Photometric redshift & BAOs

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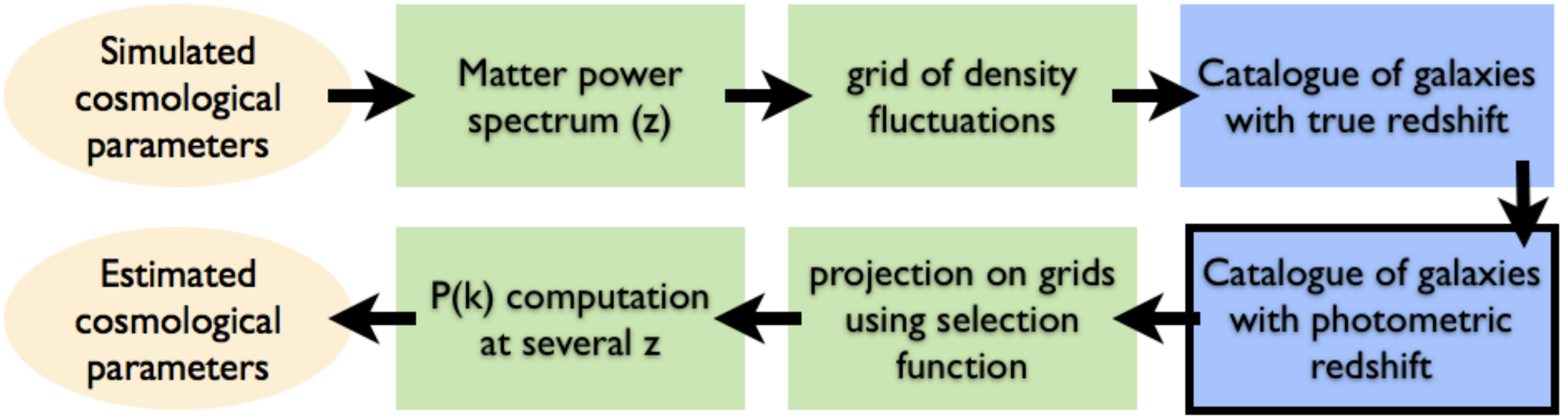

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Simulation des BAOs

A. Choyer PhD

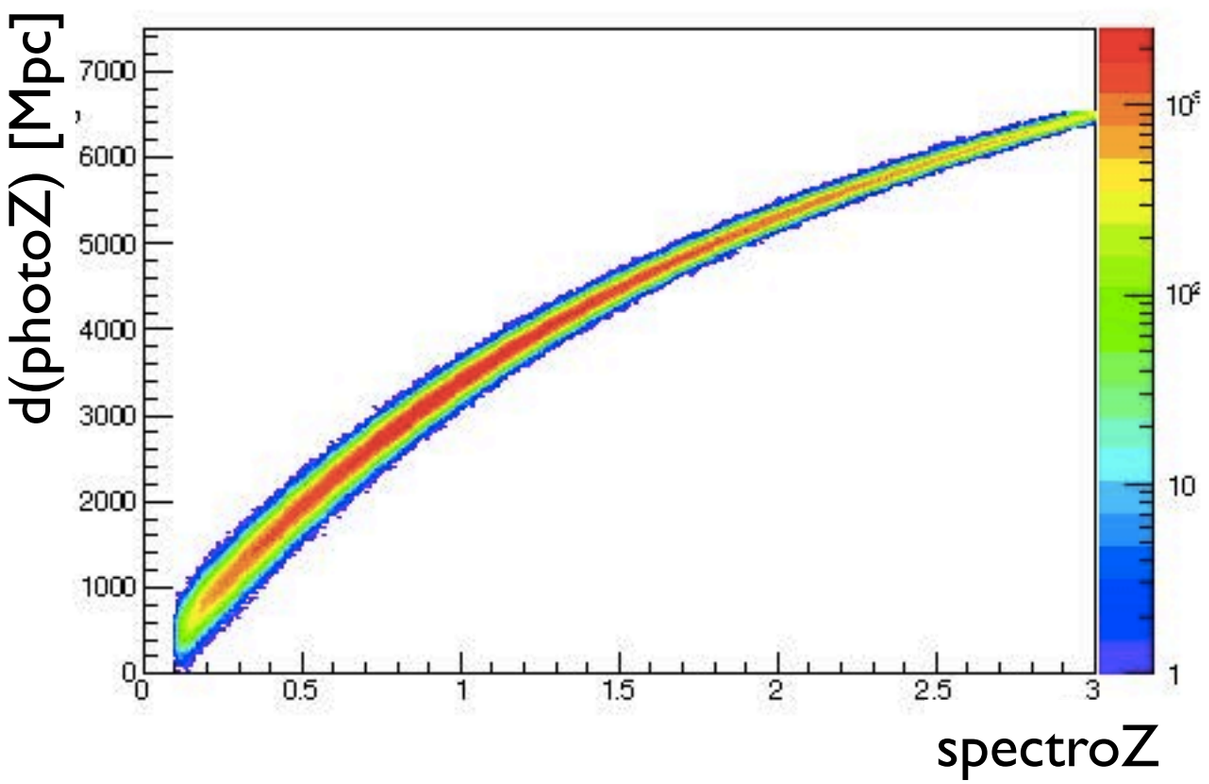
Reconstruction de l'échelle des BAOs à partir des redshifts photométriques : (1) suivant une erreur **gaussienne**, (2) **erreur photo-z**

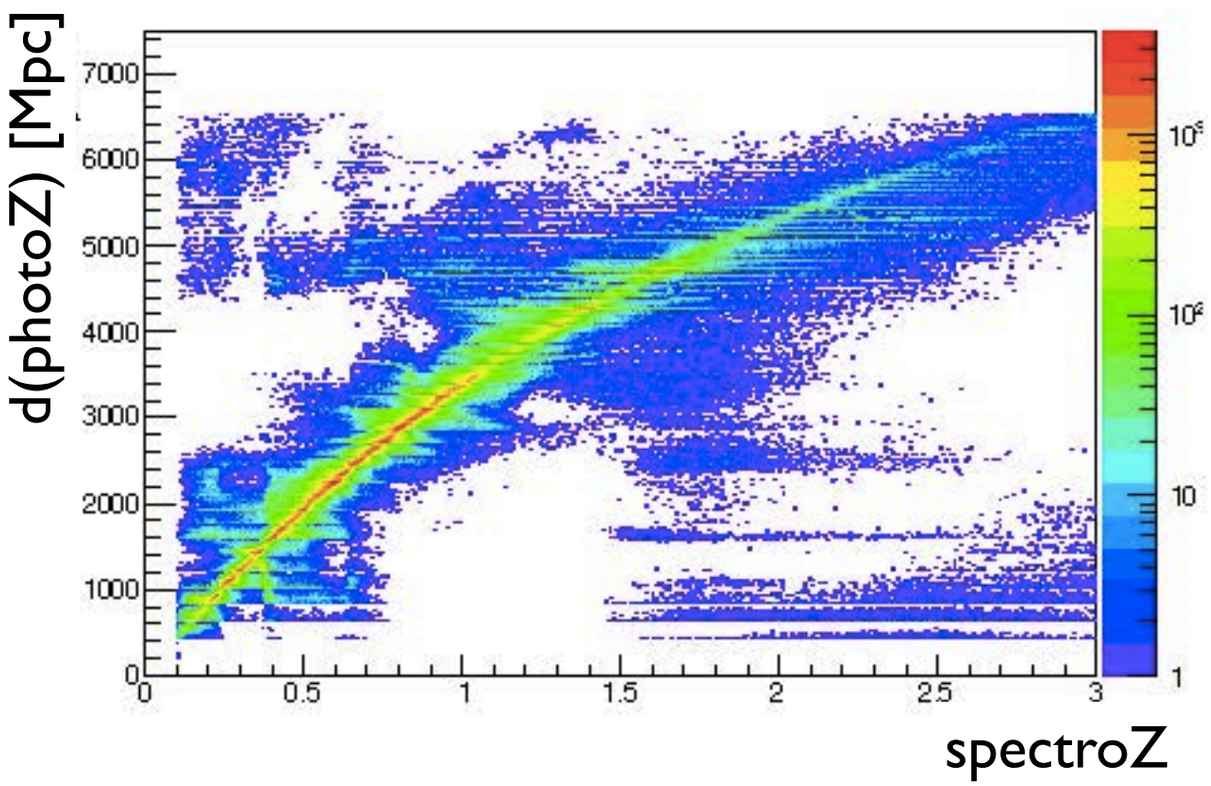
Erreur gaussienne :

