

SYNAPPS

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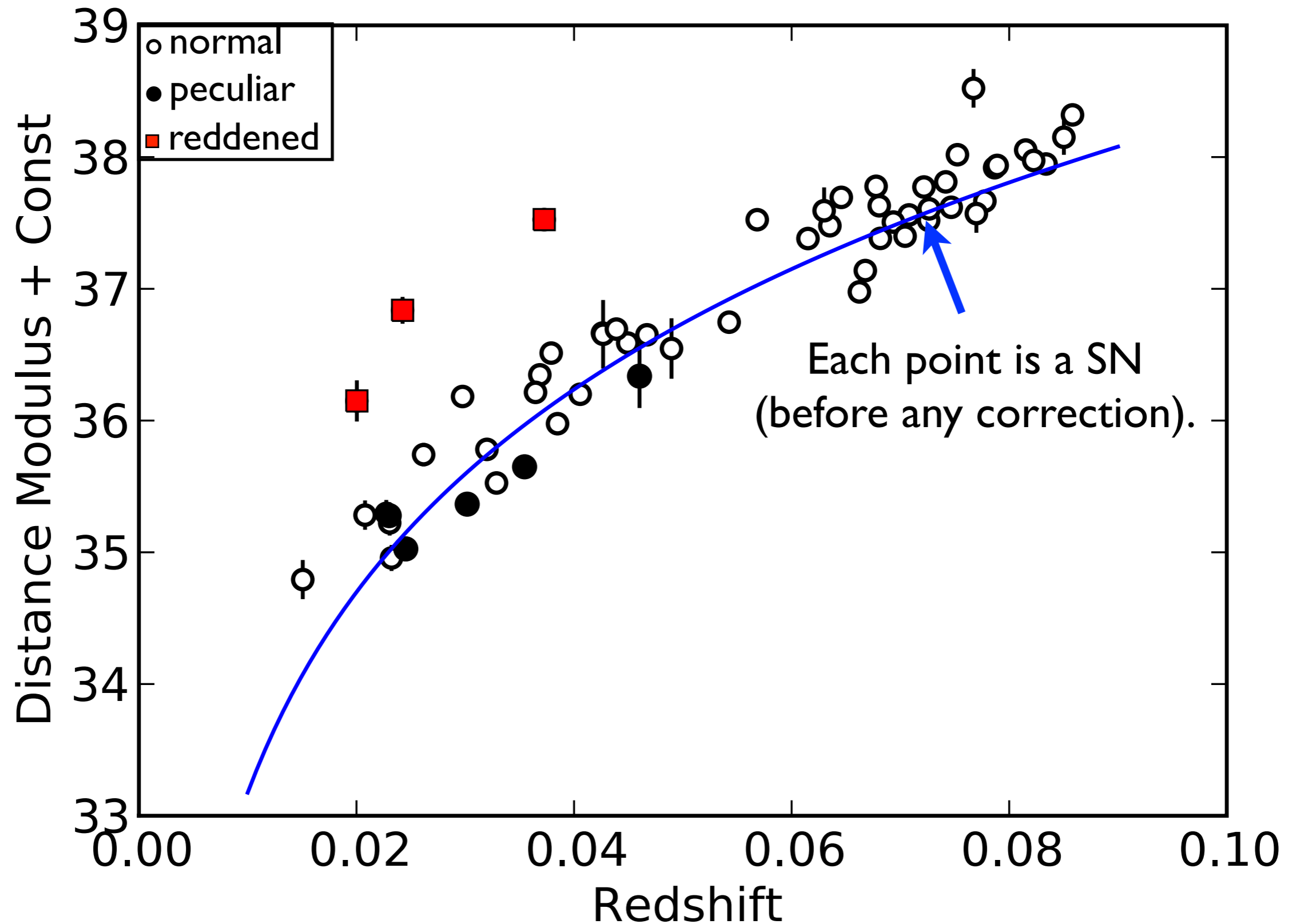
2010-05-19 SciDAC Meeting



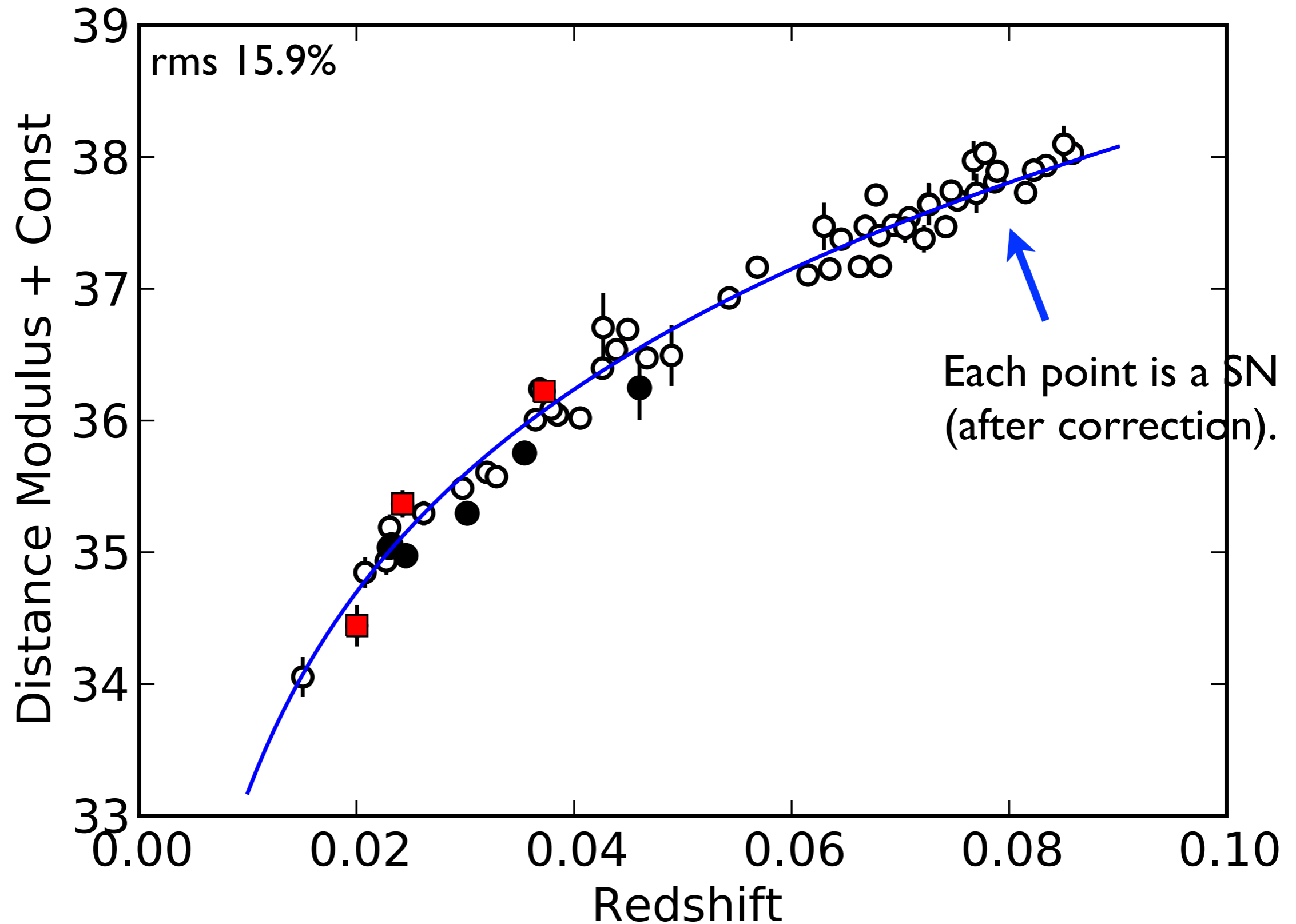
Outline

- Context: SNfactory data set
- Dealing with the data: Synapps
- Sample calculations
- Future directions

