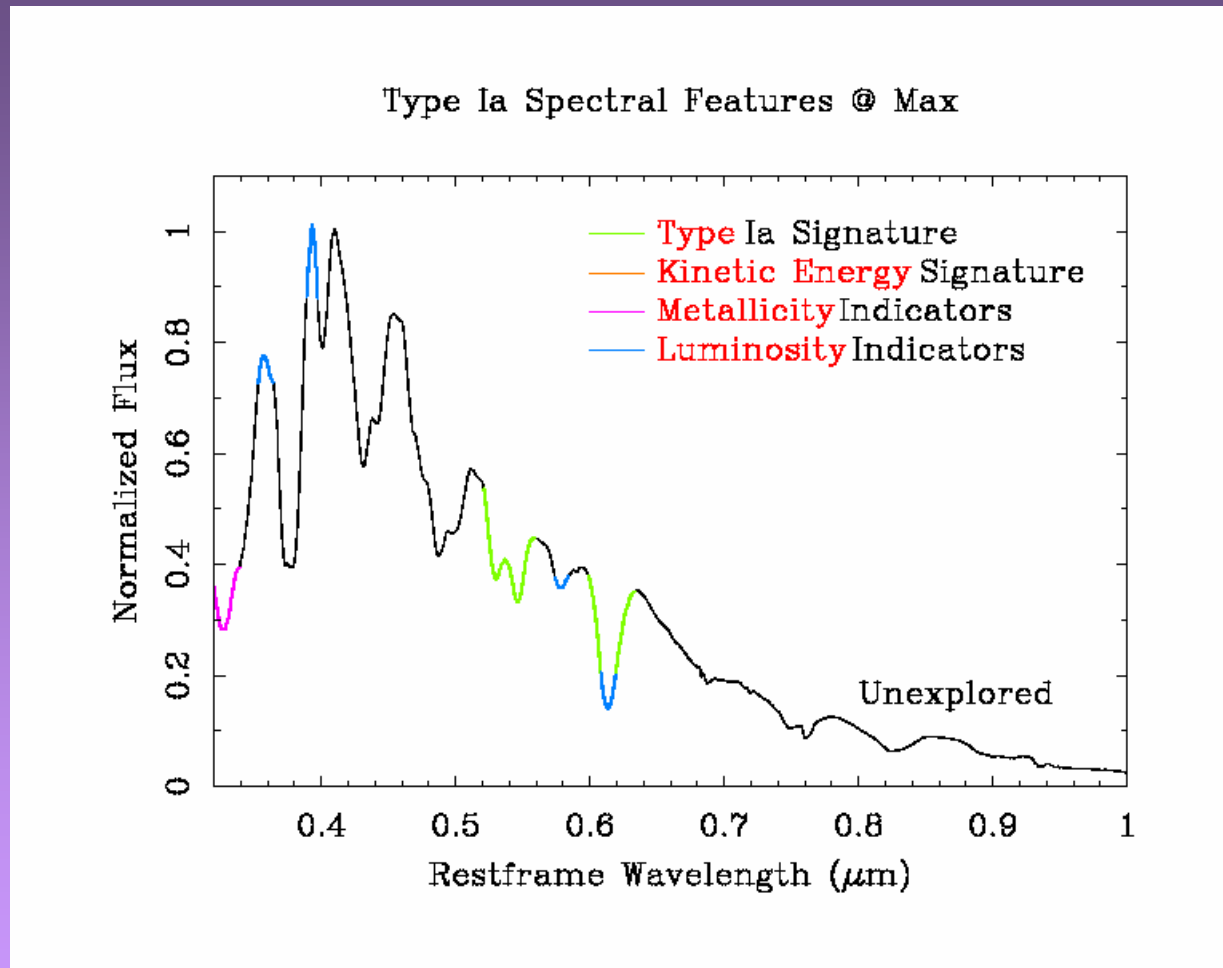
Lightcurve Standardization



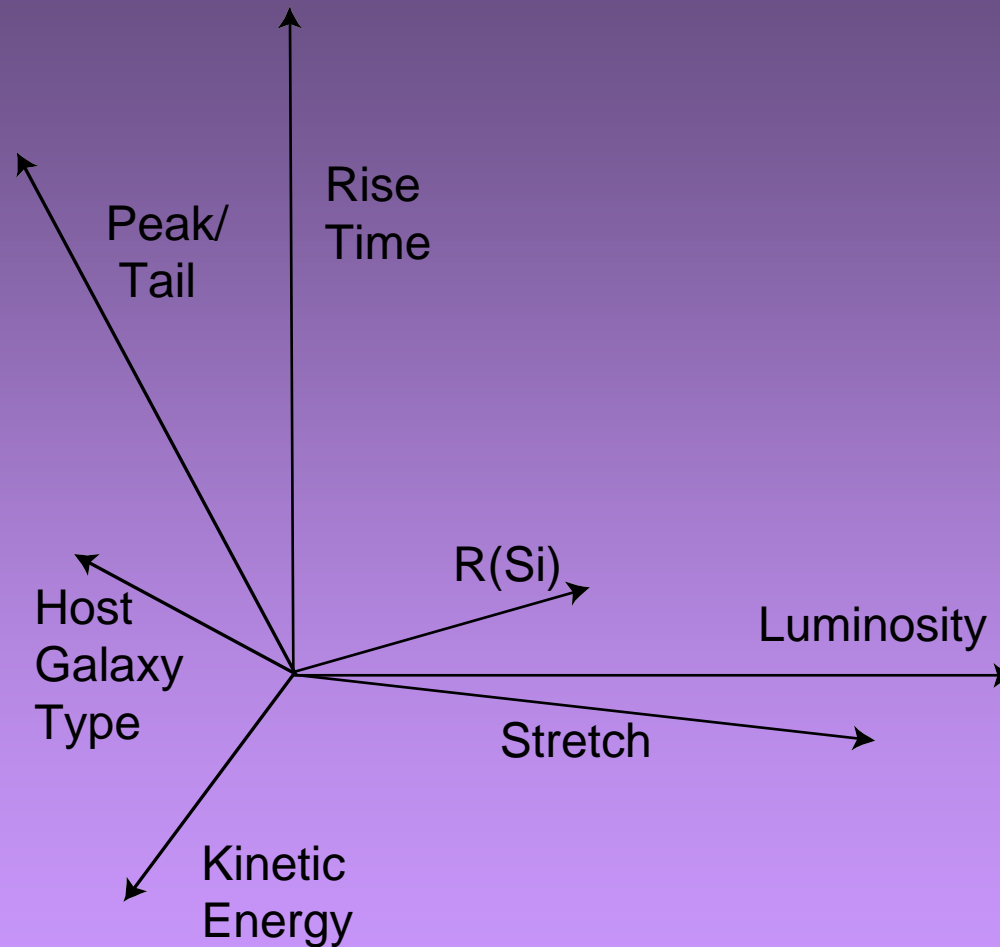
Spectroscopic “CAT Scan”



Type Ia Supernova Spectral Features



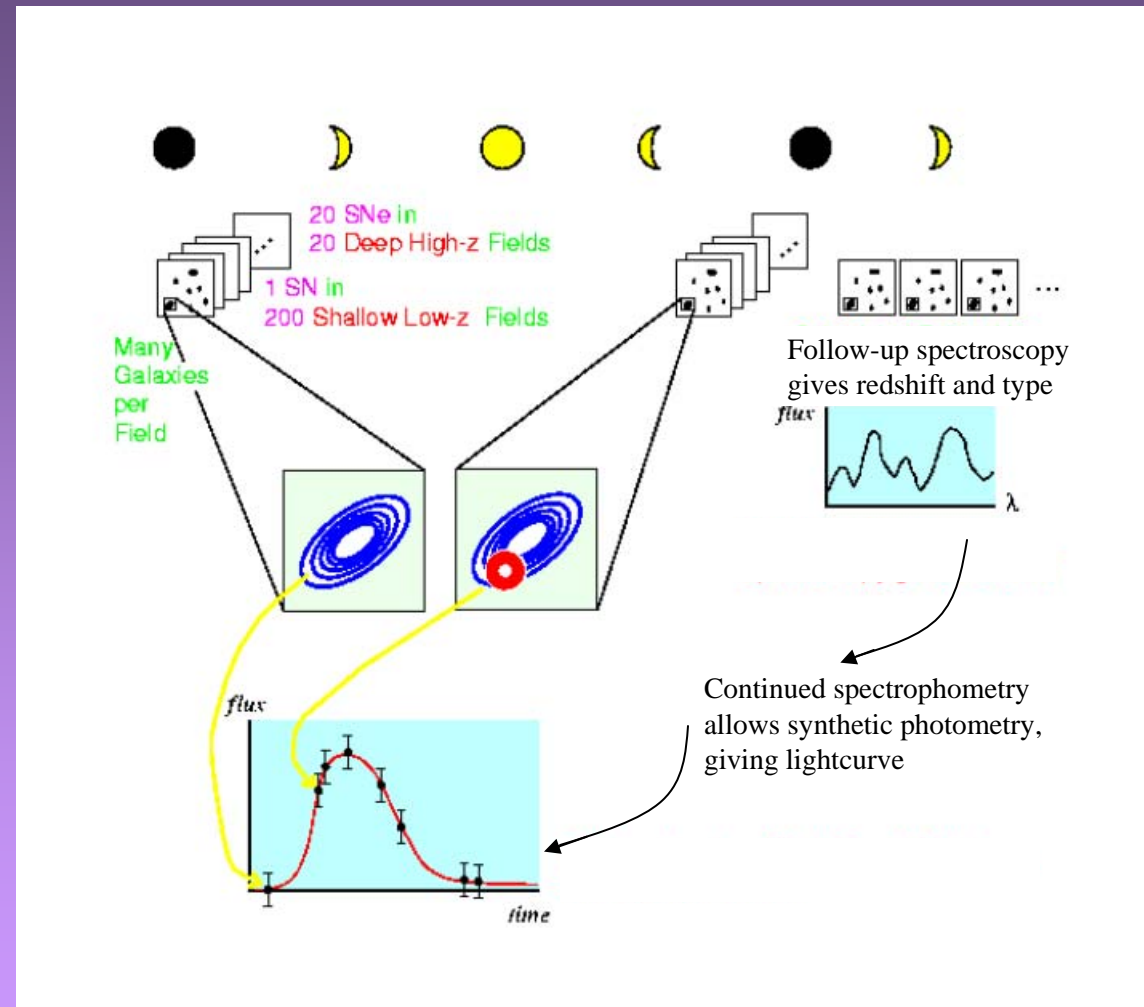
SNfactory Probes Parameter Space



Nearby Discovery Challenge

SNfactory:
50 Gb per night,
every night

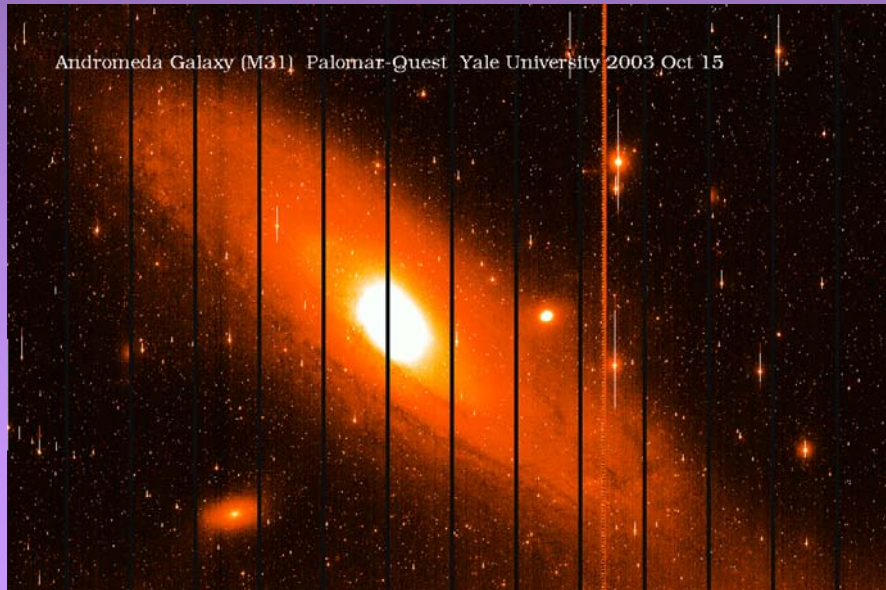
High Redshift:
5 Gb per night,
every 3rd night