- $\sigma_z = \sigma_0(1+z)$
- $\sigma_0 = 0.01 \equiv 50$ Mpc à $z_s = 0.5$ attendue pour LSST
- $\sigma_0 = 0.03 \equiv 150$ Mpc précision actuelle

Erreur photo-z :

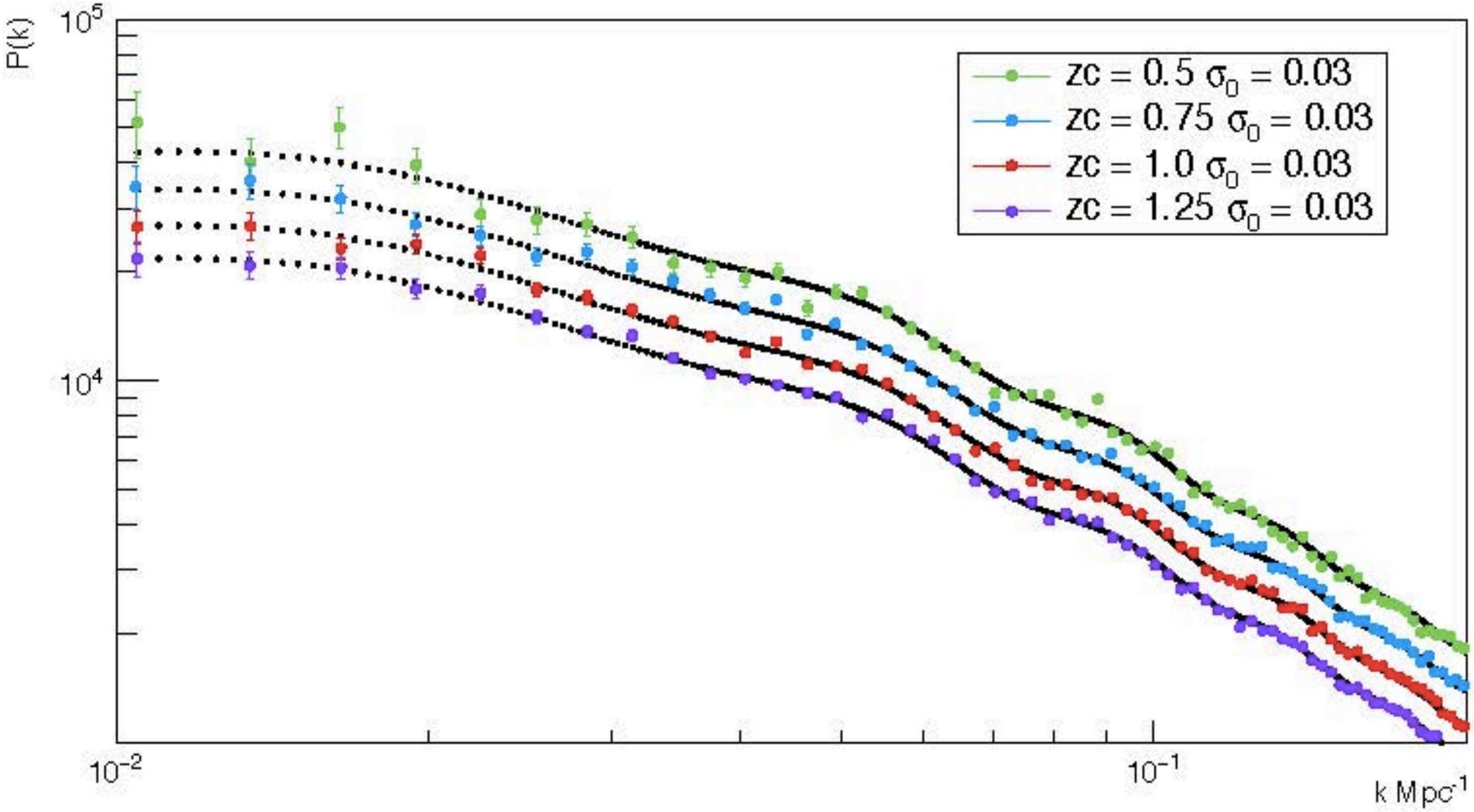
- reconstruction photo-z pour un sous-échantillon de galaxies
- $\delta z = \delta z(z_s, T, MA) = z_p - z_s$
- coupure de qualité : $m_i < 25.3$ (pas de coupure BDT)





Reconstruction du spectre

- Transformée de Fourier de la fonction de corrélation à 2 points $\Rightarrow$ spectre de puissance $P(\vec{k}) = TF(\xi(\vec{r}))$
- Erreur sur $z \Rightarrow$ amortissement du spectre :
  $P(k_x, k_y, k_z) \rightarrow P(k_x, k_y, k_z) \times \exp[-(k_z \sigma_z)^2]$

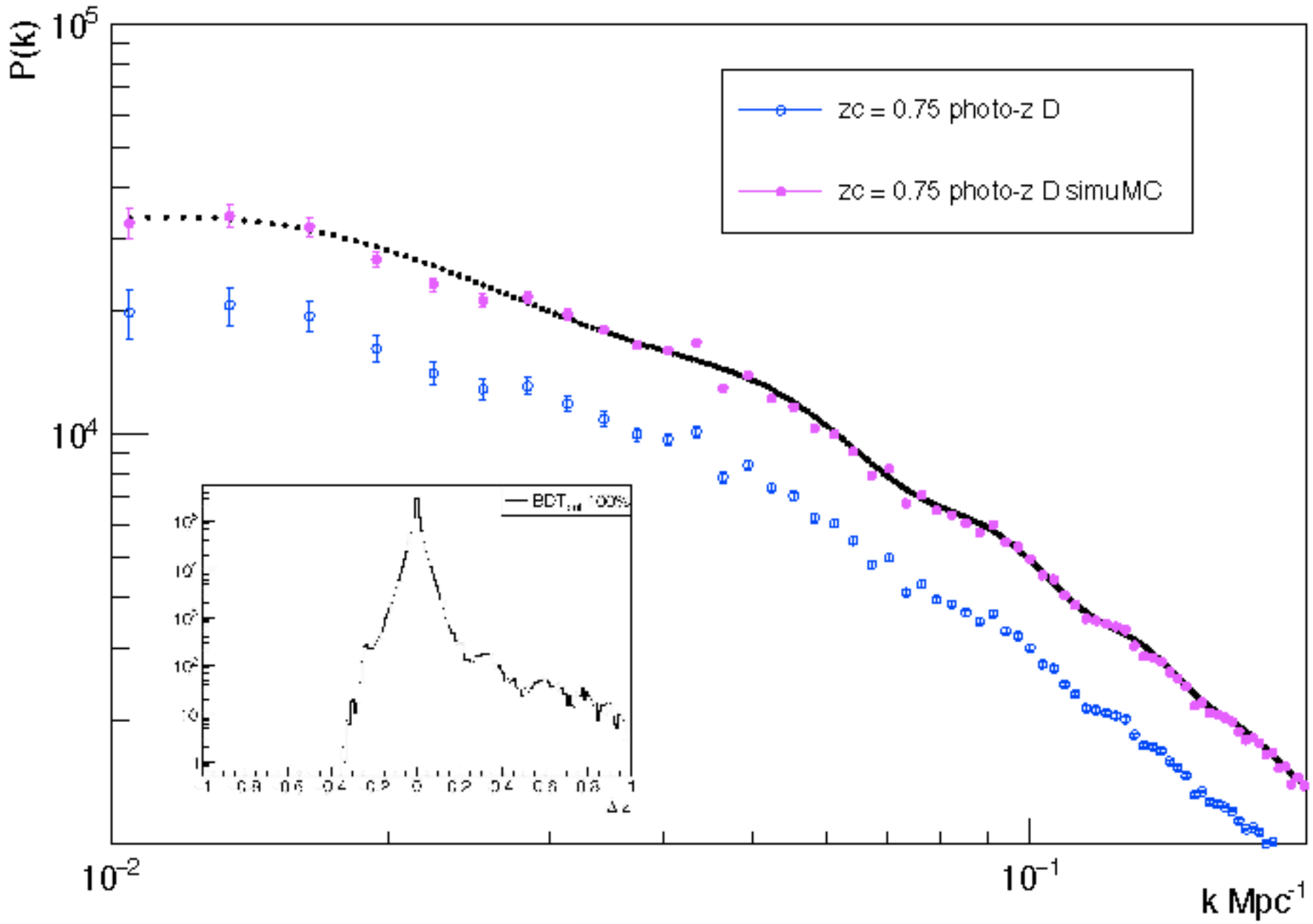


Reconstruction du spectre - erreur photo-z

A. Choyer PhD

Correction de l'amortissement du spectre :

