SYNAPPS

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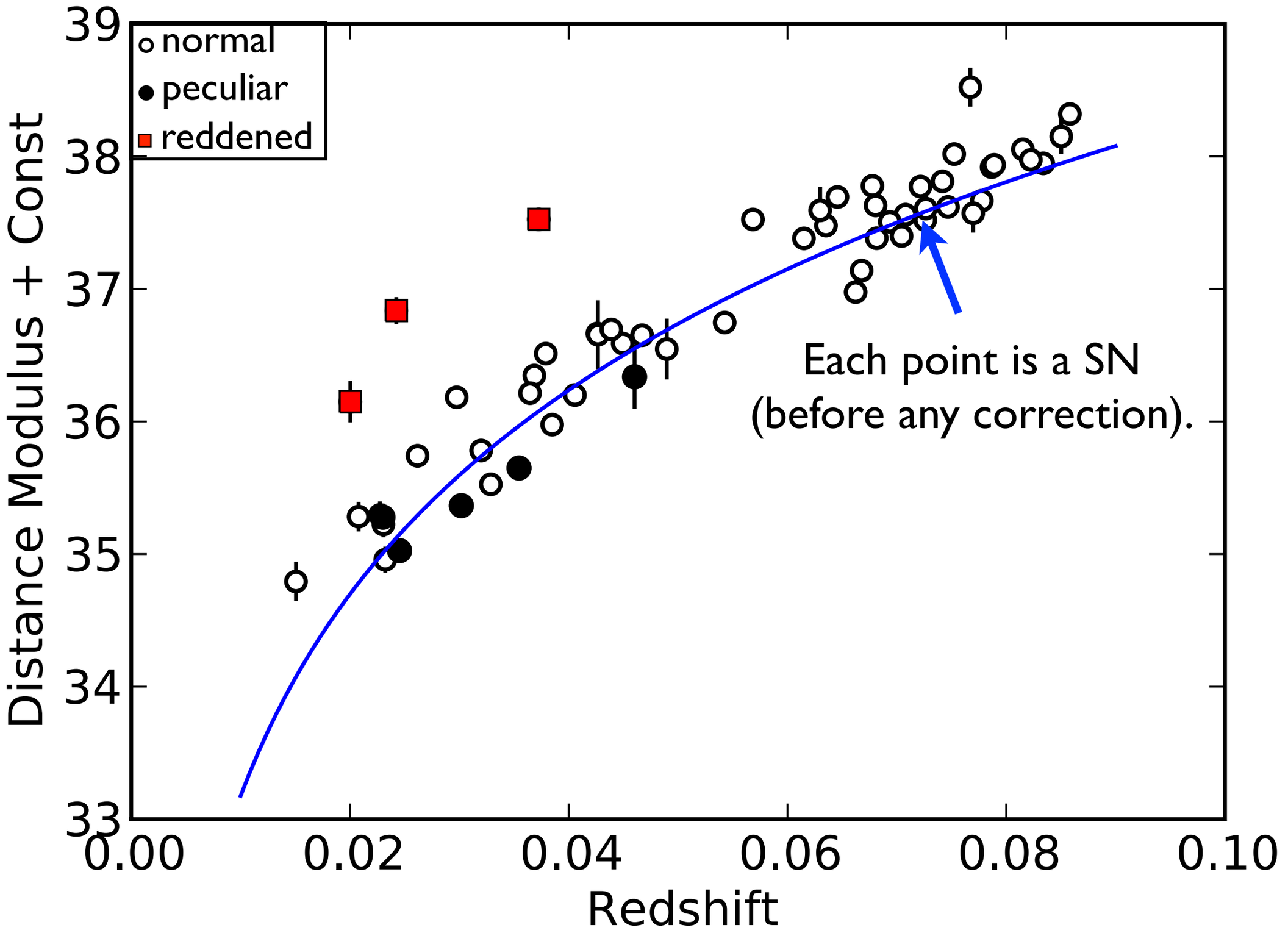
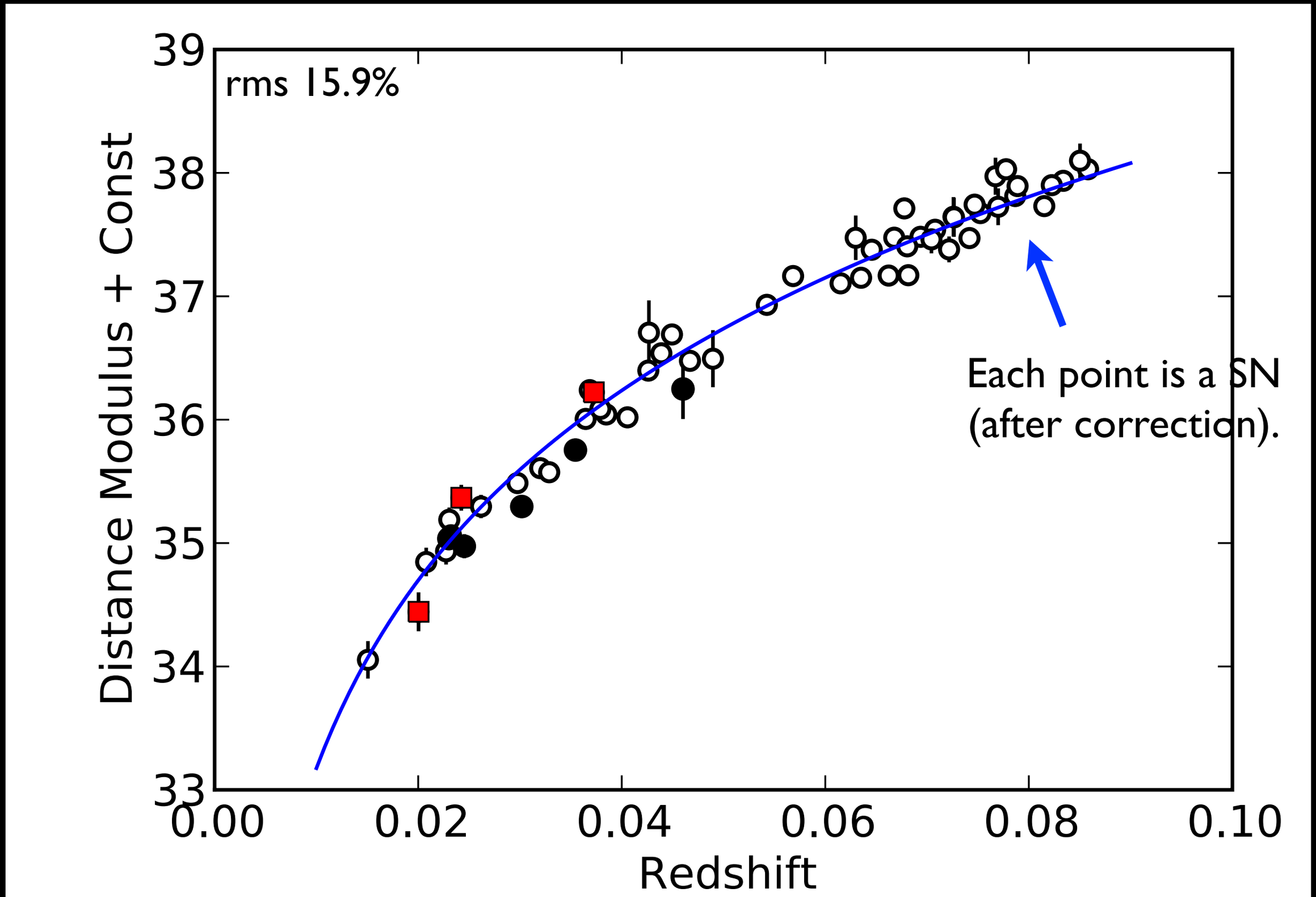
Outline