Palomar-QUEST Survey

QUEST II Camera (Yale & Indiana)

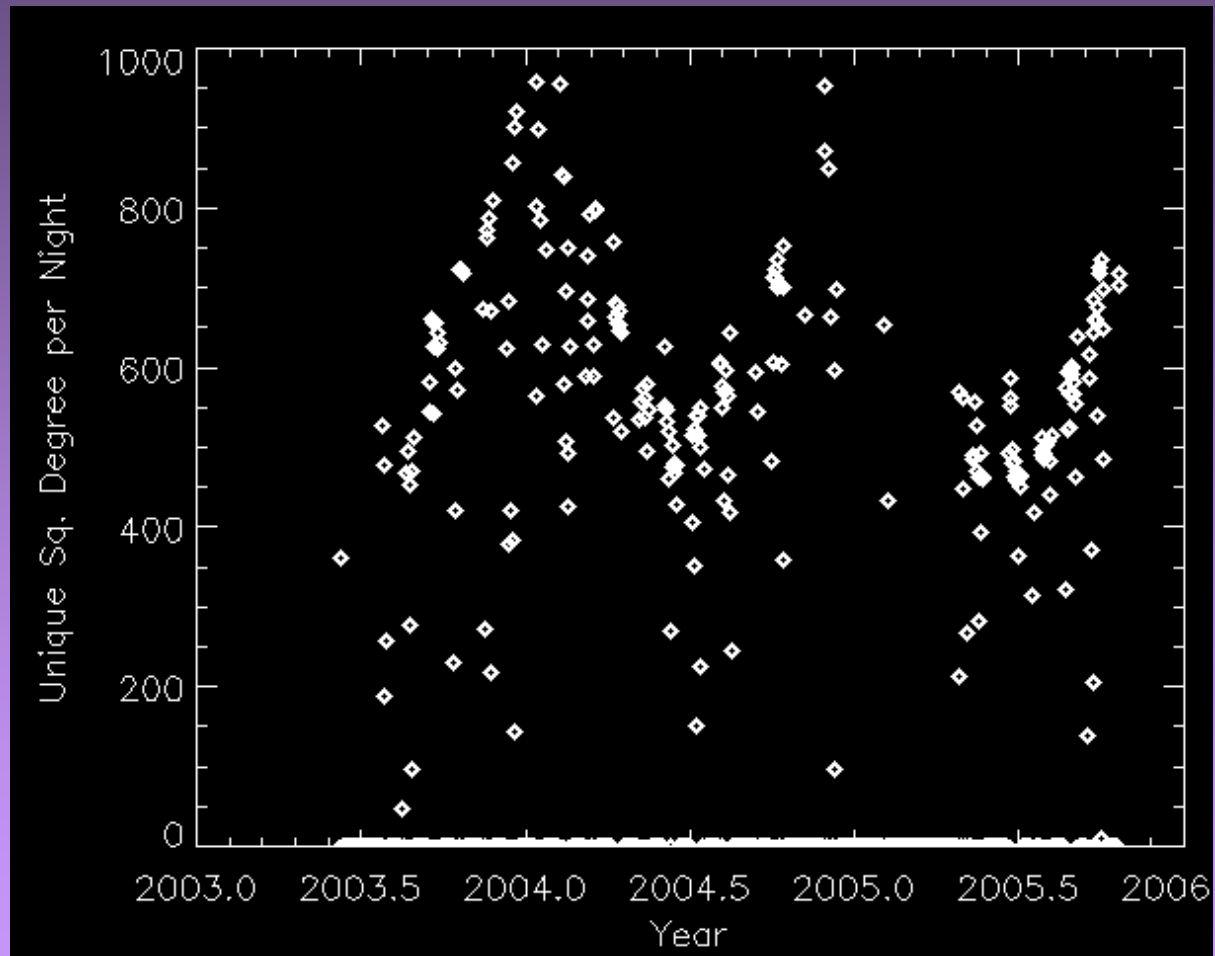
- 112 CCDs
- 2400 x 600 @ 0.87 arcsec/pix
- 9.4 sq. deg
- 40 sec readout time
- or sidereal rate readout



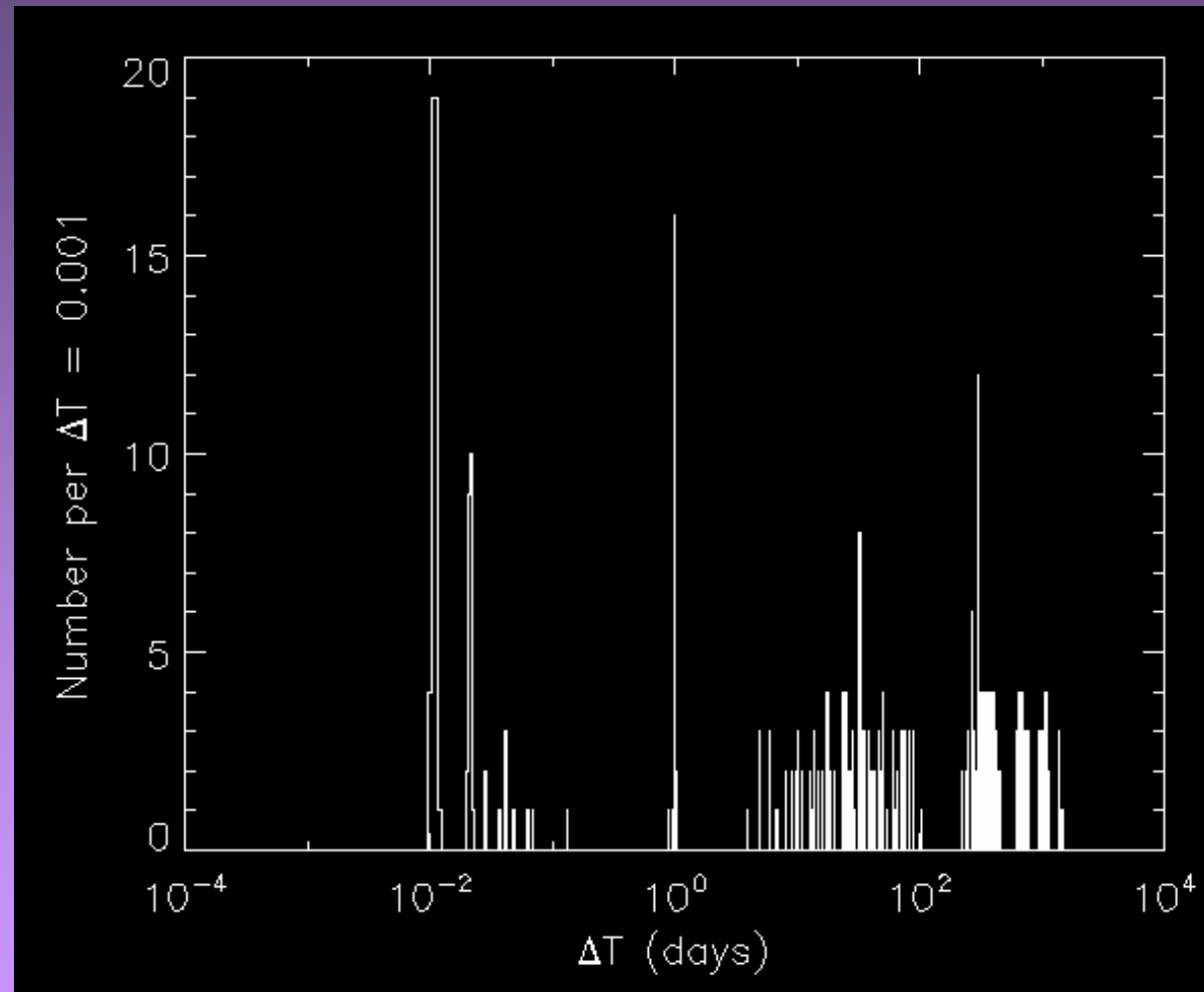
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

- Point & track
 - 3 exposures over 30 min
 - 60s or 150s exposures
 - RG610 filter
- Driftscan
 - Johnson UBRI
 - Gunn rizz
 - +/- 30 deg dec. range