- simulation de 50 grilles (erreurs photo-z) $\Rightarrow$ calcul d'un spectre moyen
- rapport entre le spectre théorique et le spectre moyen
- ajustement par une loi exponentielle



$$\langle z \rangle = 0.75$$

$0.57 < z < 1.55$

correction photo-z :

best fit : $\sigma_0 \equiv 0.026$

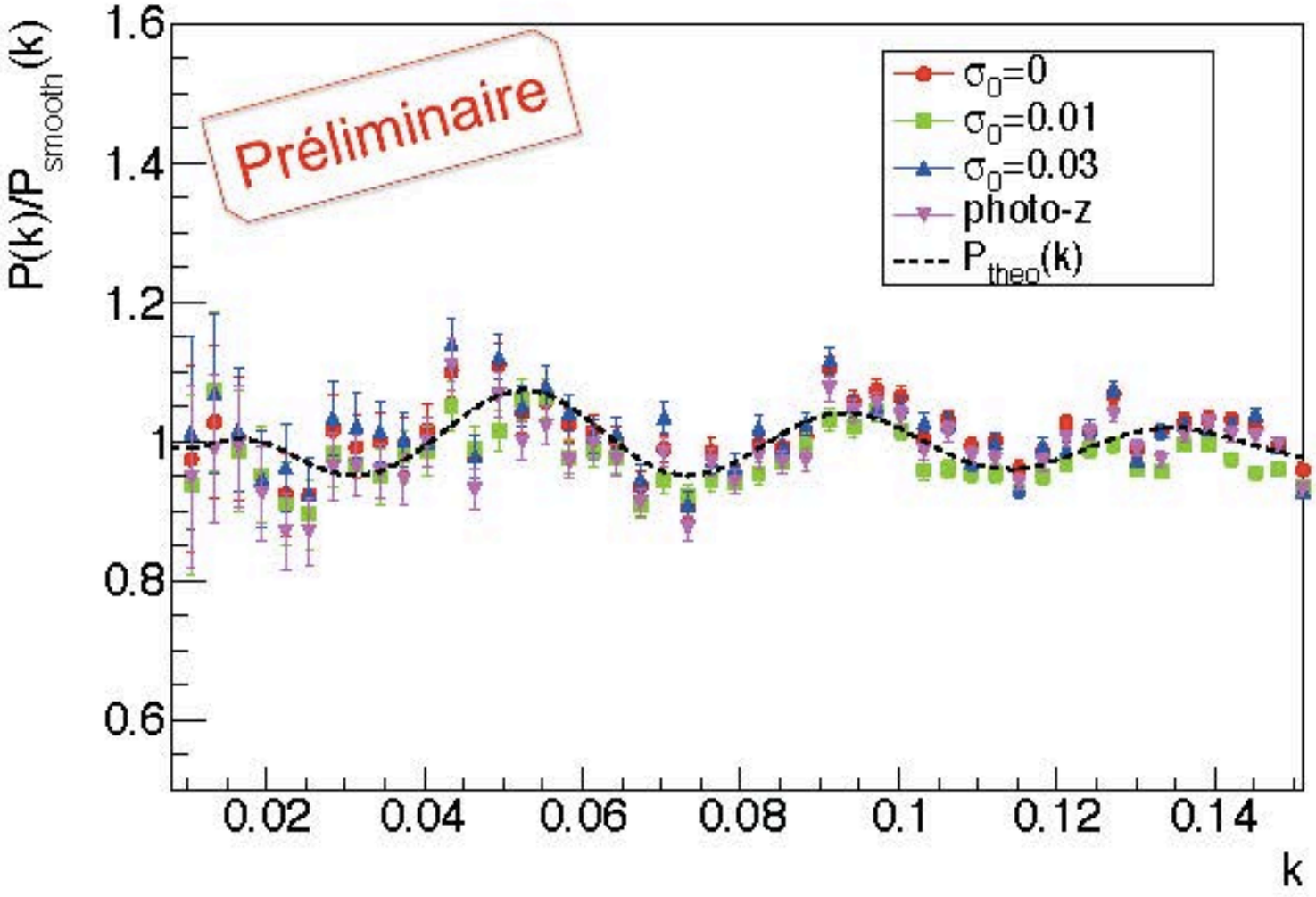
$\langle RMS \rangle$ photo-z $\equiv$ 0.022

$\Rightarrow$ une simulation est indispensable

Extraction de l'échelle BAO

Méthode "wiggle only" :

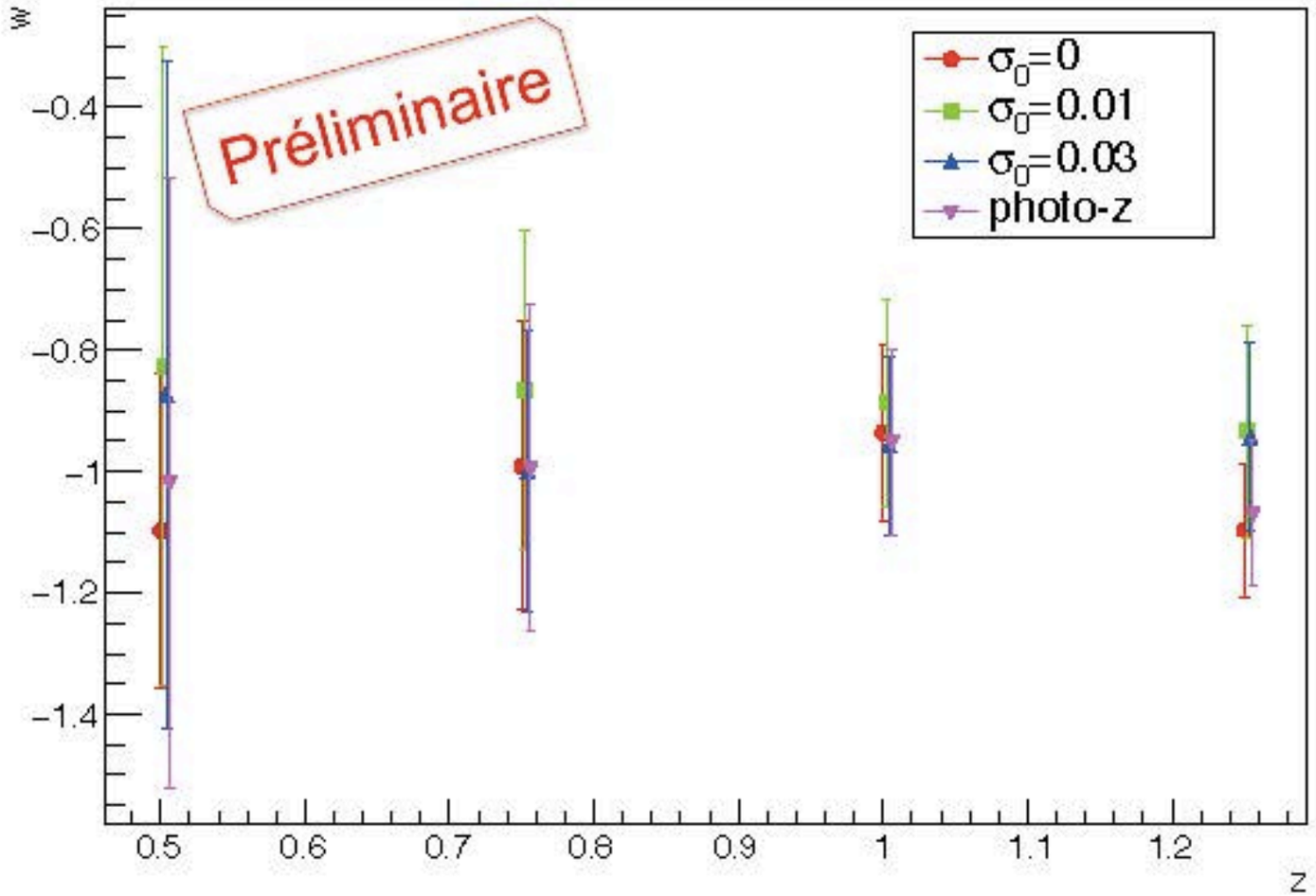
$$P(k) \to P_{wiggle} = \frac{P(k)}{P_{smooth}(k)} \sim 1 + \mathbf{A}k \exp\left[-\left(\frac{k}{0.1Mpc}\right)^{1.4}\right] \sin\frac{2\pi k}{\mathbf{k_a}}$$



