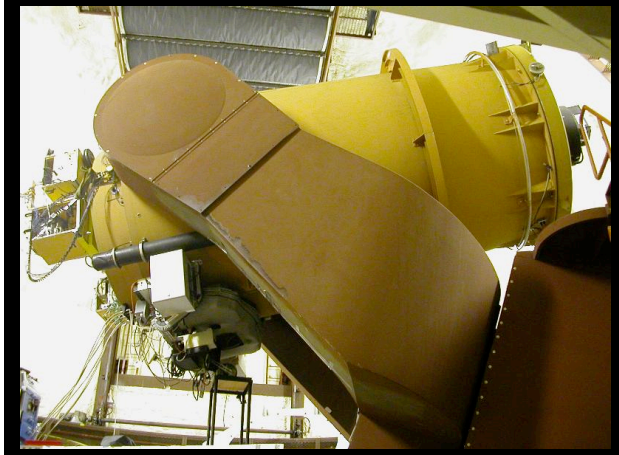
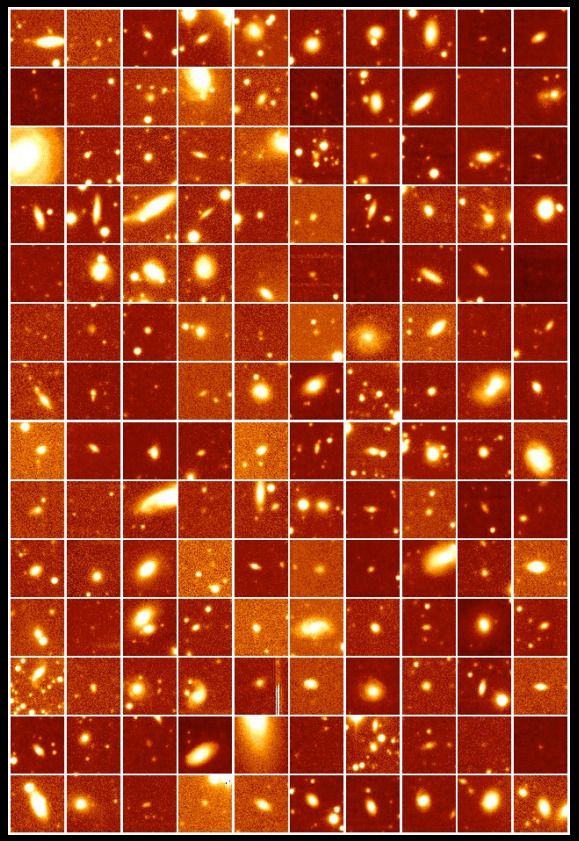
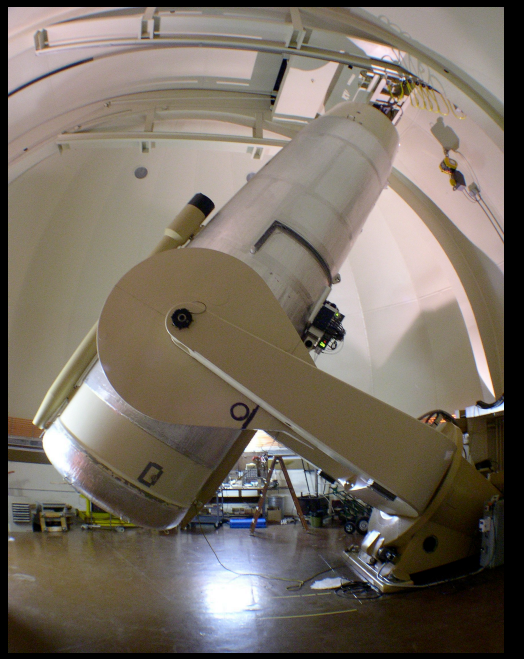
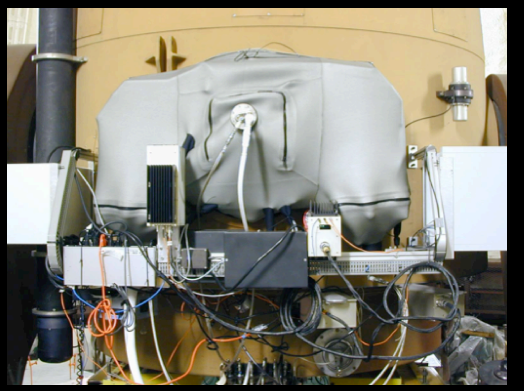
Nearby Supernova Factory









IPNL
C. Buton
N. Chotard
Y. Copin
E. Gangler
G. Smadja
R. Pereira

LPNHE
P. Antilogus
S. Bailey
S. Bongard
R. Pain
C. Wu

Yale
C. Baltay
D. Rabinowitz
R. Scalzo

LBL
G. Aldering
M. Childress
H. Fakhouri
S. Loken
S. Perlmutter
P. Nugent
R. Thomas
K. Runge
J. Zylberberg