PT Nightly Sky Coverage

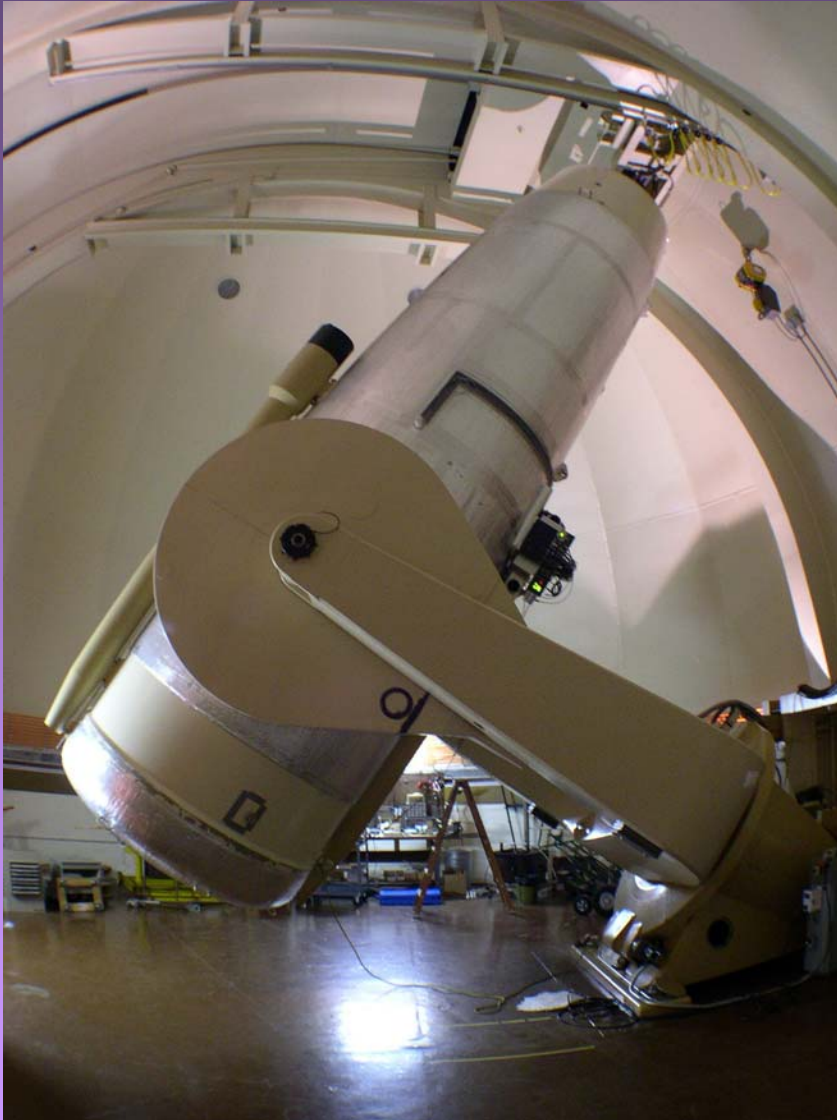


PT Time Sampling

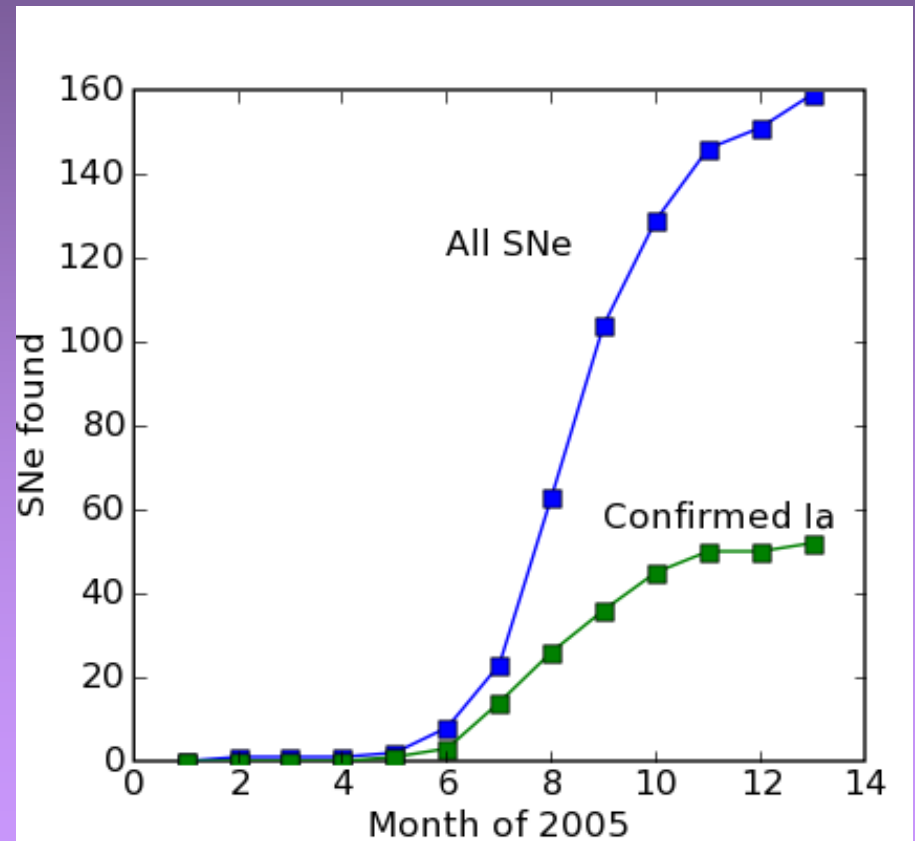


Sky Coverage/Follow-up Constraints

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.



- 99 SNe from prototype search
- Best “rookie year” search
- Adapted to new QUEST II camera
- 71 confirmed + 89 probable in new search

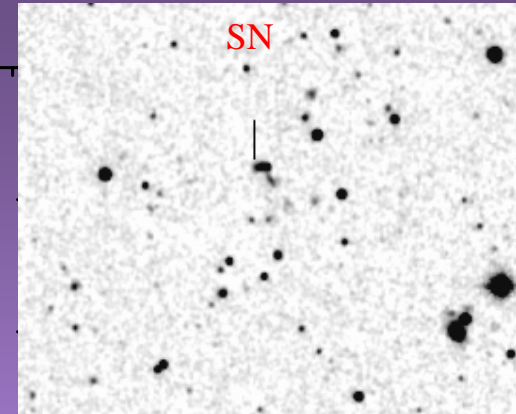
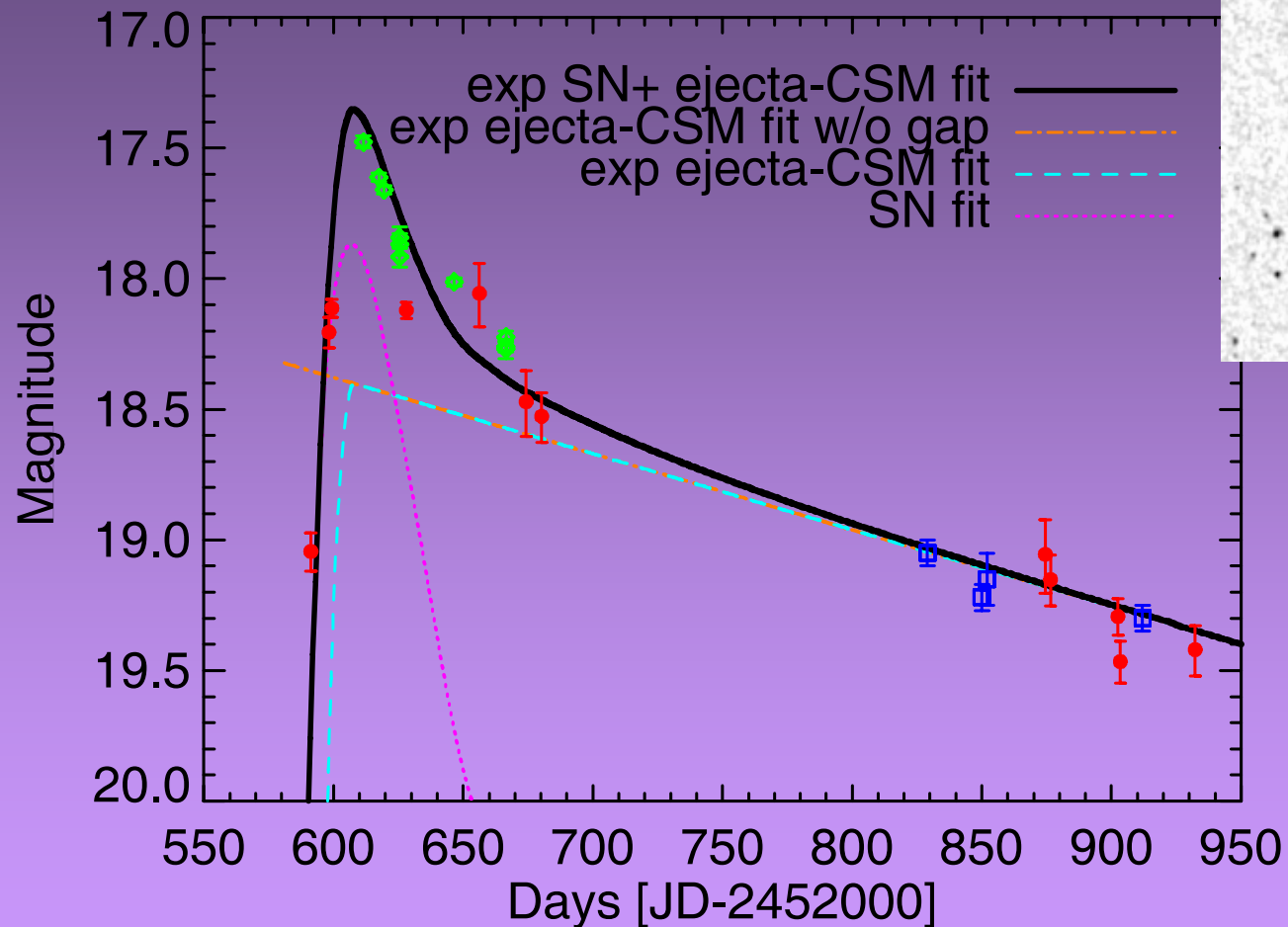


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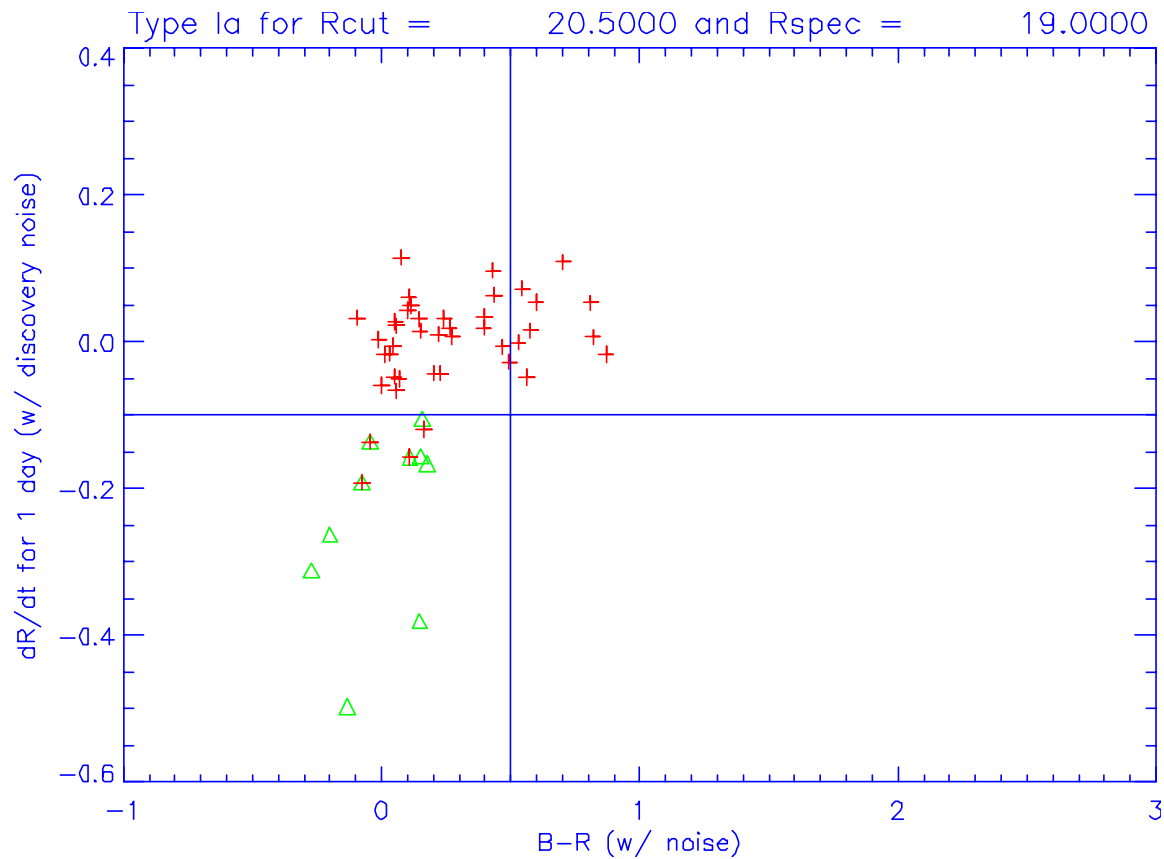
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Blind Search Unearths Strange SNe



