Photometric Redshifts for the DES

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Introduction

- Photometric redshifts are estimates of redshifts based on identification of spectral features using only broadband photometry
- Photo-z estimators are much faster and can reach fainter objects than spectroscopy, but are less accurate.

Outline

- 2 and 1/2 methods
  - Training Set Fitting Method
  - Template Fitting Method
  - Hybrid Methods
- Filter coverage
  - What can IR filters do to help
- Error distribution
  - How do photo-z errors affect estimates of cosmological parameters

Training Set Fitting Method

- Assume that redshift is a function of magnitudes
  - Not perfect since there are degeneracies
- Find the best fitting function using a training set with known magnitudes and spectroscopic redshifts
  - Typically done by minimizing chi-square
- Examples:
  - Polynomial Fitting
  - Neural Network

- Advantages:
  - Training set contains additional information, such as the various distributions
  - No need to know types of objects.
  - Less calibration issues
- Disadvantages
  - Strong dependence on training set
    - Training set must be a representative sample of the full survey
    - No extrapolation
    - Errors in particular z range can affect other z ranges
  - Redshift vs magnitudes function is more degenerate at high redshifts

Template Fitting Methods

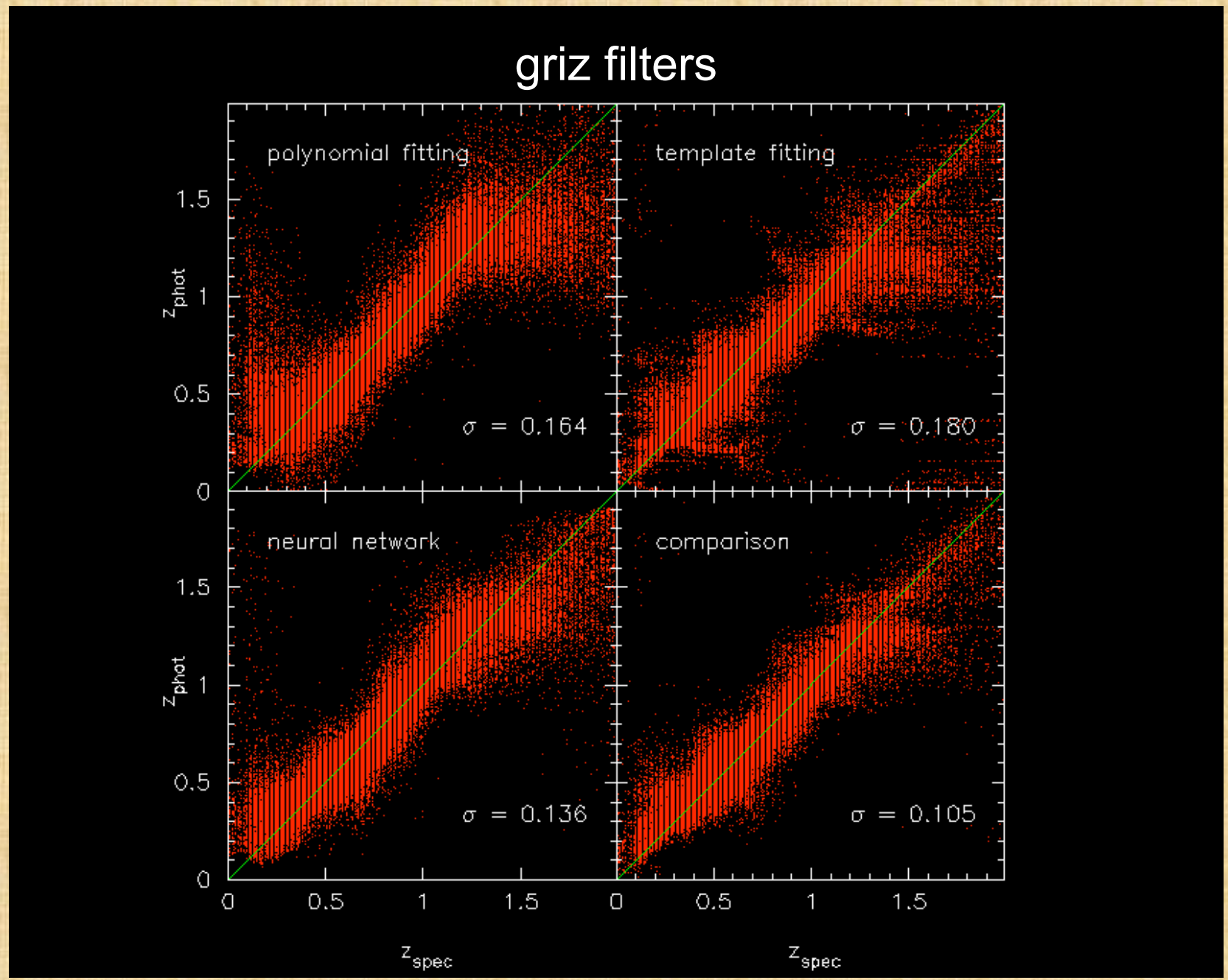
- Given model SEDs (templates), find the combination of SED and redshift that best reproduces the observed magnitudes
- Typical Templates:
  - Coleman, Wu, and Weedman (Empirical)
  - Bruzual and Charlot (Theoretical)
- Examples:
  - Hyper-z
  - Bayesian