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

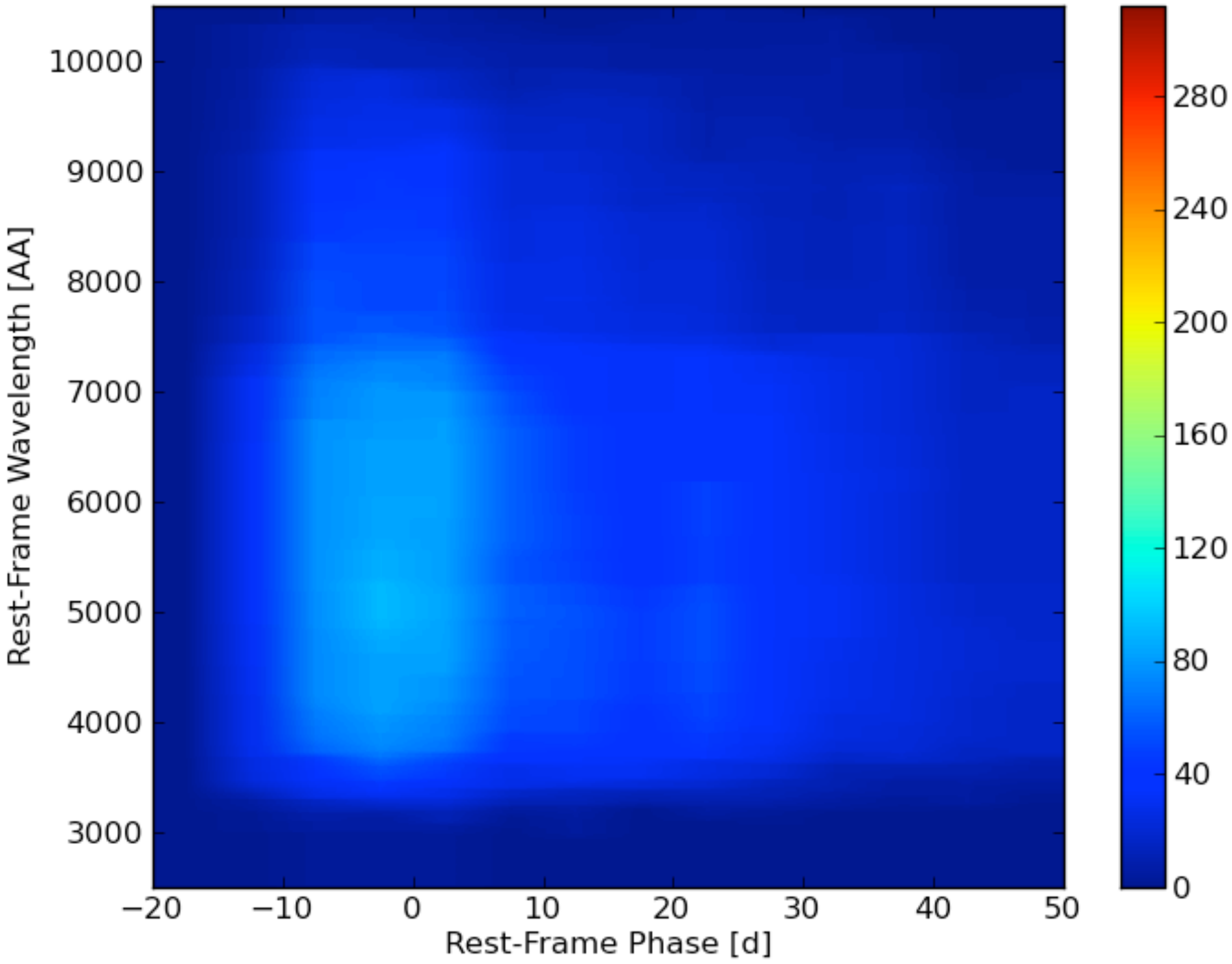
Type Ia SN Cosmology



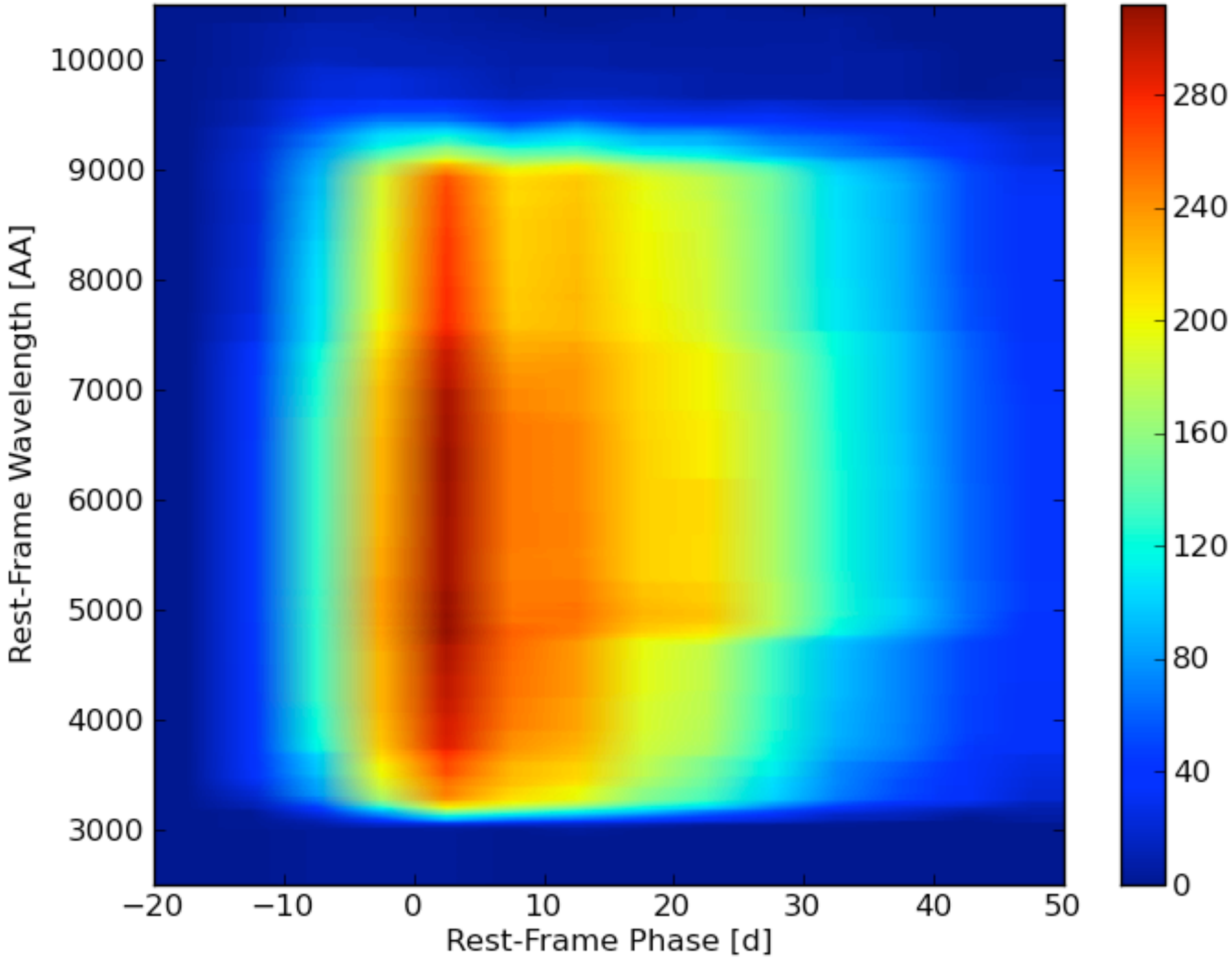
LC-corrected Hubble Diagram