CRAL
E. Pecontal

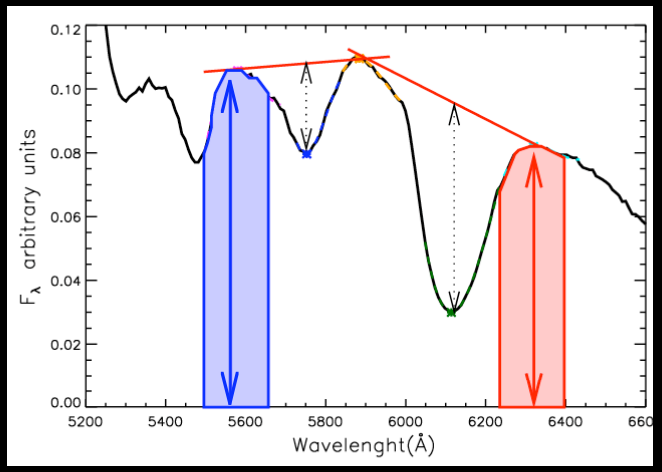
CPPM
C. Tao
D. Fouchez

A New Paradigm

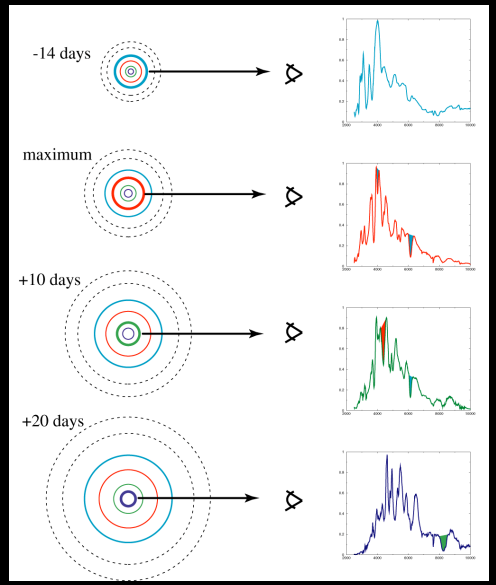
- Search at low redshift just like at high redshift
  - boost discovery rate
  - wide-field, impartial to presence of an associated galaxy
  - find better analogs to high-redshift environment
- Fully integrate photometry and spectroscopy
  - *for photometry:*
    - Eliminate K-corrections and S-corrections
    - Tackle dust extinction using more colors
    - Eliminate atmospheric dispersion degeneracies
  - *for spectroscopy:*
    - Spectroscopy for more SNe
    - Time series of spectra for each SN
    - Properly subtract host galaxy light
    - Eliminate effects of slit losses and atmospheric dispersion