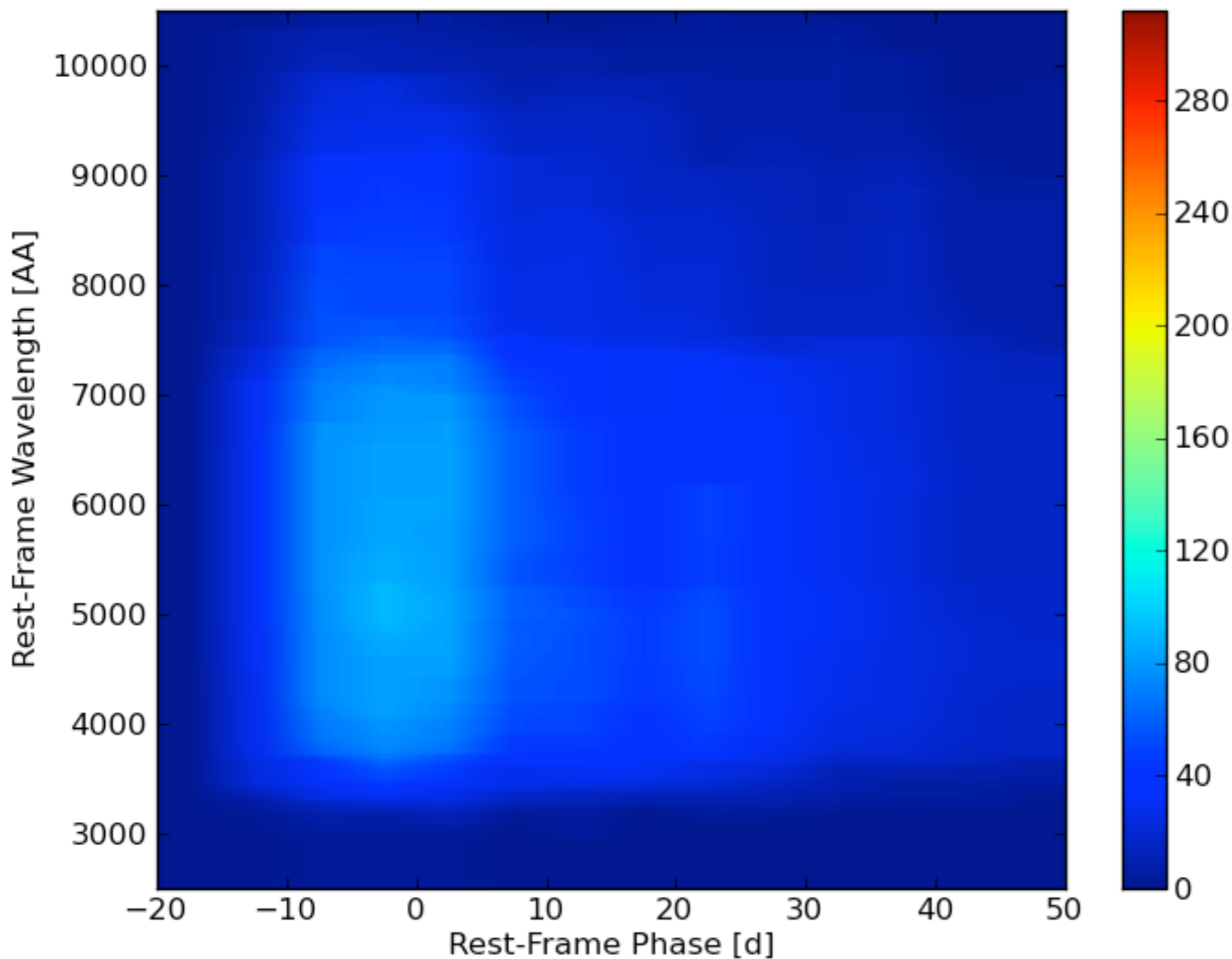
Type Ia SN Cosmology



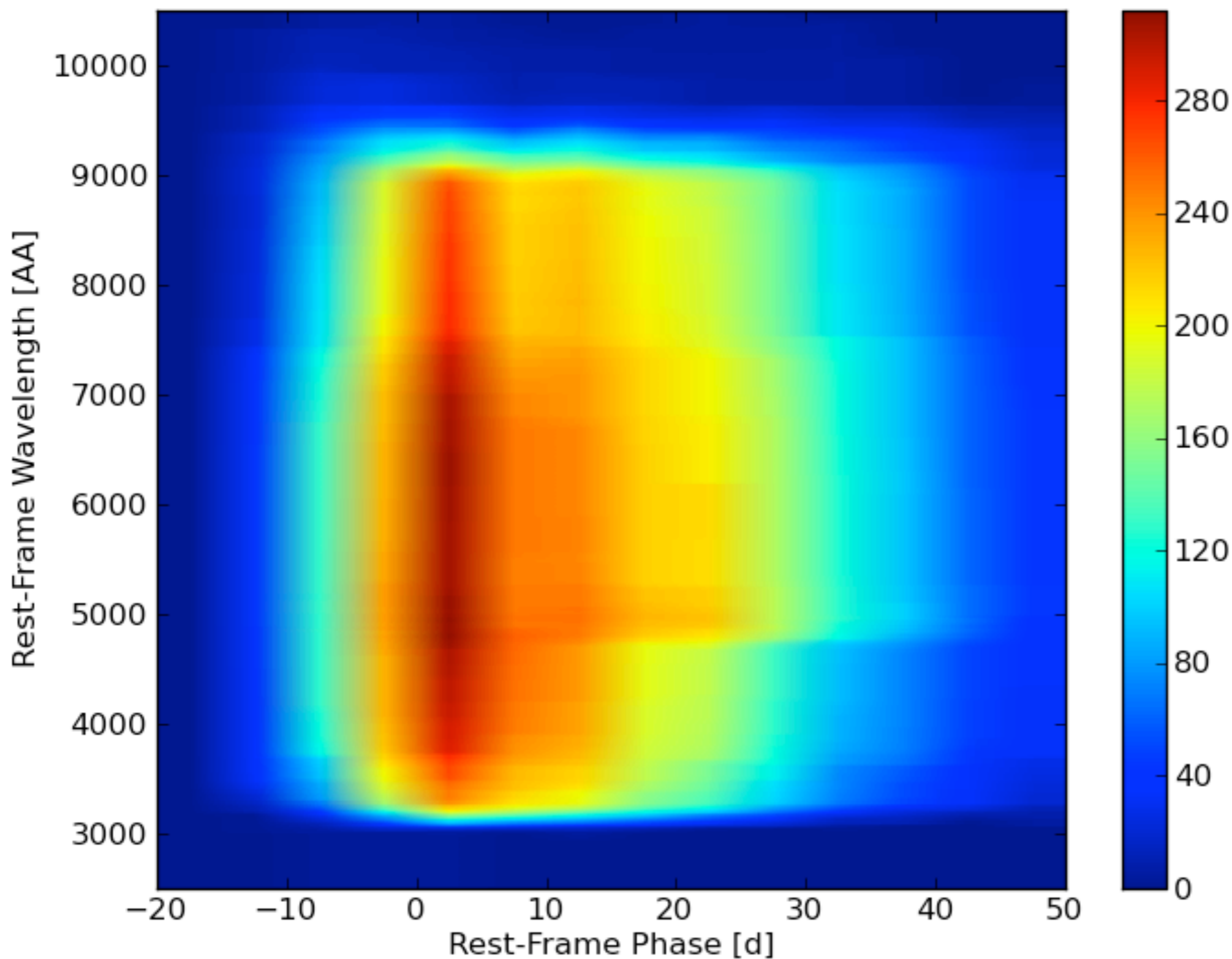
LC-corrected Hubble Diagram