- échelle BAO : $k_a = (2\pi/s)$
- A : amplitude de la perturbation
- minimisation du χ^2 $\to \mathbf{k_a = 0.042 \pm 0.003}$ pour z=0.75, avec les erreurs photo-z

Résultat sur w

Reconstruction du spectre de puissance et estimation de l'échelle BAO pour différentes valeurs du redshift
$\Rightarrow$ estimation du paramètre d'énergie noire en fonction du redshift



- $k_a^{obs} = k_a^{mod} \frac{D_V}{D_V^{mod}}$
- $D_V(z) = \left[d_A(z, \mathbf{w})(1+z)^2 \frac{z}{H(z,\mathbf{w})} \right]^{1/3}$

$\Rightarrow$ mesure k_a $\Rightarrow$ estimation de D_V

$\Rightarrow$ interpolation à partir de D_V $\Rightarrow$ estimation de w

à $z = 0.75$: $\mathbf{w} = -\mathbf{0.99}^{+0.16}_{-0.17}$ à partir des redshifts photométriques
$\Rightarrow$ validation de la chaîne de simulation

- Simulation chain from simulated cosmological parameters to fitted cosmological parameters in place and working
- PhotoZ reconstruction operationnal (no BDT)
- Checked from z=0.75 to 1.25

What has still to be done after her thesis ?

- Add the possibility to fit (w0, wa) and only w0
- Extend the redshift range from 0.5 to 2 at least
- Add the BDT information
- Propagate the photoZ error to the spectra

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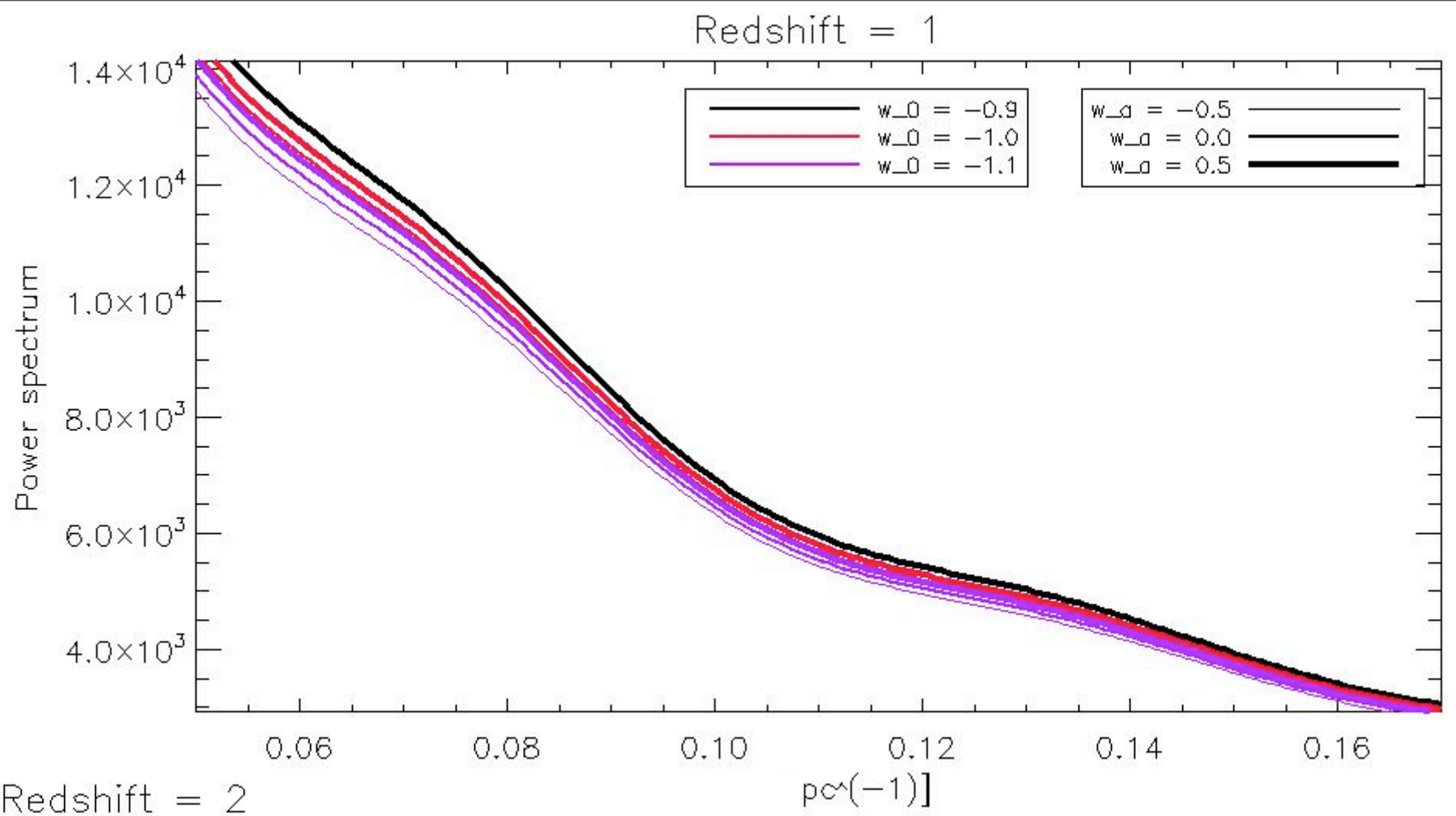
Baseline = Planck 2015

Possibility to change parameters, including now w0,wa (Marion)



Impact on the growth factor. High degeneracy between wa & w0

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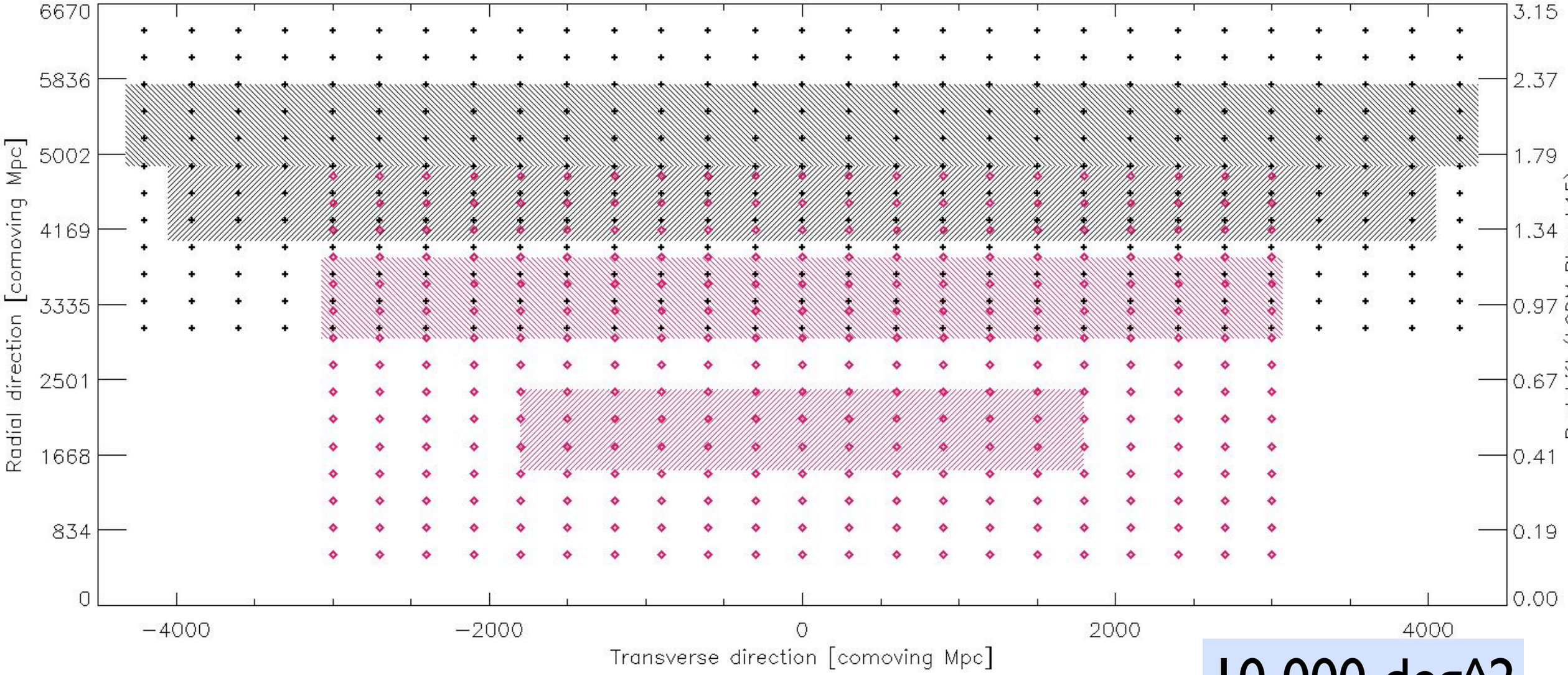