- Advantages:
  - No need for training sets
  - Errors in a particular redshift range do not affect errors in other redshift ranges
- Disadvantages:
  - Sensitive to template choices
  - Filter calibration

Hybrid Methods

- Combine the advantages of empirical fitting and template fitting methods
- Examples:
  - Comparison method
  - SED construction/correction using training set

griz filters



griz + YJHKs filters

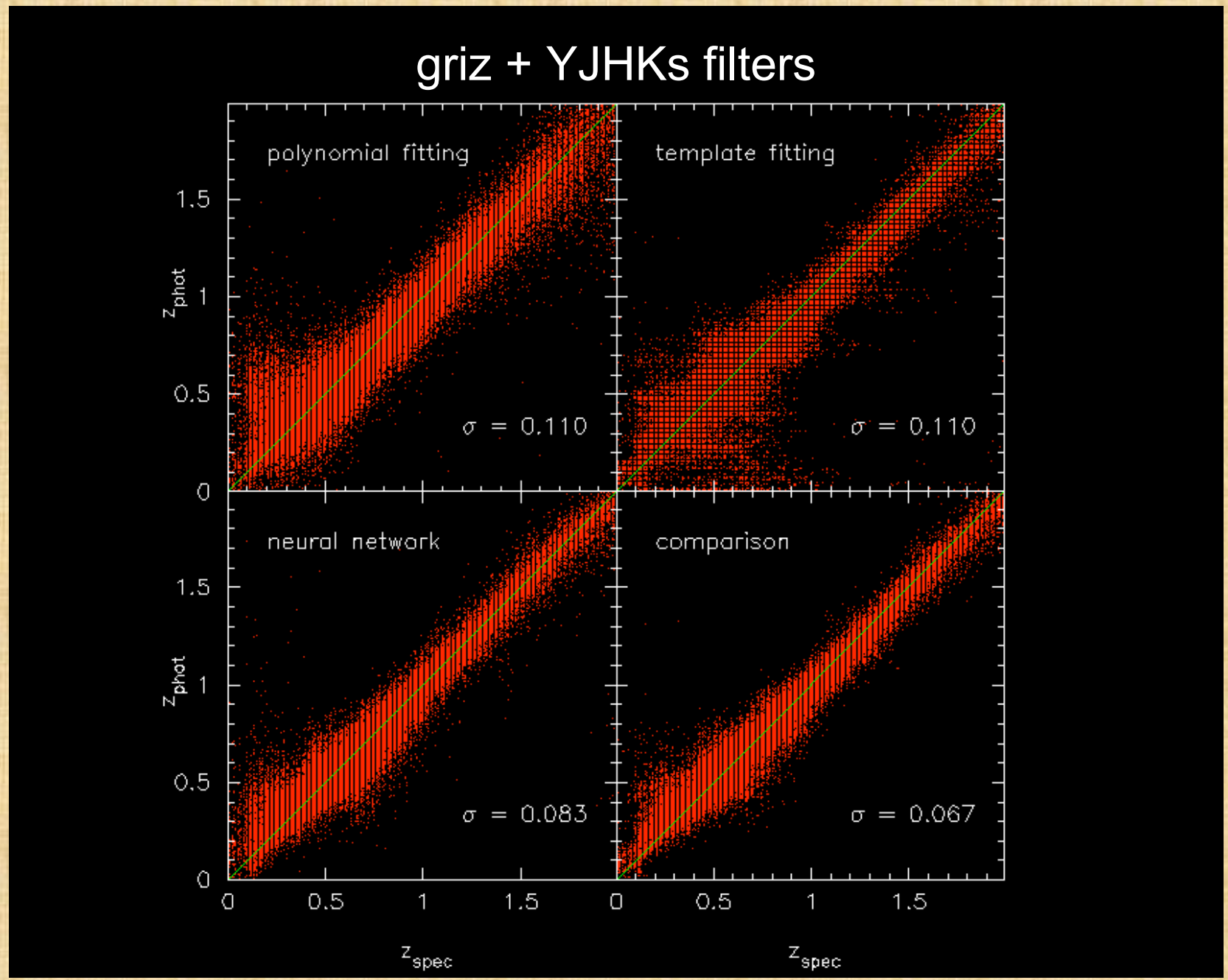
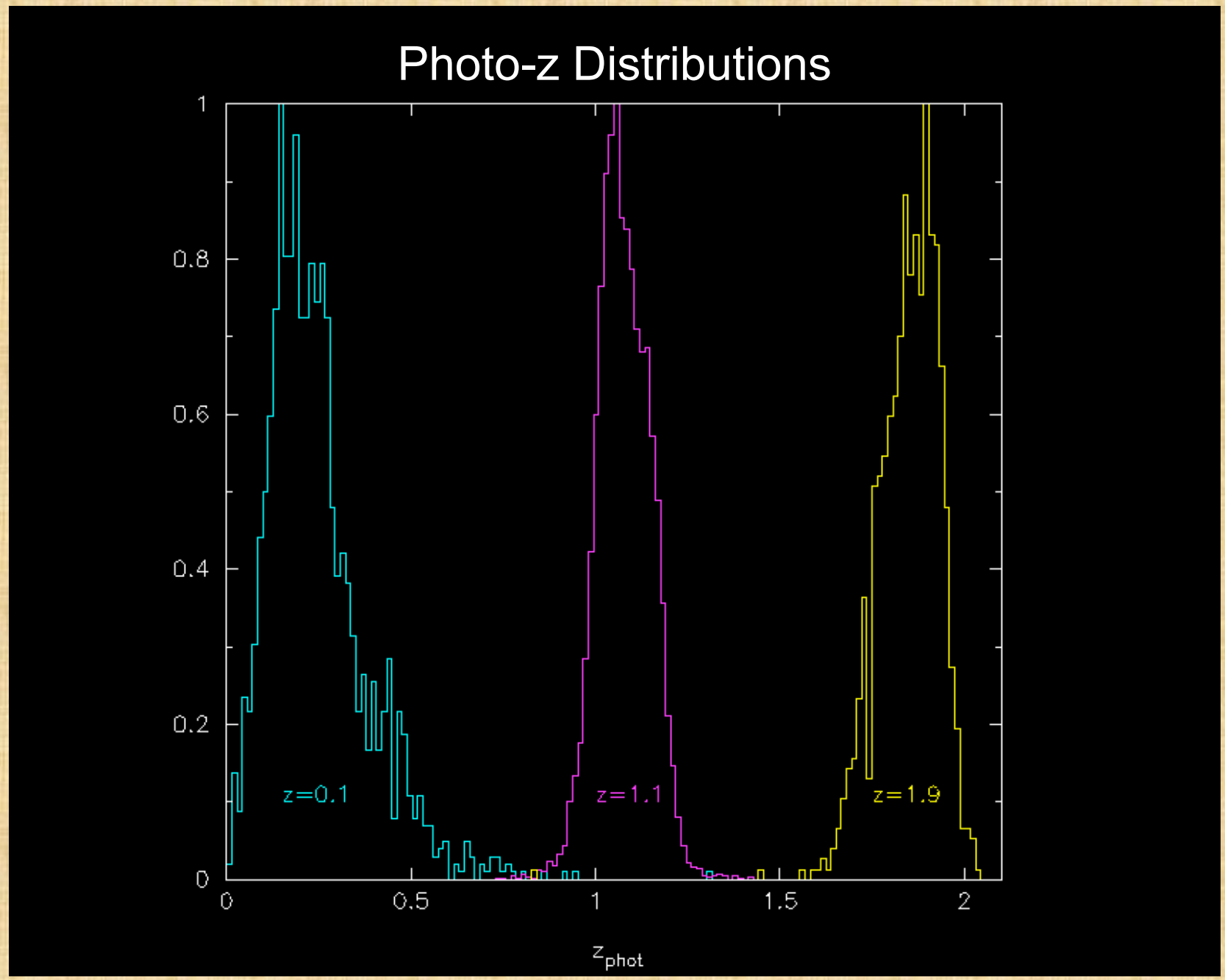
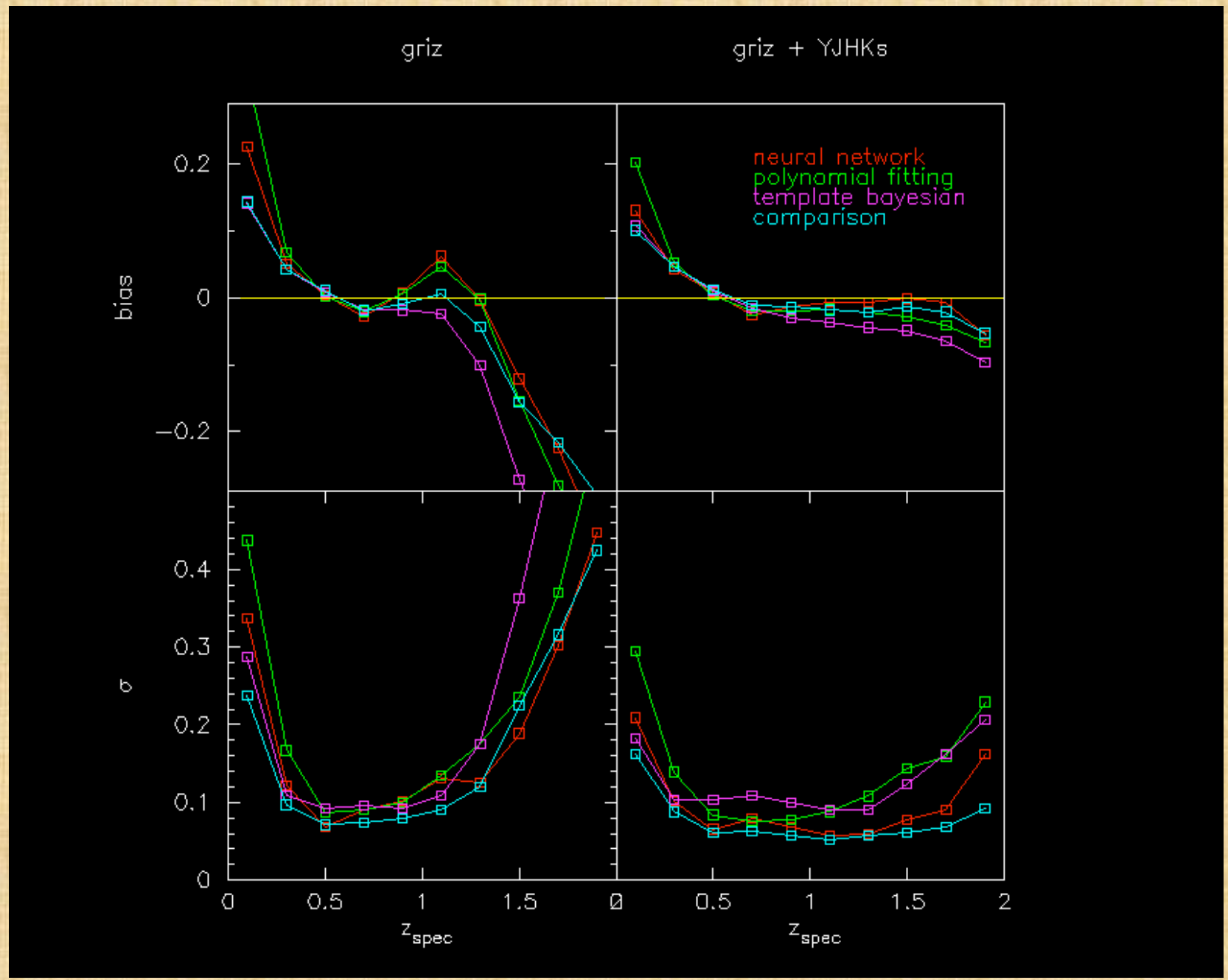
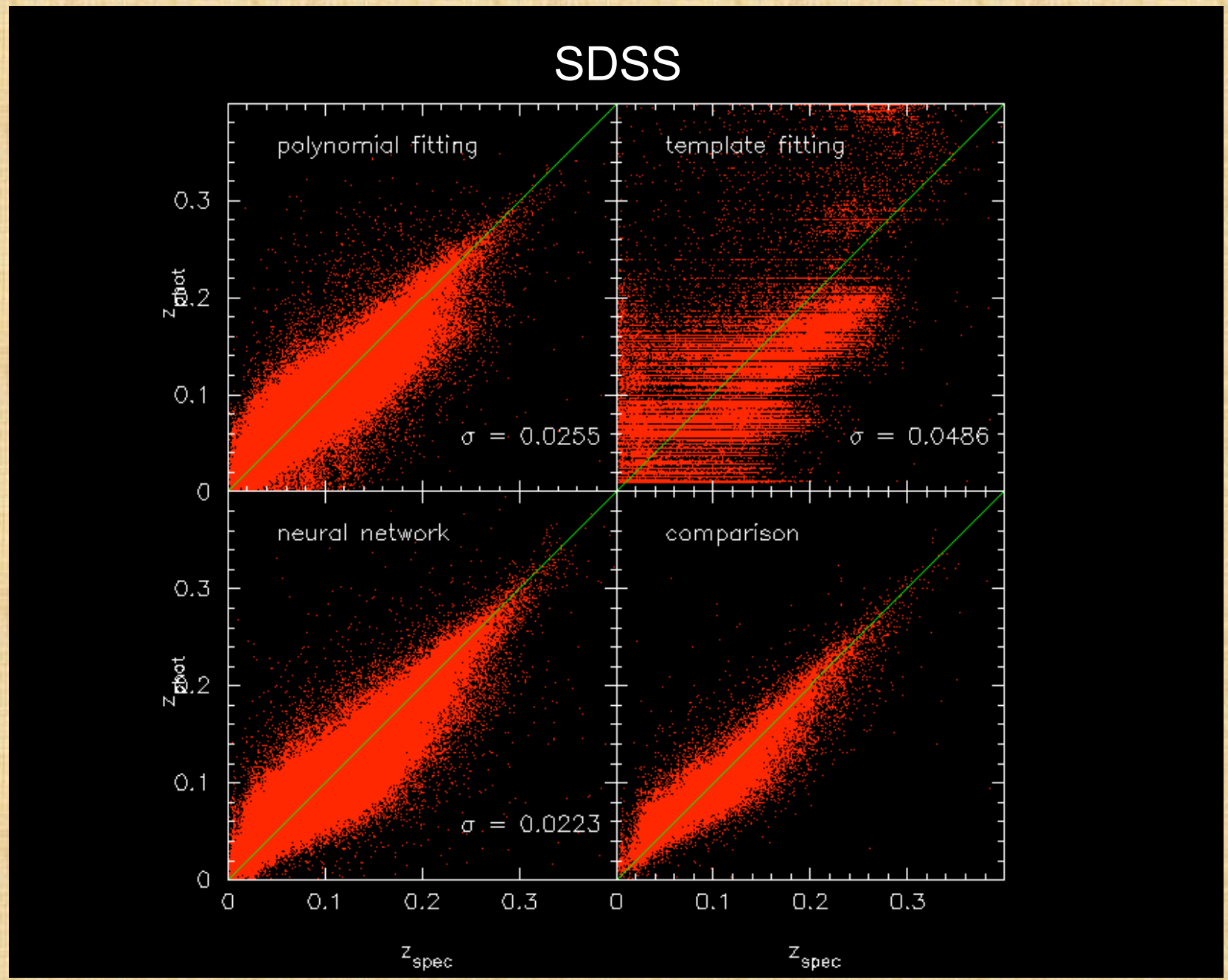