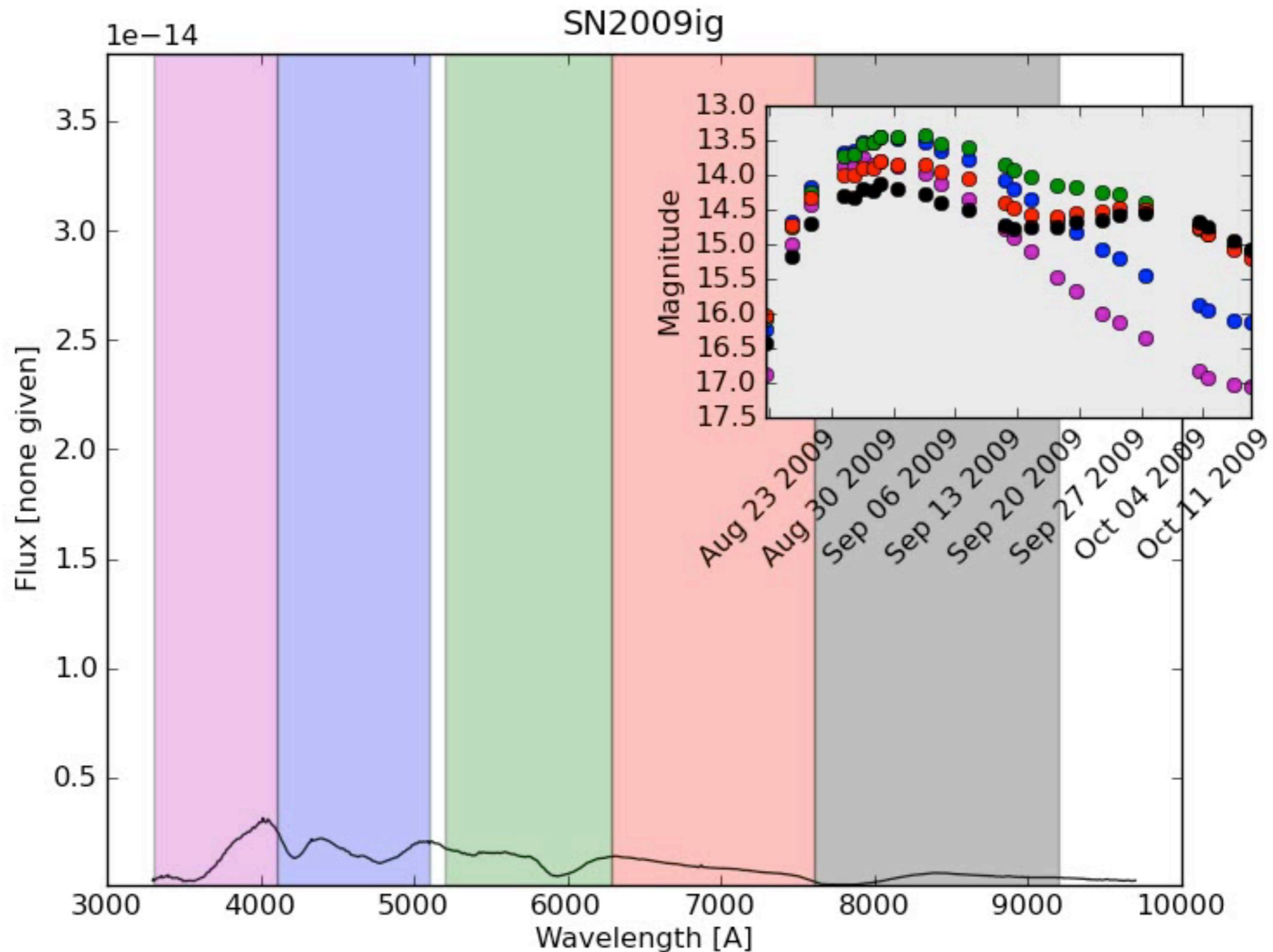
Published SN Ia Coverage



Published + SNfactory

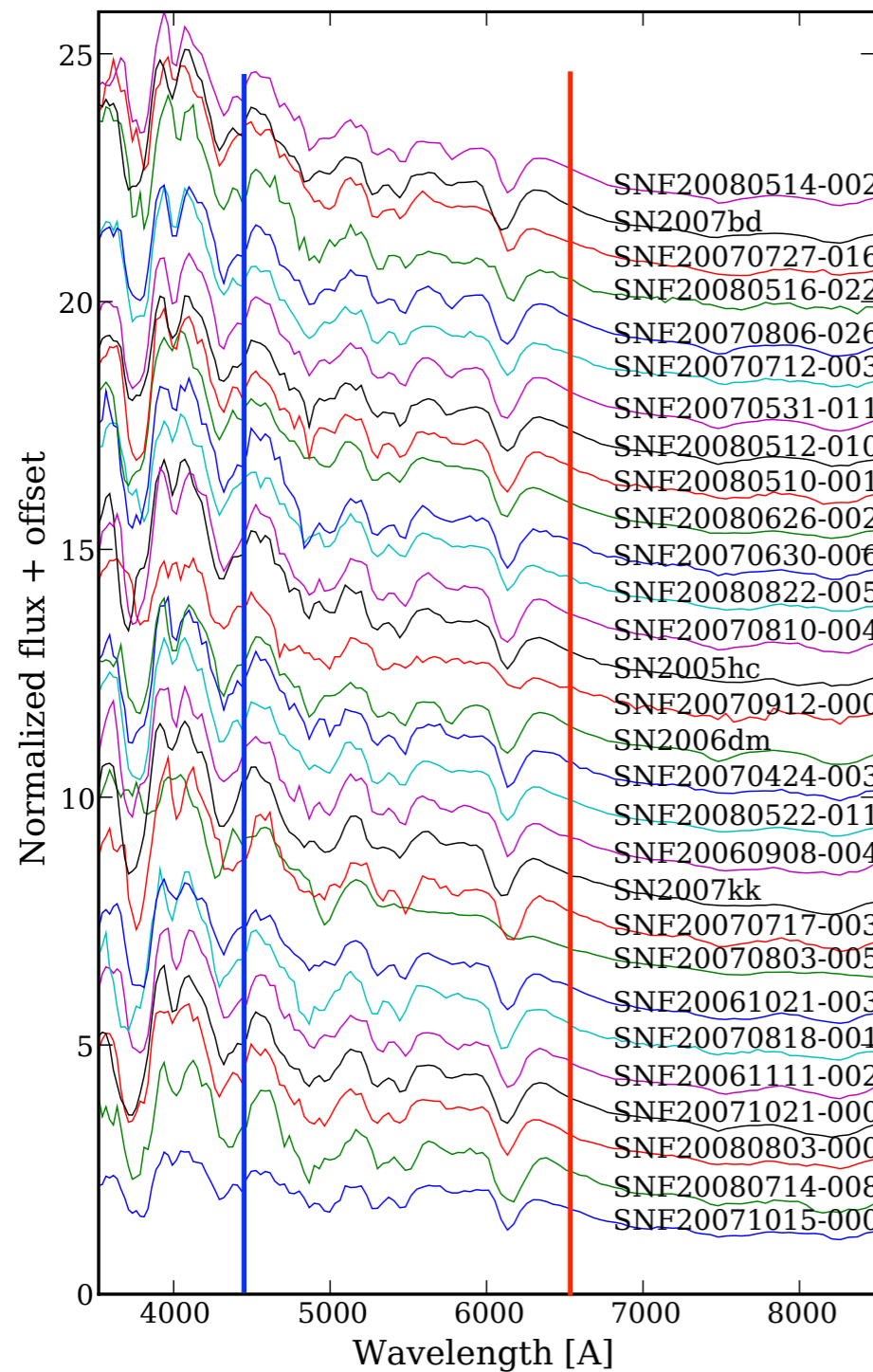


