SDSS II Supernovae with BOSS Host-Redshift

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Thanks to my collaborators:

Bob Nichol, Hubert Lampeitl, Masao Sako, Matt Olmstead, Peter Brown, Kyle Dawson, Mat Smith and all the team.

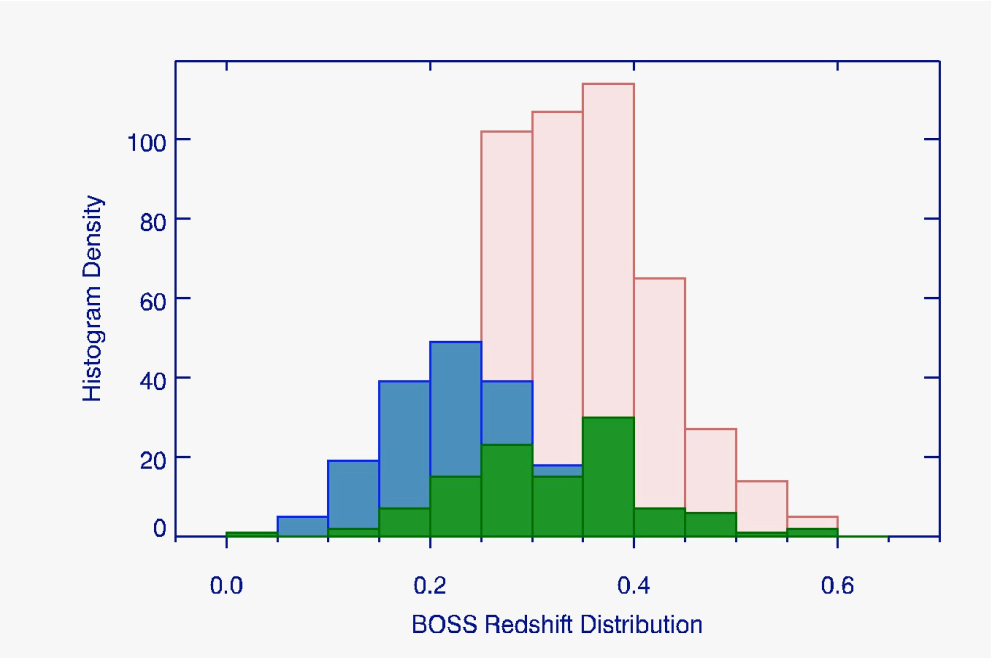
Outline

- Data
- Photometric Classification
- Hubble Diagram
- Work in progress: Bias Tests
- Work in progress: Cosmology

BOSS Host Galaxy Follow up

- SDSS II SN survey ~500 spec Ia
- Database of 10,000s of transients
- Photoz's too noisy for using on a Hubble diagram
- Spec z improves light curve fit
- Host galaxy information should help investigate the causes of intrinsic scatter
- Select anything with a reasonable probability of being a supernovae (Type Ia, II etc)

Redshift Distribution



- 3394 SN host galaxies with accurate redshifts
- Important for next generation of SN surveys

Photometric Classification

- Classified by fitting templates to the light curves to find the lowest chi sq using the host redshift as a prior
- Calculated Bayesian probabilities to the SN being a Type Ia, Type Ib/c or Type II
- 1227 classified as Type Ia
- Light curve quality cuts
- Rejected host galaxies, where the SN position was >15kpc from the galaxy

