PHAT (PHoto-z Accuracy Testing)

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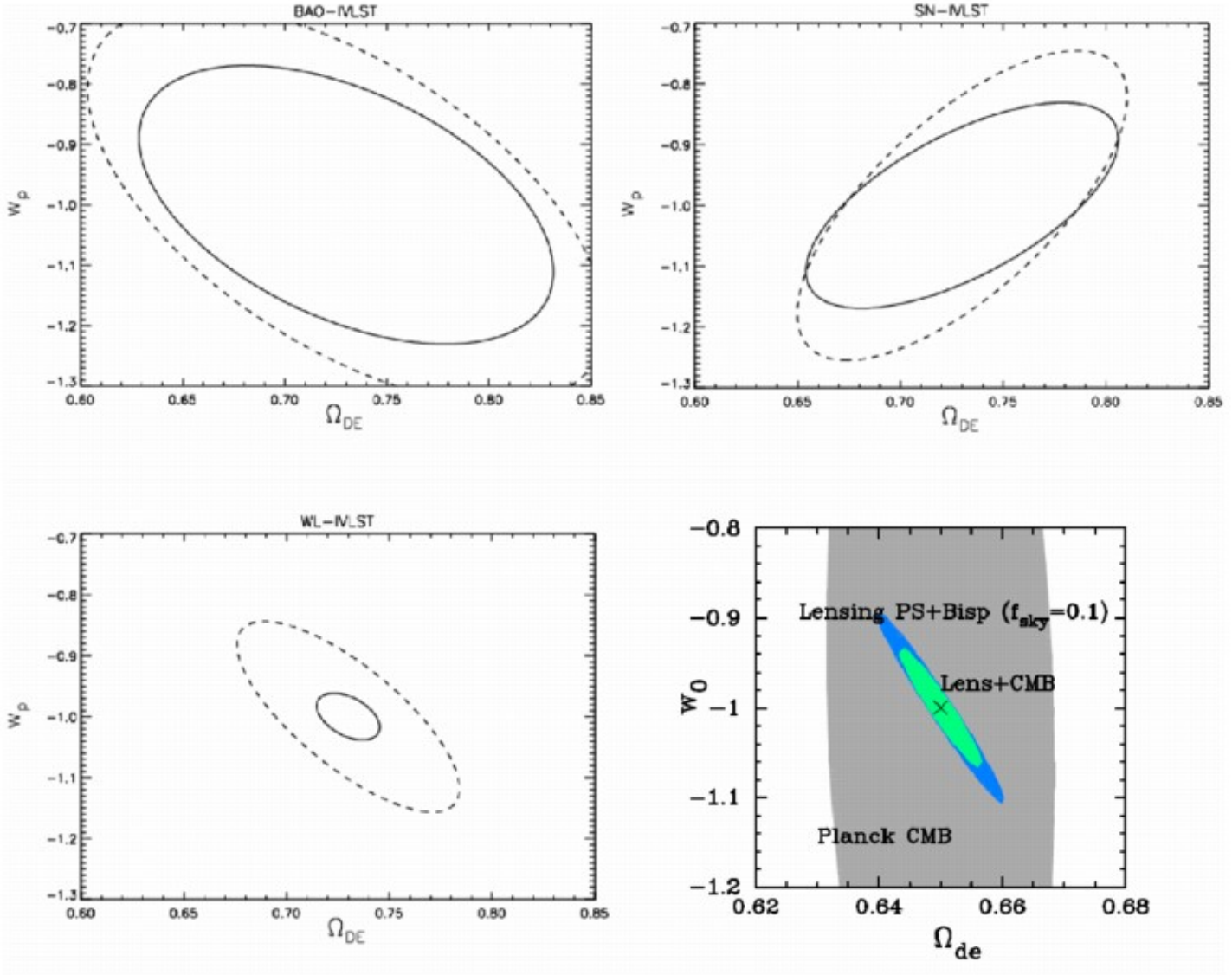
April 28, 2009

Outline

DETF report



from Albrecht et al. (2006)

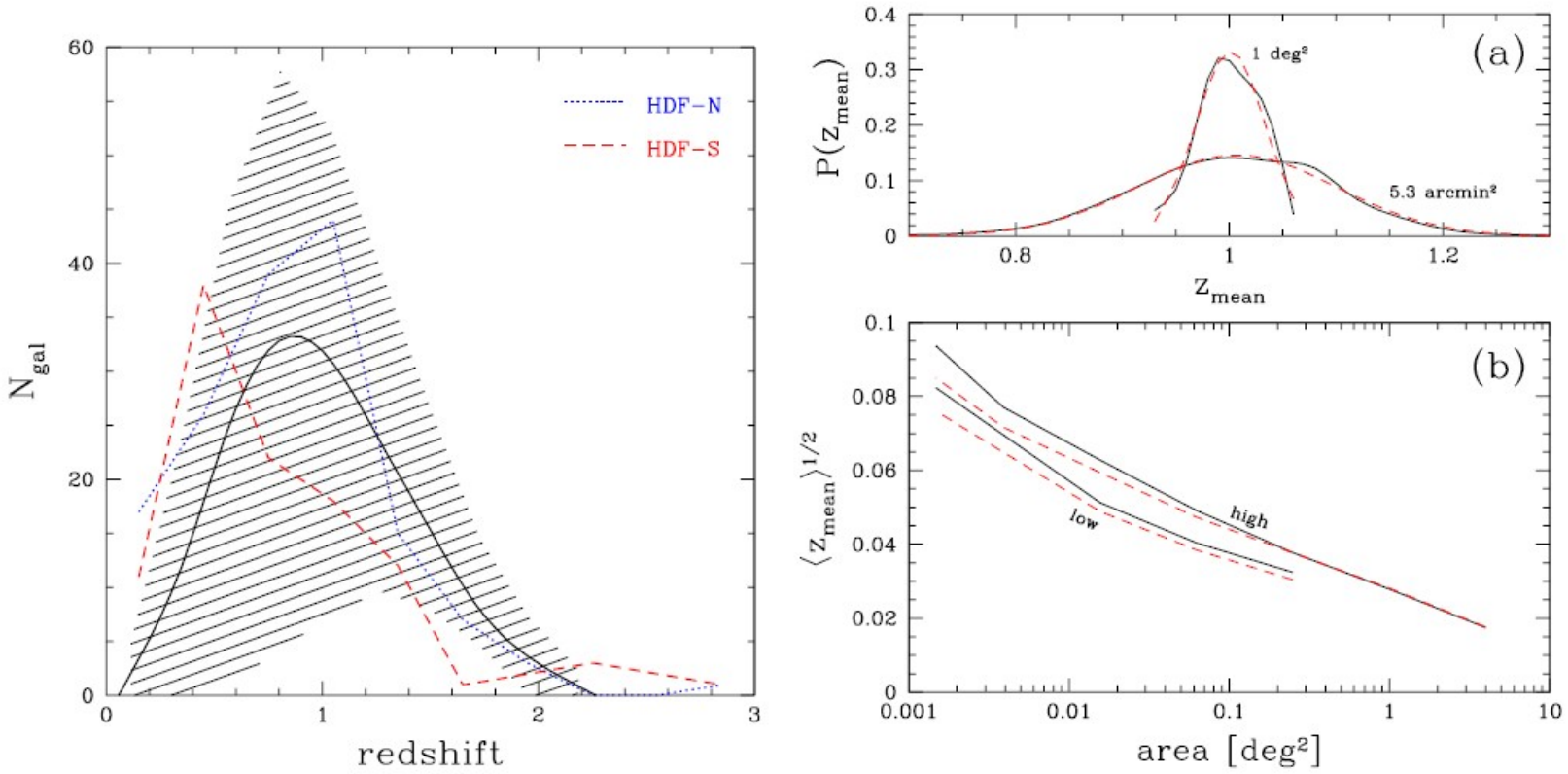
Weak Lensing Measurements

What do we measure?

$$\left\langle \gamma^2 \right\rangle \propto 0.01^2 \, {\sigma_8}^2 \, \Omega^{1.6} \, {z_s}^{1.4} \, \theta^{-(n+2)/2}$$

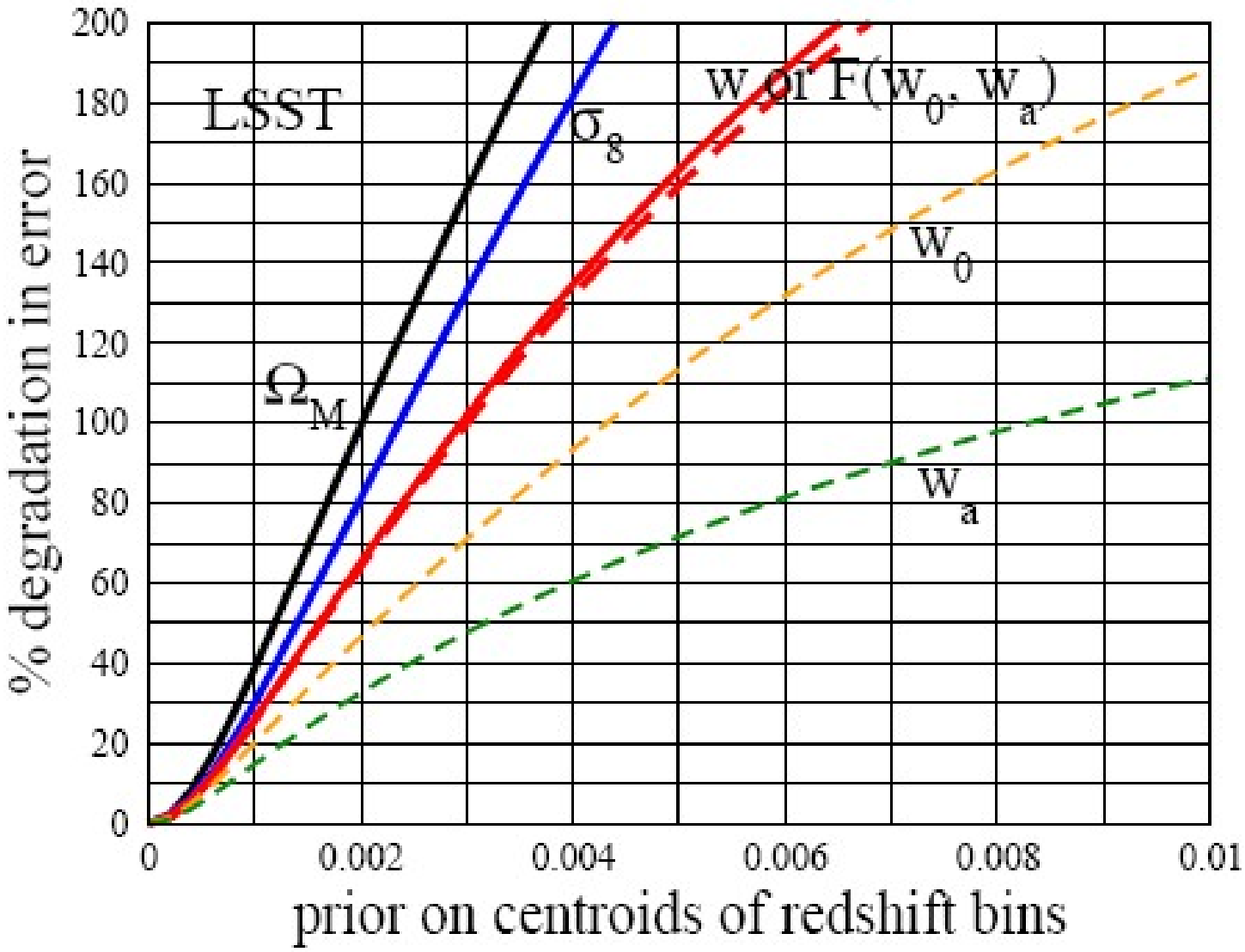
- σ_8: Mass power spectrum normalisation
- Ω: Mean density parameter
- n: Slope of the power spectrum
- z_s: Redshift of the sources

Uncertainty in the redshift distribution



from van Waerbeke et al. (2006)

Errors of cosmological parameters



from Huterer et al. (2005)

PHAT – PHoto-z Accuracy Testing

Goals

- Credibility
- Quantitative understanding
- Rank and profile methods

Tools

- Standardised test environments
- Study:
  - Codes
  - Templates
  - Filter sets
  - S/N
- Long term: study different approaches on galaxy photometry