Getting to the Physics with Spectroscopy

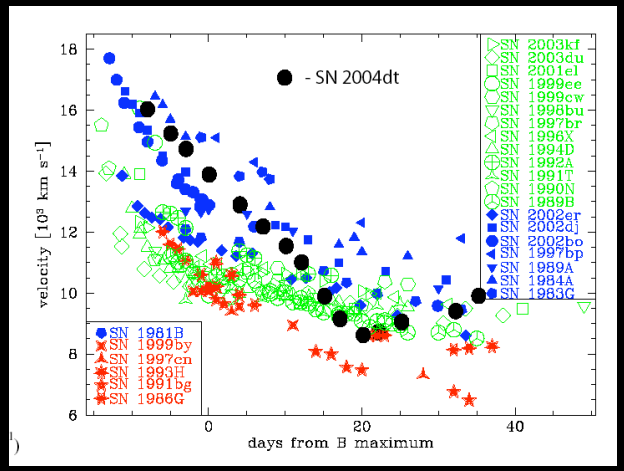
Luminosity Indicators



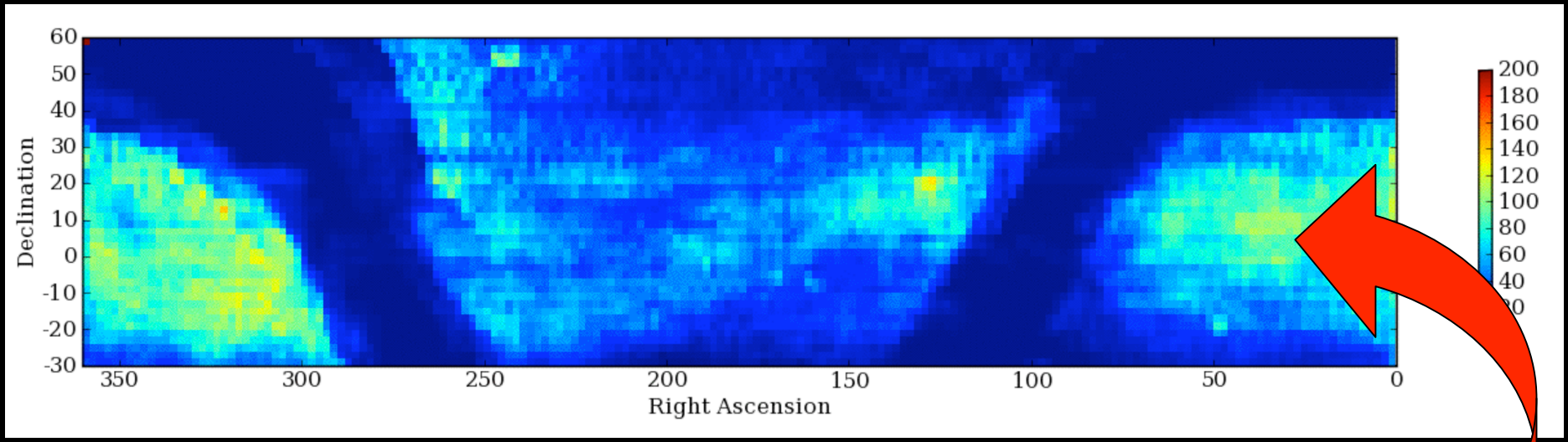
Abundance Tomography

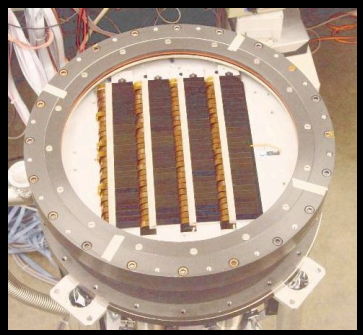


Kinematics



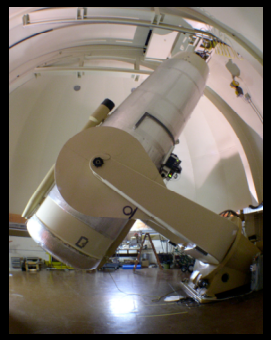
Nearby Supernova Factory Search





QUEST Camera

+



Oschin Schmidt

+

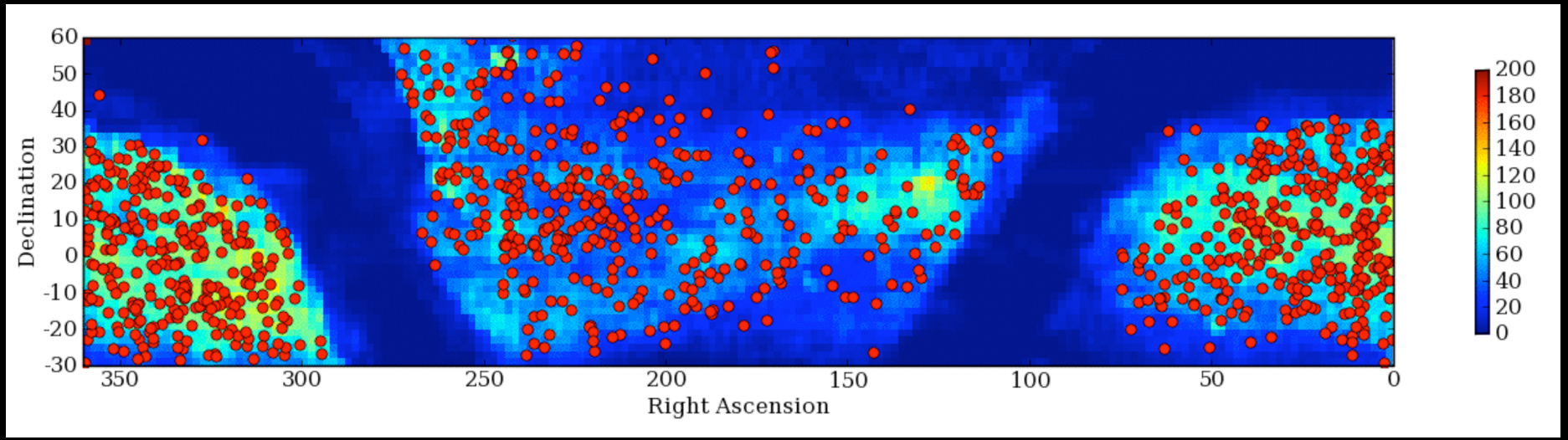
HPWREN

+

NERSC

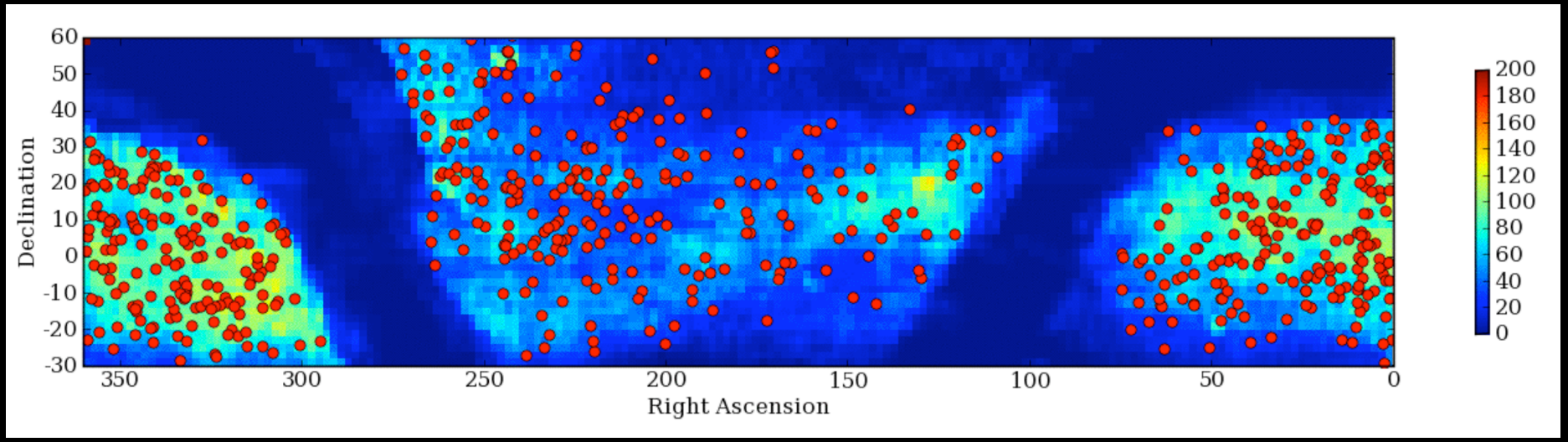
=

SNe over 2π of the Sky



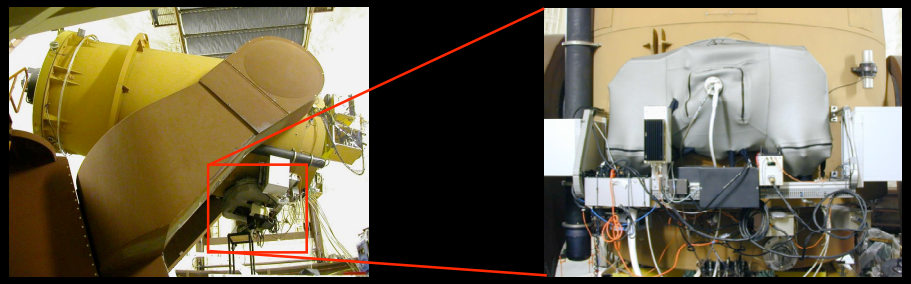
More than 1000 SNe in ~28 months of searching during 2005-2008