I Light Curve Point = I Spectrum

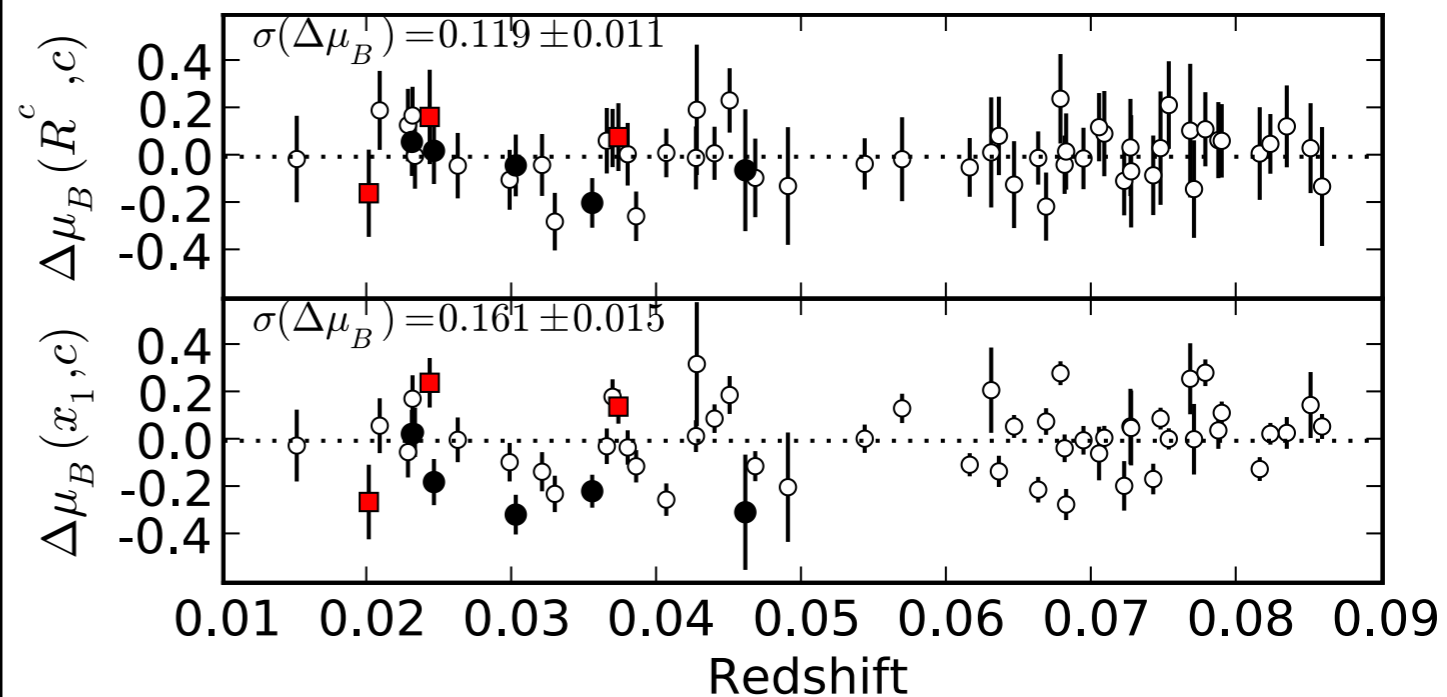
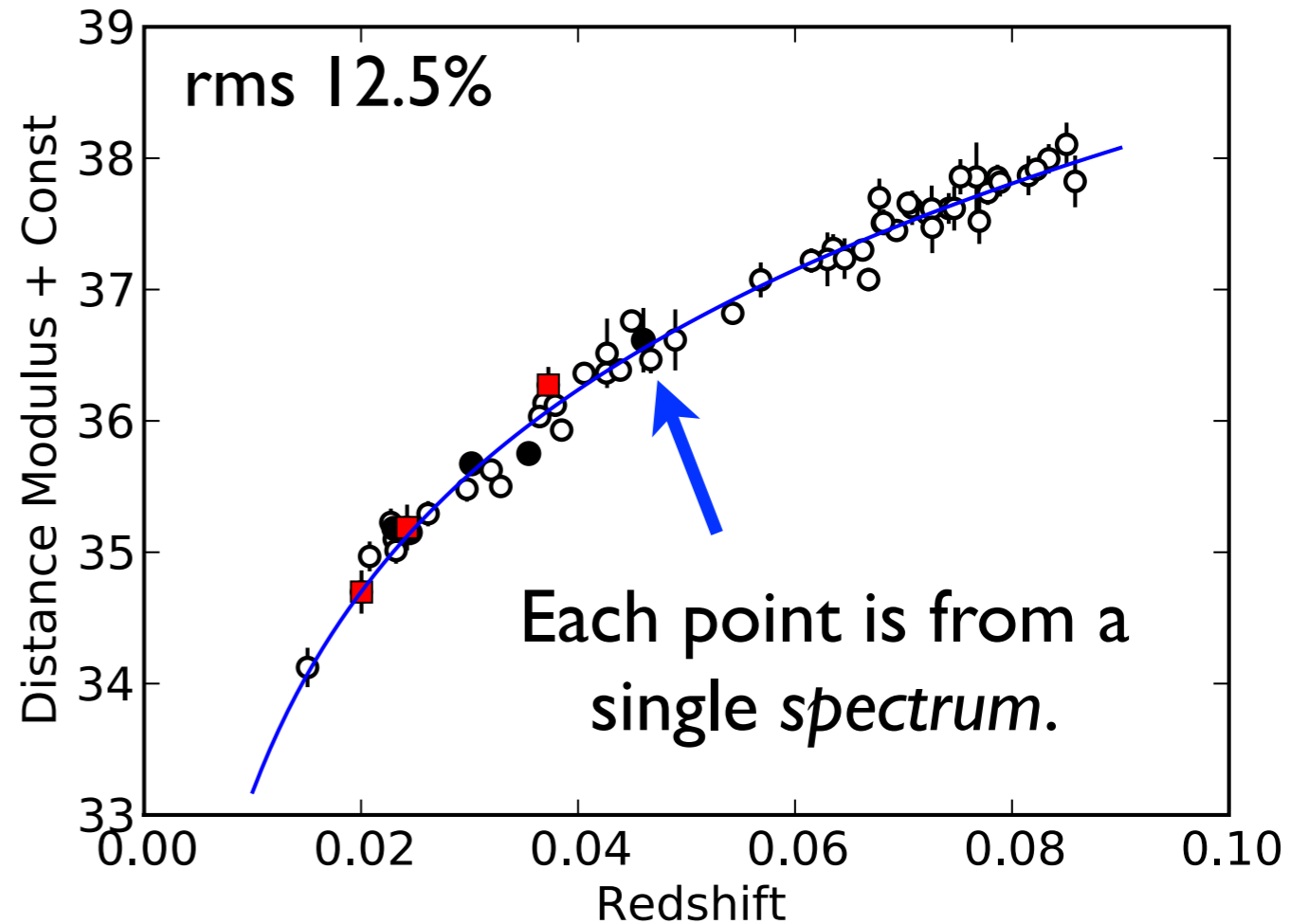