Wood-Vasey,
Wang & Aldering
2004, ApJ, 616, 339

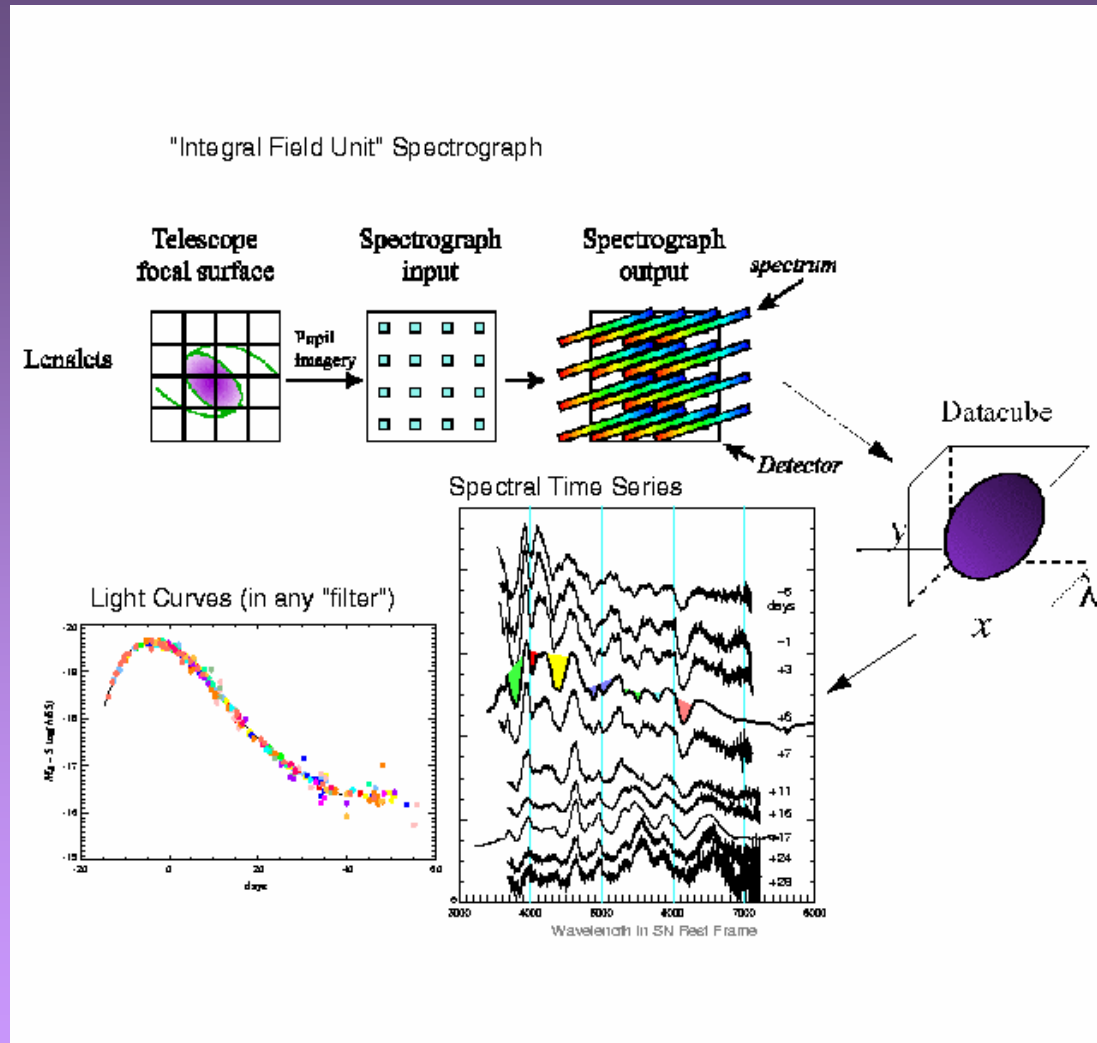
Photometric Screening



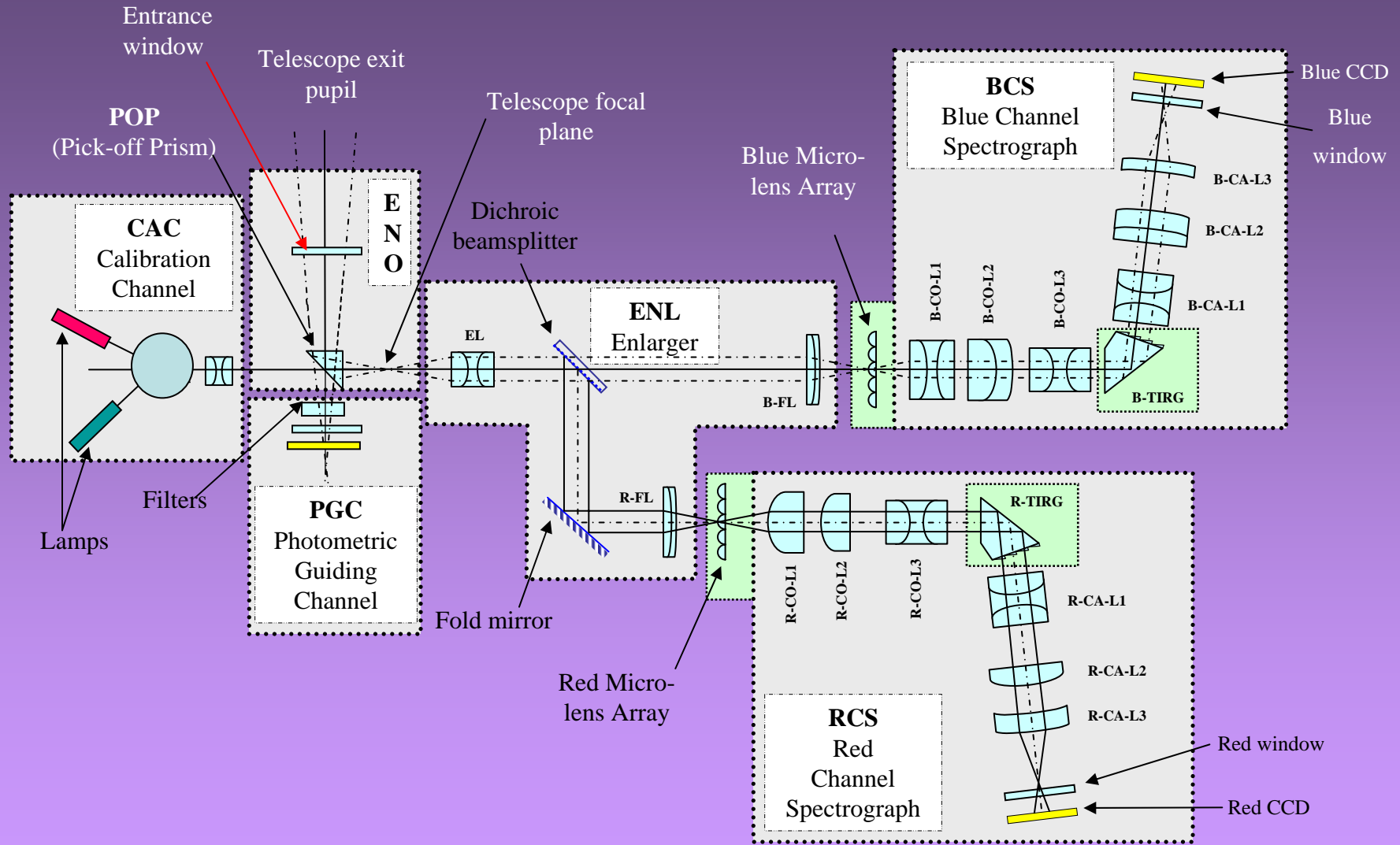
Screening Facilities:

- P-Q retakes
- McDonald 0.9-m
- Lick 1.0-m
- UH 2.2-m

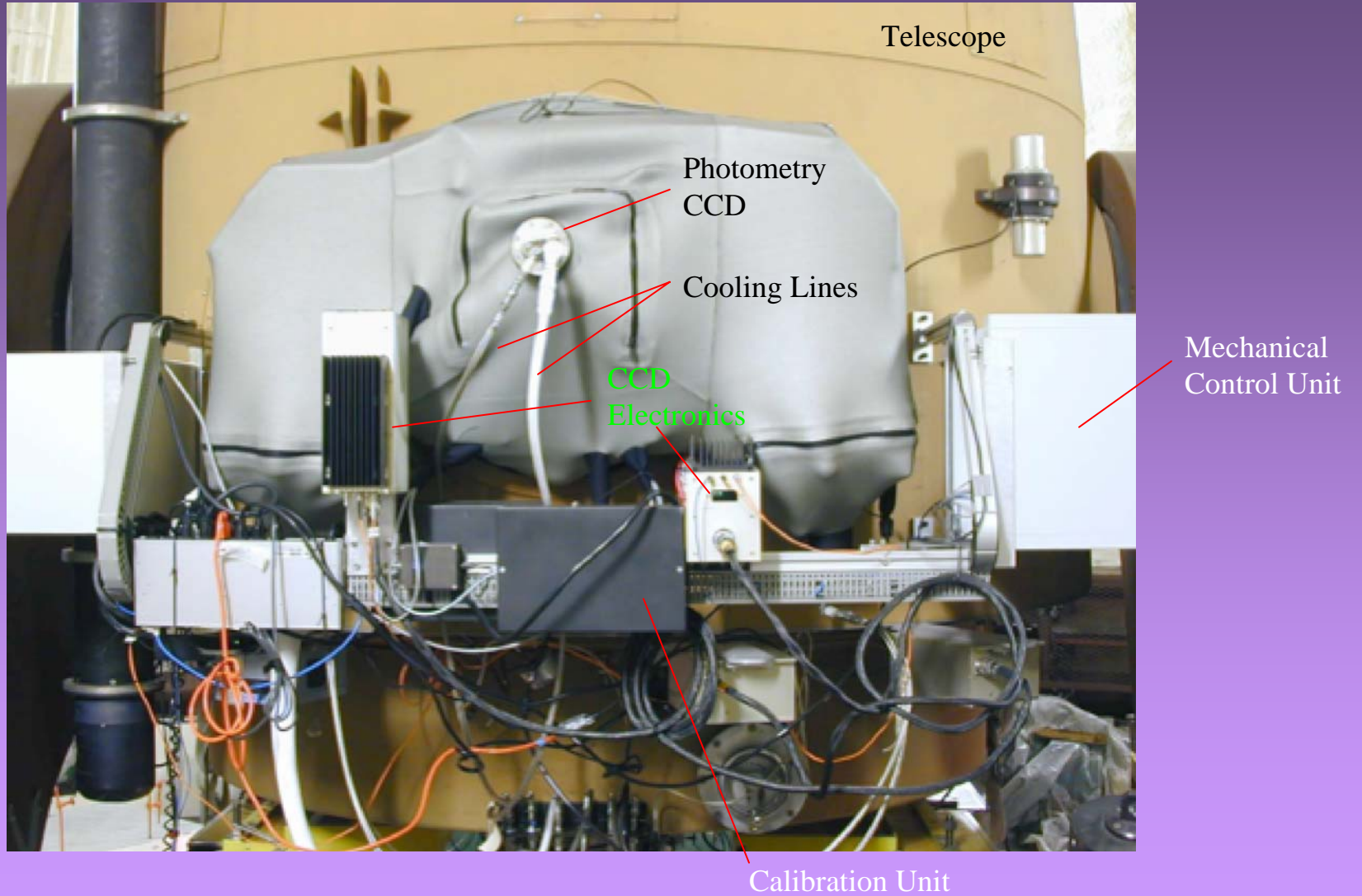
SNIFS Operating Principle



SNIFS Optical Layout



SNIFS on the UH 2.2m



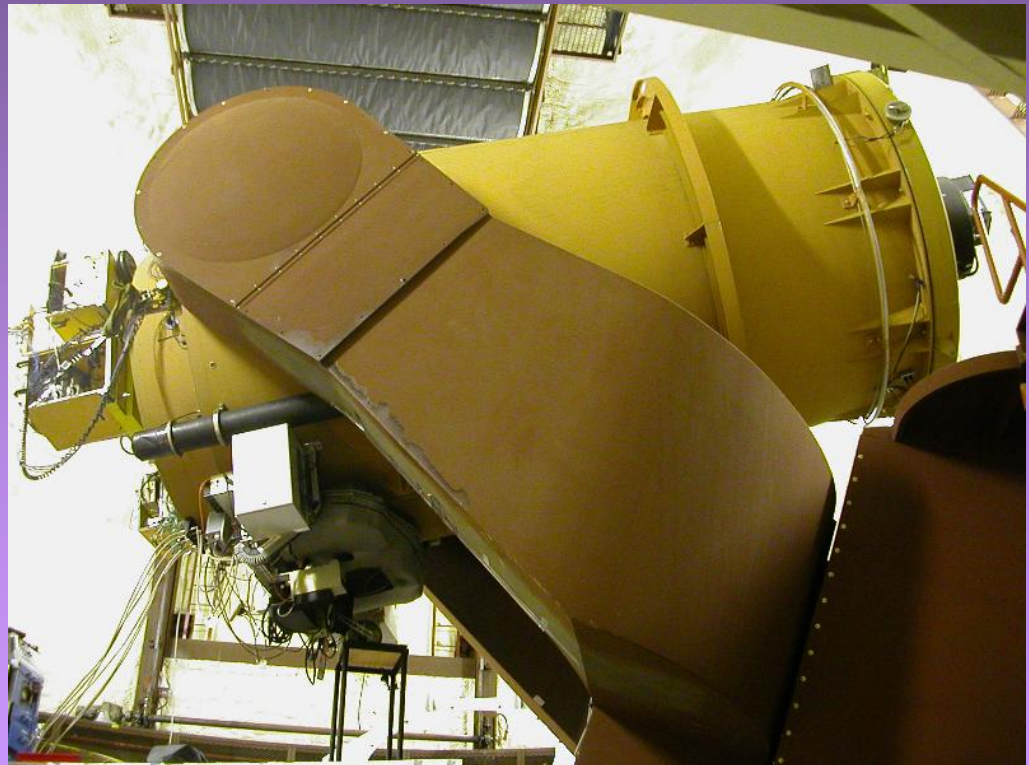
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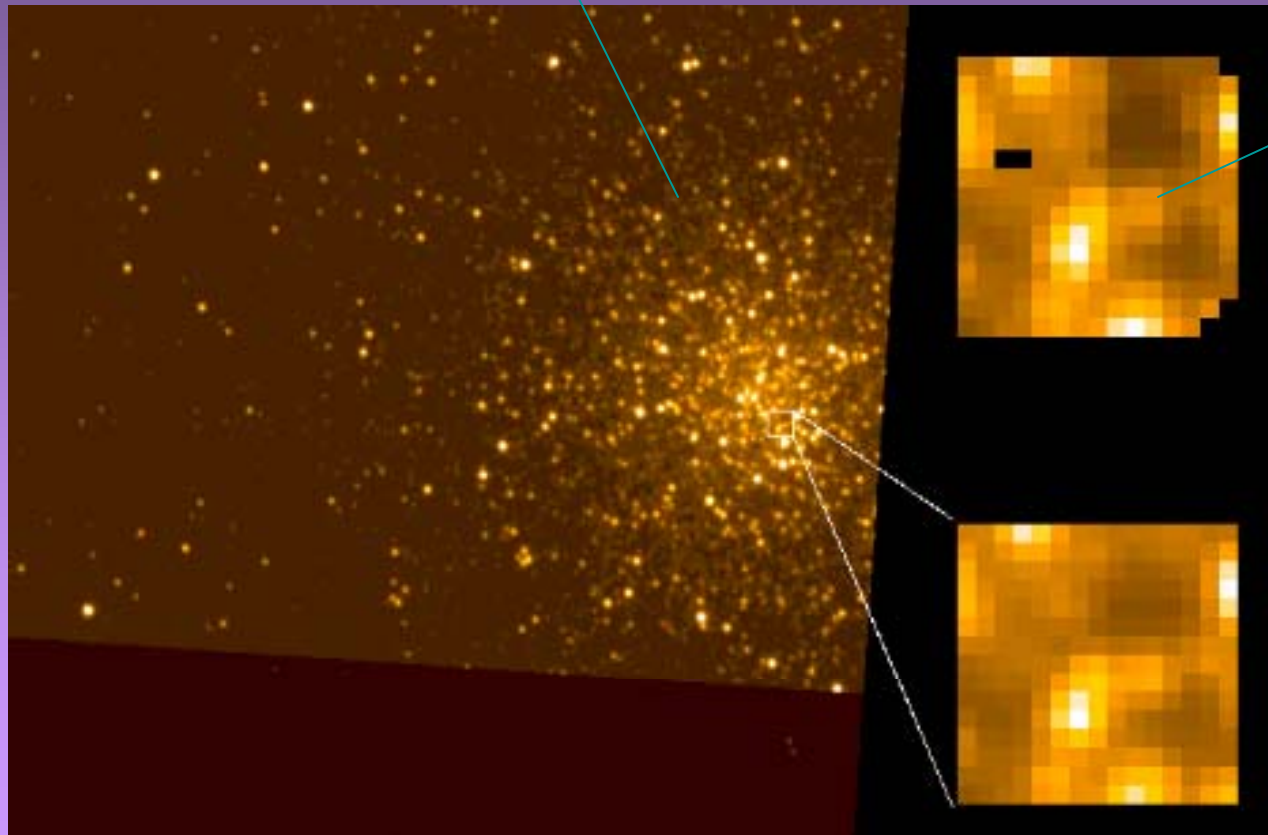
SNIFS Operations

- 20% share of UH 2.2-m
- 2nd half of night
- Two half-nights every five nights
- Permanently mounted
- Remote operations
- Supervised scripted observing
 - France night shifts
 - US day shifts
- Automated acquisition
 - field identification
 - field positioning
 - guide star selection
- Photometricity from GS video
- Automated data reduction



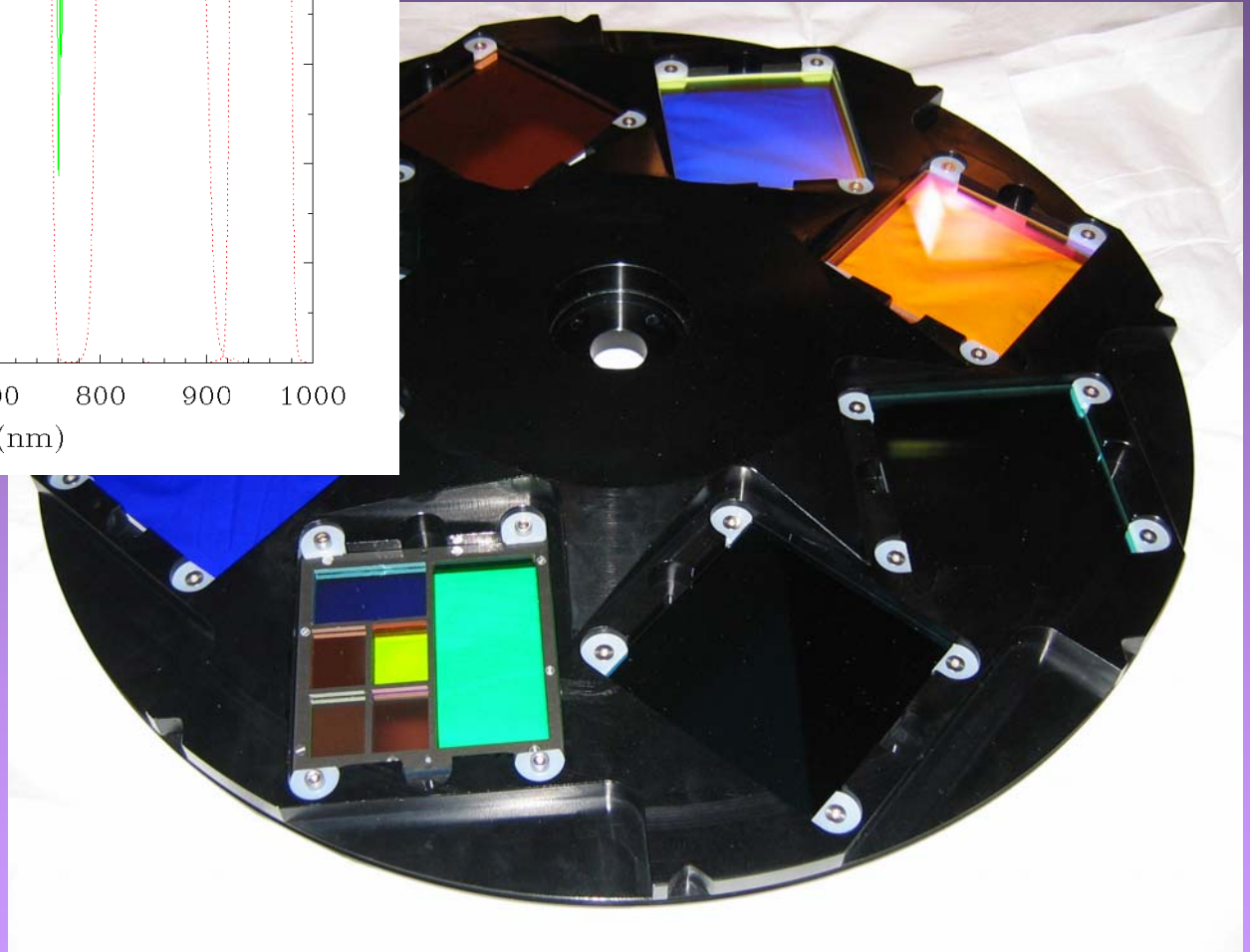
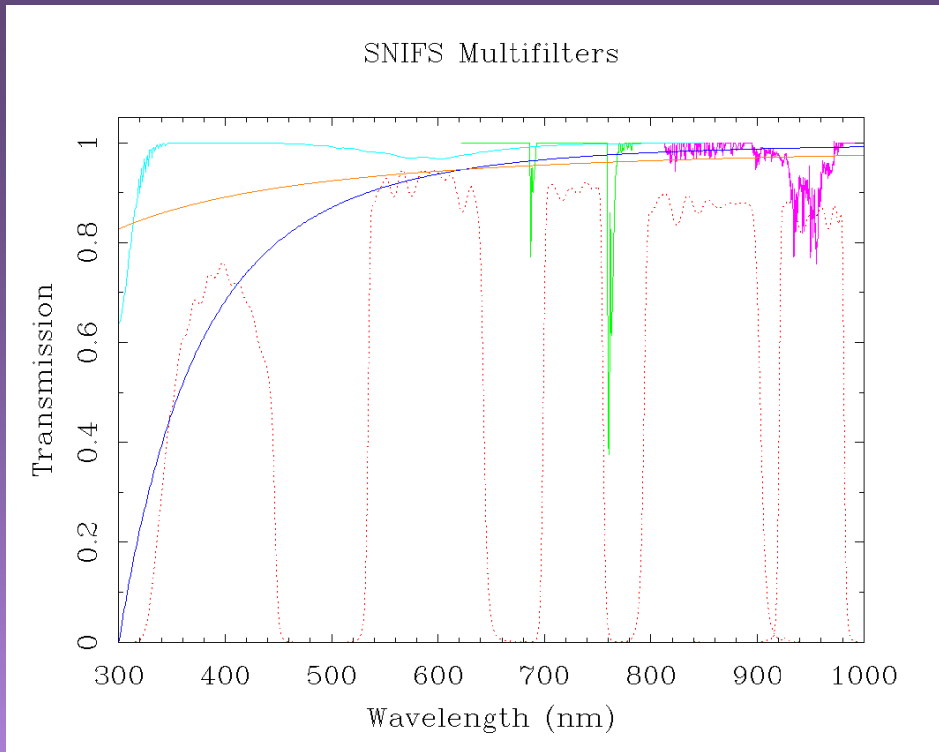
SNIFS IFU Example