SNe over 2π of the Sky



624 SNe w/ spectroscopic types - mostly from the SuperNova Integral Field Spectrograph

UH88



SNIFS

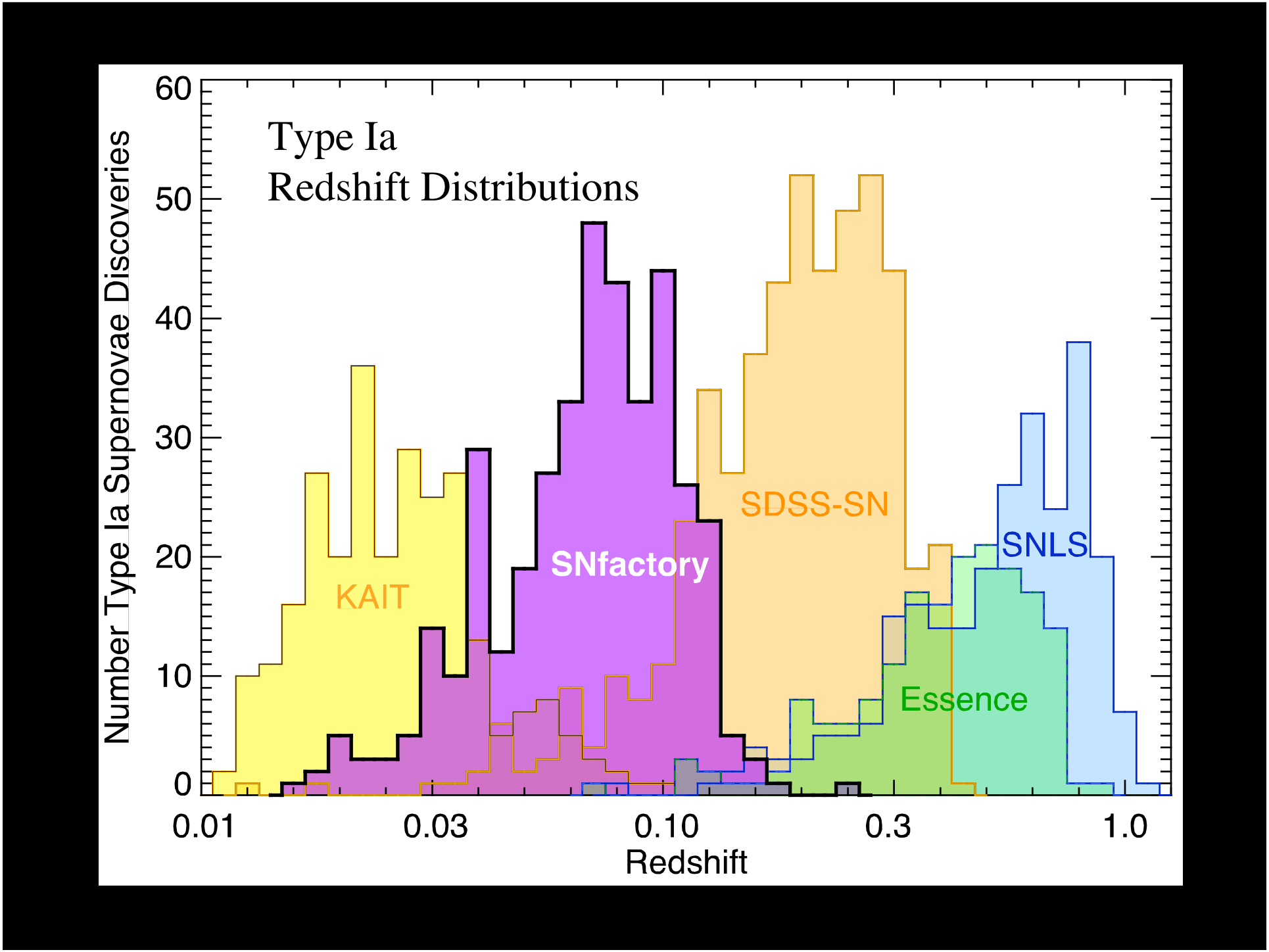
396 SNfactory & 50 IAUC SNe Ia

We faced fire and brimstone to get the data!