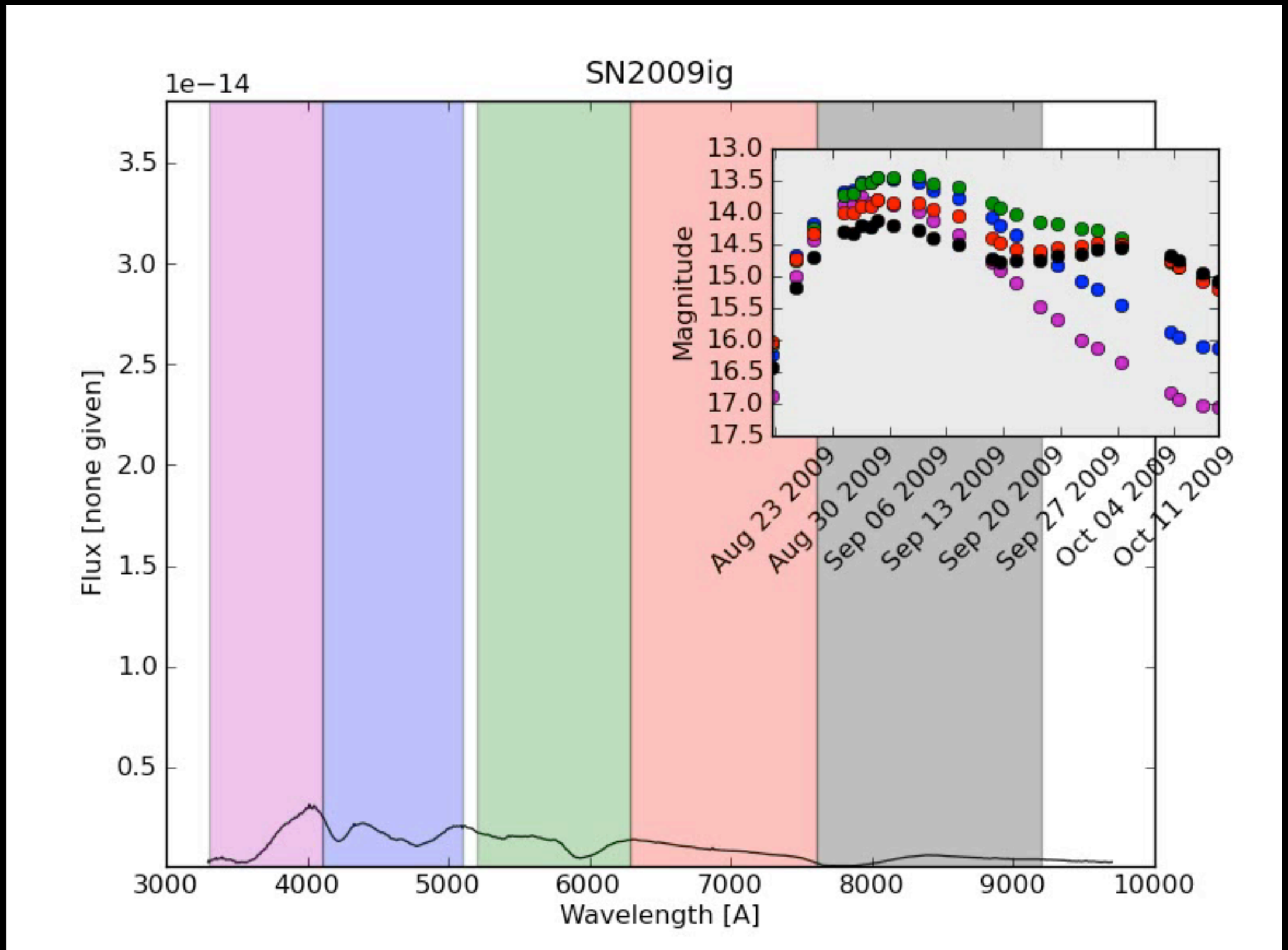
Published SN Ia Coverage



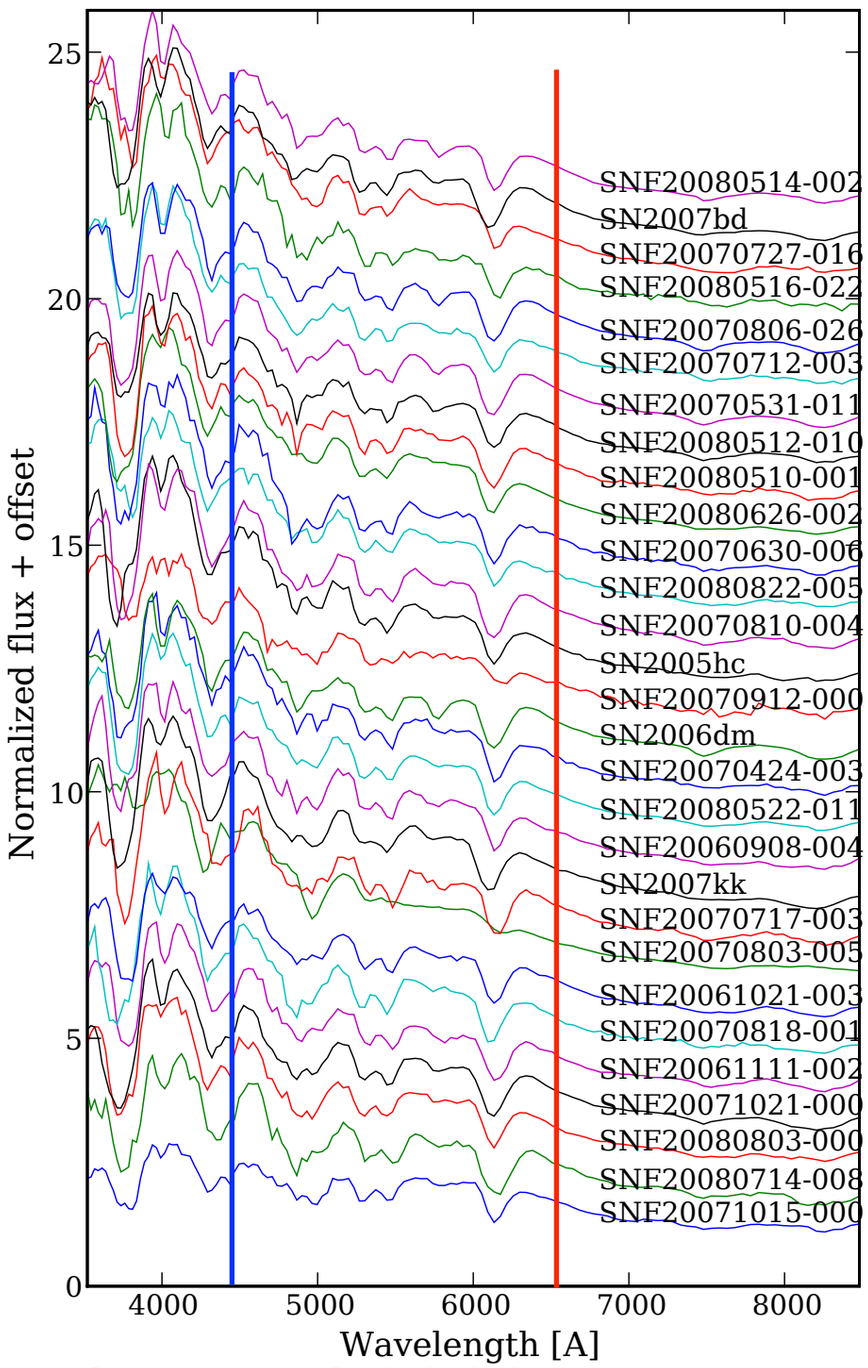
Published + SNfactory



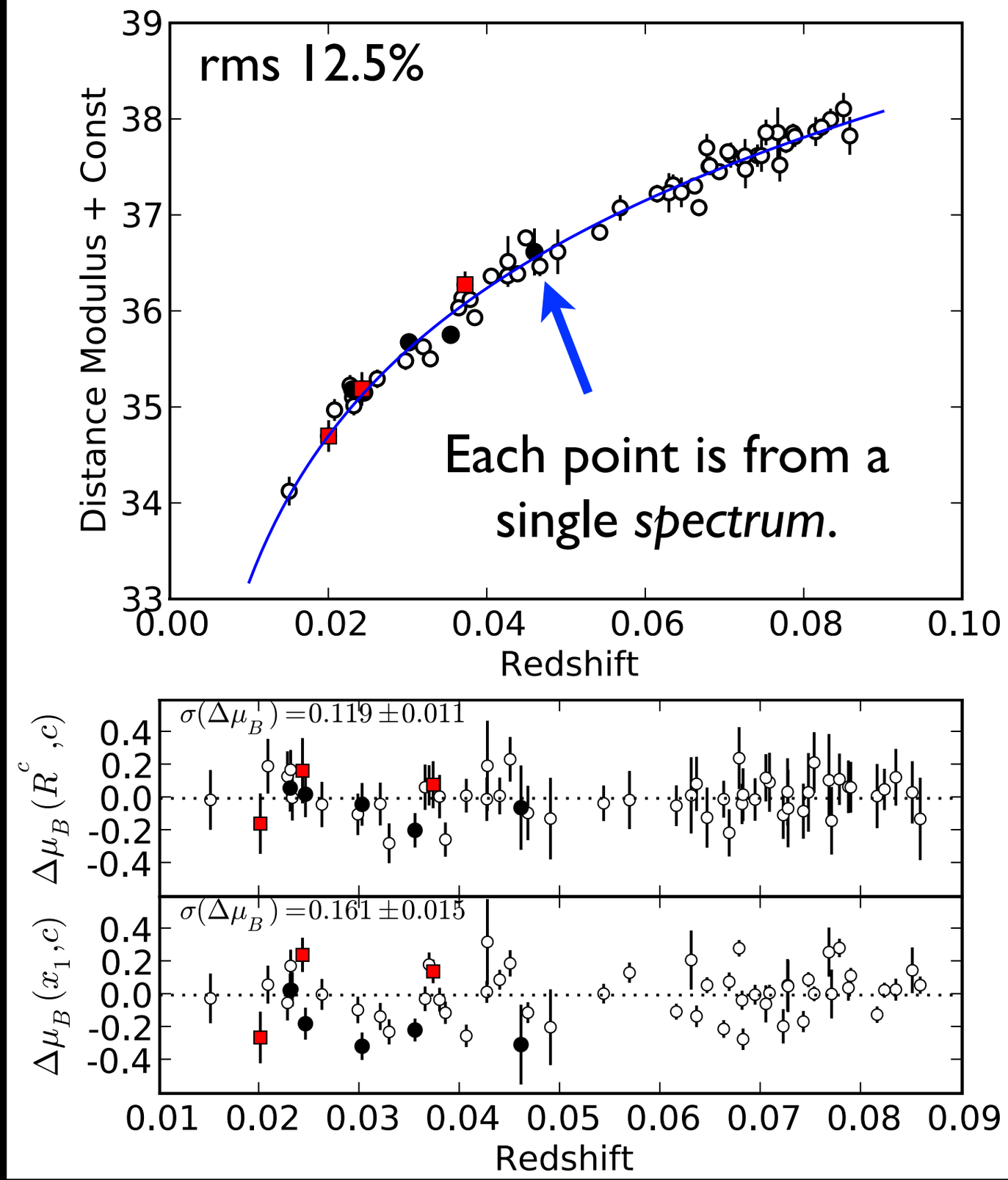
1 Light Curve Point = 1 Spectrum