10 000 deg^2

- Points = centers of the pixels of the simulated grids. Real spacing is 50 times tighter
- A grid “low z” (pink) + a grid “ high z” (black) (one cube too huge --> not allowed)
- hashed areas = grids where galaxies are projected (z=0.5, 1.0, 1.5, 2.0)
- simulation in the range [0.2-3] to avoid lost of galaxies with strong error
- geometry could/should be still tuned (thicker at low z to have simular volume ?)

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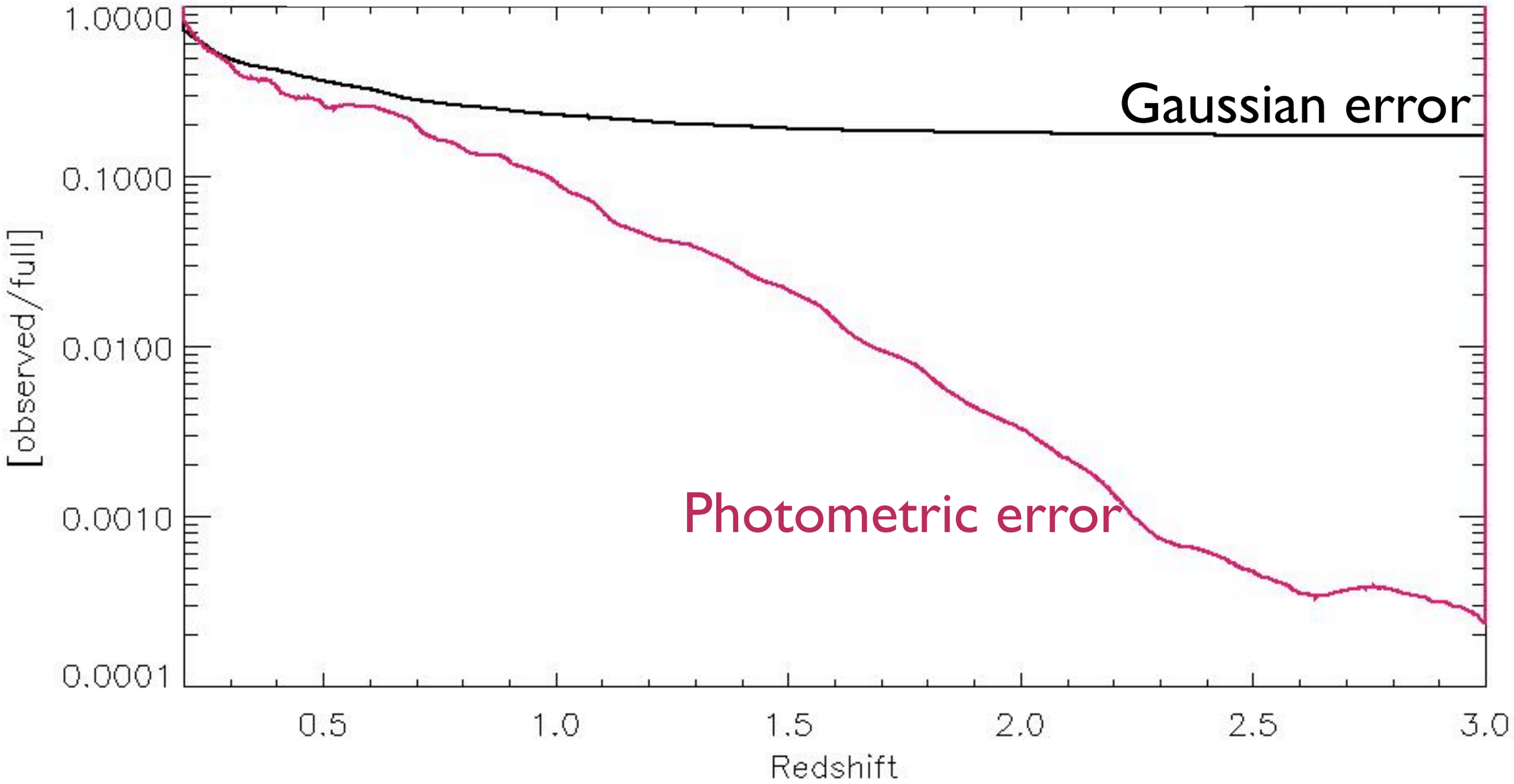
Selection function - golden sample



- Golden sample (magnitude cut) in both cases
- Using both cubes, slightly smoothed (needed @ high z)
- same selection function for any Gaussian error (0, 0.01, 0.03)
- photometric case, huge correction @ z=2 (500 !) --> we must be very confident !

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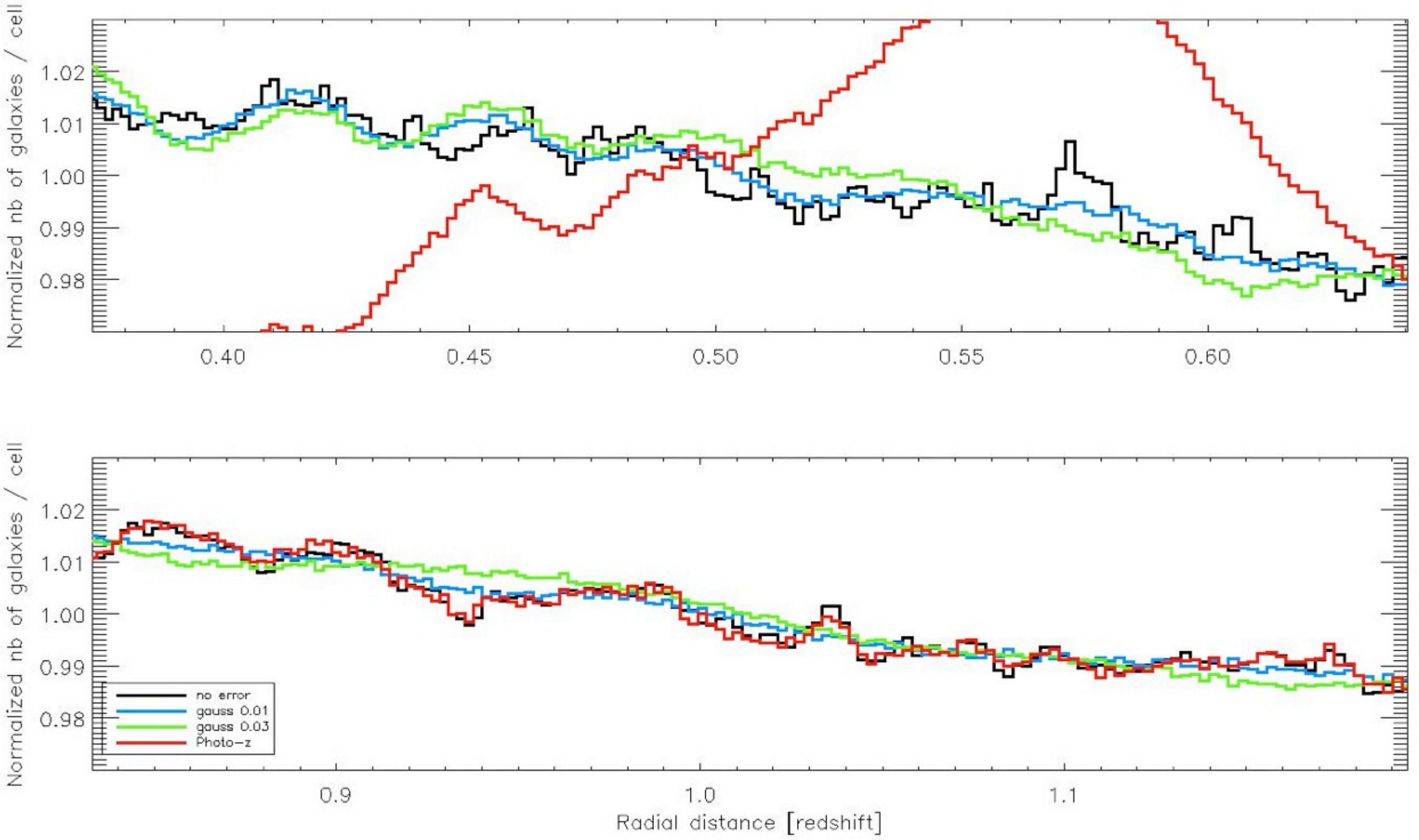