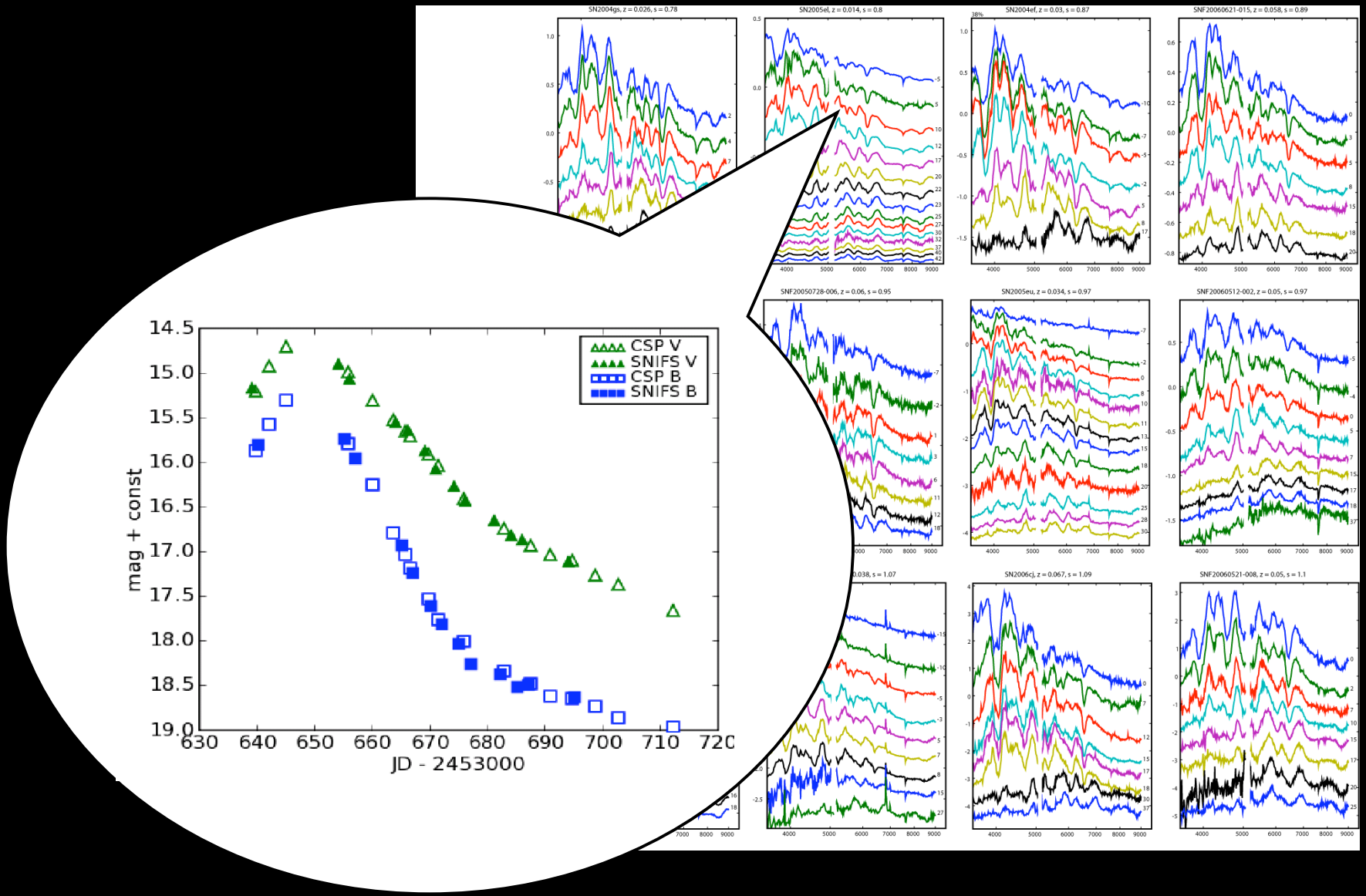
Fire closes
Palomar Observatory

Mag 6.7 earthquake hits Mauna Kea

Fire sweeps antenna site at North Peak

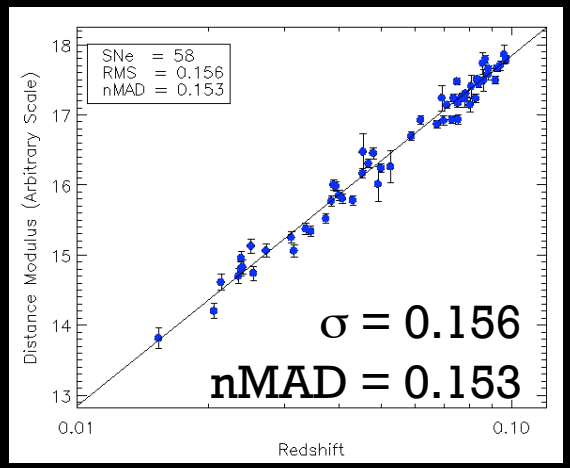

Type Ia
Redshift Distributions
Number Type Ia Supernovae Discoveries
Redshift
0
10
20
30
40
50
60
0.01
0.03
0.10
0.3
1.0
KAIT
SNfactory
SDSS-SN
SNLS
Essence