PHAT – Photo-z Accuracy Testing

Timeline

- Sep 2007: Start of PHAT
- Mar 2008: 1st simulation released
- May 2008: Wiki page launched with results from 1st simulation
- Aug 2008: GOODS-North catalogue released
- Sep 2008: Photo-z workshop in London
- Dec 2008: PHAT workshop in Pasadena
- Mar 2009: GOODS results on Wiki

Websites

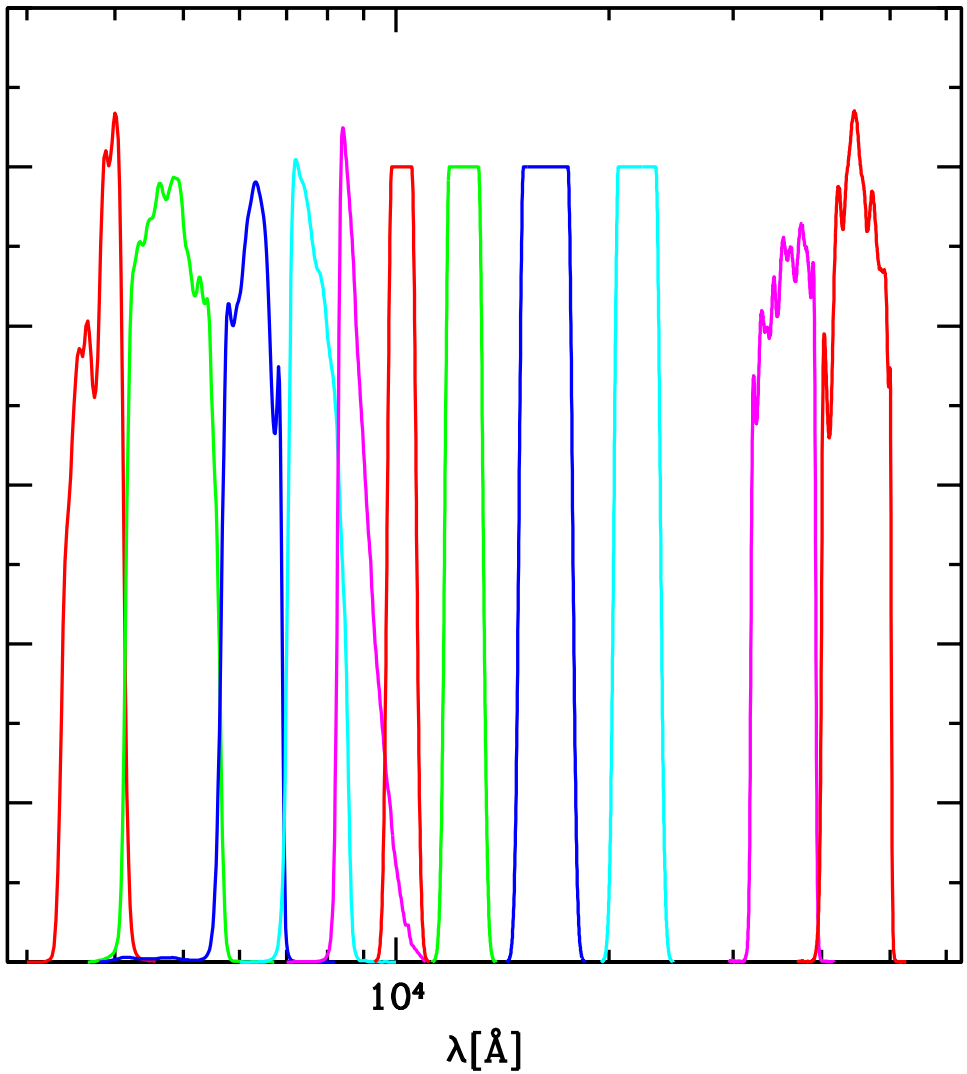
- PHAT Wiki page:
  `http://www.astro.caltech.edu/twiki_phat/bin/view/Main/WebHome`
- PHAT mailing list:
  `http://astro.caltech.edu:88/mailman/listinfo/phat`

First simulation by S. Arnouts

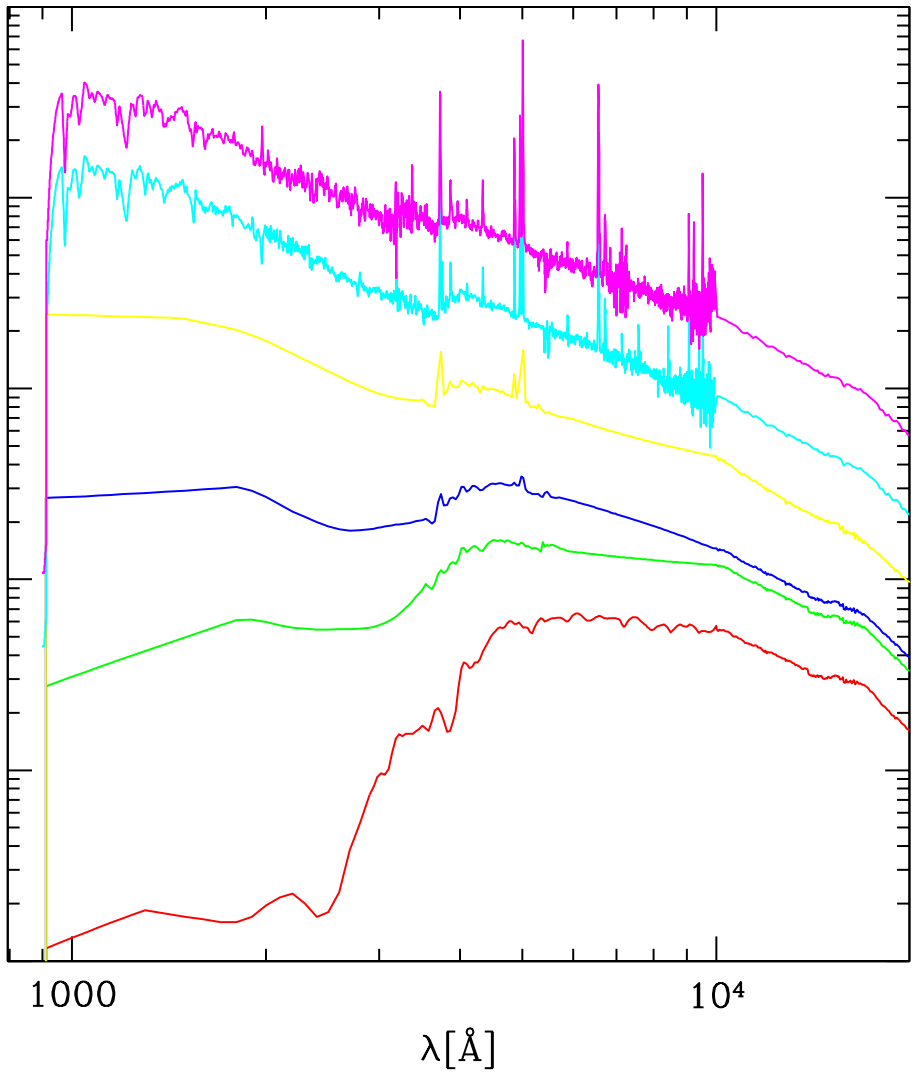
Motivation

- Start as simple as possible.
- Test low-level agreement.
- Provide:
  - 2 catalogues
  - Template set
  - Filter curves
  - Optimal training set