$$E_{Ia} = \int P(z) e^{-\chi^2/2} dz dA_v dT_{\max} d\Delta m_{15,B} d\mu$$

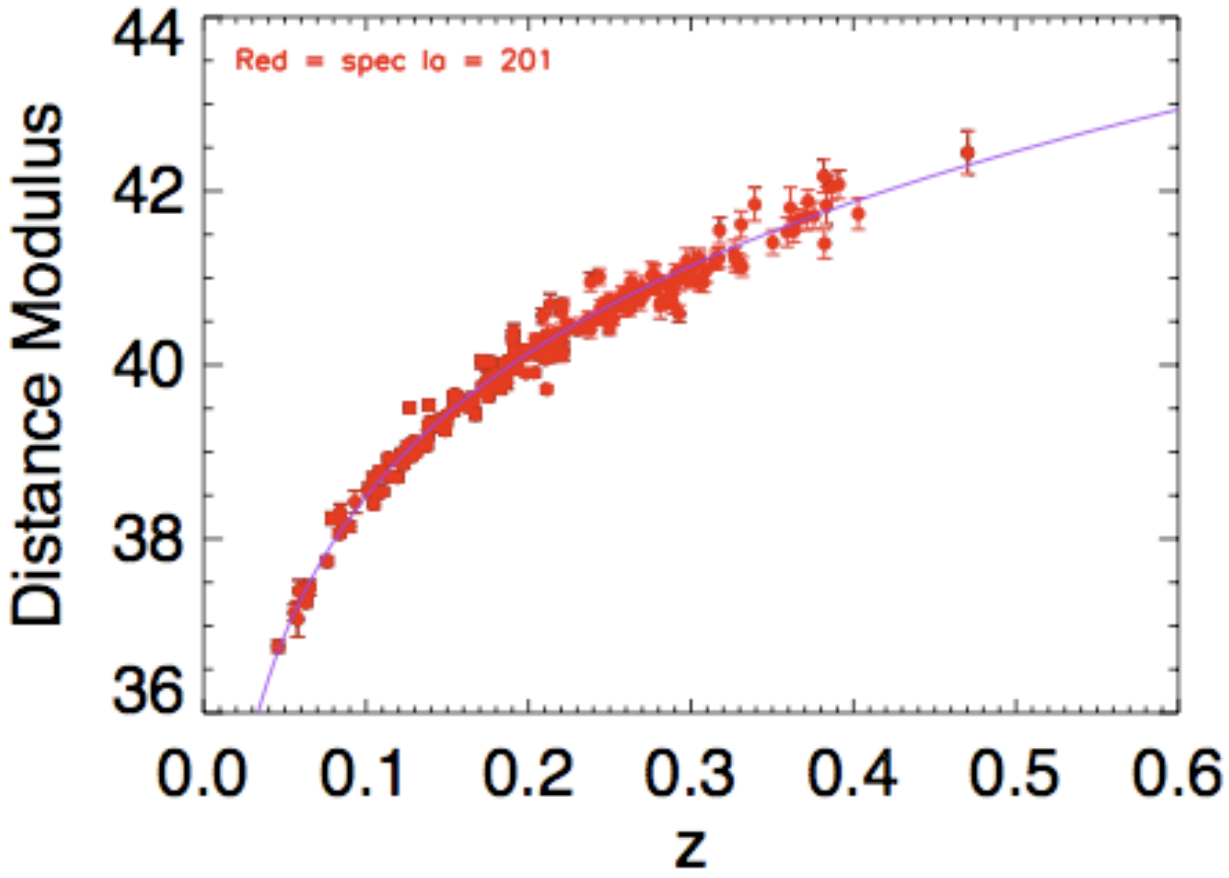
$$P(z) = \frac{1}{\sqrt{2\pi\sigma_z}} e^{-(z-z_{ext})^2 / 2\sigma_z^2}$$