Library of Spectral Time Series

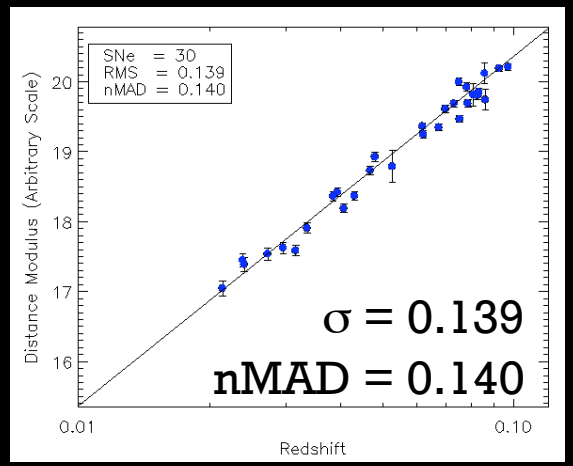


Now Several Paths to SN Hubble Diagram

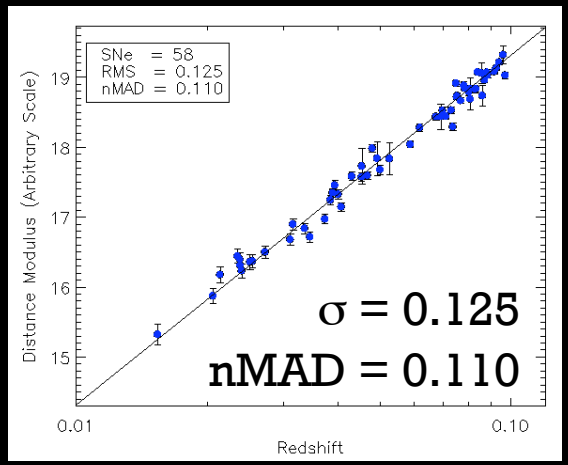
Stretch-Color



$\mathcal{R}$(SiSS)-Color

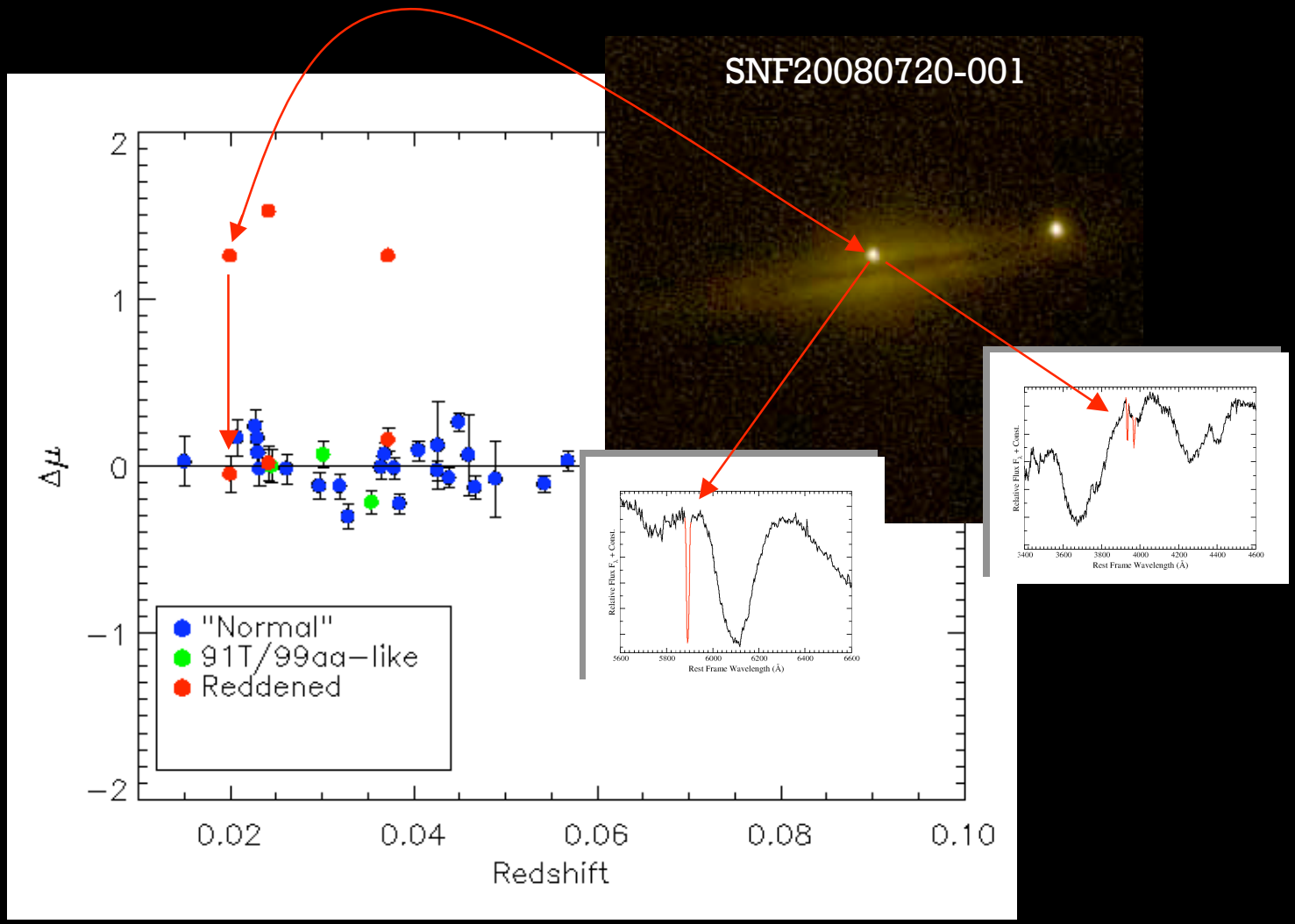


$\mathcal{R}$(642/443)