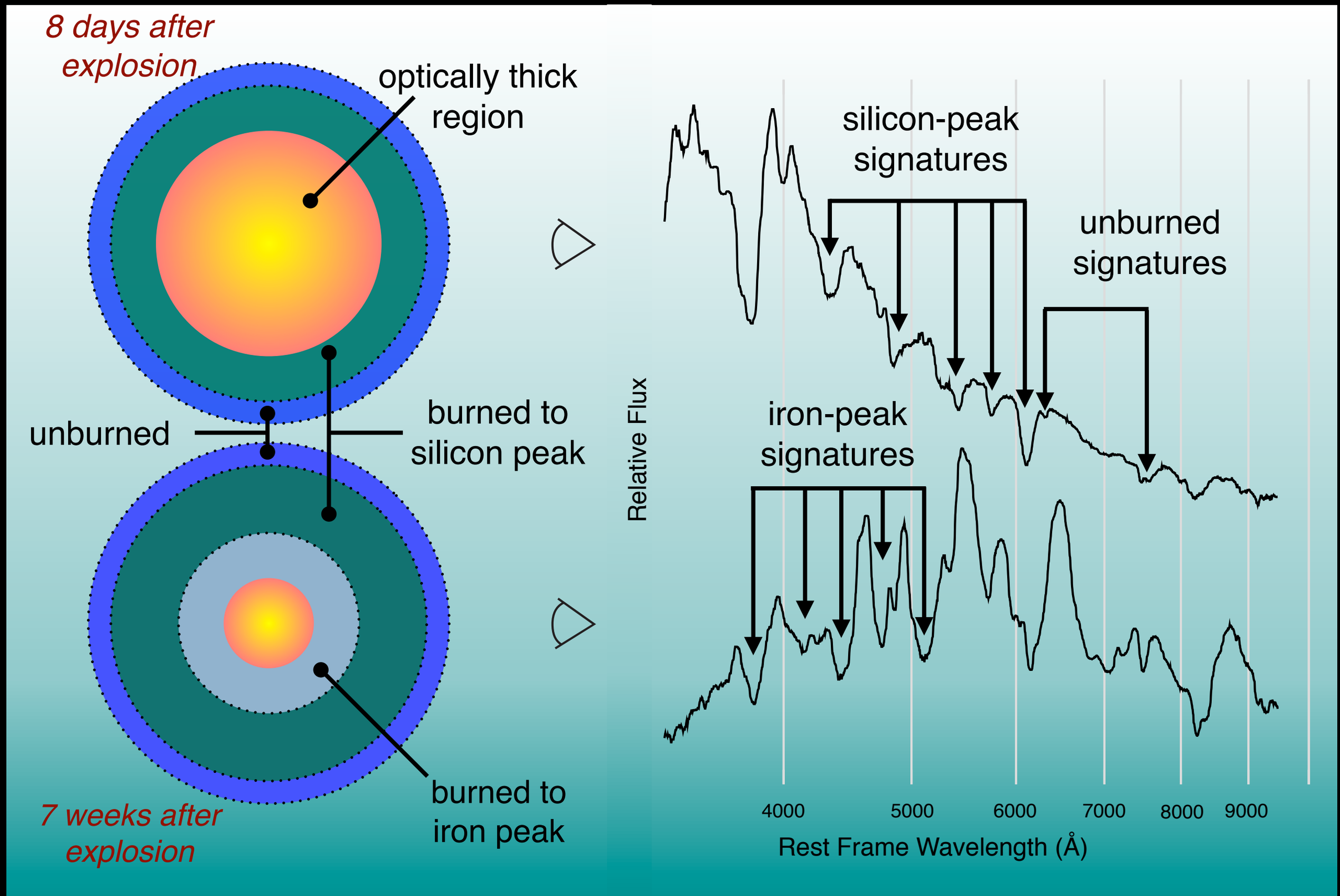
Spectroscopic Correction



Bailey et al 2009



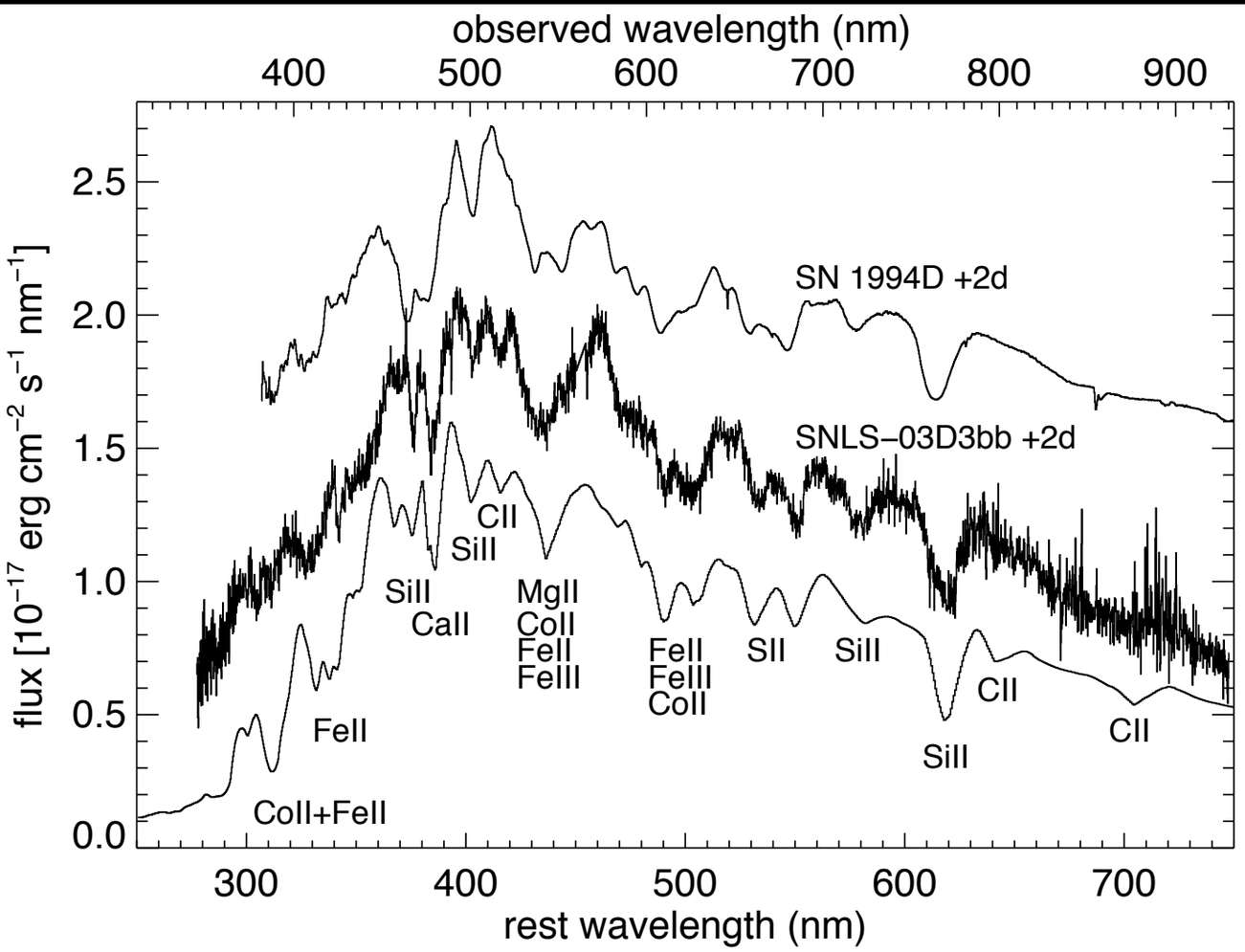
SN Spectroscopy



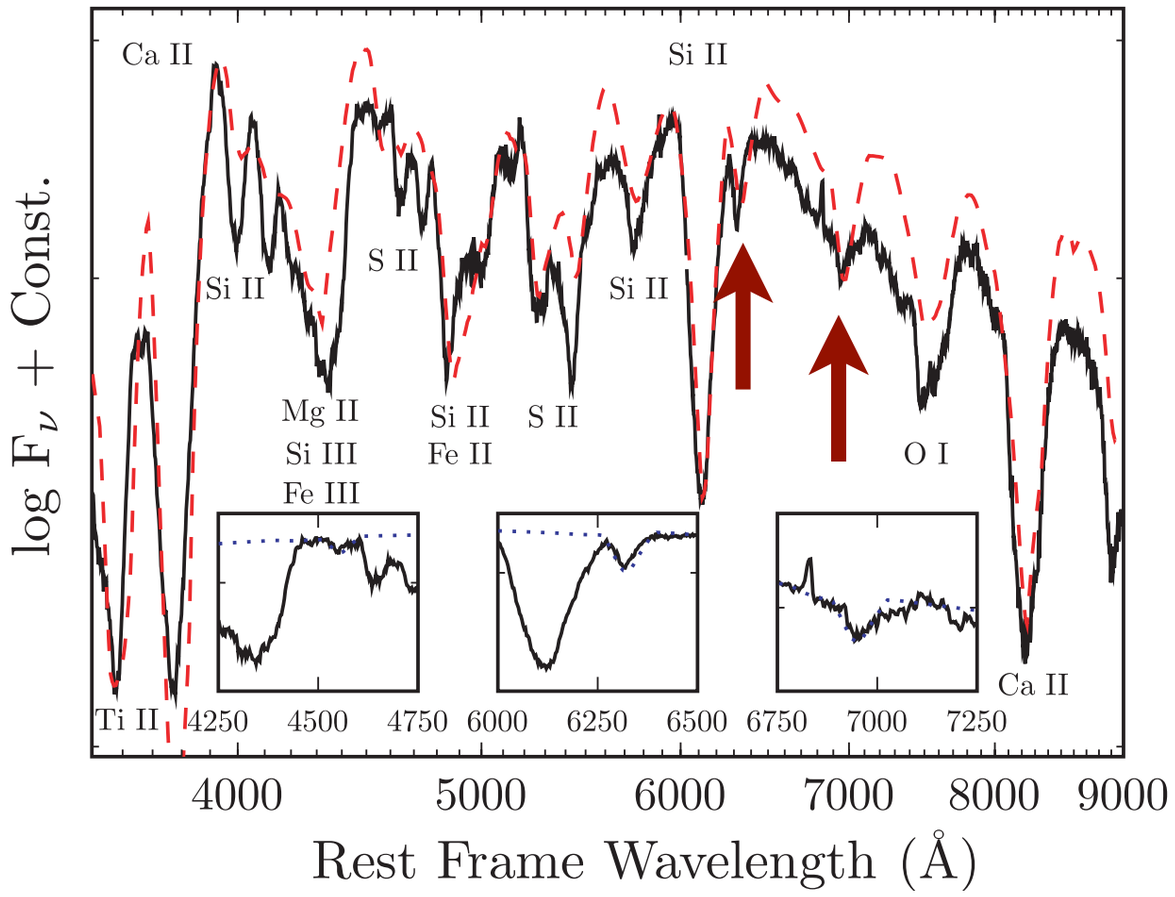