$$P_{type} = \frac{E_{type}}{E_{Ia} + E_{Ibc} + E_{II}}$$

Sako et al. 2011

New Hubble Diagram

- 751 SN with host redshifts on Hubble Diagram



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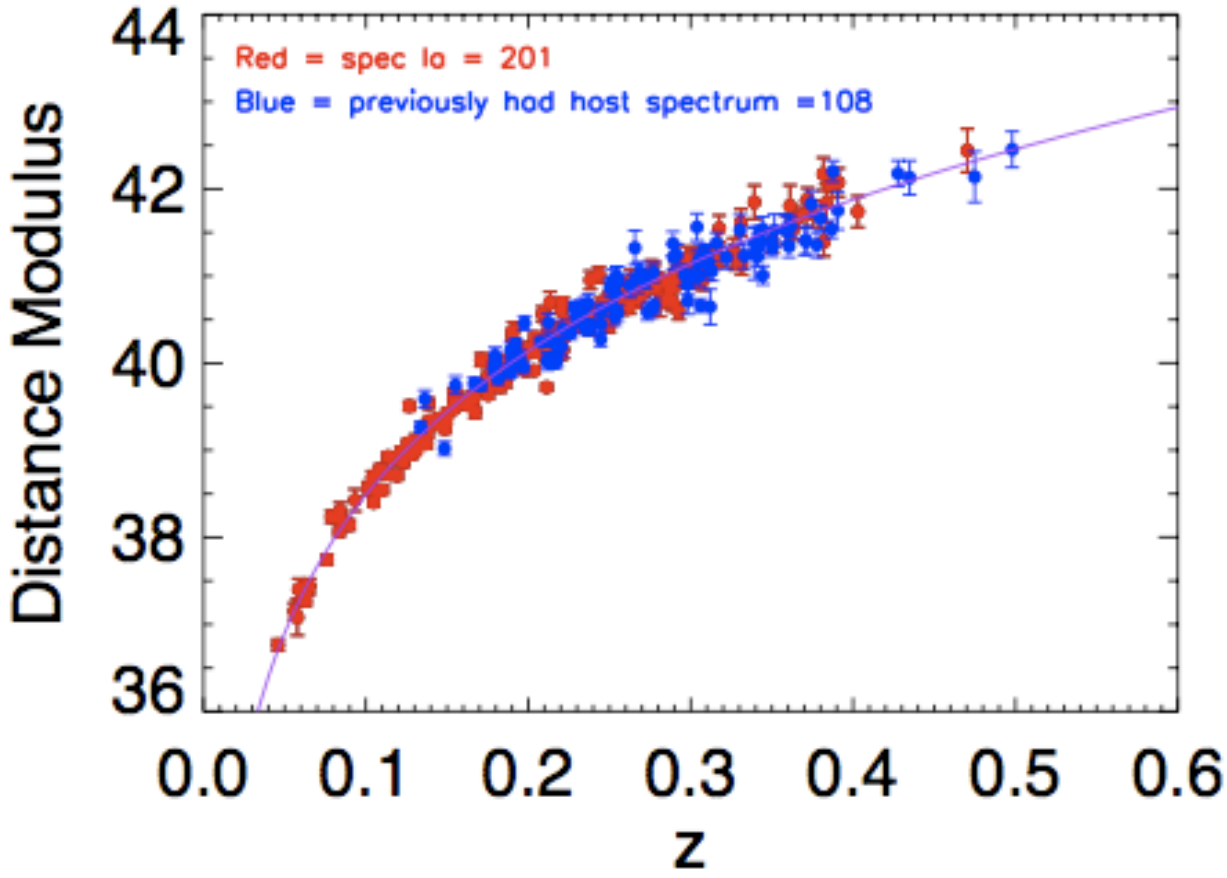