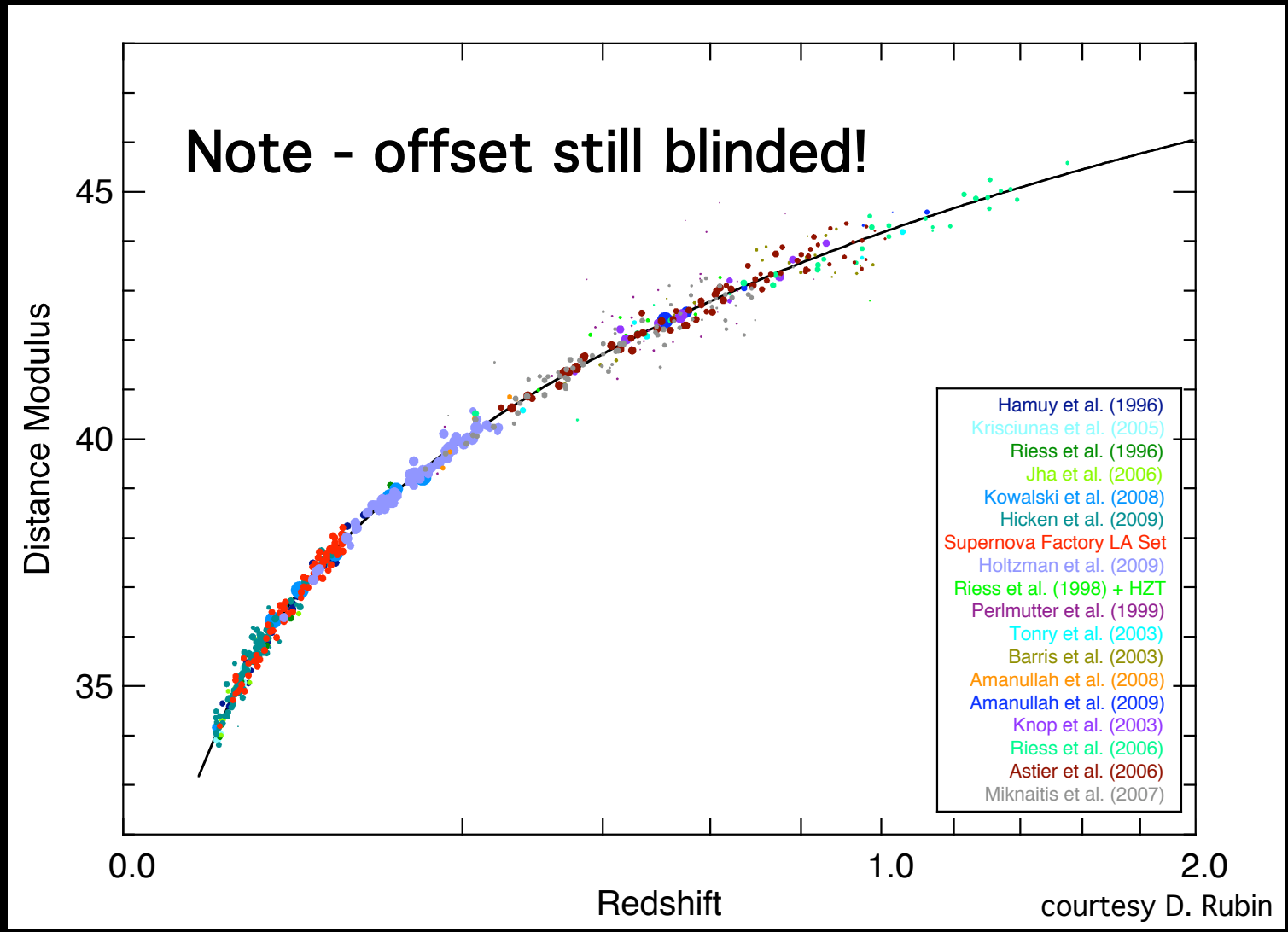


Bailey et al, 2009

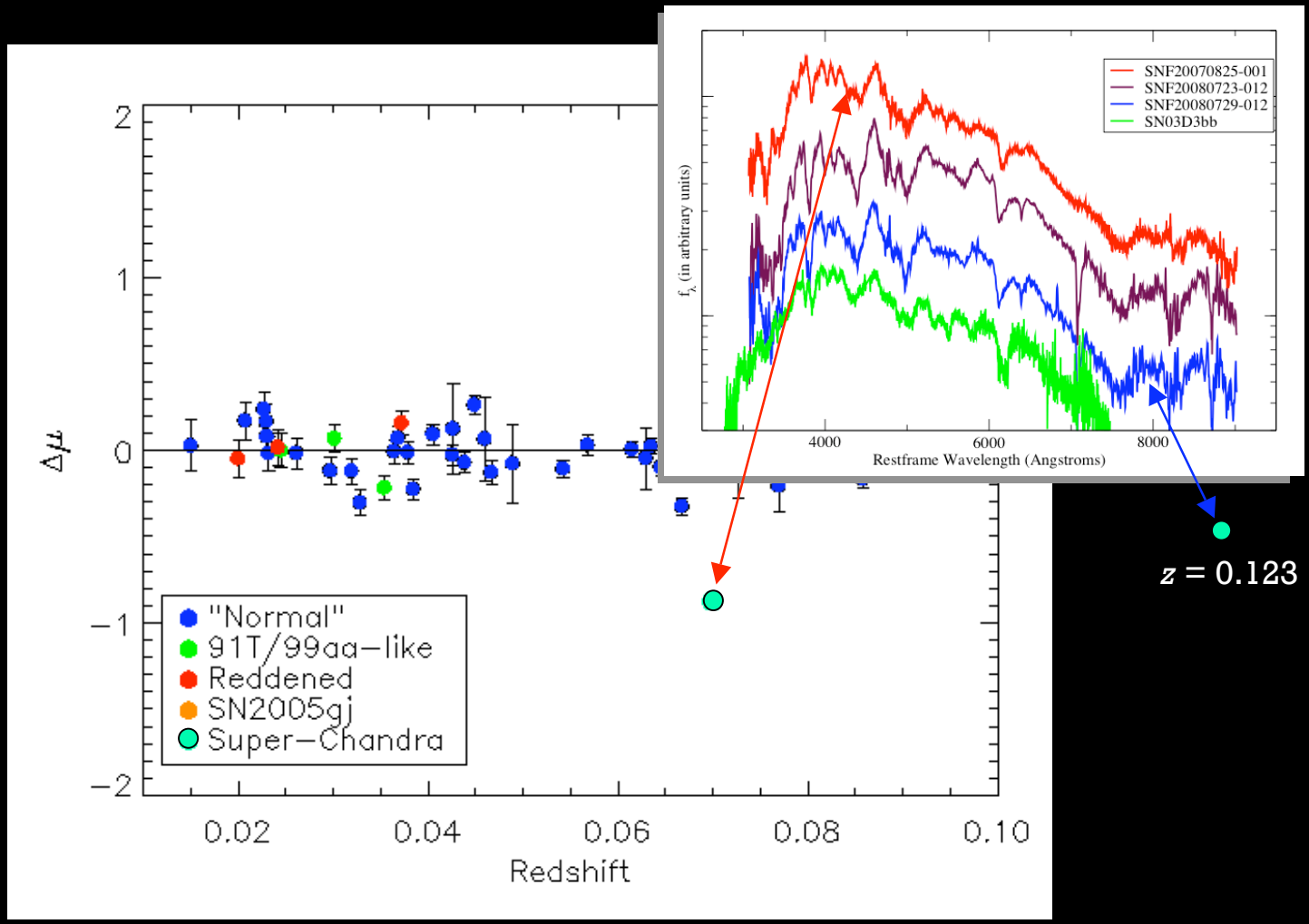
$\mathcal{R}_{642/443}$ Handles Difficult Cases



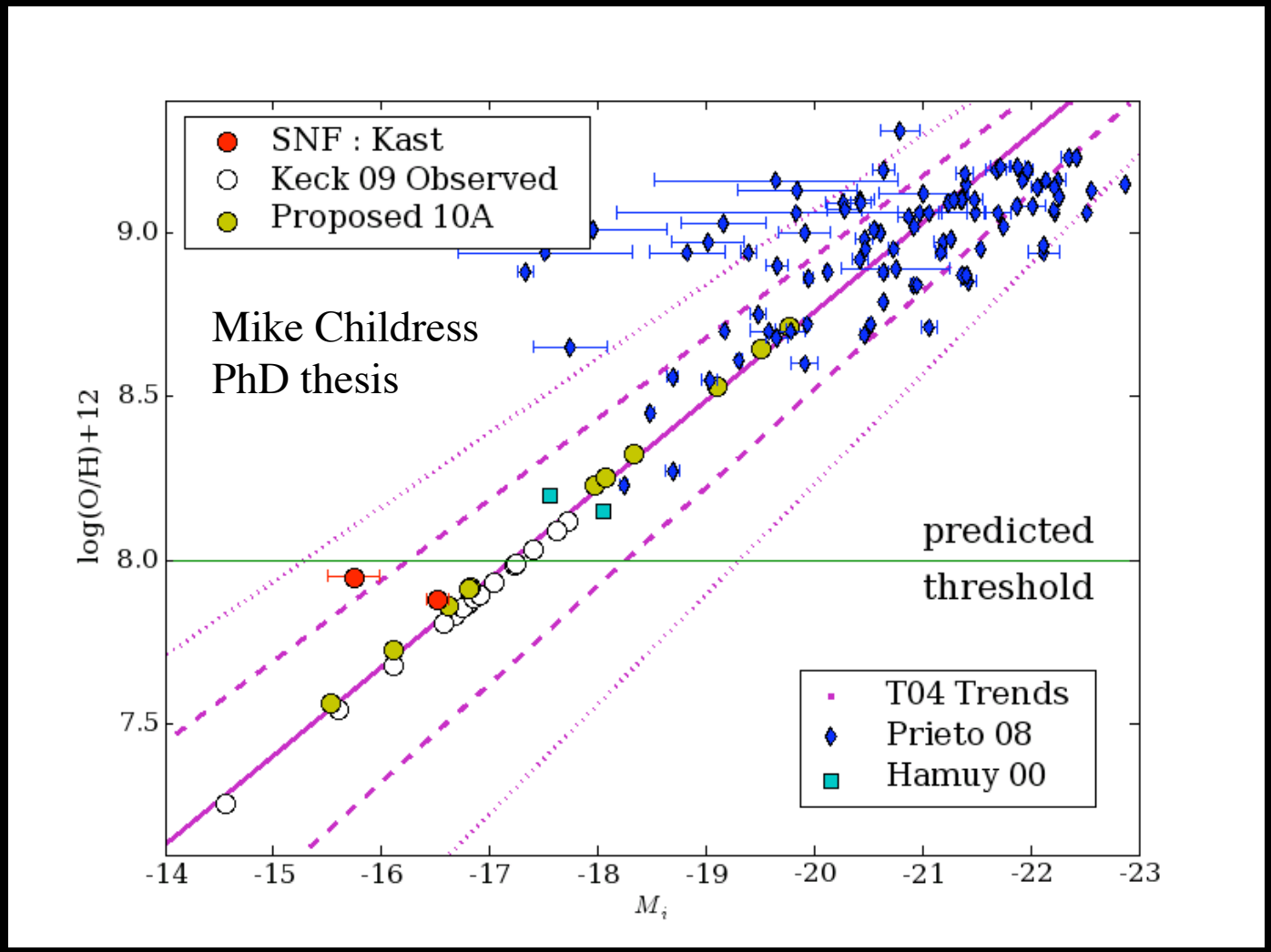
Stretch-Color Hubble Diagram



Have We Seen the Double-Degenerates?