- Histograms of the redshift in the grid @ 0.5 (top) and @ 1.0 (bottom)
- not perfect @ z=0.5 with photoZ ...

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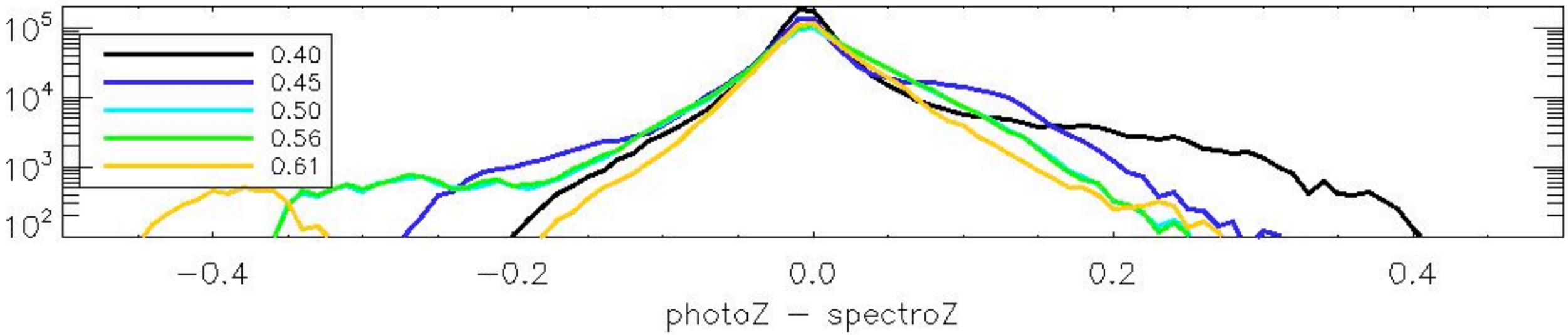

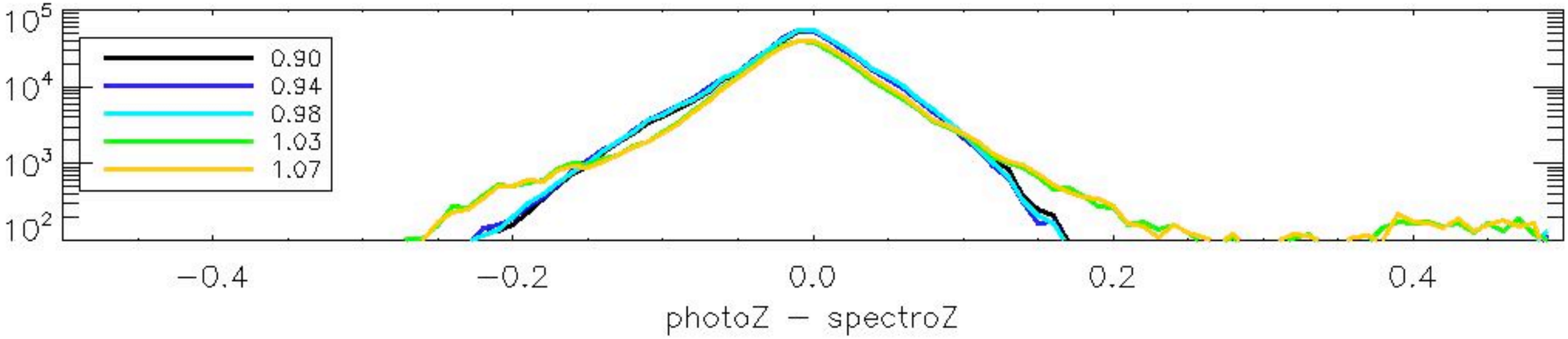

- Histograms of the redshift (photoZ - true) around z=0.5 (top) and 1.0 (bottom)
- Some photoZ distributions significantly differ from a symetric distribution around the spectroZ --> too many galaxies @ z=0.4 are recovered at z=0.6
- Not a bug: due to degenerescence between Lyman/Balmer breaks.
- Can we / Do we want to live with that ?

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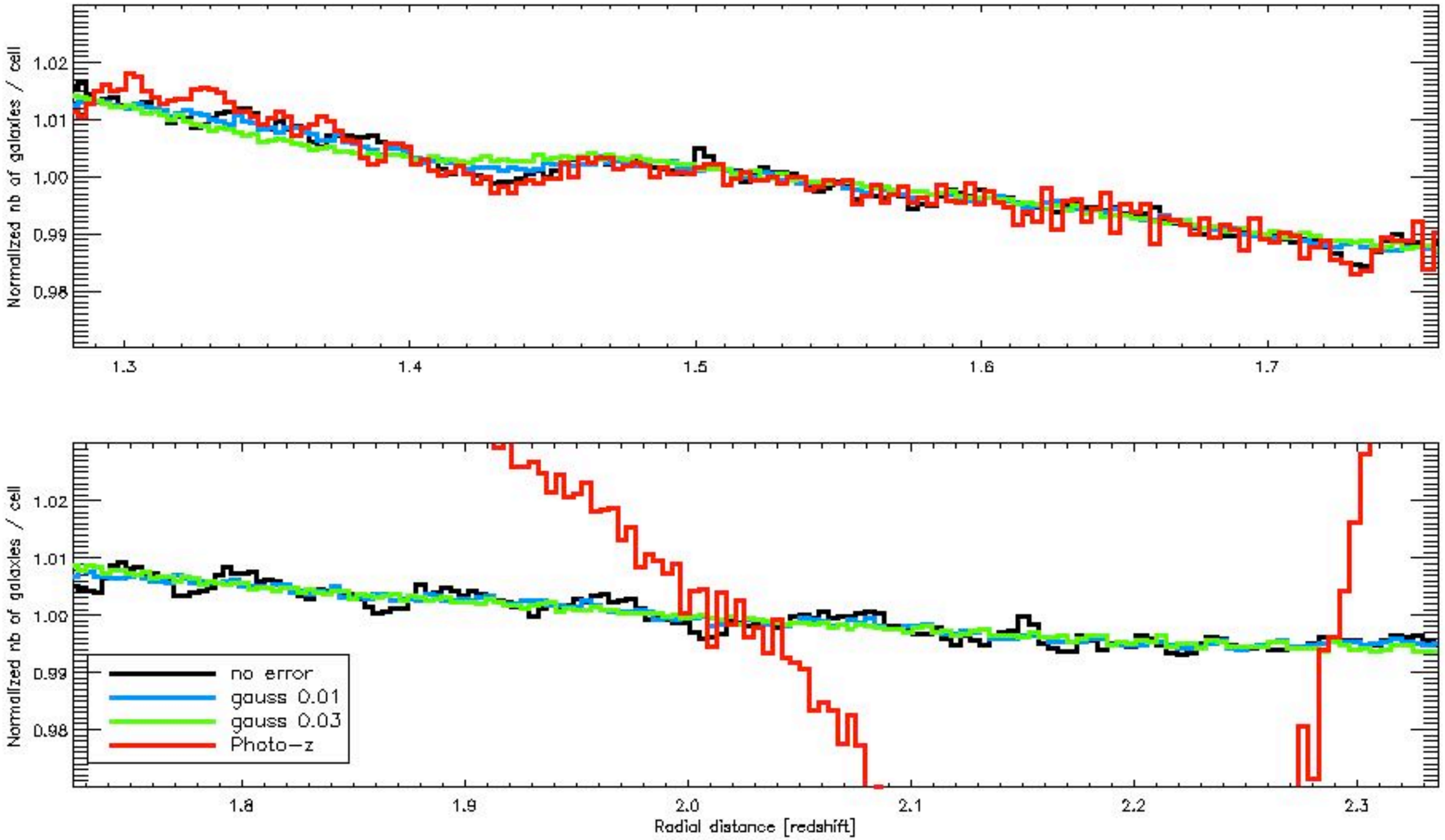

- Histograms of the redshift in the grid @ 1.5 (top) and @ 2.0 (bottom)
- some bias @ z=2.0 with photoZ ...