Spectroscopic Correction

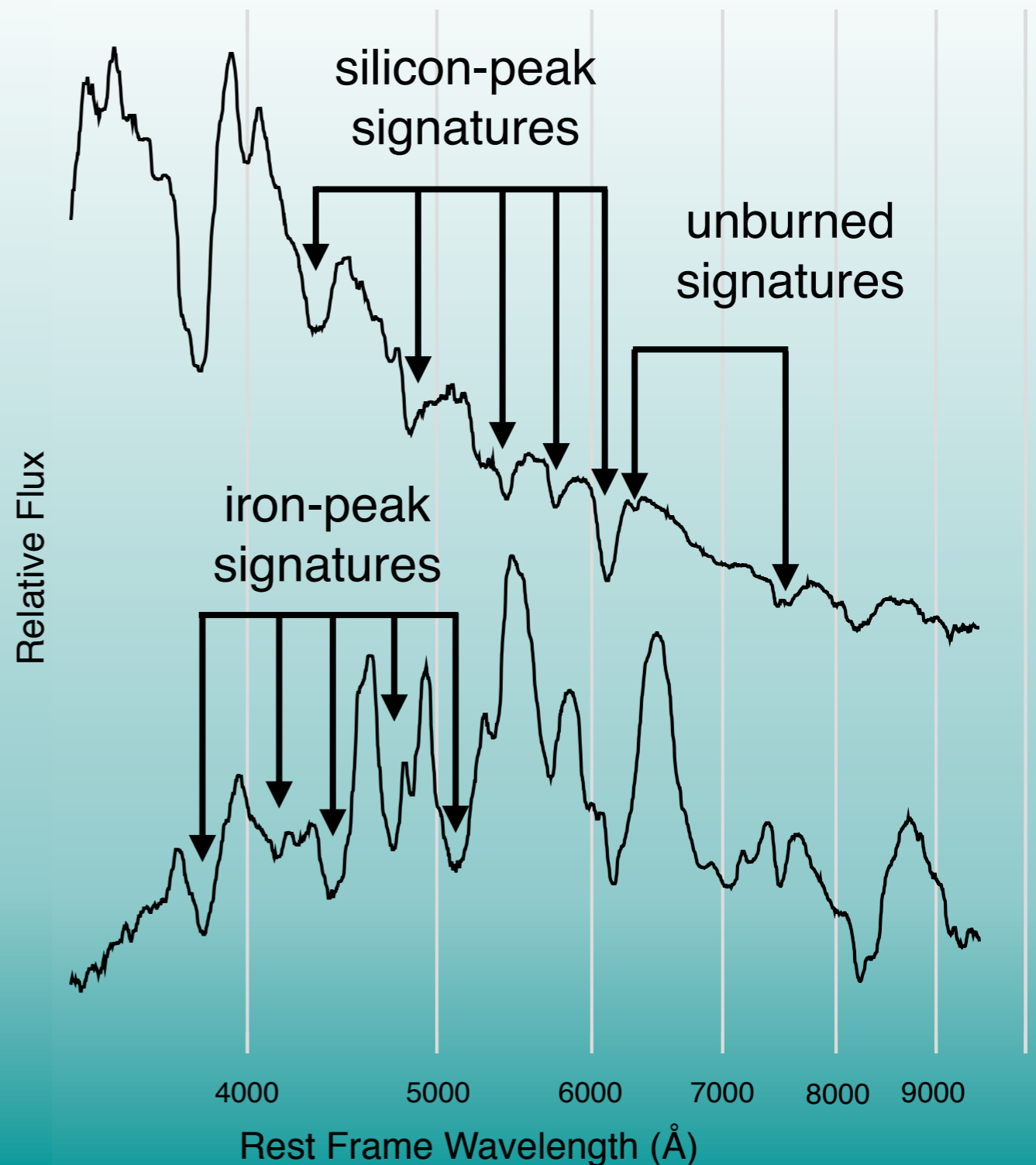
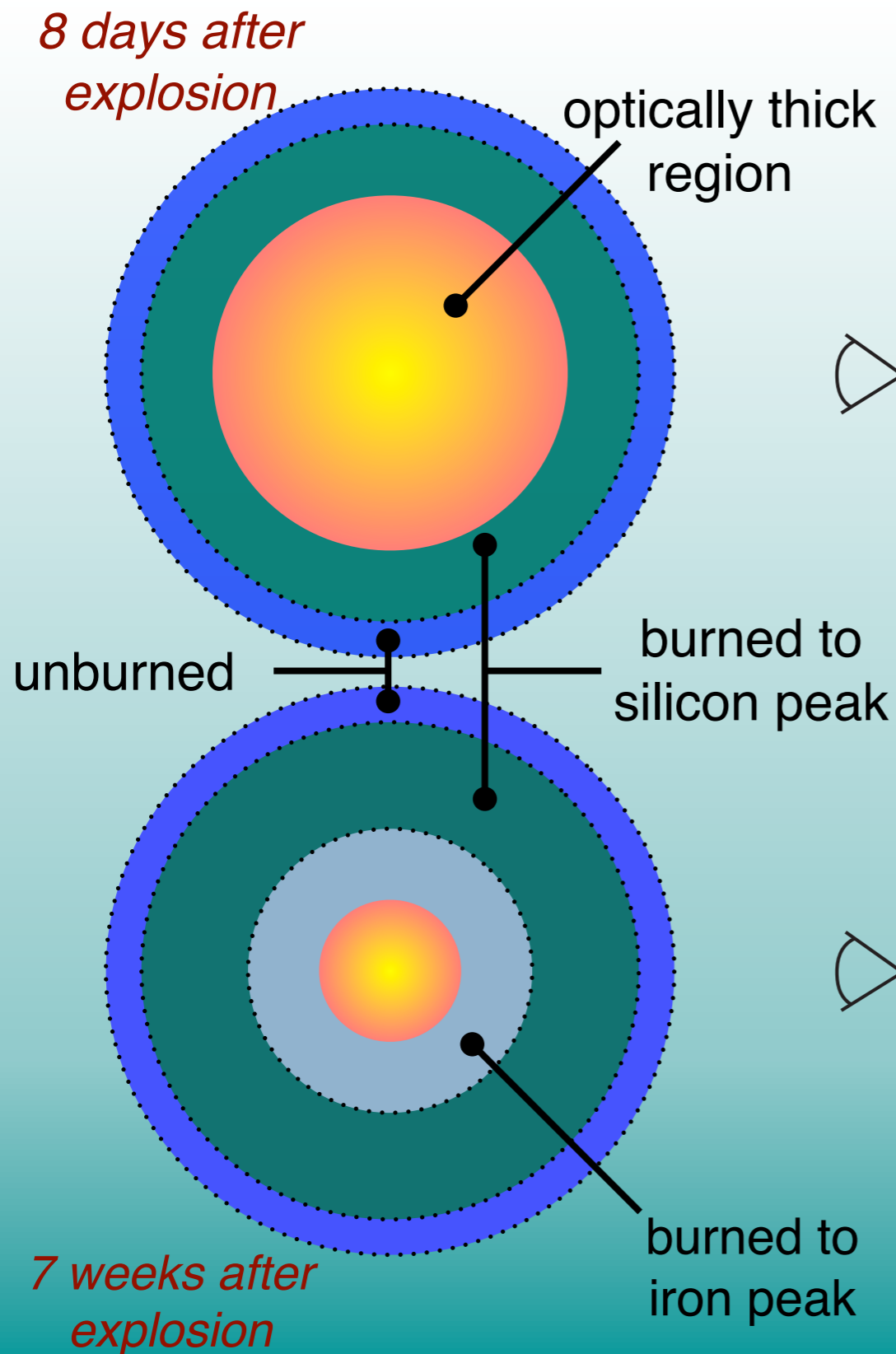
training spectra (1/2 of data)