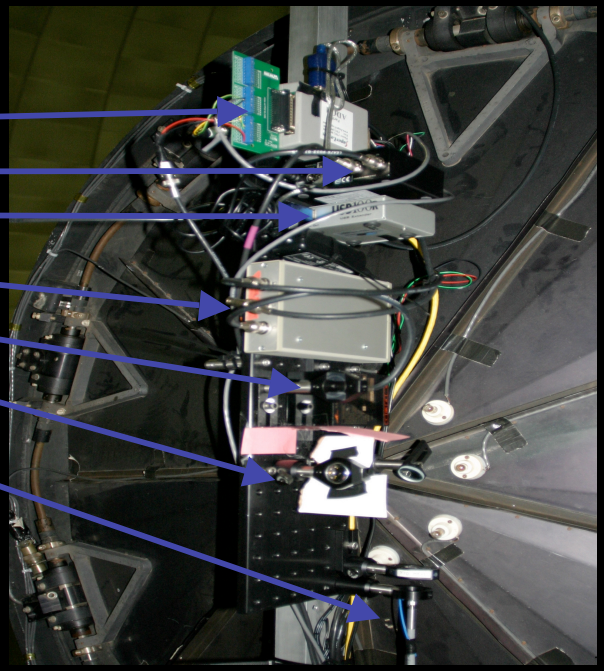


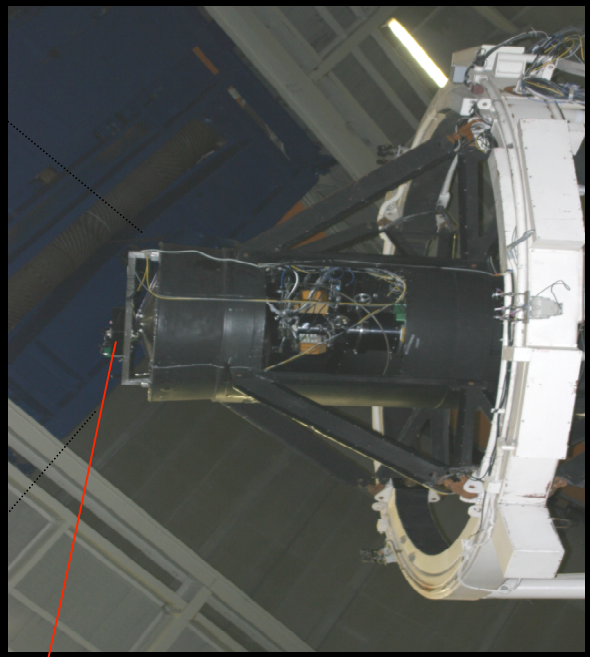
Environmental Clues and Constraints



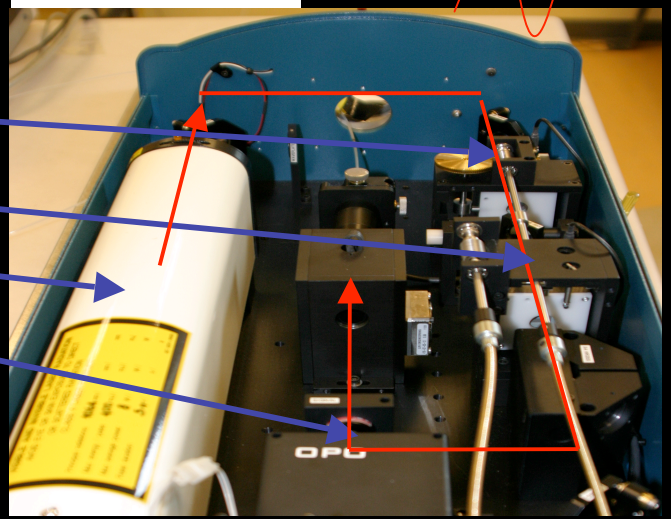
Galaxy Metallicity

Galaxy Luminosity





Optical fiber



Technique:

- Illuminate flat field screen with monochromatic laser light from a tunable laser, and take a spectral image at each λ.
- Deliver a fixed “dose” of light to the system, as measured by a NIST calibrated photodiode.
- Measuring the flatfield flux relative to that seen by the photodiode allows the measurement of the total system throughput, in situ, relative to the well-characterized diode.

Courtesy C. Stubbs

Work for the Coming Year

- SNIFS
  - Complete final references for 2005-2008 SNe
  - Follow-up of SNe Ia targeted by HST/STIS
  - Supplement current sample with other interesting SNe
  - Development of absolute color calibration system
- Cosmology analysis
  - Finalize flux calibration
  - Complete host galaxy redshifts
  - Finalize host subtraction pipeline
- Spectral analysis
  - Develop new/improved spectral luminosity indicators
  - Abundance tomography
  - Spectral temporal-luminosity model, $F(\lambda,t,s)$

Summary

- Several fundamentally different standardization methods have been demonstrated to work well using spectrophotometric data.
- New methods using spectrophotometry are showing significant improvement over imaging based methods.
- Type Ia population dominated by SNe standardizable to 6%.
- Highly-extincted SNe Ia can be standardized at optical wavelengths
  - more examples needed to break intrinsic color - dust degeneracy
- Oddball SNe Ia and those in low-luminosity hosts help probe progenitor properties.
- Deeper understanding of SNe Ia for cosmology demands spectrophotometry