Filter set



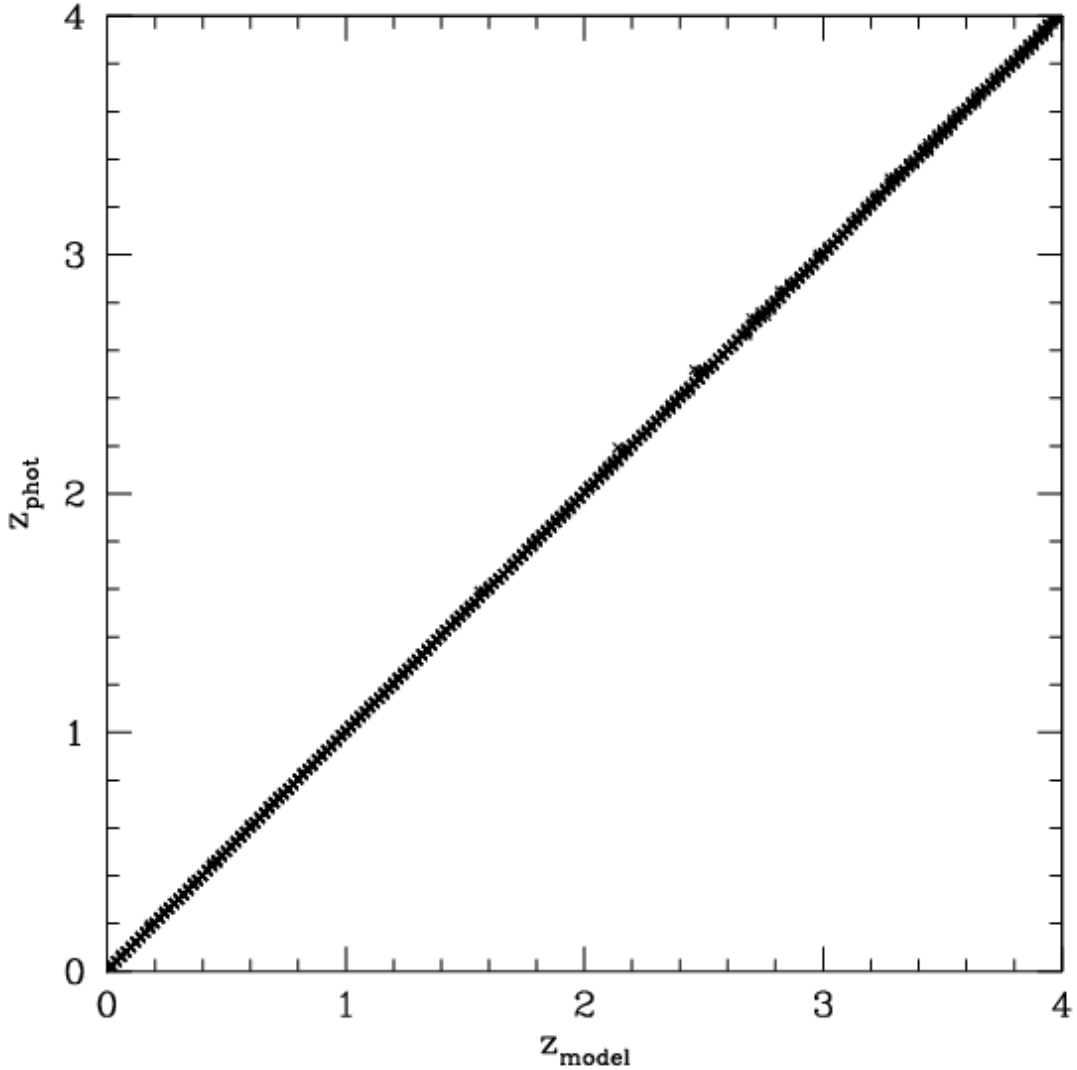
Template SEDs



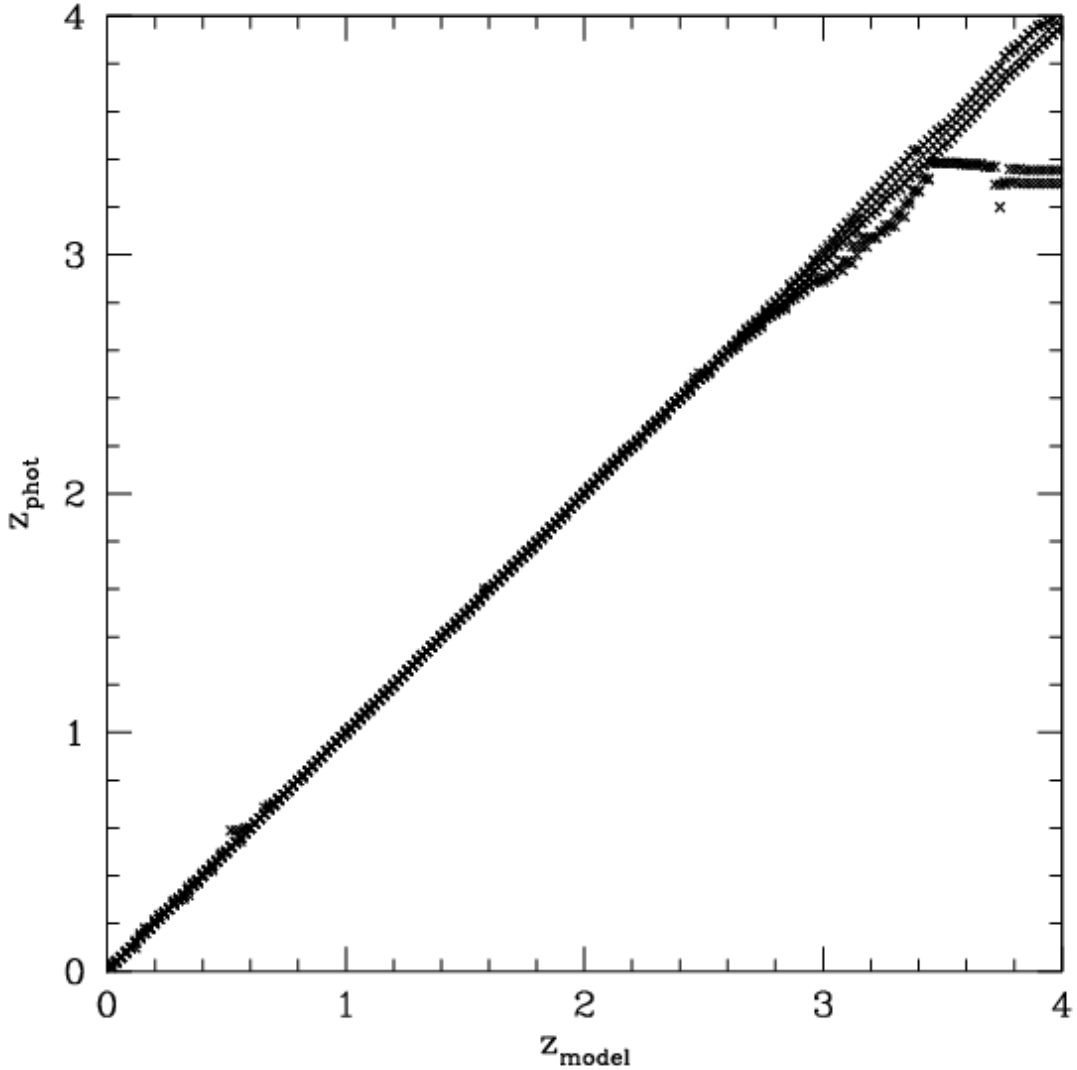
Results from 15 people

- Abdalla, Filipe
- Arnouts, Stephane
- Assef, Roberto
- Brammer, Gabriel
- Carliles, Sam
- Coe, Dan
- Dahlen, Tomas
- Feldmann, Robert
- Gerdes, David
- Gillis, Bryan
- Kotulla, Ralf
- Li, Tornado
- Miralles, Joan-Marc
- Purger, Norbert
- Singal, Jack