SNIFS direct image of
globular star cluster

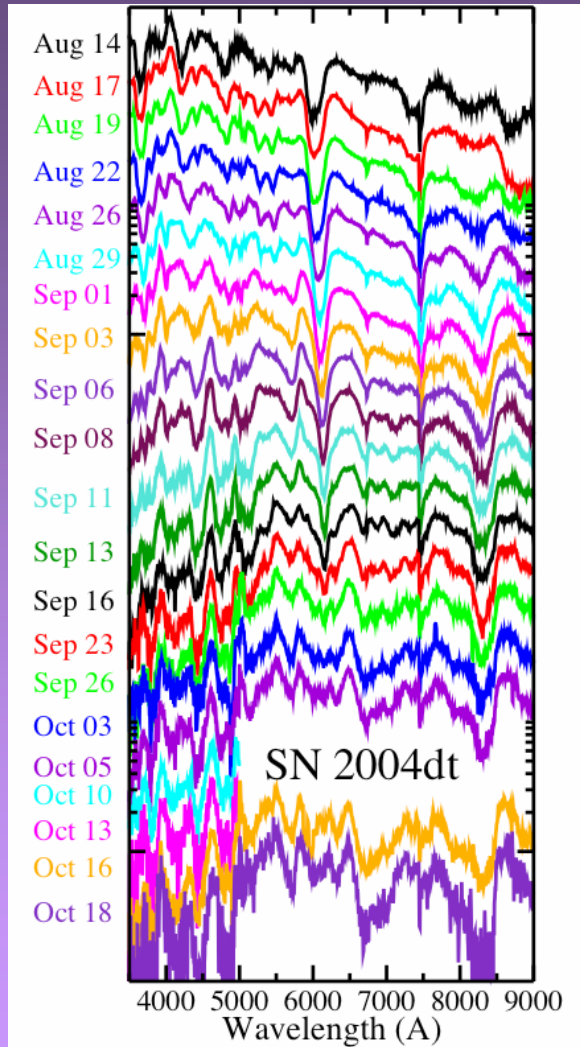


Reconstructed
IFU image

Unique Calibration Method



Spectra are Rolling In



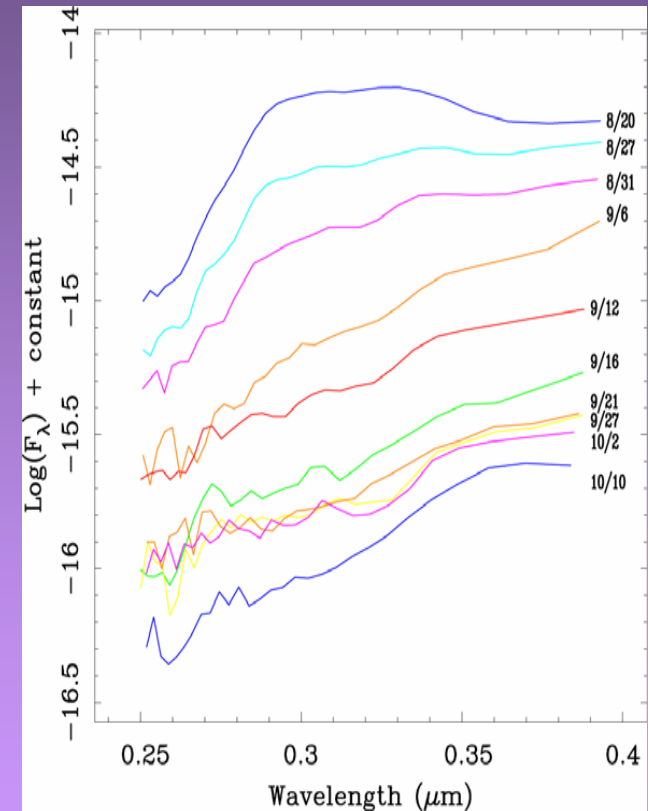
Spectral time series for:

SN2004dt SN2004ef
SN2004gc SN2004gk
SN2004gs SN2005L
SN2005M SN2005ac
SN2005ag SN2005ak
SN2005al SN2006D
SN2006X + 21 More

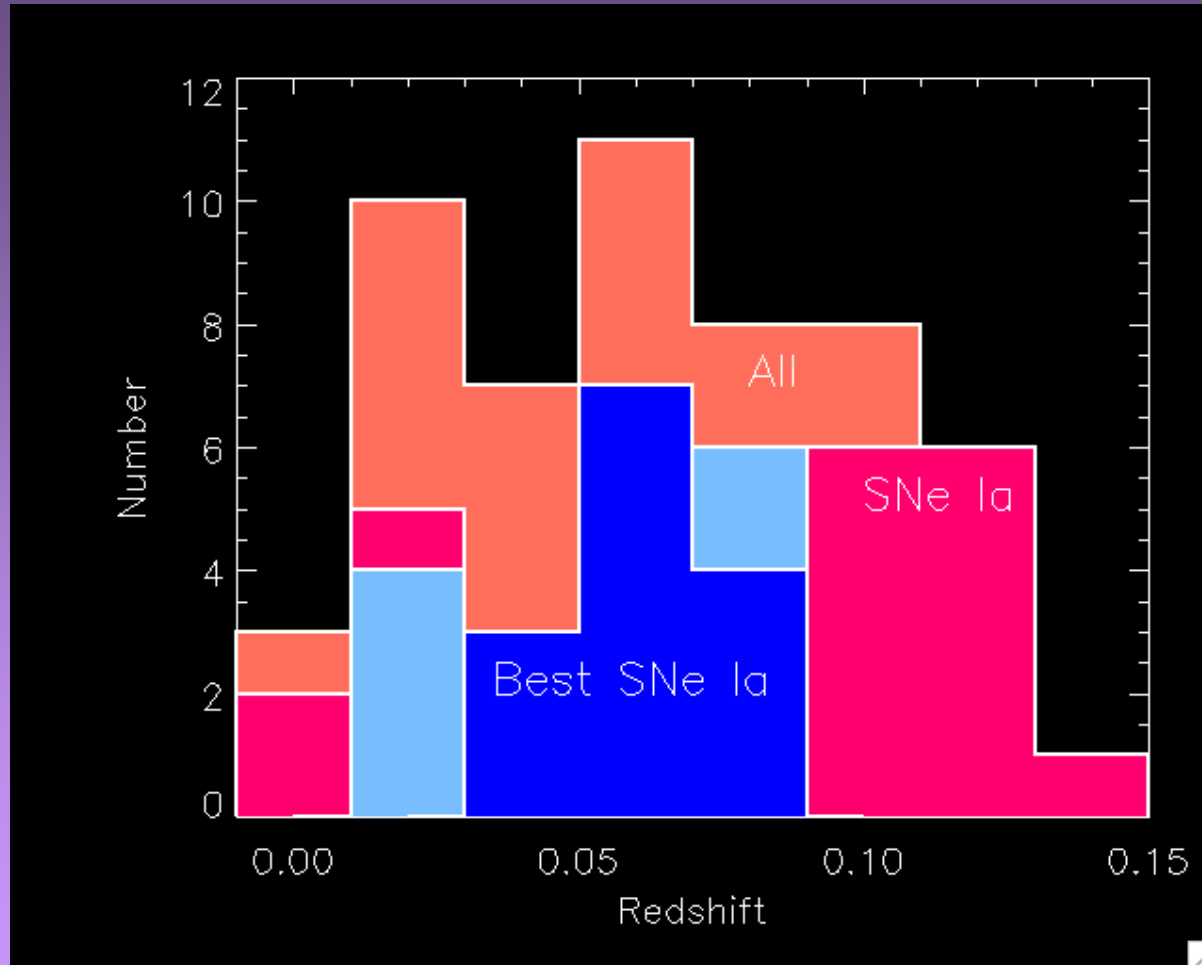
50 more screened

Our SN spectral dataset is already as large as 60% of all published spectra since 1937.

+ UV spectral time series from *HST* for several SNe!