Spectrum Synthesis

- 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

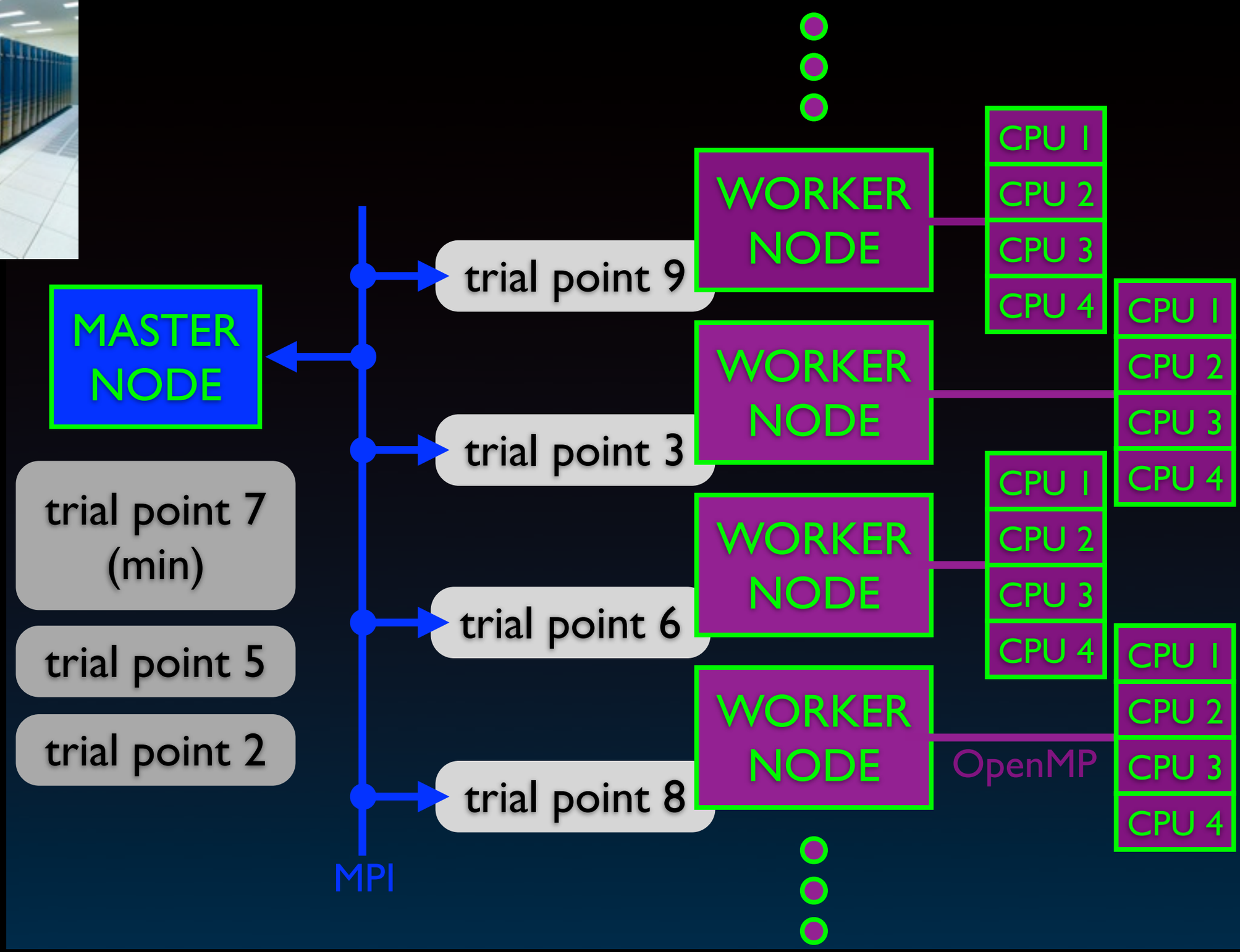
Scaling to 2000+ spectra?

What We've Done