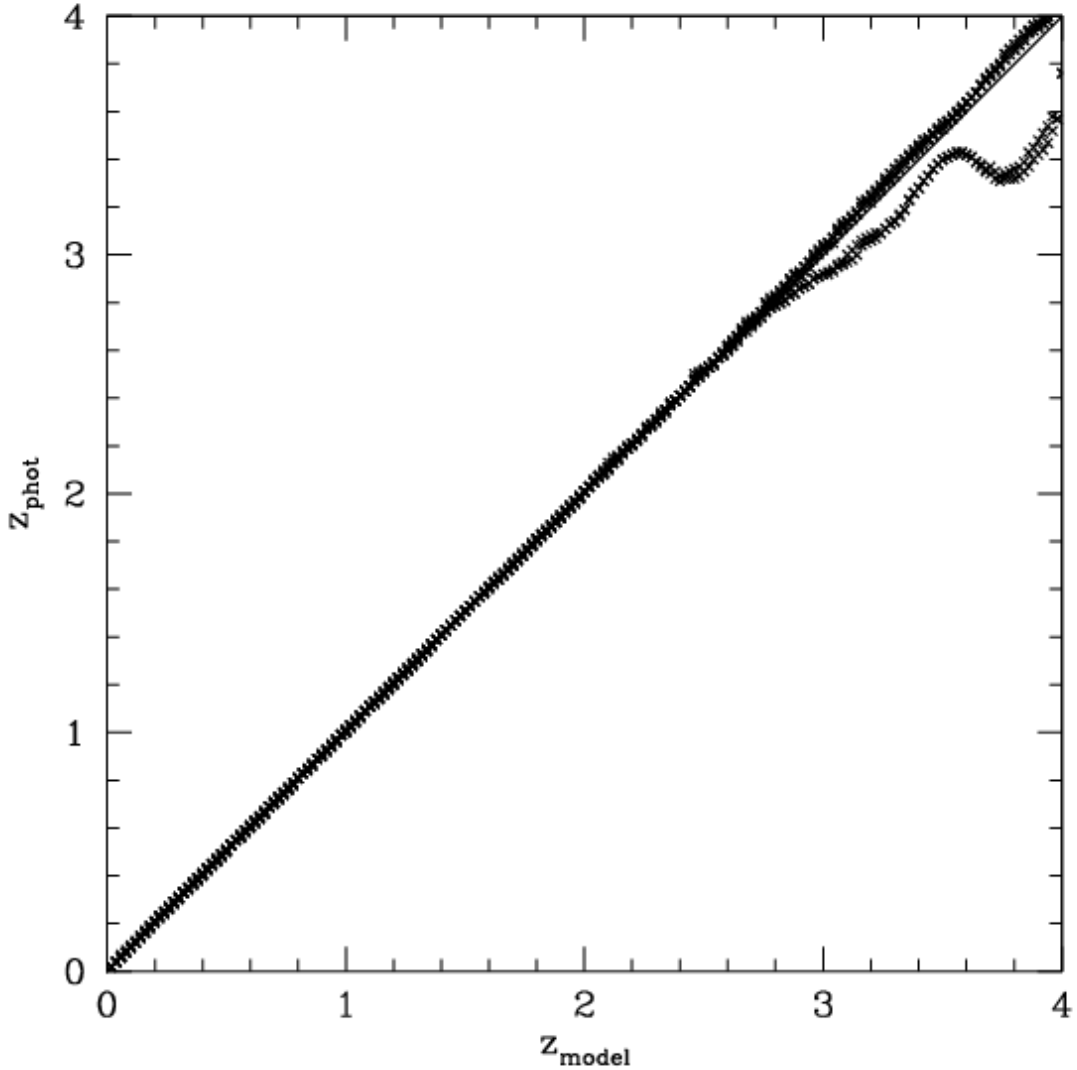
Noise-free catalogue - *ZEBRA*



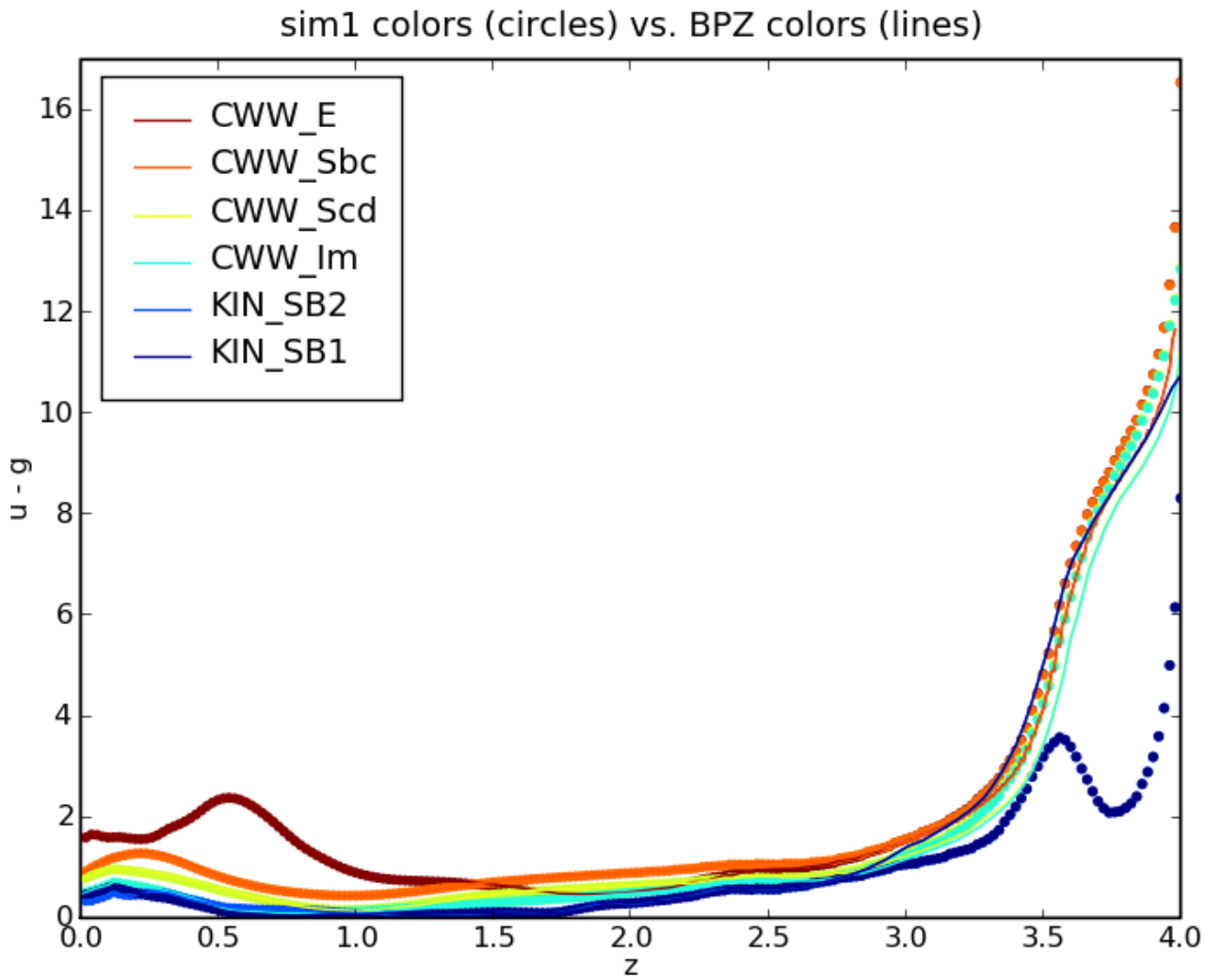
Noise-free catalogue - *Hyperz*



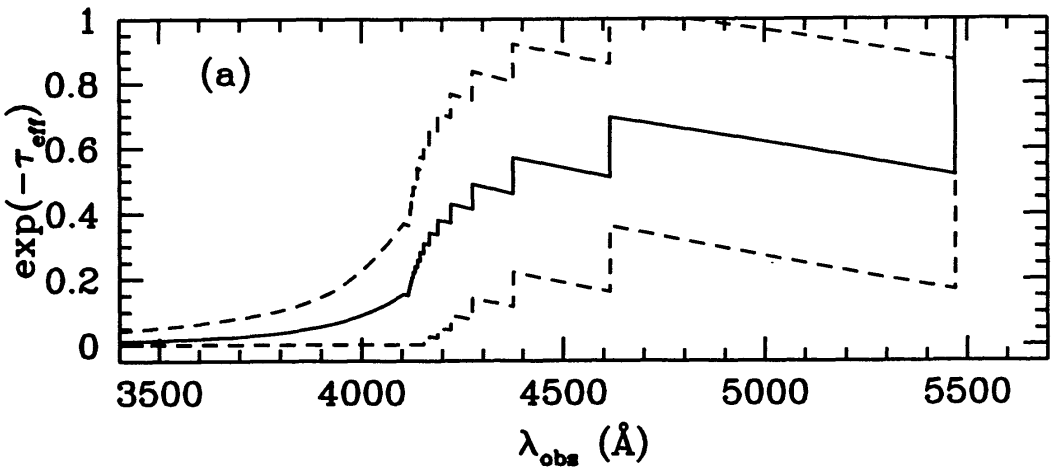
Noise-free catalogue - *BPZ*

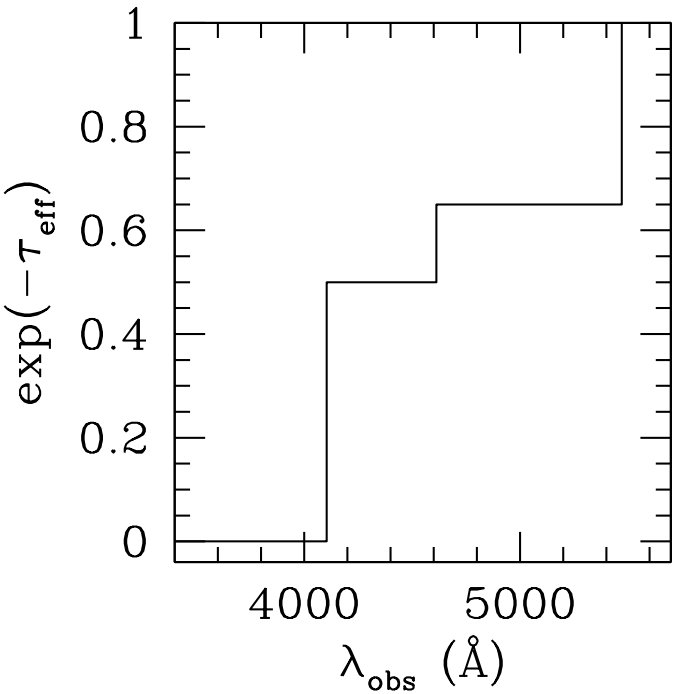


Noise-free catalogue - *BPZ*

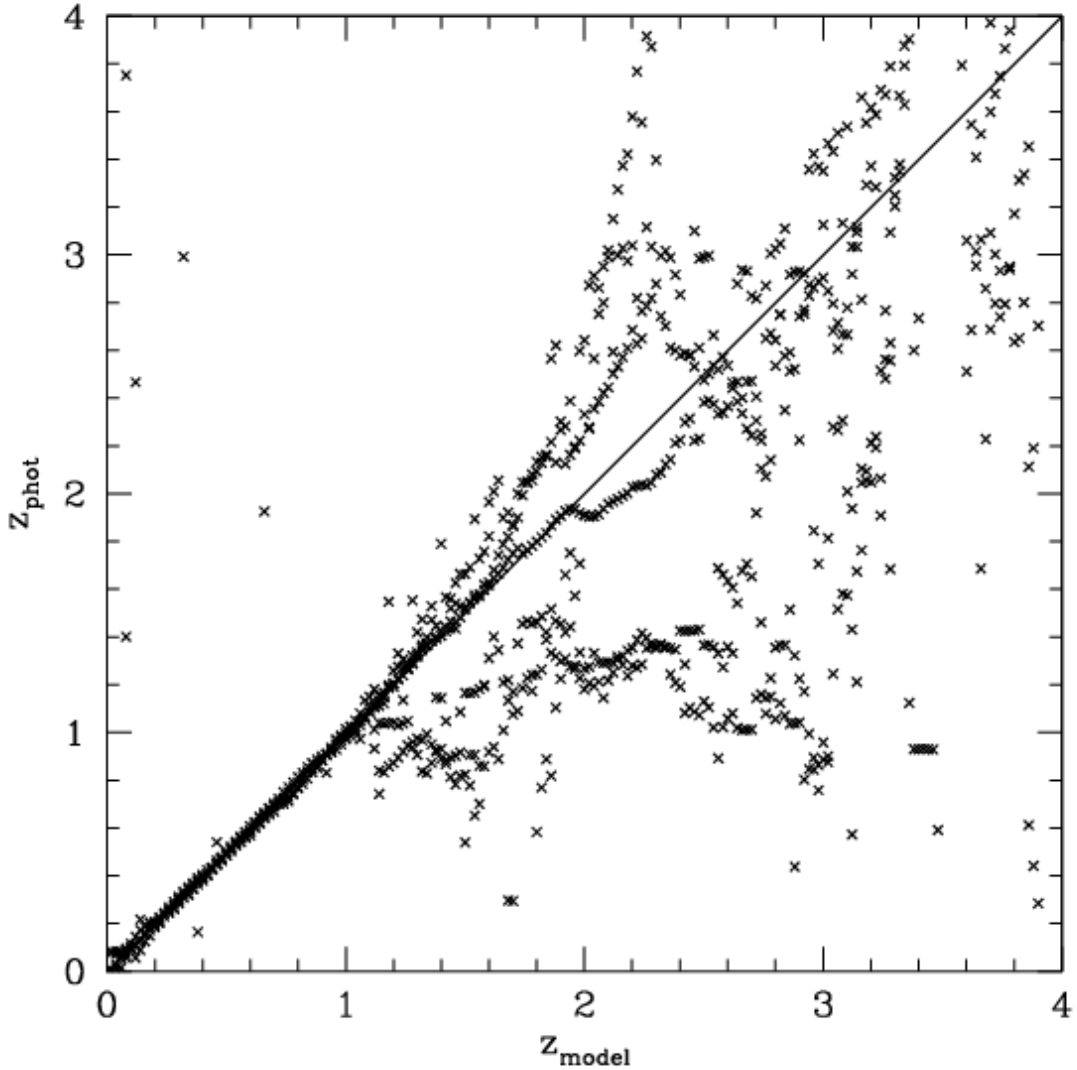


Different IGM handlings

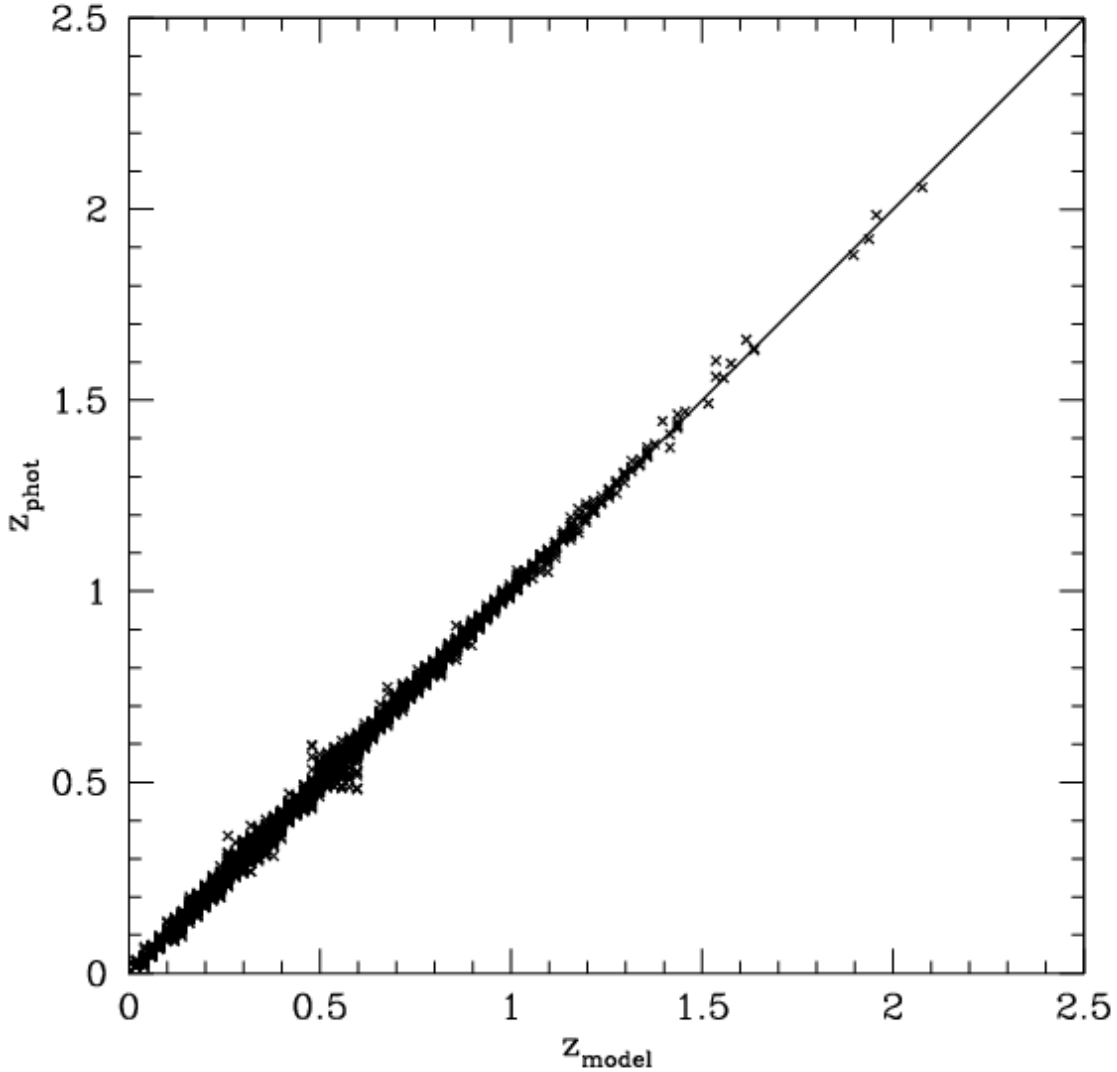




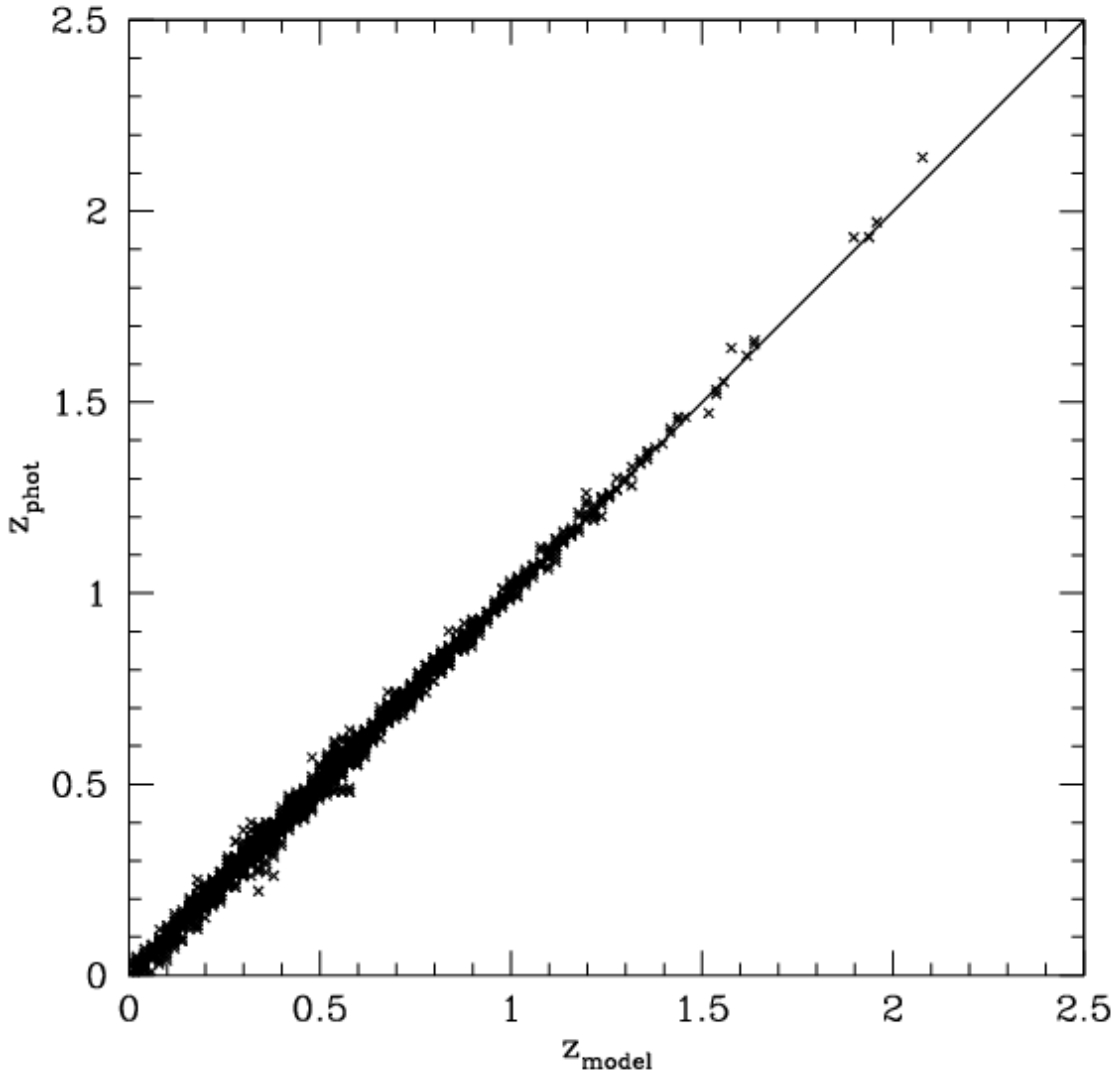
Noise-free catalogue - empirical code



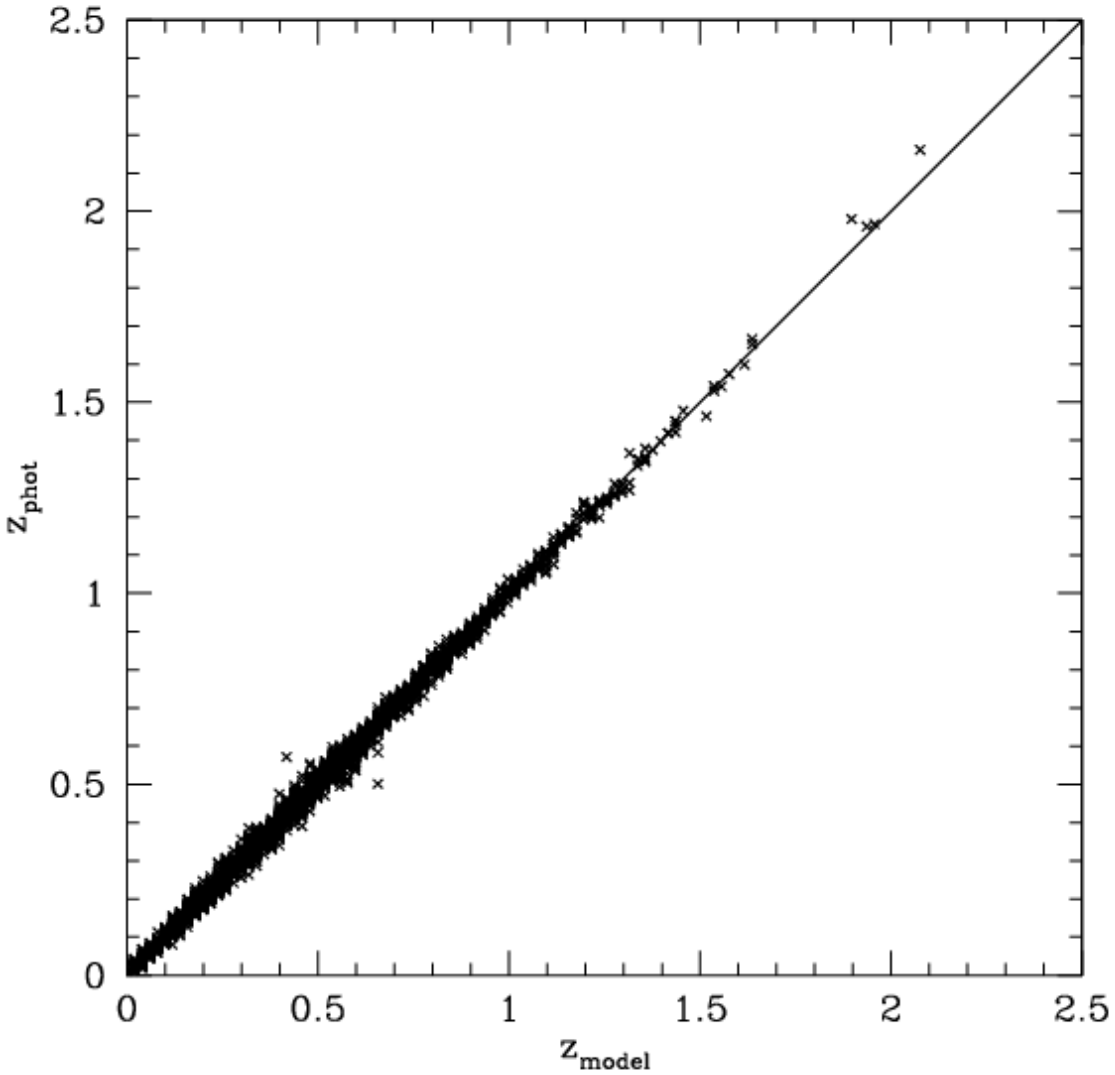
Catalogue with noise - *Le Phare*



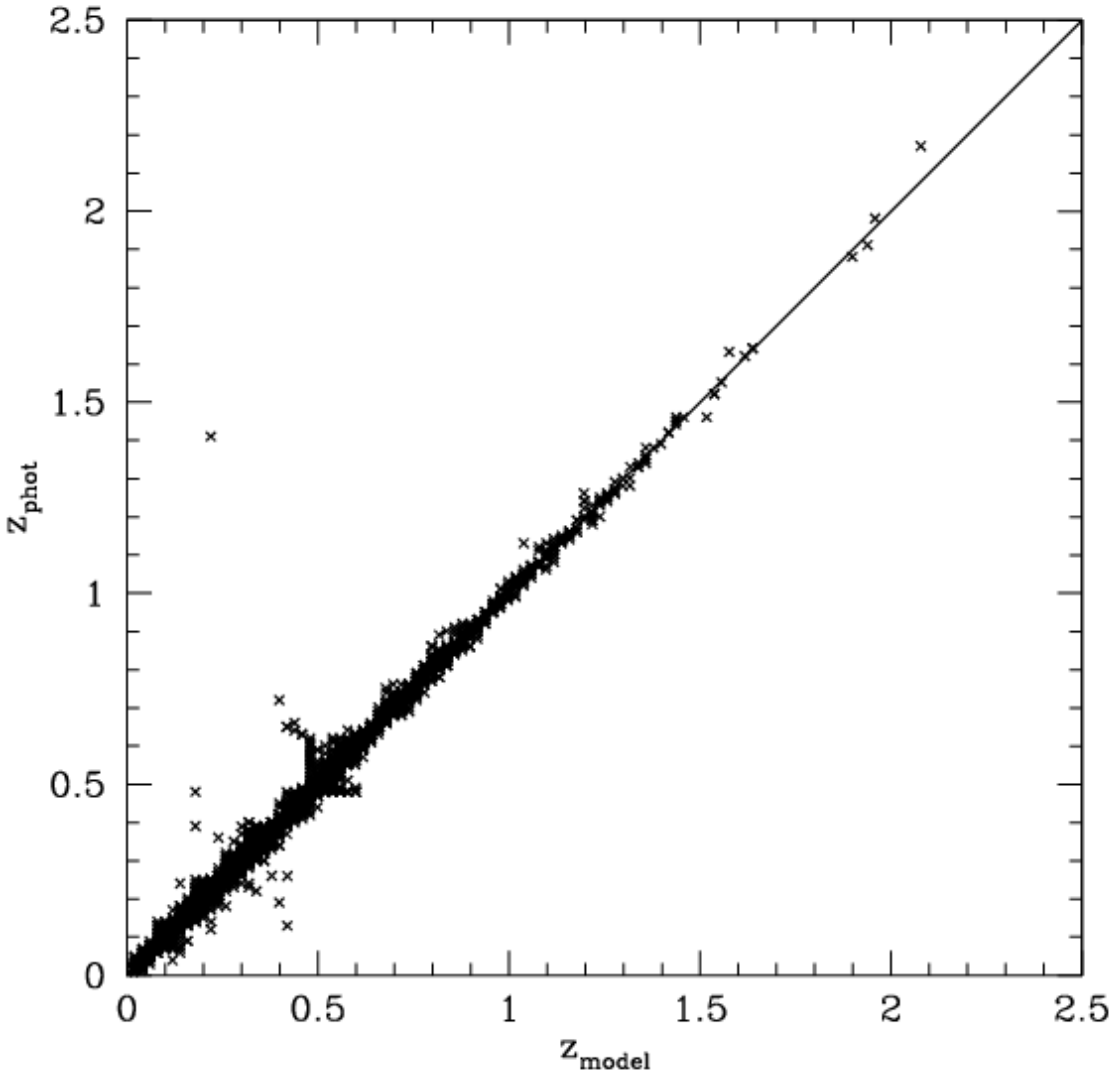
Catalogue with noise - Tomas Dahlen (template-based)



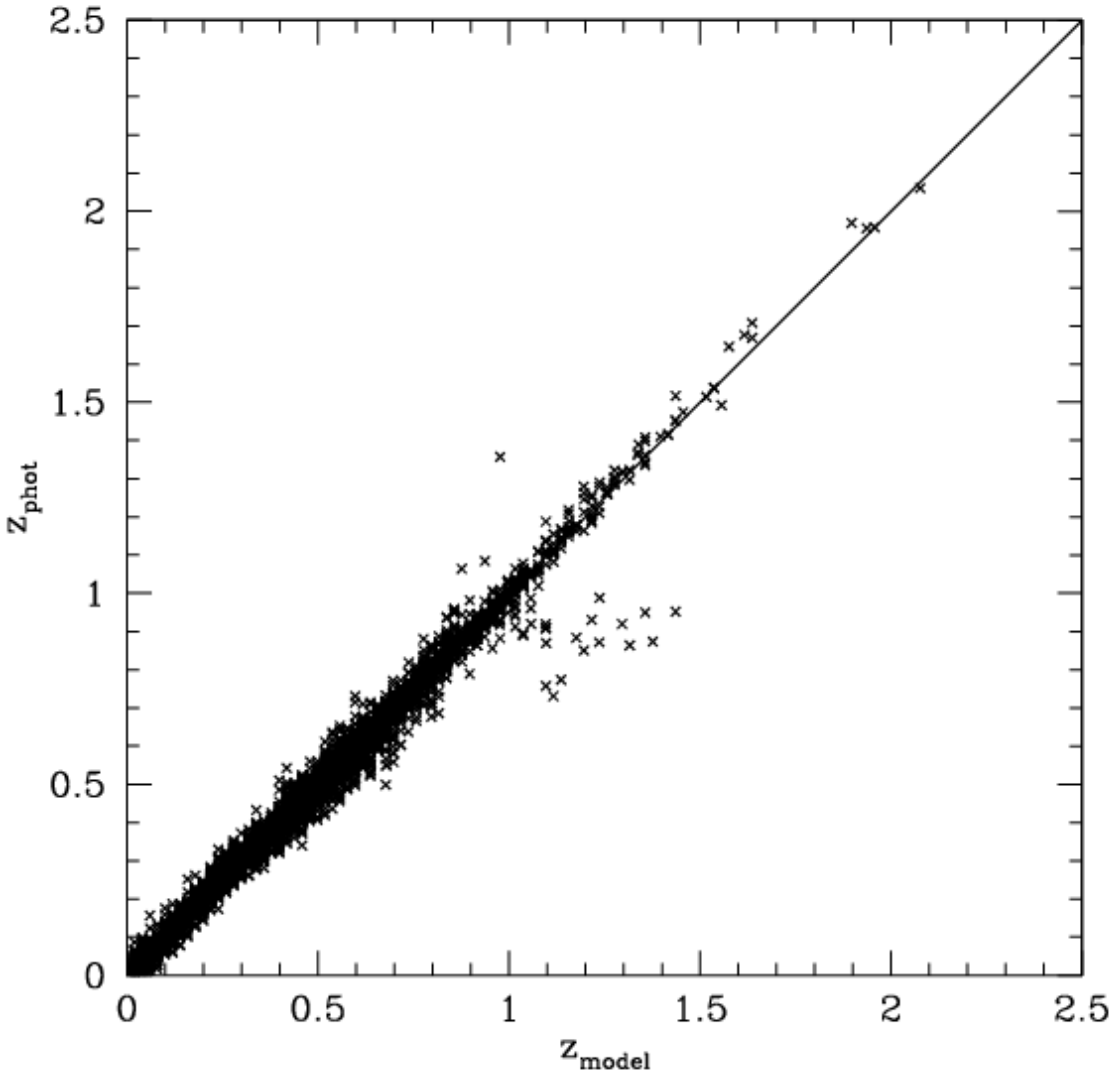
Catalogue with noise - Filipe Abdalla (empirical)



Catalogue with noise - Roberto Assef (template-based)



Catalogue with noise - Tornado Li (empirical)



Tornado's photo-z code

- Empirical fitting method
  - Assuming galaxy redshift is a function of galaxy magnitudes and colors

$$z = a_0 + \sum_{i}^{N} a_i m_i + \sum_{i}^{N} \sum_{j=i+1}^{N} a_{ij} (m_i - m_j)^2$$

  - For each input galaxy, the fitting solutions (a0, ai, aij) are derived using 300 training-set galaxies which have the best mag. and colors to the input galay in the training set
  - If some columns give crappy fitting results, i.e., the fitting is not good, reject the columns and re-do the fitting
  - If a galaxy only has photometry in some filters but not all UBVRIJHK, then the fitting is derived using training-set galaxies which have the photometry in the same passbands. Minimum three passband photometry is required.
  - Somehow my photo-z code is very slow. Suspect because of mpfitfun.pro. Any suggestion to make the code faster are welcome !