Redshift Distribution

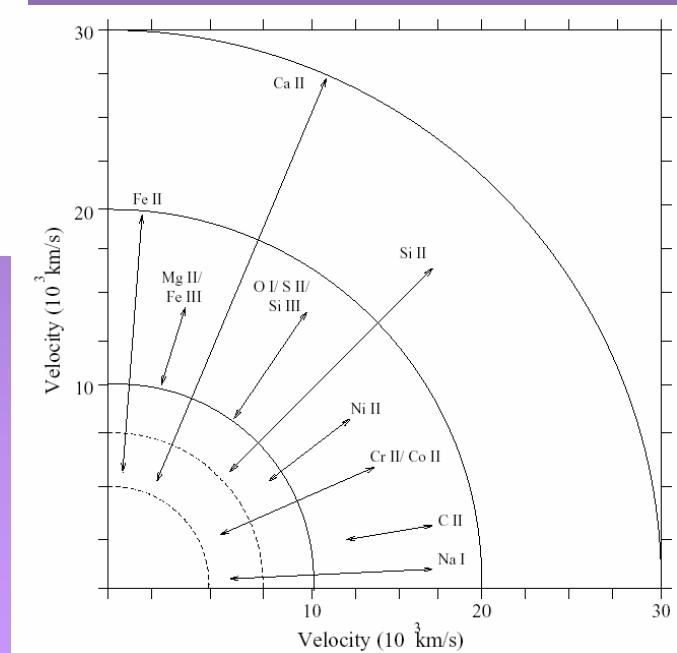
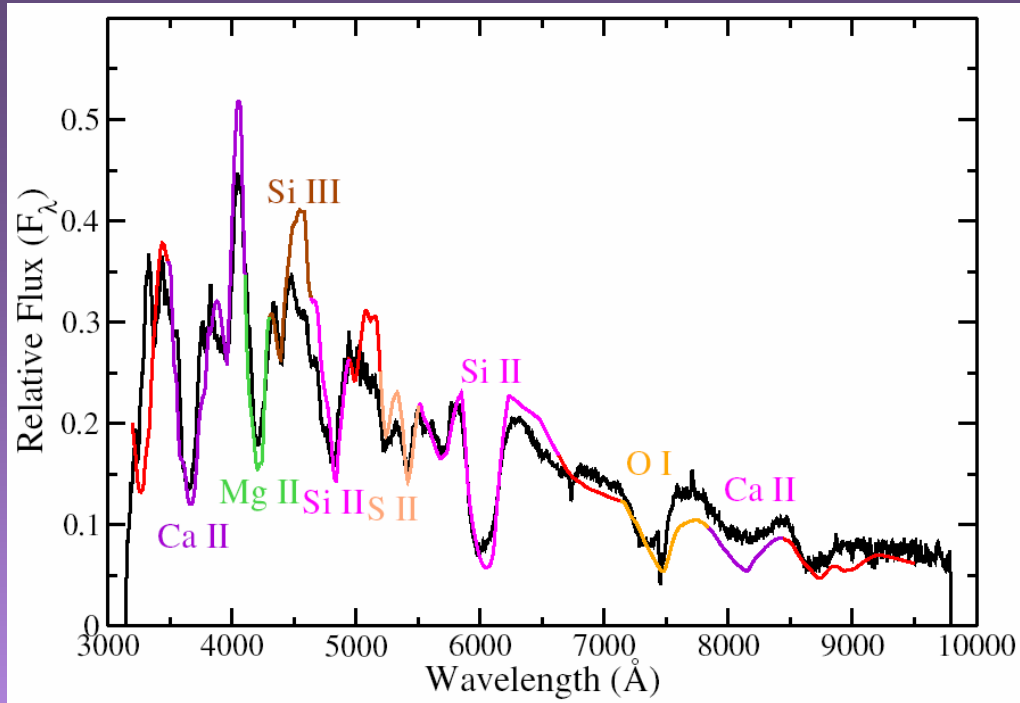


Nov '05:
42 Ia
21 II
2 Ib/c
60 untyped

Research Highlights

- Over 1000 science spectra at 603 epochs
- Over 160 SNe discovered in 8 months; 71 typed with SNIFS
- Spectral time series for 30 SNe Ia
- Discovery and follow-up of Type Ia supernovae showing hydrogen
- Discovery of “failed Type Ia” - unburned light elements in core
- UV - optical - NIR spectral coverage for some SN (from HST & Keck)
- In-depth spectral studies
 - Carbon (progenitor material) detected
 - High velocity calcium
 - Missing Fe – only intermediate mass elements
 - Hydrogen in SNF2005xxxx-000