Bailey et al 2009



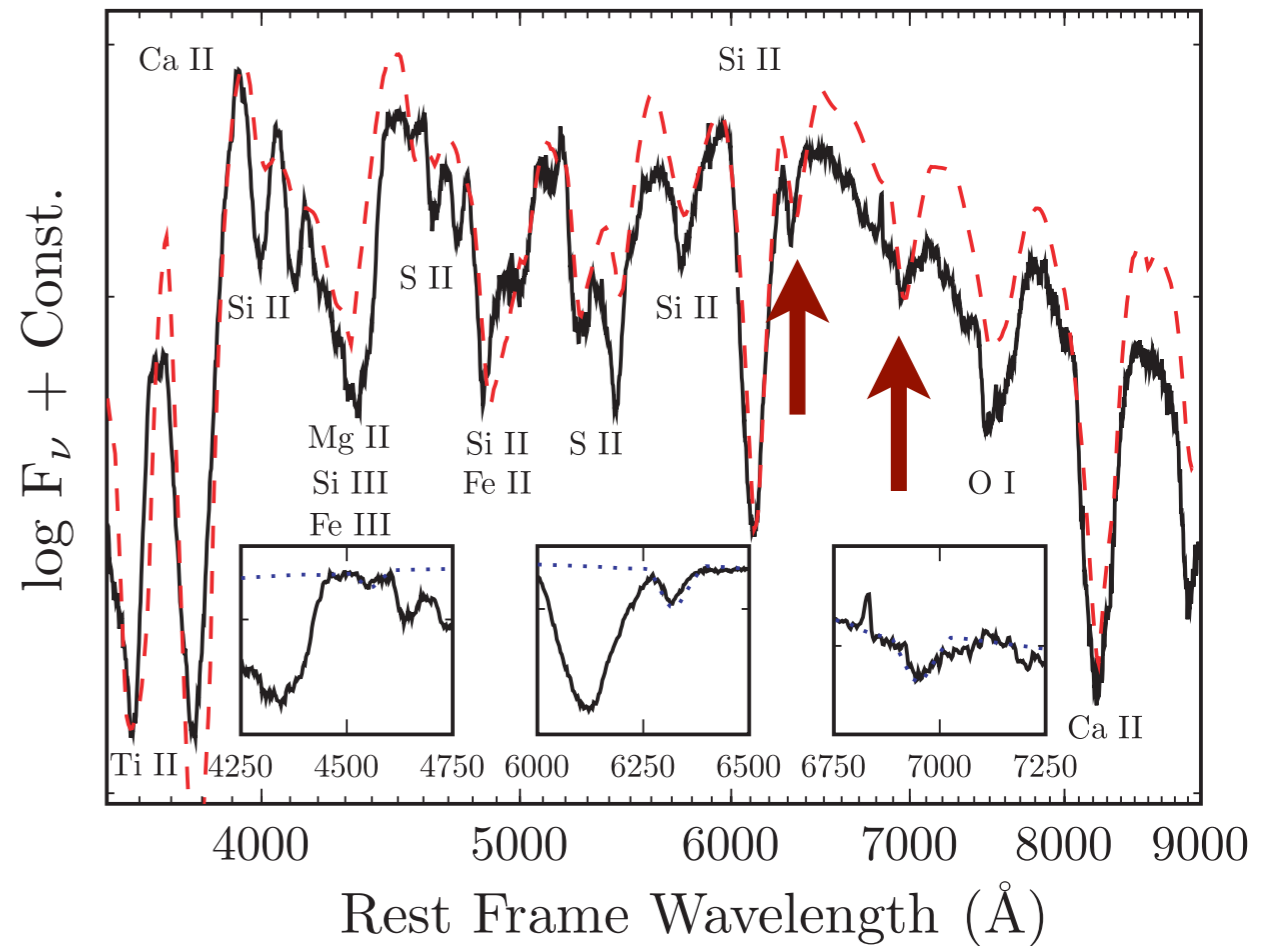
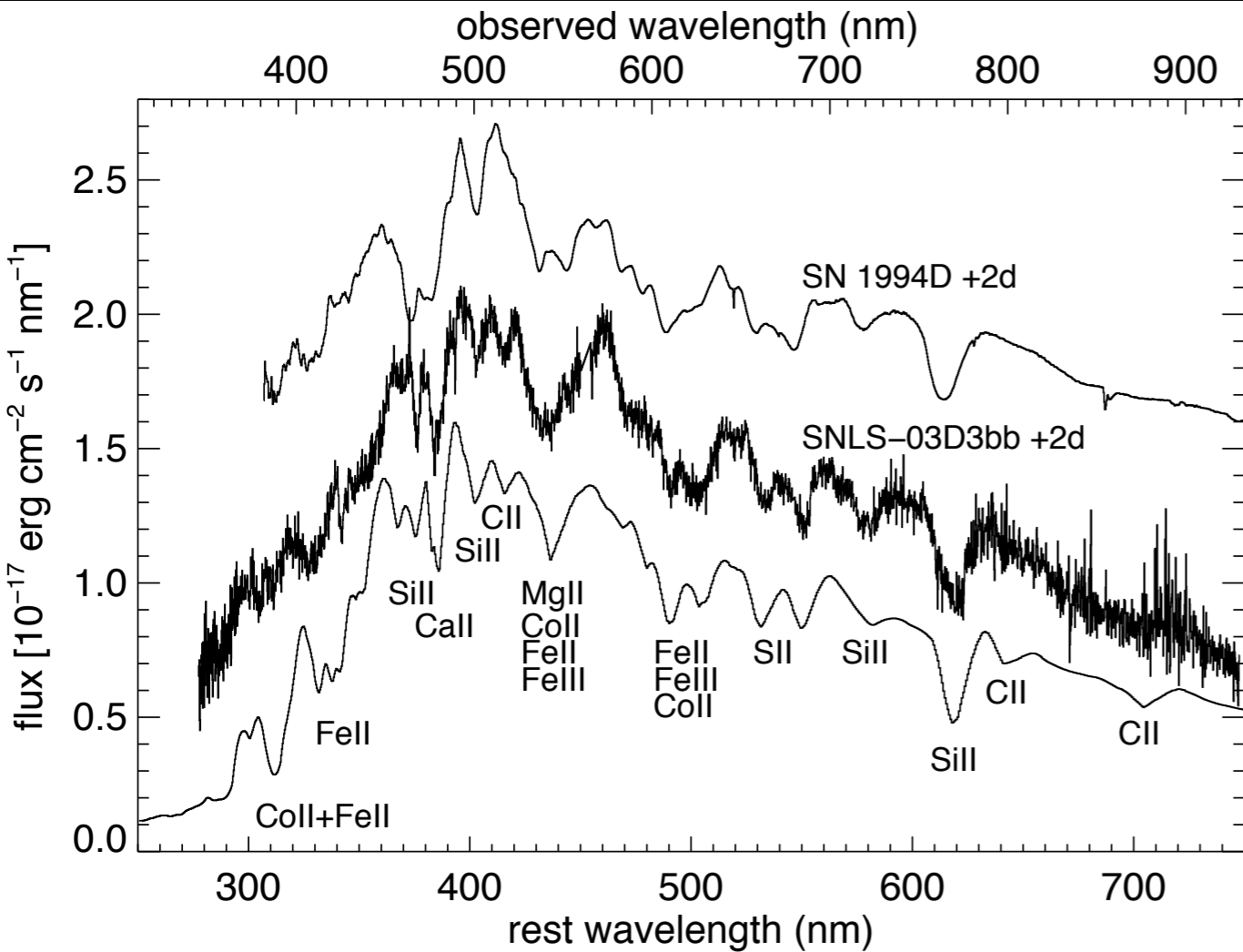
SN Spectroscopy



Spectrum Synthesis

- Ultimately, we will have some petabyte model grid over all possible initial conditions with all the physics well (these take time to develop...).
- But, it would be useful to have tools that can scale to the data sets we have now to direct detailed modeling efforts.
- Example code: Synow. Highly parameterized Sobolev code for direct (interactive) analysis of SN spectra.
- Even though the code is approximate it produces useful constraints on explosion models from data.