Conclusions from first simulation

Conclusions

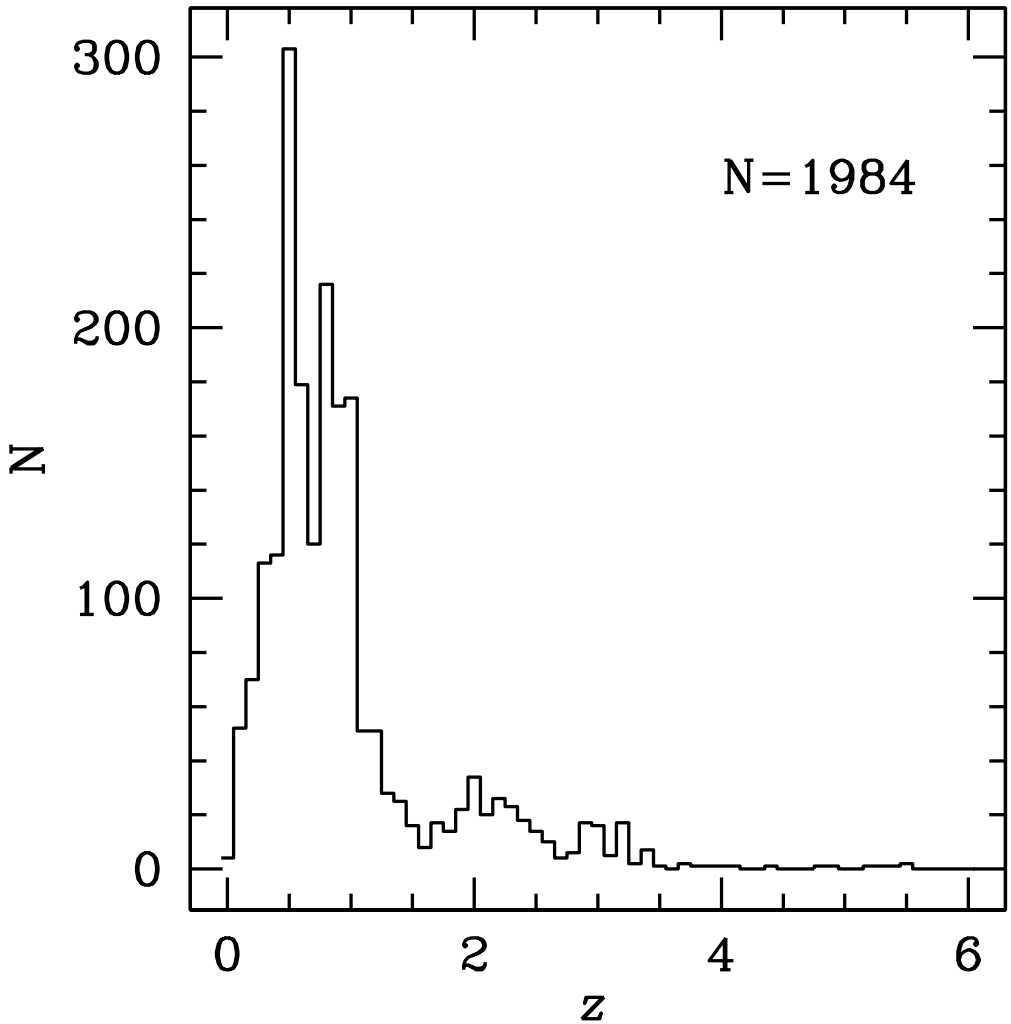
- Generally good agreement
- Empirical and template-based codes work
- However, more than a factor of 2 accuracy differences
- IGM handling very different in the different template-based codes
- Importance of user-handling

GOODS-North catalogue by P. Capak

Motivation

- Several people: “We want real data.”
- Highly motivating
- Going back later
- Provide:
  - Filter curves (*UBVRI*, 4× ACS, *JHK*, 4× IRAC)
  - Small training set

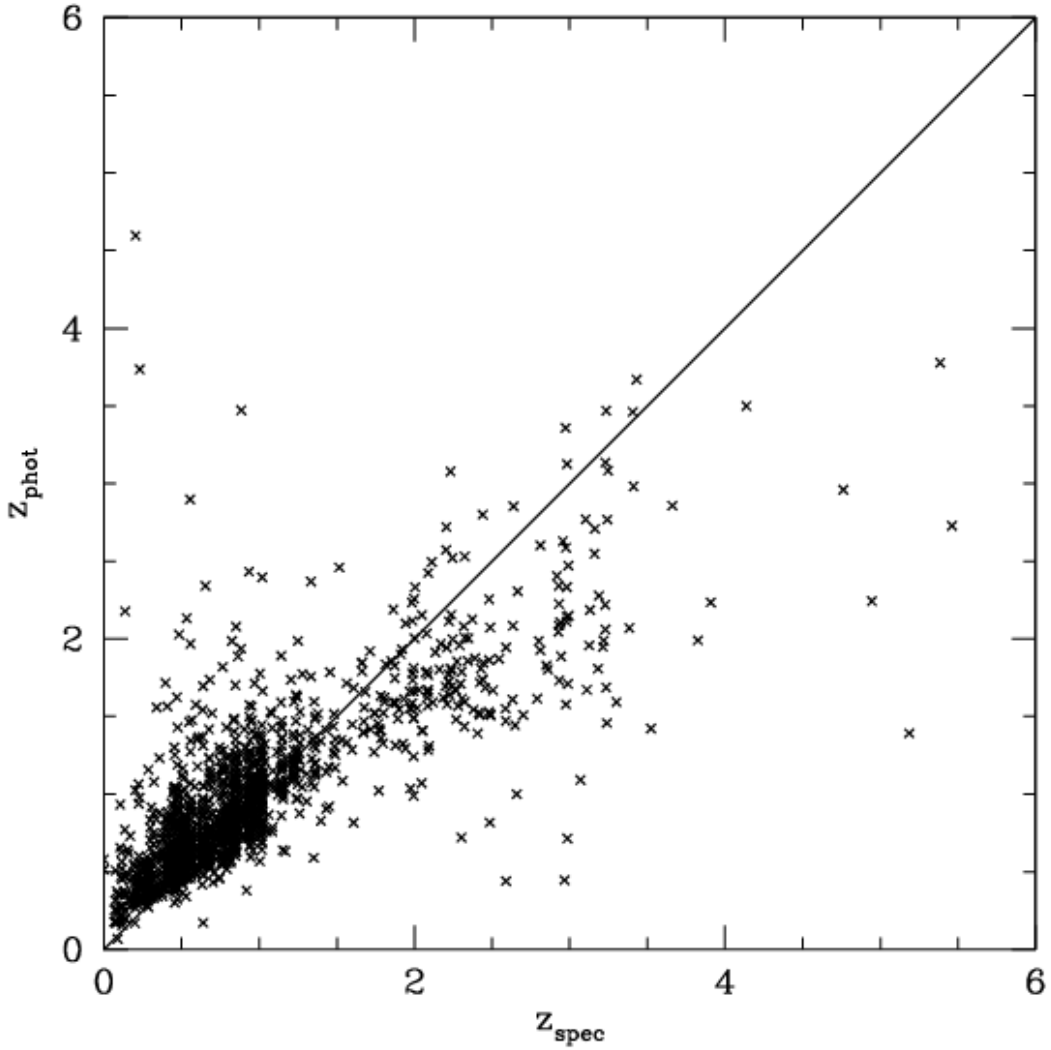
GOODS-North catalogue z-distribution



Results from 9 people

- Assef, Roberto
- Banerji, Manda
- Brammer, Gabriel
- Coe, Dan
- Kotulla, Ralf
- Li, Tornado
- Miralles, Joan-Marc
- Schmidt, Sam
- Wolf, Chris

Manda Banerji (ANNz)



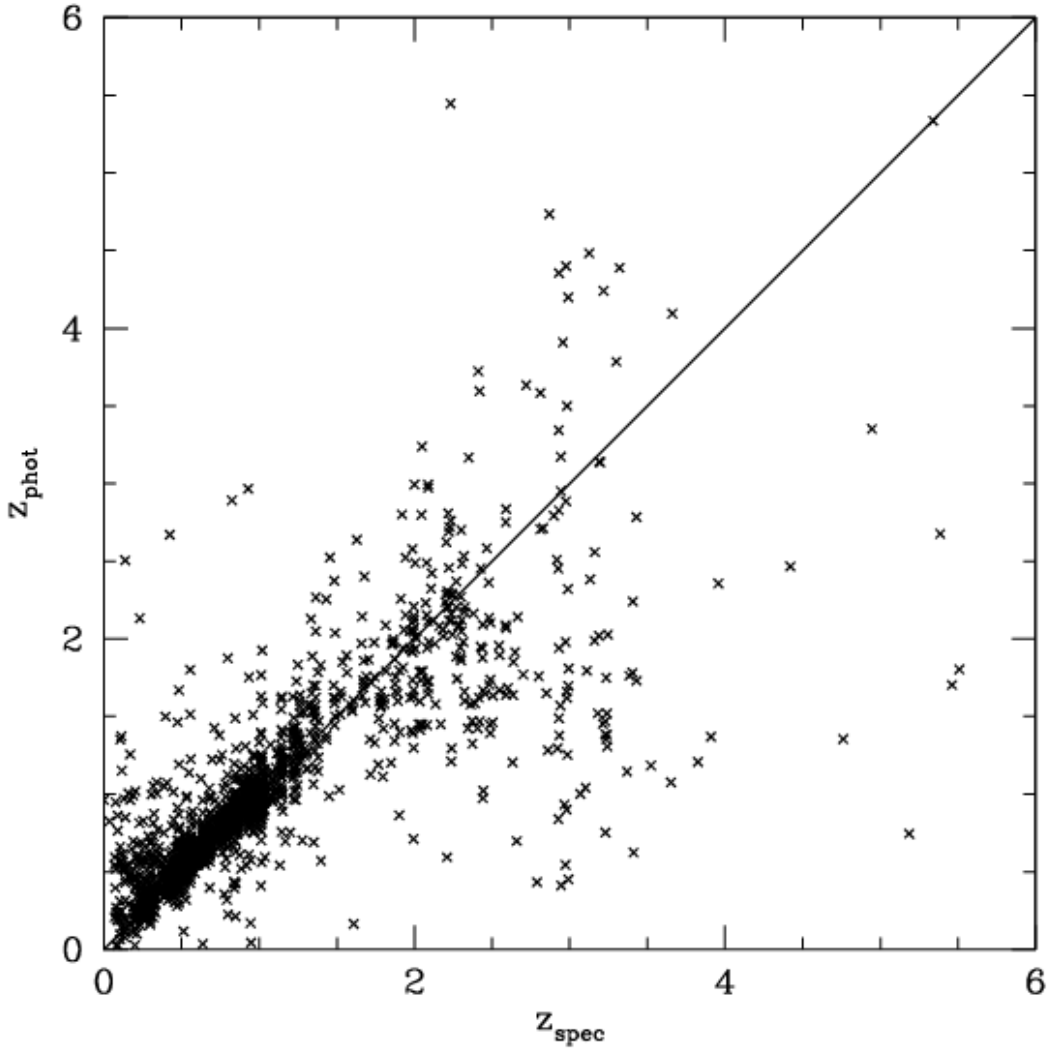
Statistics

bias $= -0.01$

$\sigma = 0.07$

outliers $= 31.0\%$

Tornado Li (empirical)