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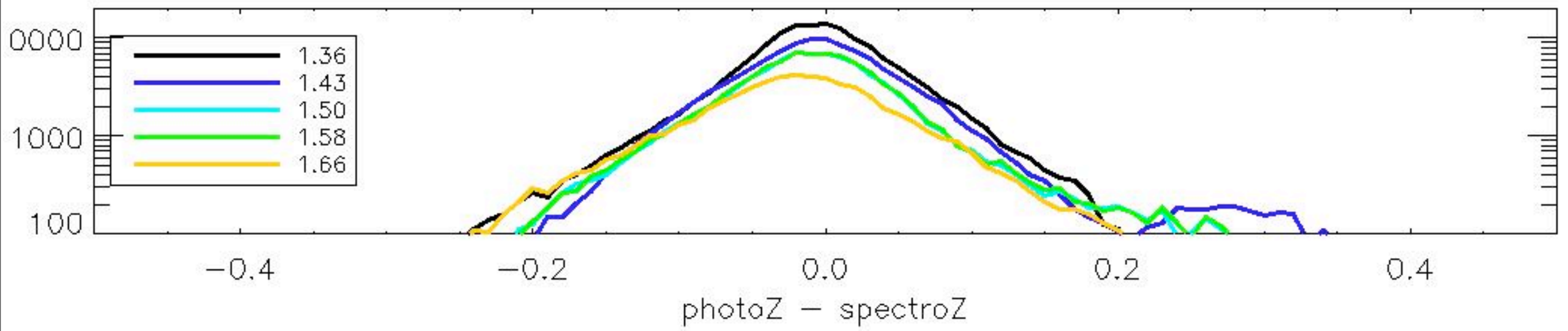

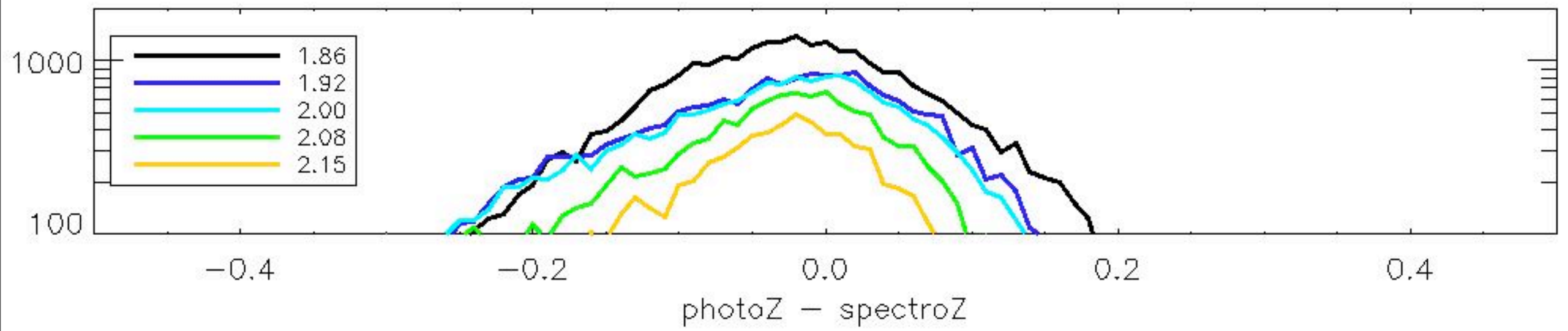

- Histograms of the redshift (photoZ - true) around z=1.5 (top) and 2.0 (bottom)
- Reasonnably symetric @ z=1.5 (but low efficiency ...)
- Slightly biased @ z=2.0 (and very low efficiency)

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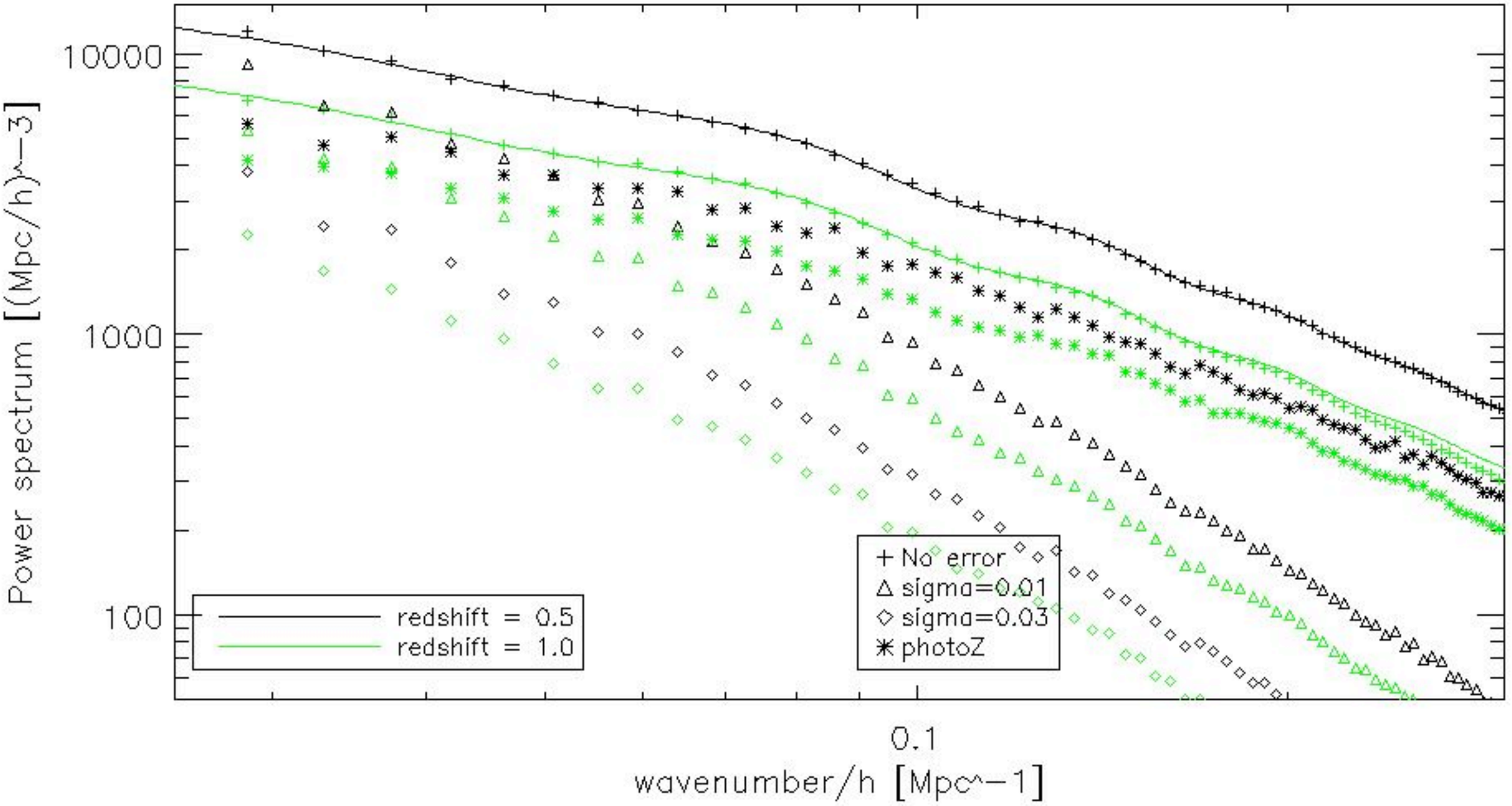