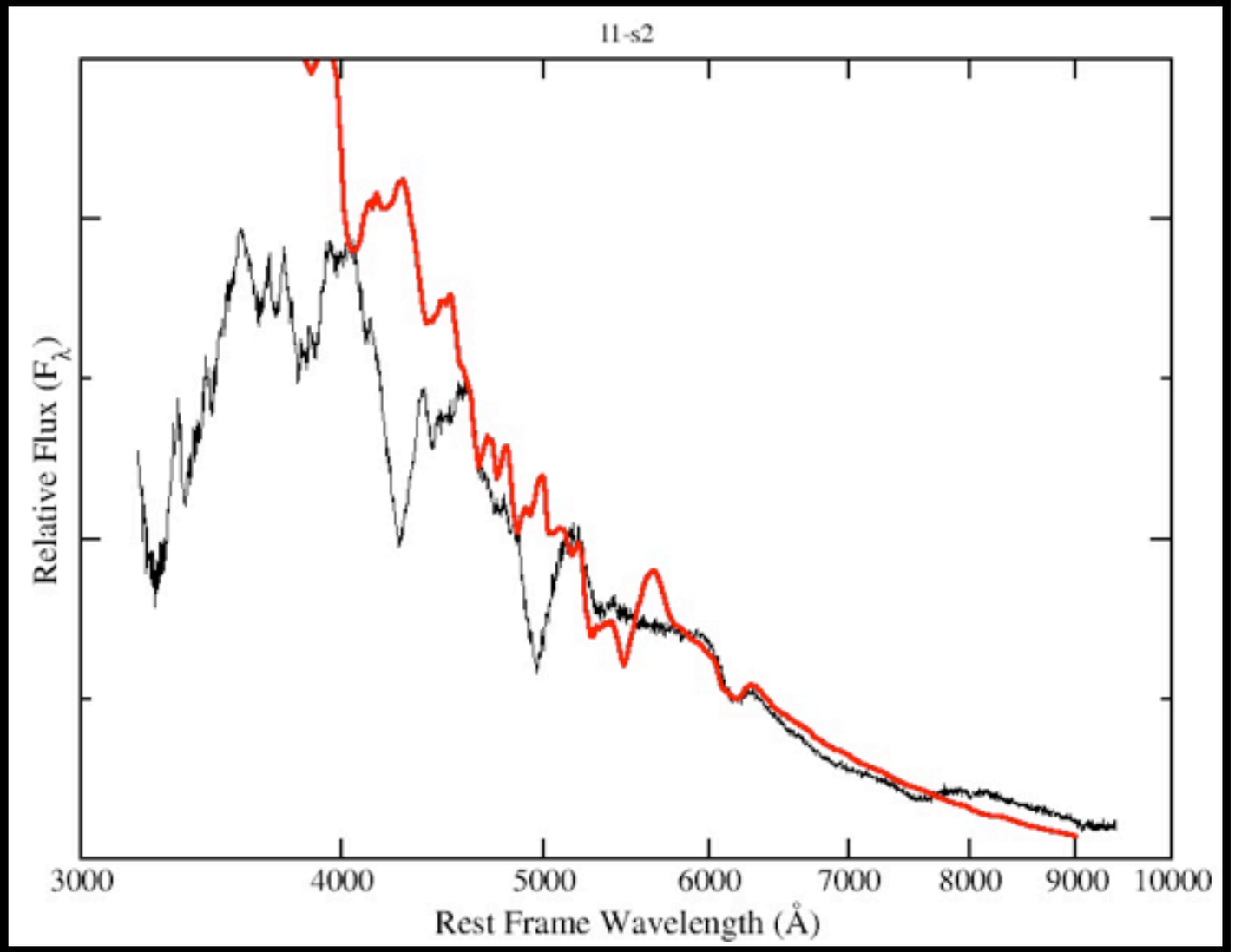
- (Goal) data-driven science: Interface numerically-intensive theory and data-intensive observations.
- Make spectrum synthesis part of the objective function under a nonlinear optimization framework.
- Try to address model systematics (approximations used) and retain empirical flexibility.
- Span mid-scale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