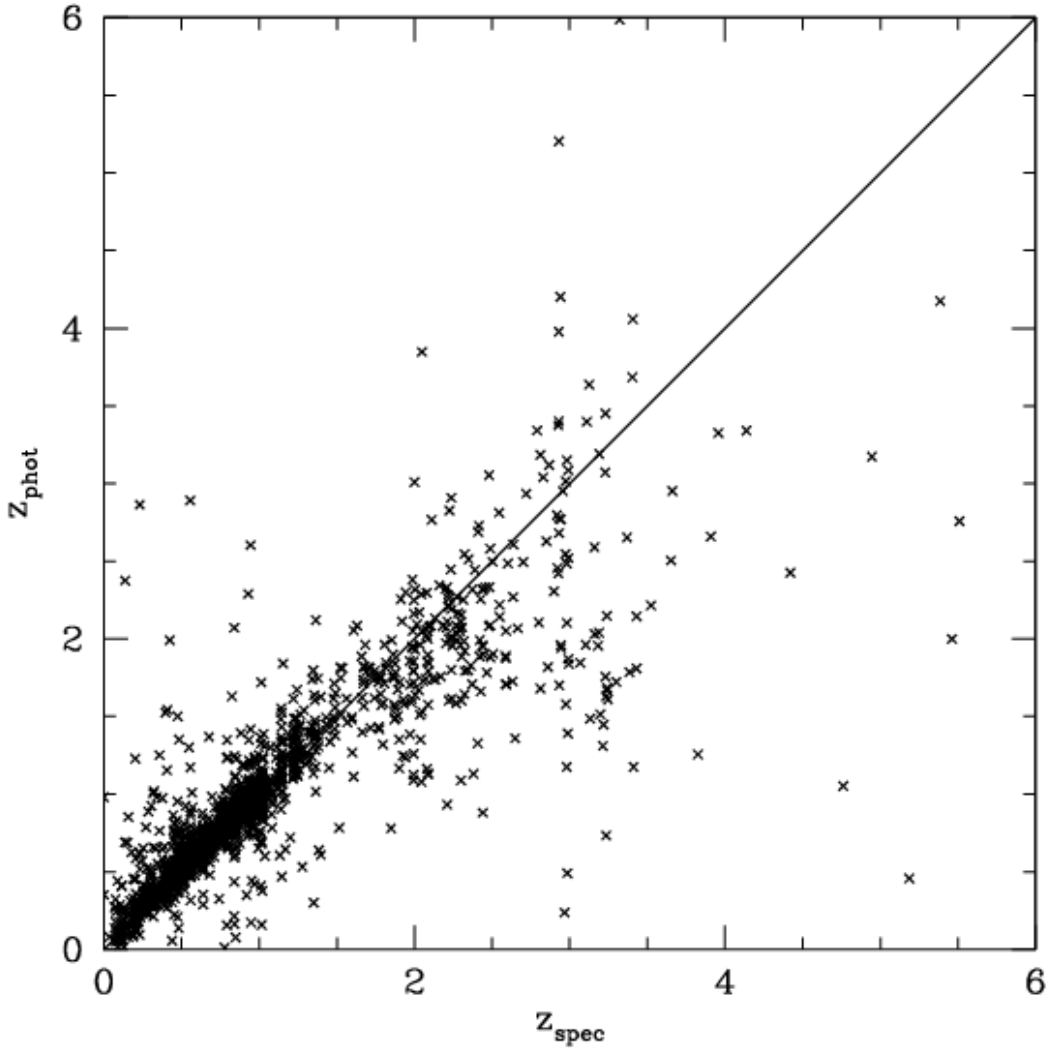
Statistics

bias $= -0.01$

$\sigma = 0.052$

outliers $= 18.0\%$

Tornado Li (empirical) without IRAC



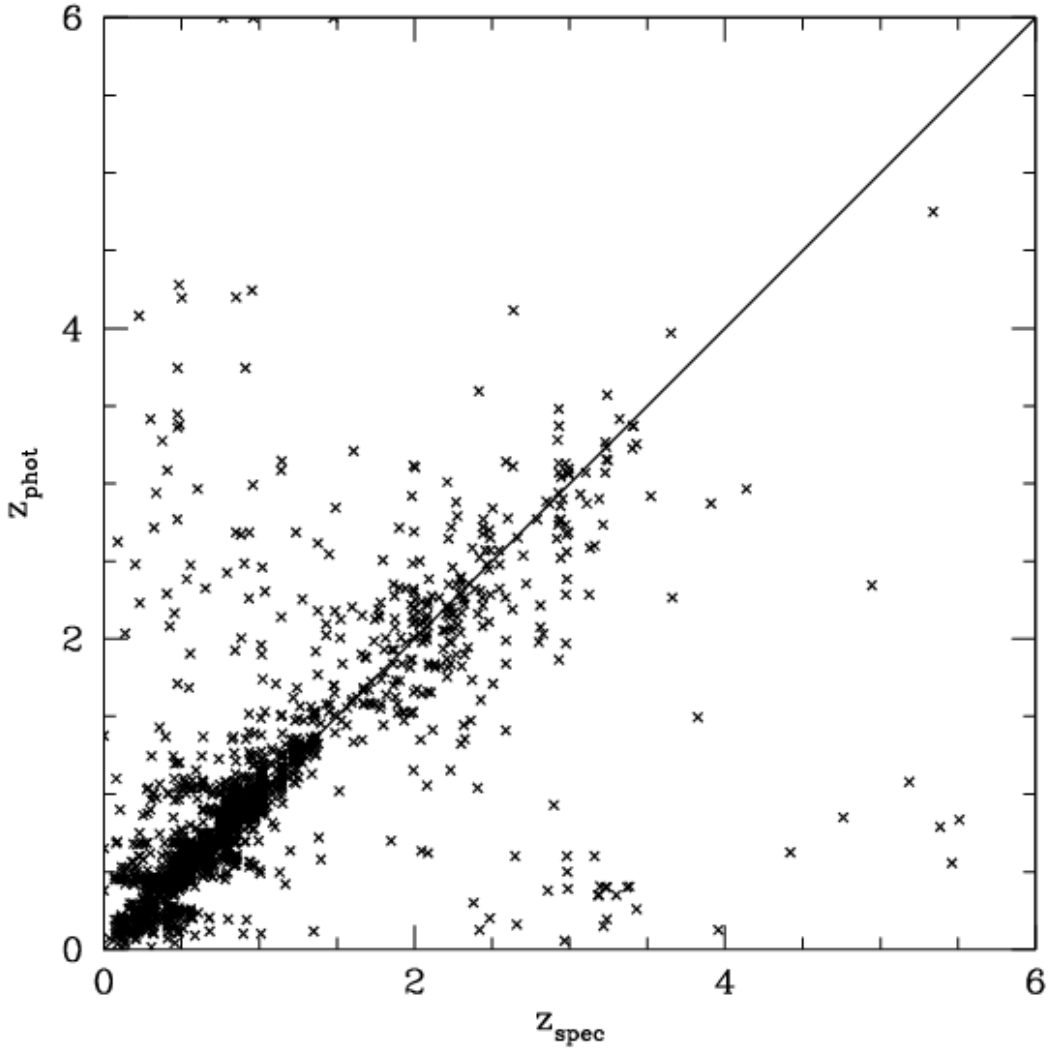
Statistics

$\text{bias} = -0.01$

$\sigma = 0.051$

$\text{outliers} = 13.7\%$

Joan-Marc Miralles (Hyperz)



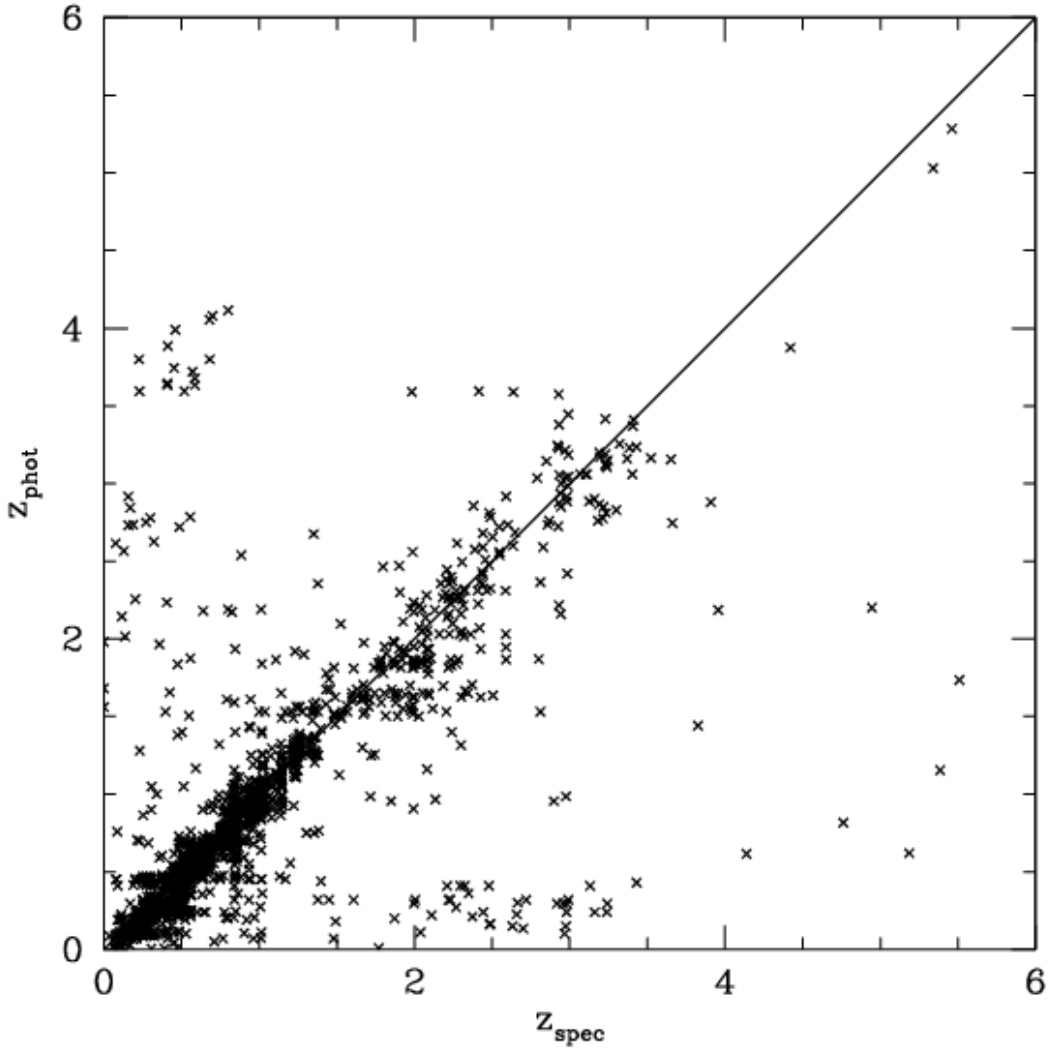
Statistics

bias $= 0.00$

$\sigma = 0.058$

outliers $= 18.5\%$

Joan-Marc Miralles (Hyperz) without IRAC



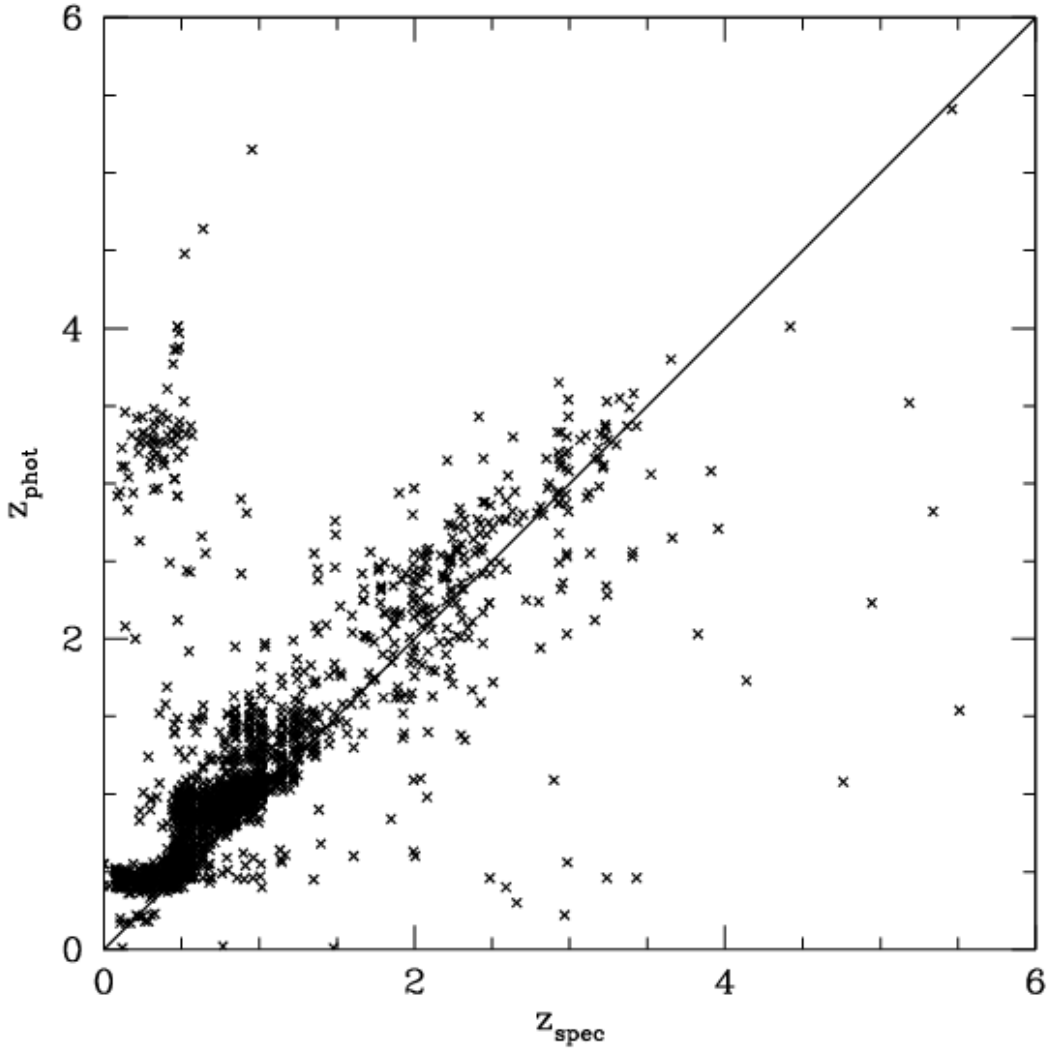
Statistics

bias $= 0.02$

$\sigma = 0.055$

outliers $= 14.7\%$

Dan Coe (BPZ)