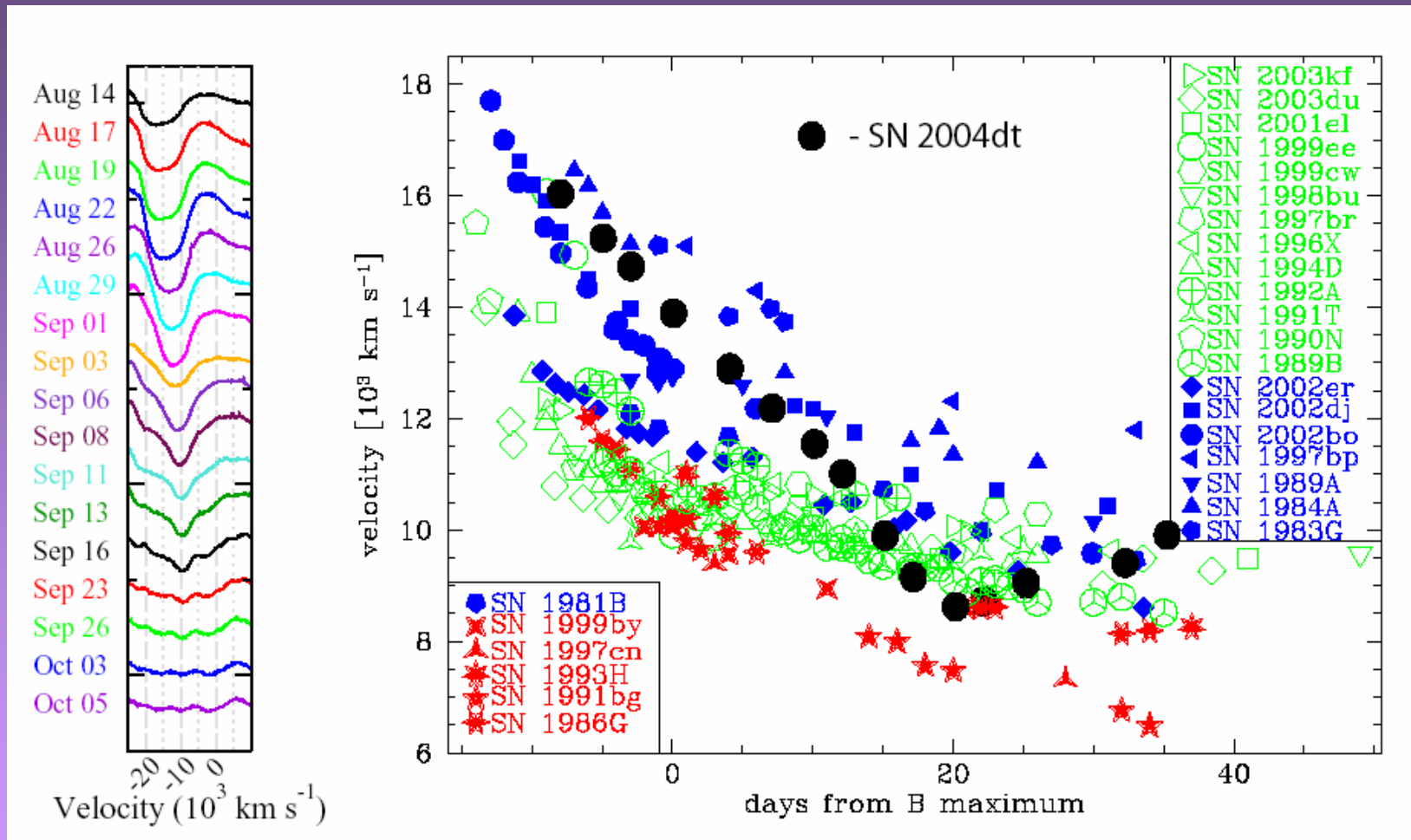
SYNOW Analysis



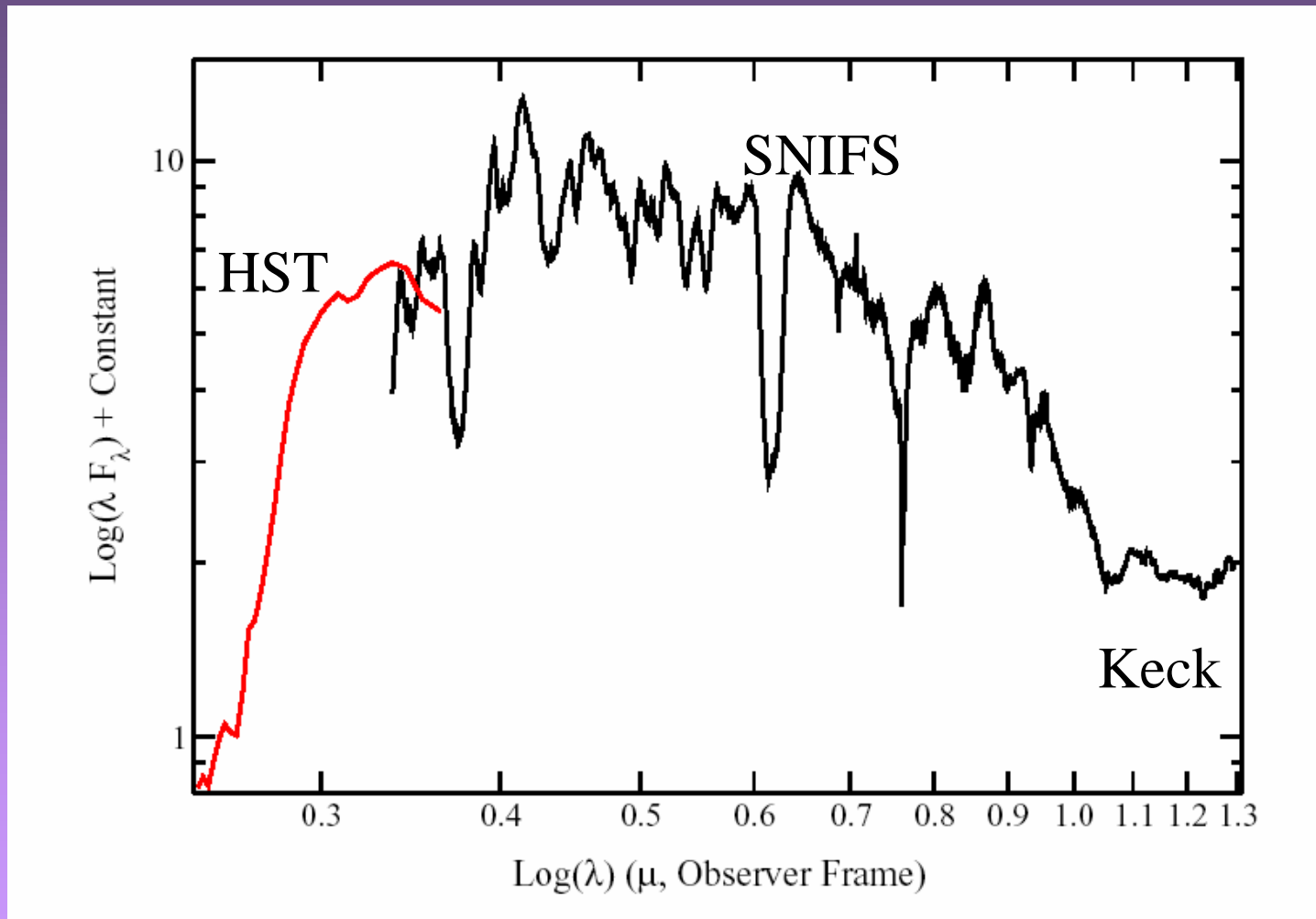
Automated SYNOWAnalysis

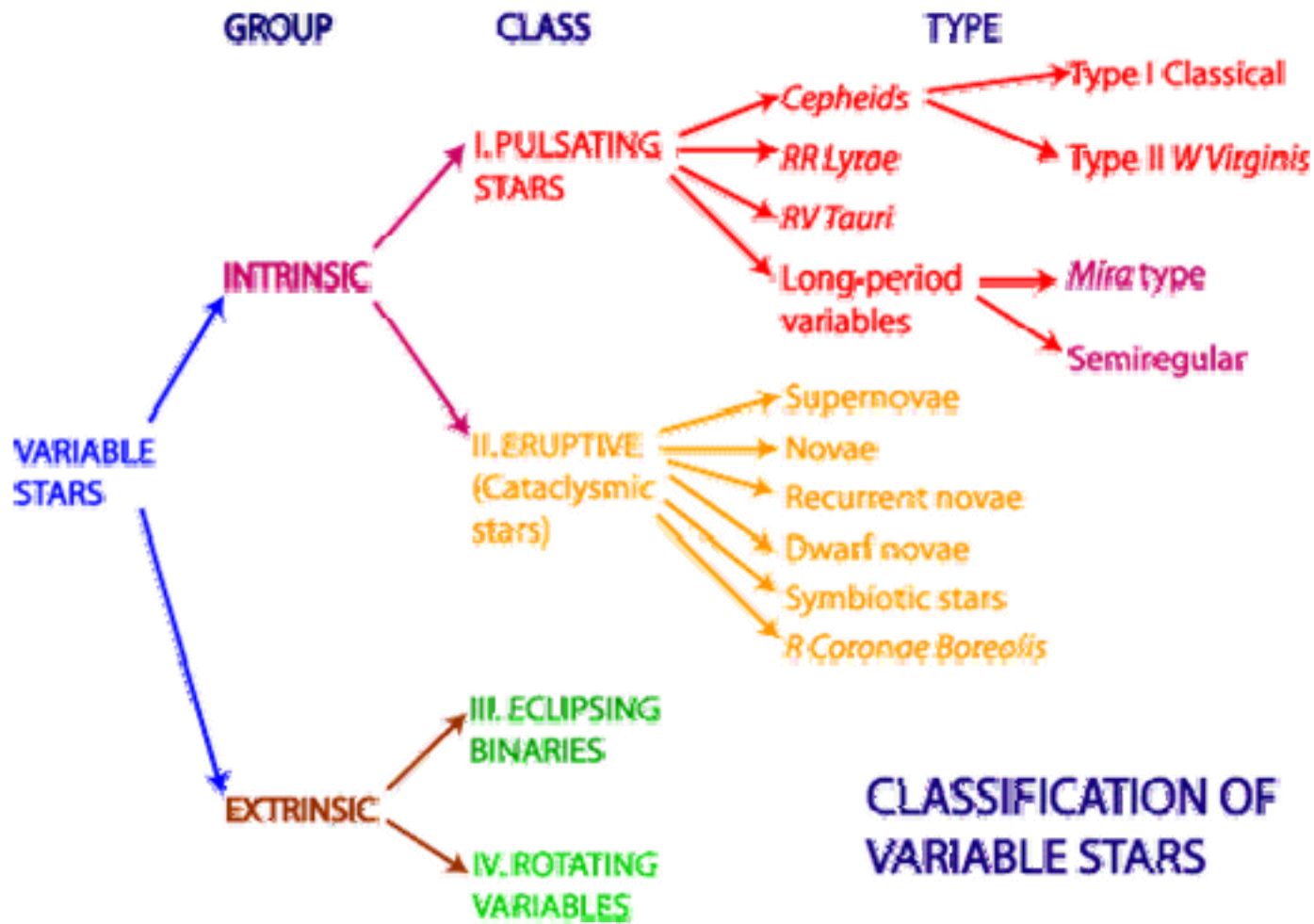
QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.

Velocity Evolution Comparison

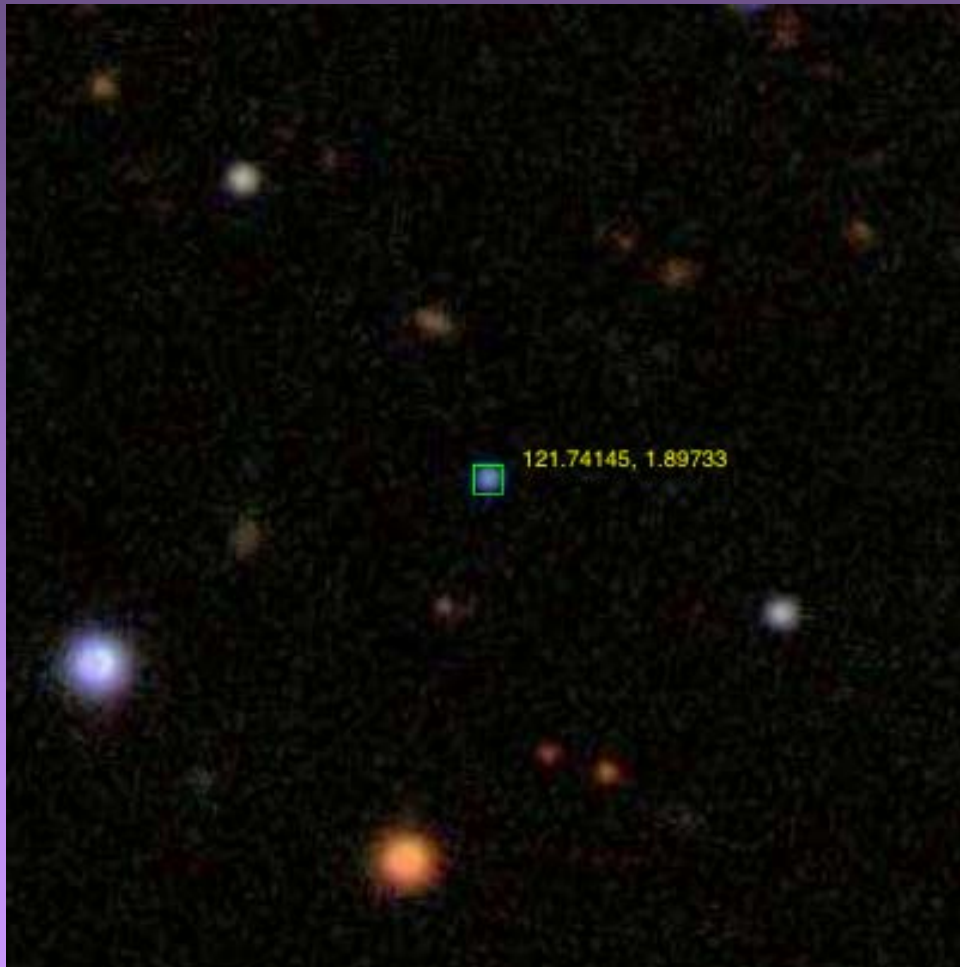


SN2004dt UVONIR Spectroscopy





Celestial Disappearing Act

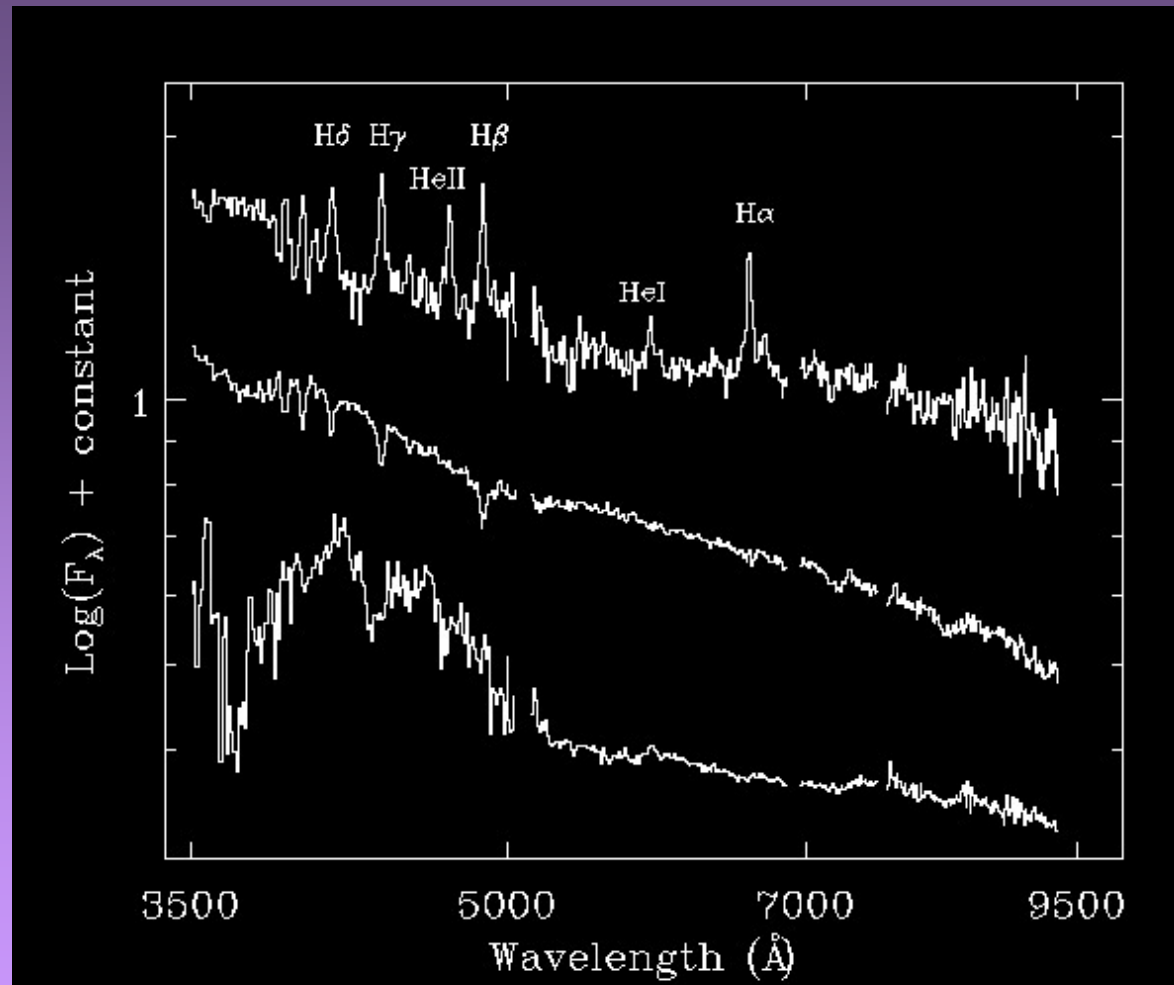


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Non-Supernova Transients



Summary

- SNfactory focuses on Type Ia supernovae for cosmology
- Palomar-QUEST Survey is powerful transient finder
- SNIFS spectroscopic screening for classification
- Non-supernovae are asteroids, variable stars and AGN
- 6 CV's, 7 AGN, 1 Houdini star, 1 unknown star, 1 unknown
- Other transients passed on to others in P-Q Consortium