Direct Analysis



Howell et al. 2006
SNLS03D3bb

Thomas et al. 2007
SN2006D

Scaling to 2000+ spectra?

What We've Done

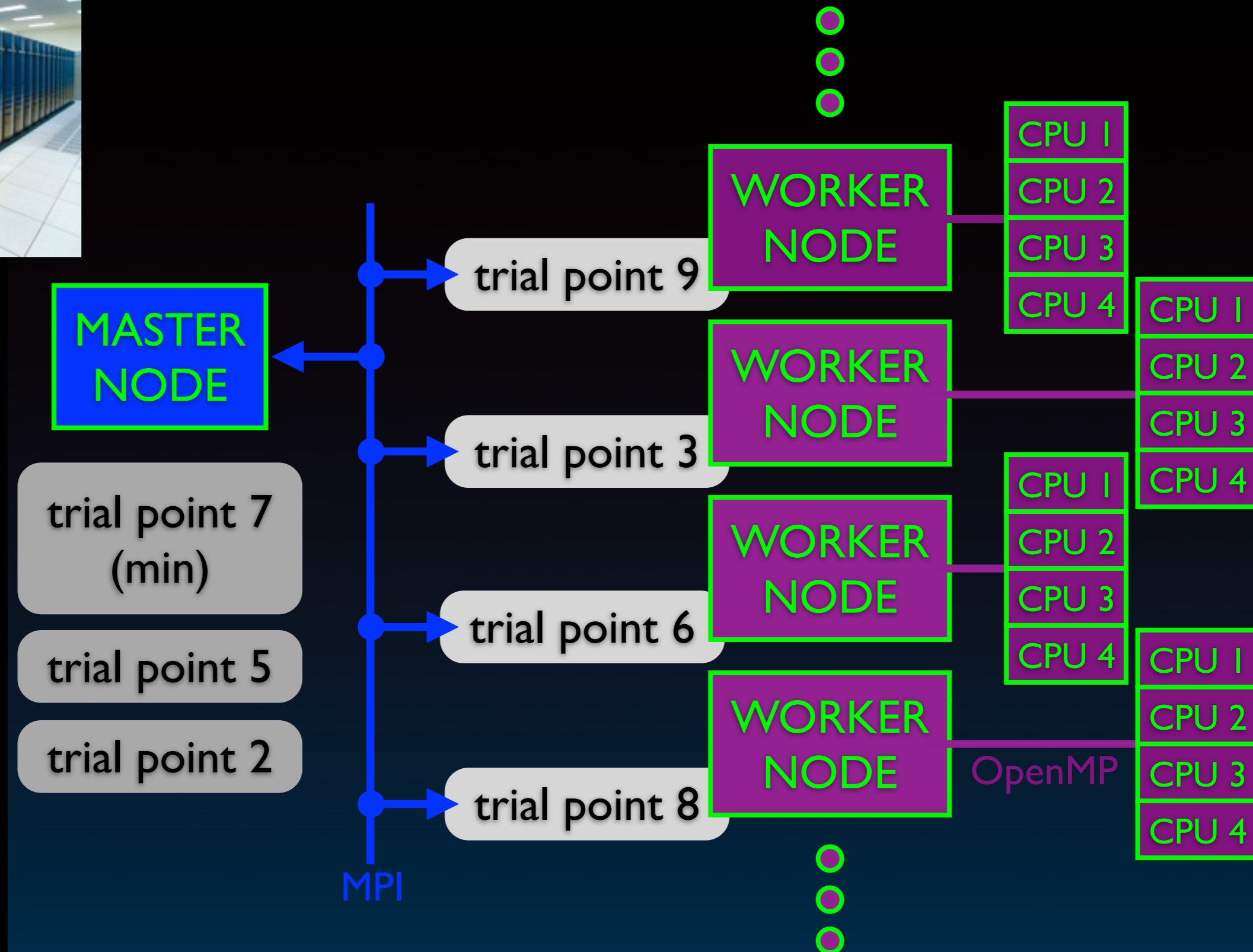
- (Goal) data-driven science: Interface numerically-intensive theory and data-intensive observations.
- Make spectrum synthesis part of the objective function under a nonlinear optimization framework.
- Try to address model systematics (approximations used) and retain empirical flexibility.
- Span mid-scale computing (Linux clusters) but also support supercomputers; publish the code.
- Amortize spectrum synthesis setup, parallelize optimization strategy, parallelize spectrum synthesis.