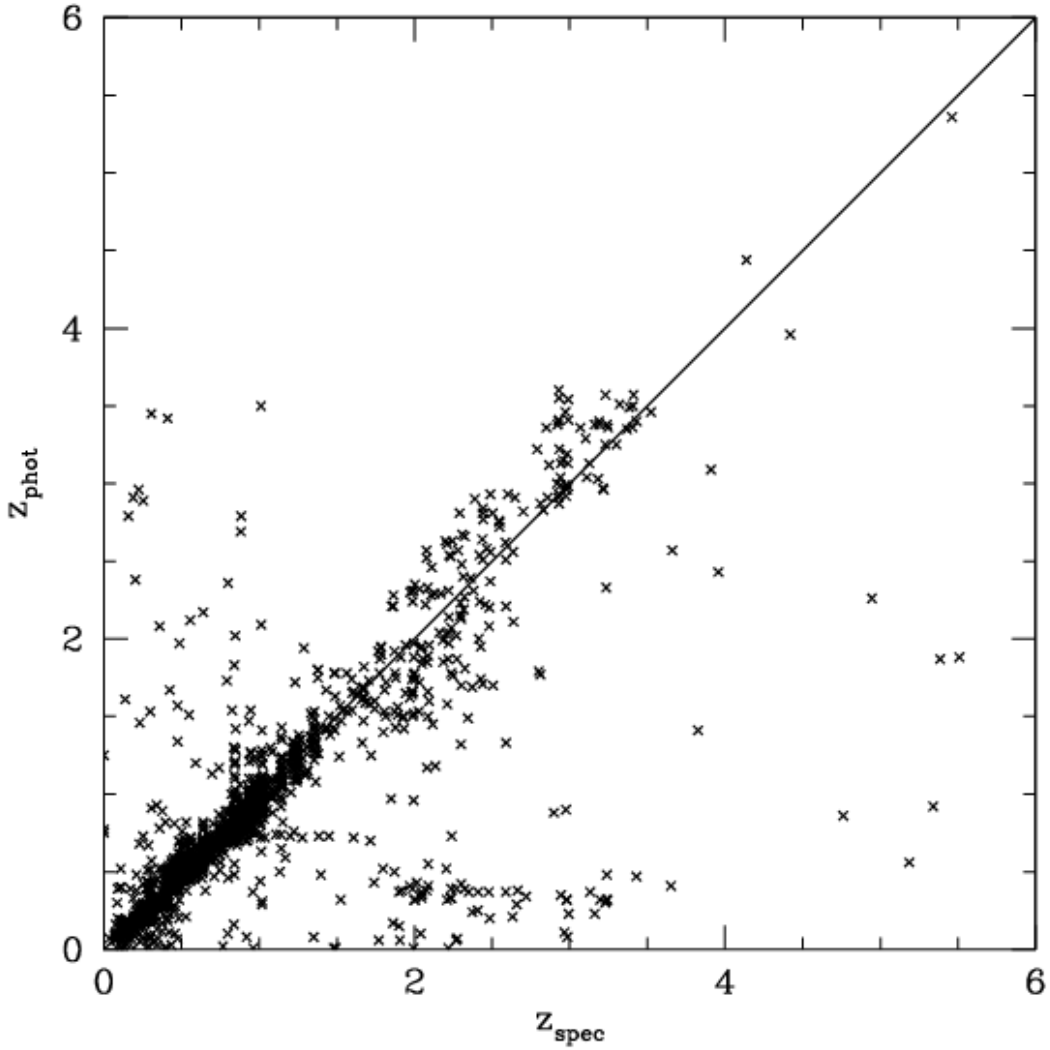
Statistics

bias $= -0.05$

$\sigma = 0.06$

outliers $= 30.9\%$

Dan Coe (BPZ) without IRAC



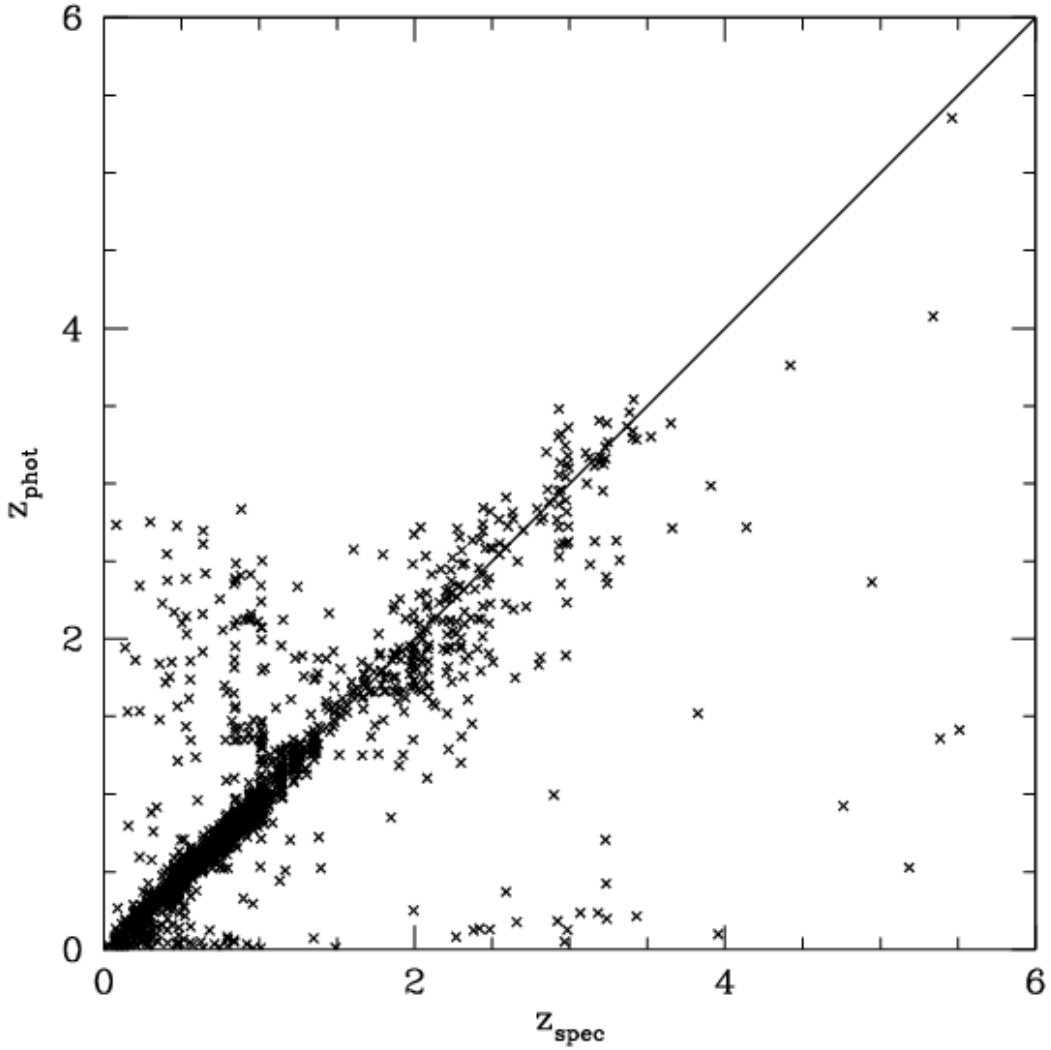
Statistics

bias $= 0.01$

$\sigma = 0.048$

outliers $= 11.4\%$

Gabriel Brammer (EAZY)



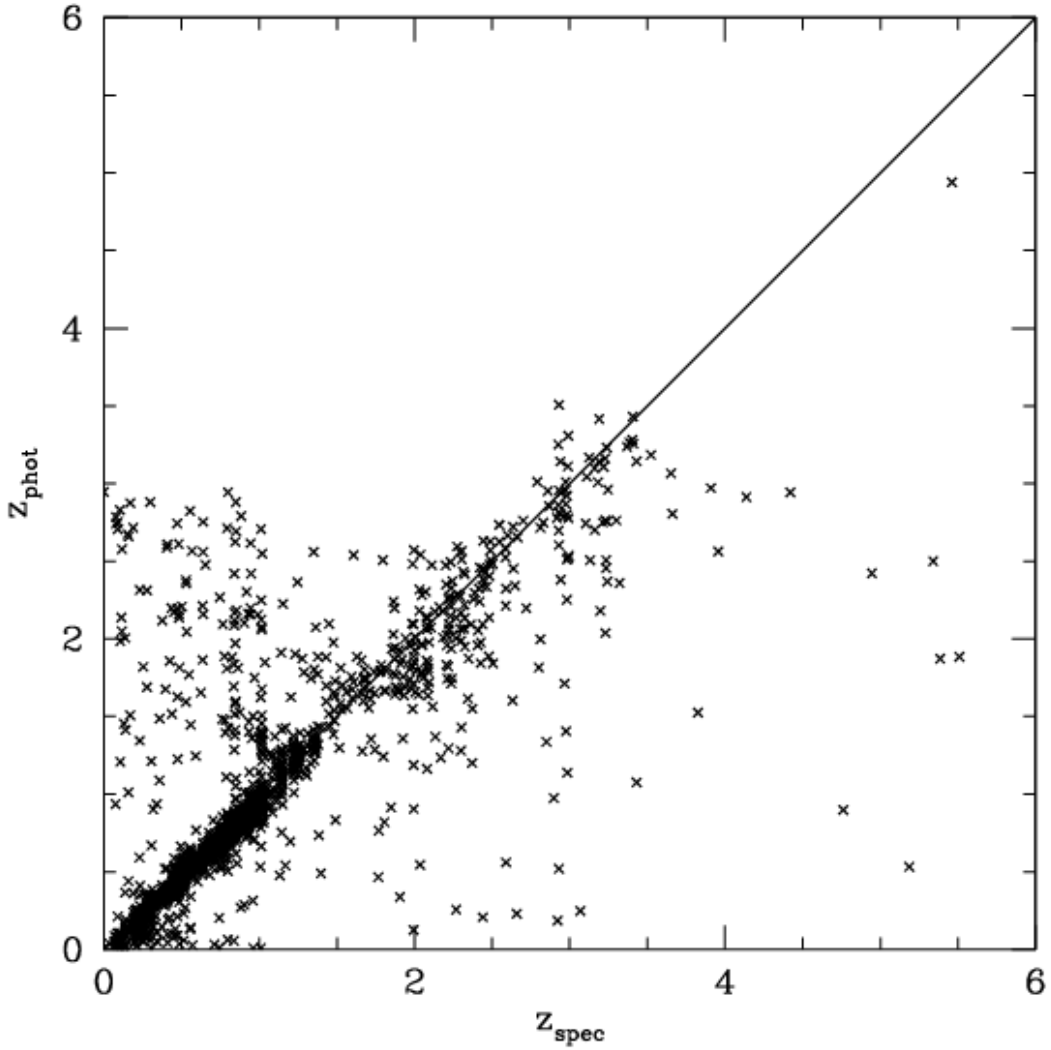
Statistics

bias $= 0.02$

$\sigma = 0.042$

outliers $= 11.6\%$

Gabriel Brammer (EAZY) without IRAC



Statistics

bias $= 0.02$

$\sigma = 0.042$

outliers $= 13.5\%$

Outlook

What's next?

- More advanced analysis
- PHAT0b
- GOODS-North b
- Open to ideas from the community

Websites

- PHAT Wiki page:
  `http://www.astro.caltech.edu/twiki_phat/bin/view/Main/WebHome`
- PHAT mailing list:
  `http://astro.caltech.edu:88/mailman/listinfo/phat`