- 2 redshifts, 4 errors
- Photometric “ between” Gaussian 0.01 and 0.03

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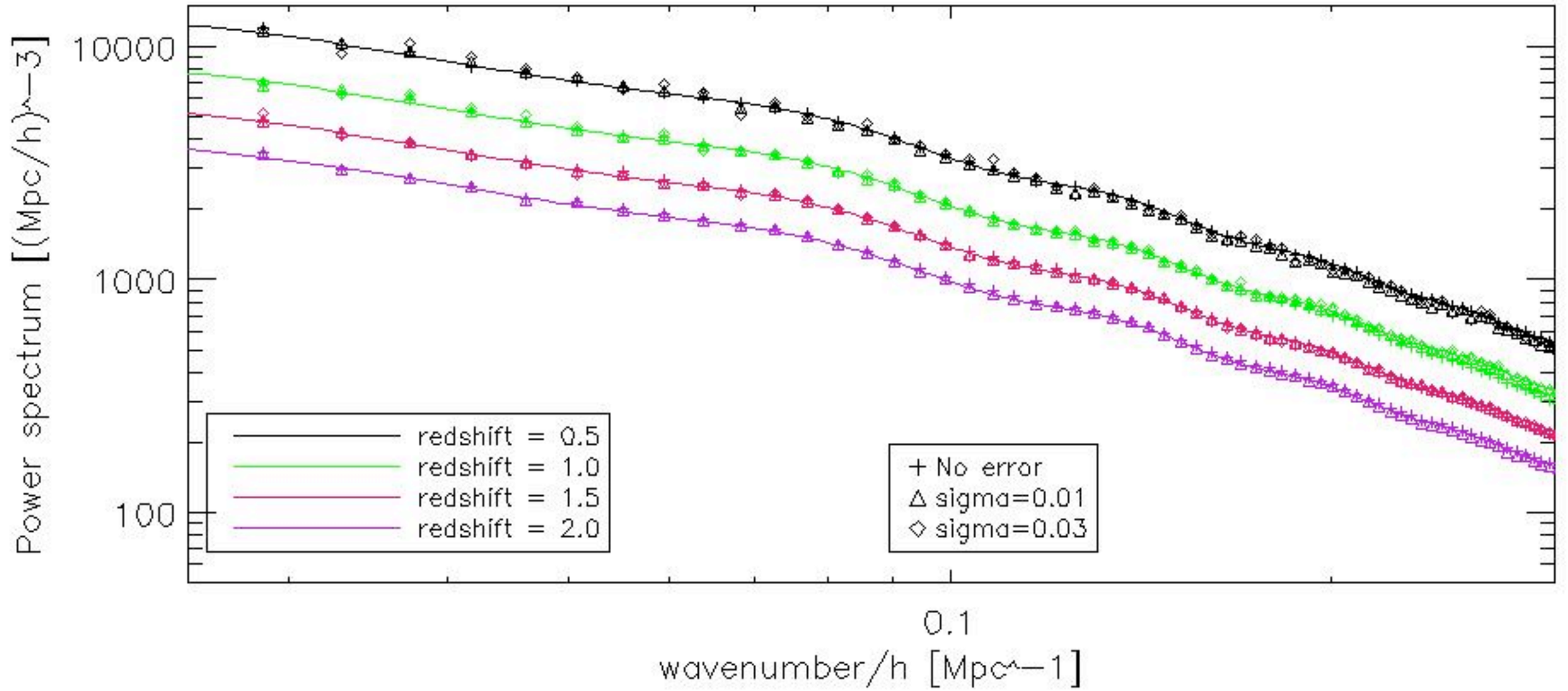

- 4 redshifts, 3 errors: no error or Gaussian ***except z=2, 0.03***
- Promising spectra !

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Conclusion

- Improve photoZ (at the redshift estimation level ? selection function level ? other a posteriori correction depending on the galaxy type ?)
- Add the BDT information (may help the previous point)
- Undamp the photoZ spectra
- Propagate the photoZ error to the spectra
- Finalize (w0,wa) estimation from k_{BAO} at different redshifts
- Write the paper !

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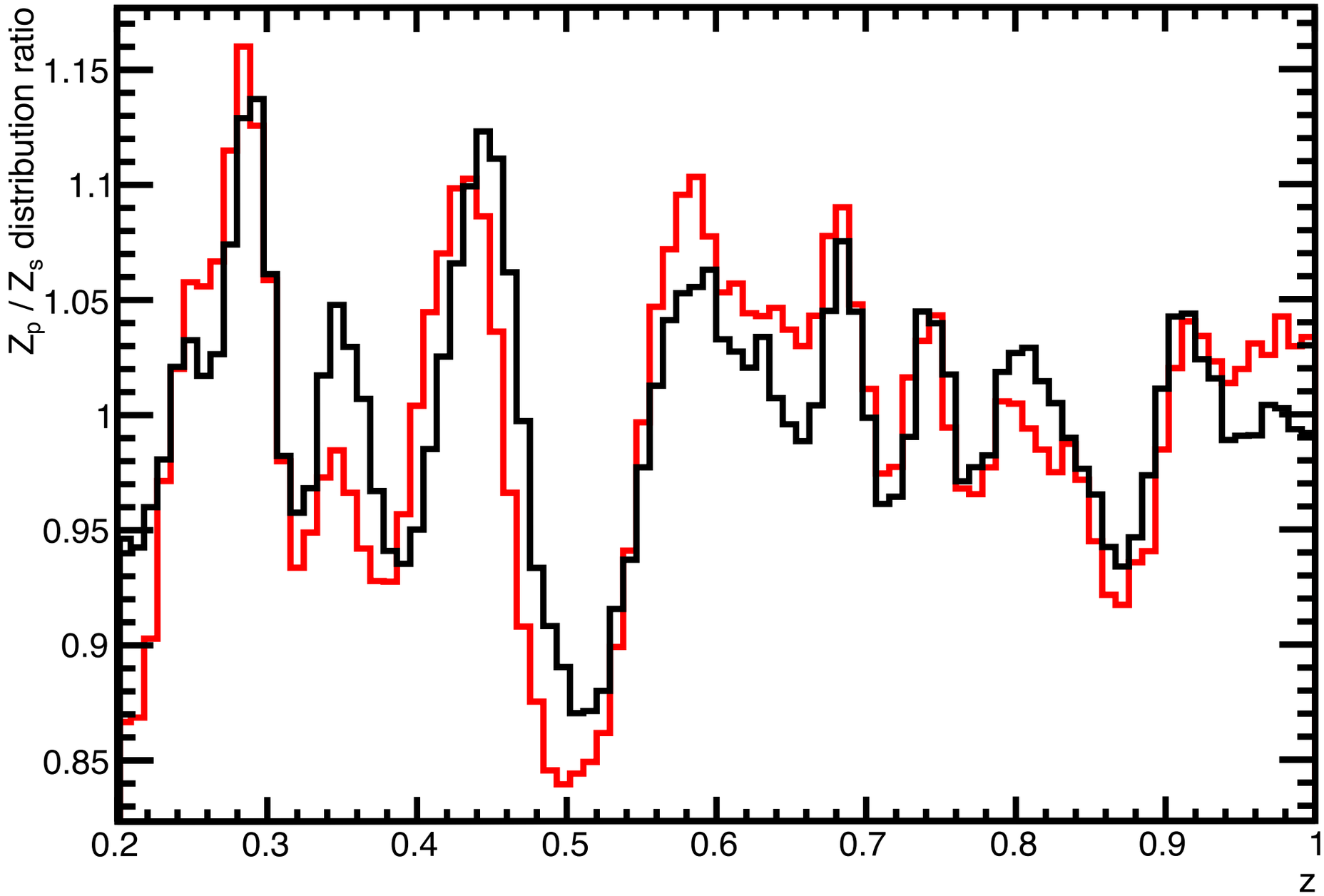

- Checked on a toy MC: simulations of photoZ from fitted distributions (Gaussians, with fitted **sigma** or **sigma and central value**)
- some fluctuations, larger @ z=0.5 - impact of the bias (to the mean value or median value)

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