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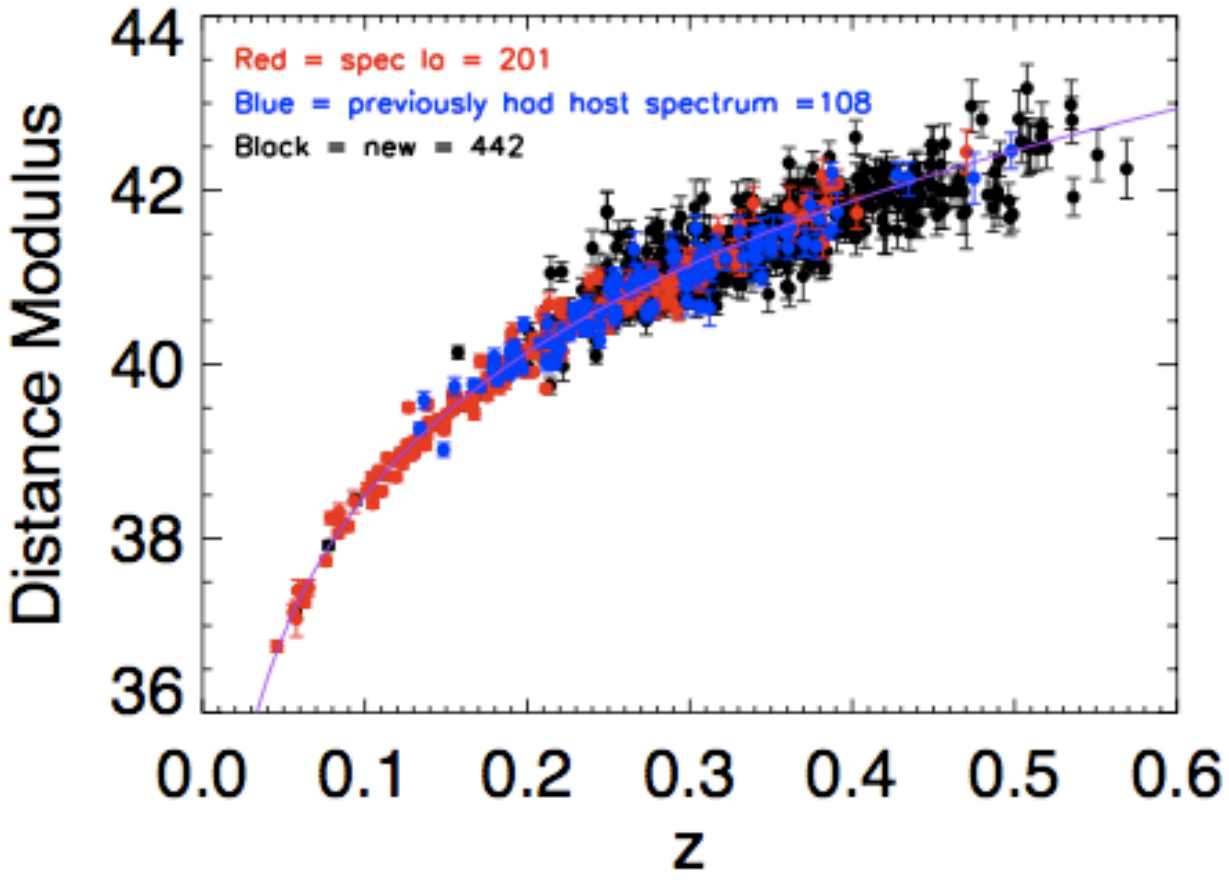
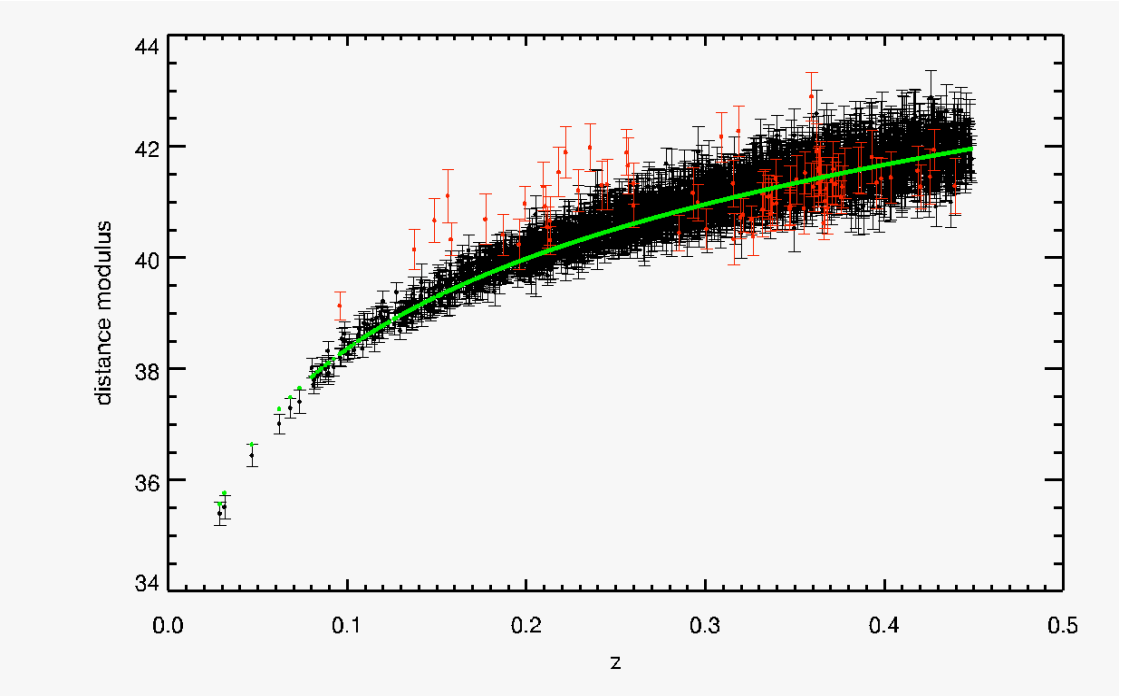