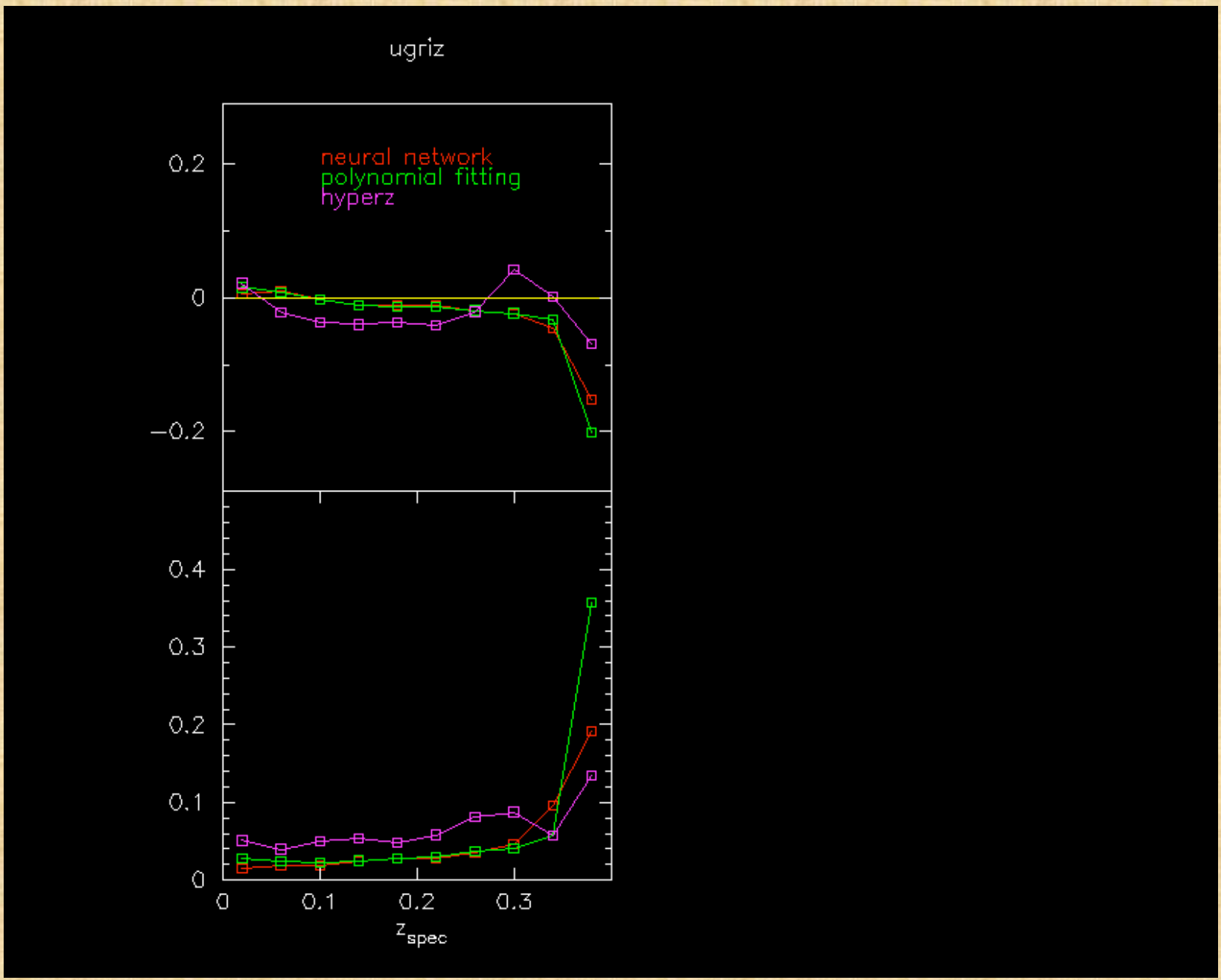
Photo-z Distributions




griz
griz + YJHKs
neural network
polynomial fitting
template bayesian
comparison
bias
σ
0.2
0
−0.2
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
z_{spec}
z_{spec}

SDSS


polynomial fitting
σ = 0.0255
template fitting
σ = 0.0486
neural network
σ = 0.0223
comparison
0
0.1
0.2
0.3
z_phot
z_spec


ugriz
neural network
polynomial fitting
hyperz
0.2
0
−0.2
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
z_{spec}

Summary

- Best training set method: Neural Net
- Best template method: Bayesian
- Comparison uses both.
- Problem with comparison: loss of points. Should correct redshift distributions.

For more

- http://astro.uchicago.edu/~oyachai
- http://astro.uchicago.edu/~mvlima
- http://astro.uchicago.edu/~cunha