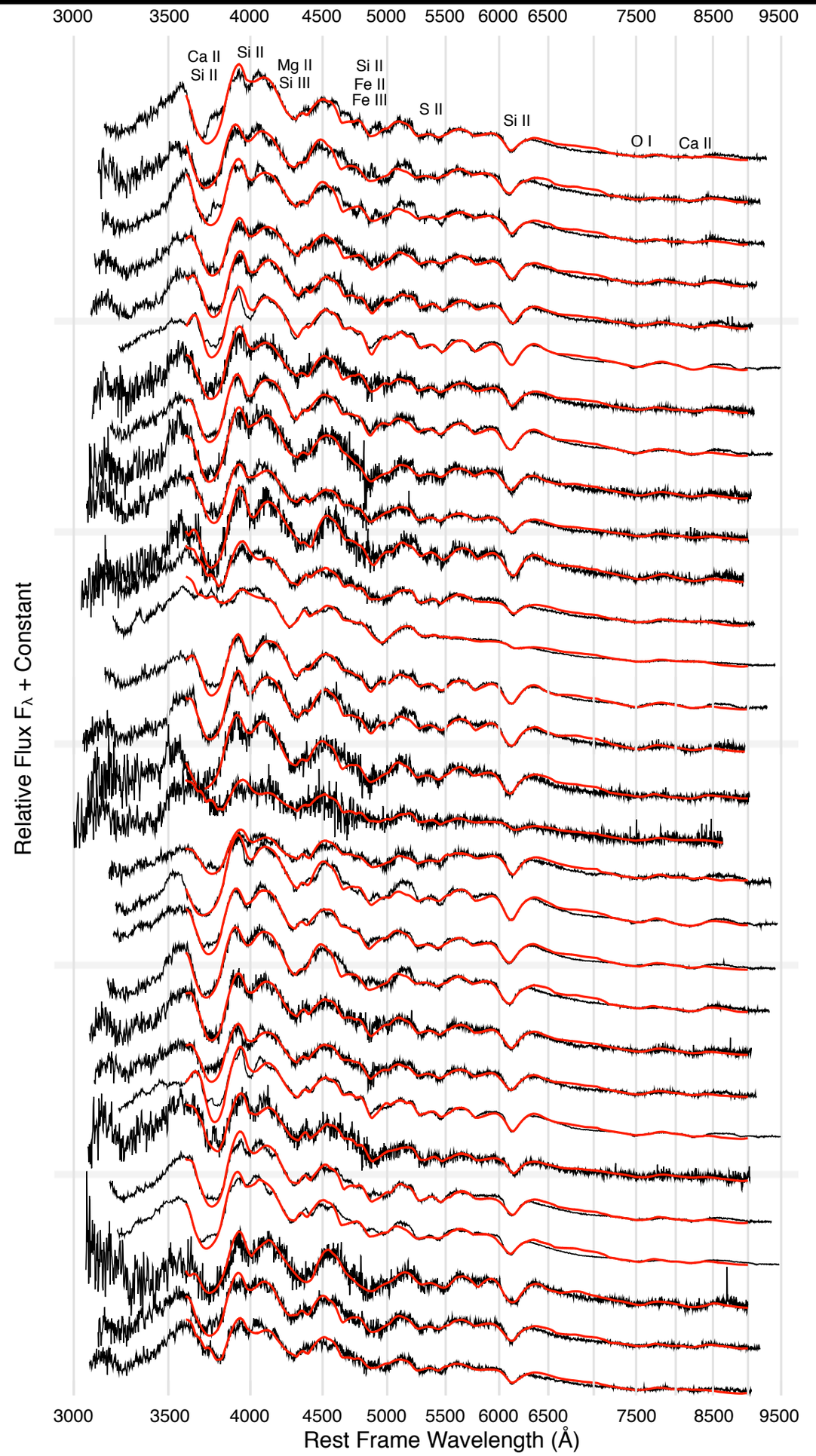
Synapps

Synapps: Synow + APPSPACK



SNe Ia at Maximum





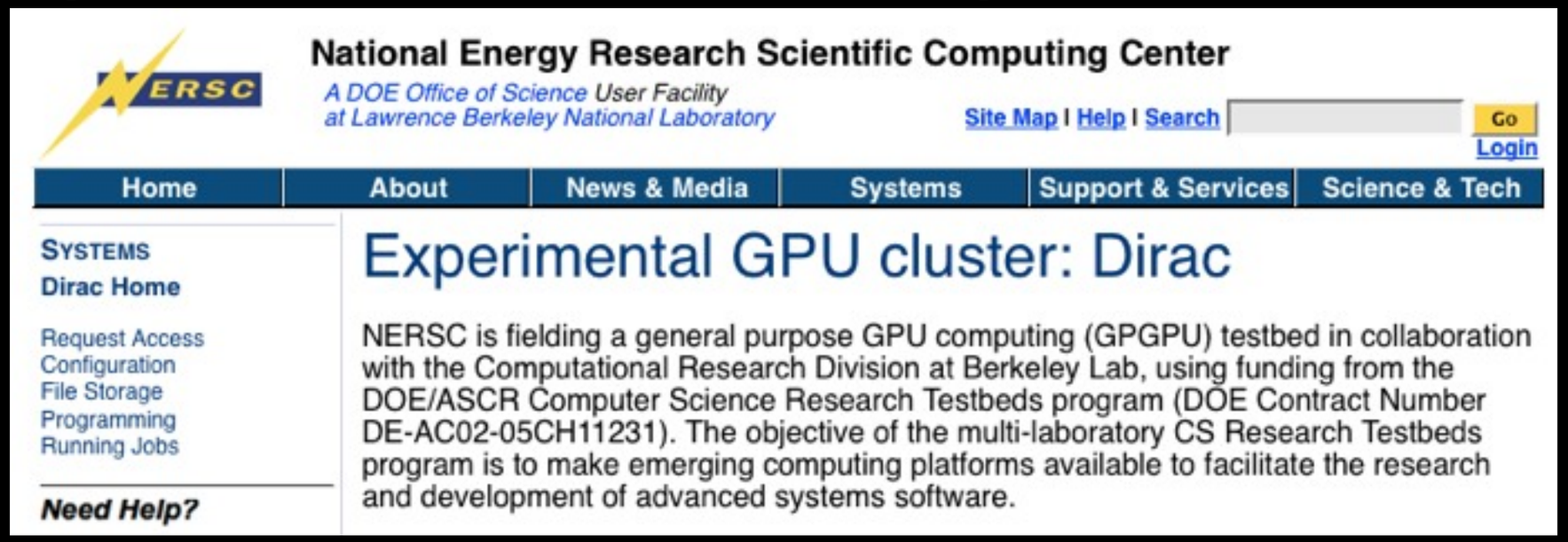
Unusual Stellar Explosions

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.



- 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.