Work in Progress: Bias Testing

SDSS SN Simulations (Kessler)

- Run all simulated SN through classifier
- Applied light curve cuts and SALT2 parameter cuts to this sample:
  - 3115 True Type Ia
  - 3030 classified as Type Ia (83 actually non Ia's)
- SN classified as Type Ia:
  - 2.8 % contamination (no bias on cosmology)
  - 94 % efficiency

Hubble Diagram 3030 SN classified as Ia



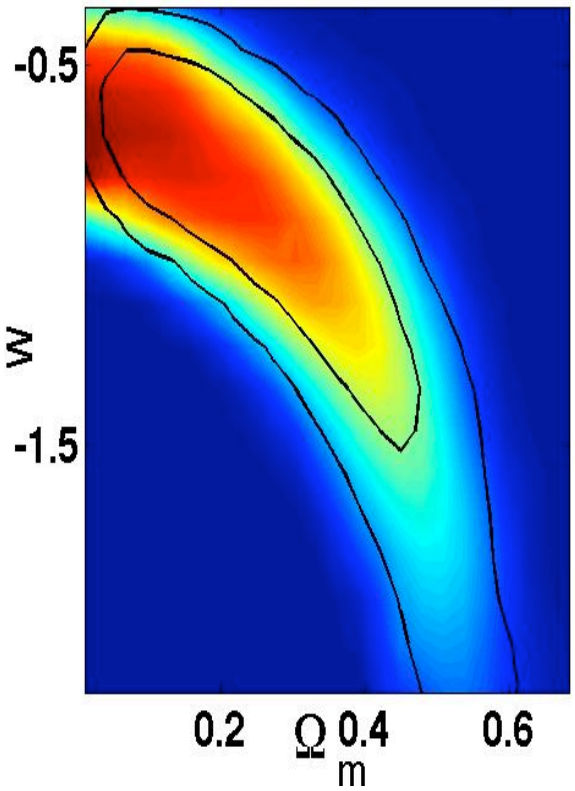
Investigating bias from photometric classification and Malmquist selection bias

Work in Progress: Cosmological Constraints

- Using **Cosmological MonteCarlo (COSMOMC)**
- Fortran 90 Markov-Chain Monte-Carlo (MCMC) engine for exploring cosmological parameter space
- Just this new data
- In future: use in combination with other probes. (BAO, WMAP etc)

68% and 95% confidence limits colour-shaded regions show the mean likelihood of the sample

First year BOSS:
235 SN Ia Fitted in COSMOMC



Summary

- One of the largest samples of Type Ia supernovae from a single unique survey: 751 Type Ia on Hubble diagram
- How good can we get cosmological constraints using only SDSS II
- Explore and understand methods needed to do future surveys such as DES and LSST