Synapps

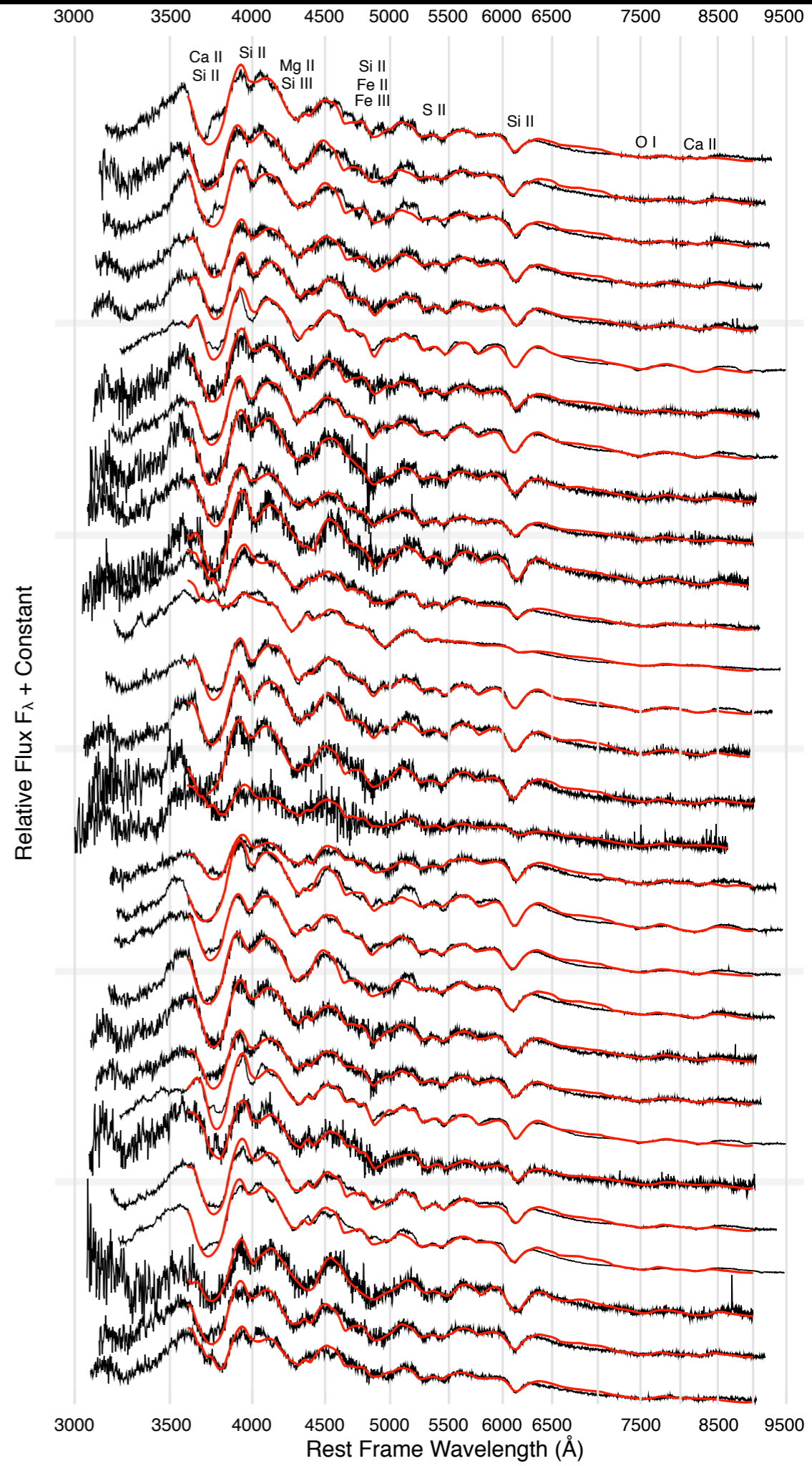
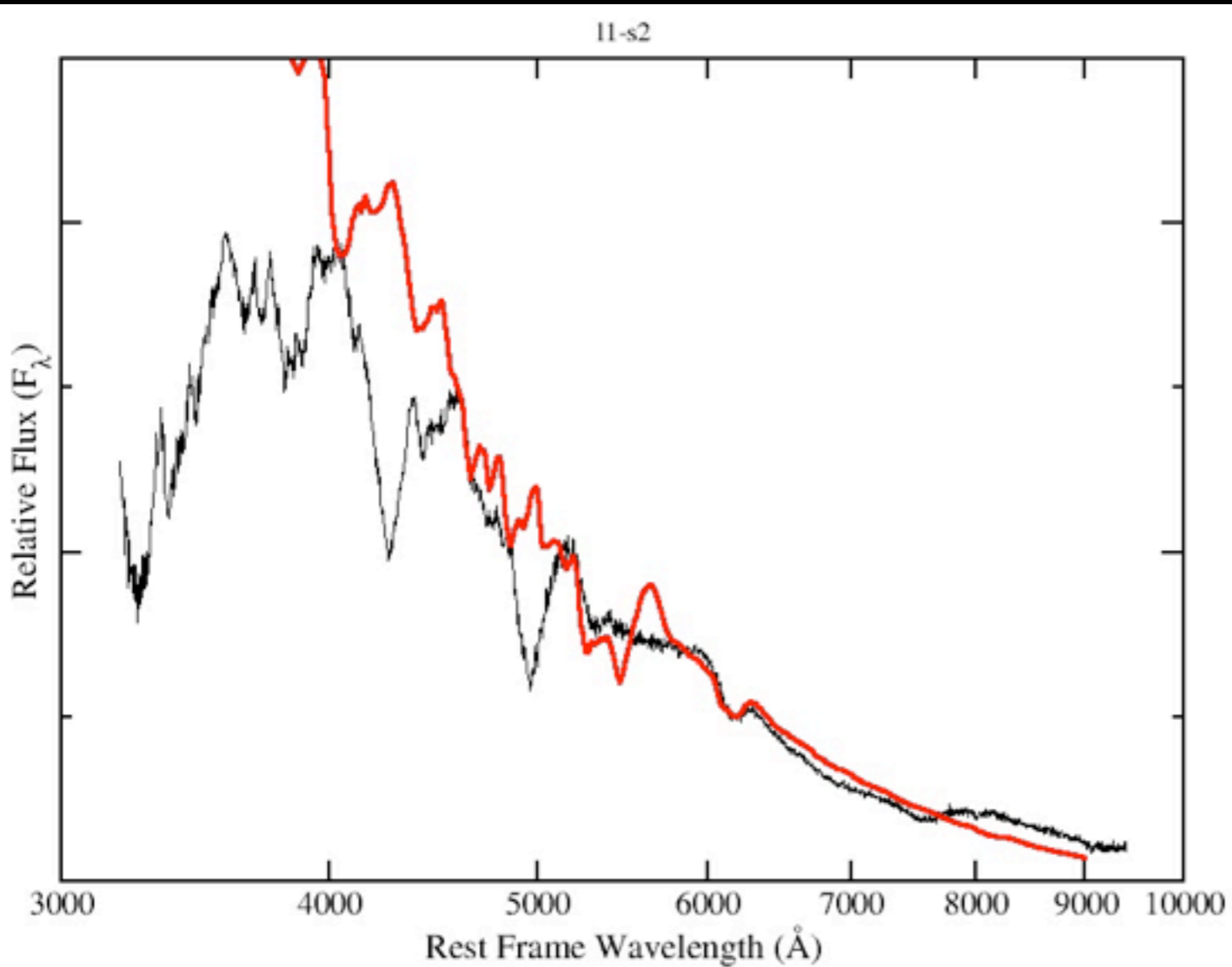


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Synapps:
Synow +
APPSPACK



SNe Ia at Maximum



Unusual Stellar Explosions

What if...?

- 1D Monte Carlo radiative equilibrium code?
 - Fit a model (run of density, composition, energy deposition) to an entire time-series.
 - More robust and directly physical constraints.
 - This would probably be a much bigger code (scaling to more cores).
- Other solvers:
 - Hybrid parallel solvers (scale much higher).

GPUs...

- GPUs: Initial experiments show 10x speedup from trivial port of bottleneck to OpenCL.



The screenshot shows the NERSC website header with the logo, title "National Energy Research Scientific Computing Center", and subtitle "A DOE Office of Science User Facility at Lawrence Berkeley National Laboratory". Navigation links include "Site Map", "Help", "Search", "Go", and "Login". A menu bar contains "Home", "About", "News & Media", "Systems", "Support & Services", and "Science & Tech". The main content area features a sidebar with "SYSTEMS" and "Dirac Home" links, and a main heading "Experimental GPU cluster: Dirac". The text below describes the GPU computing testbed and its funding.

SYSTEMS
Dirac Home

Request Access
Configuration
File Storage
Programming
Running Jobs

Need Help?

Experimental GPU cluster: Dirac

NERSC is fielding a general purpose GPU computing (GPGPU) testbed in collaboration with the Computational Research Division at Berkeley Lab, using funding from the DOE/ASCR Computer Science Research Testbeds program (DOE Contract Number DE-AC02-05CH11231). The objective of the multi-laboratory CS Research Testbeds program is to make emerging computing platforms available to facilitate the research and development of advanced systems software.

- Investigate applicability of GPUs to science apps.
- Gain experience with heterogeneous elements in a multi-user environment.
- Investigate programming models, multi-GPU to test scalability of code.

Conclusion

- Code-description paper drafted, submitting soon.
- GNU autotools build system.
- Possibility of making Synapps fitting a NERSC science gateway node project?
- Analysis of SNfactory data is proceeding, working with PTF on their weird objects.
- New work: Radiative equilibrium, GPUs.