Fitting sums of Gaussians

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- Model fitting issues
  - Choice of basis set
  - Parameter estimation method
- im2shape description
- STEP1 further analysis
- Future potential for multiple Gaussian fits

With thanks to Phil Marshall, Richard Massey and Patrick Hudelot.

Shear estimation methods

Statistics on image

e.g.

- KSB
- K2K
- Some shapelets methods?

Noise bias issues

Model fitting

e.g.

- Some shapelets methods
- im2shape

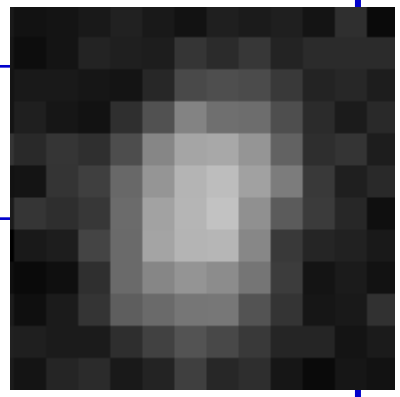
Focus on this here

Model fitting issues

- Choice of basis set
  - Shapelets
  - Sums of Gaussians (e.g. im2shape)
  - …

Issues in choice of basis set

	Sums of Gaussians	Shapelets
Orthogonality	✗	✓ if infinite set used
Simple response to shear	✓	✓
Convolution is quick	✓	✓
Easy to integrate over pixels	✓	?
Small # of parameters to describe objects well	✓	?



Assumes same basis set used for both psf and galaxies

Model fitting issues

- Choice of basis set
  - Shapelets
  - Sums of Gaussians (e.g. im2shape)
  - …
- Parameter estimation method
  - MCMC (e.g. im2shape)
  - Minimiser
  - Transformation on image (e.g. Massey et al. shapelets)
- Characterisation of uncertainties on shear
  - Don’t bother
  - Covariance matrix
  - MCMC errors

What parameters to fit?

- x, y ?
- Noise level?
- Background level?
- Parameters of basis set
  - e, θ, ab, A of Gaussians, relative position
  - shapelet coefs

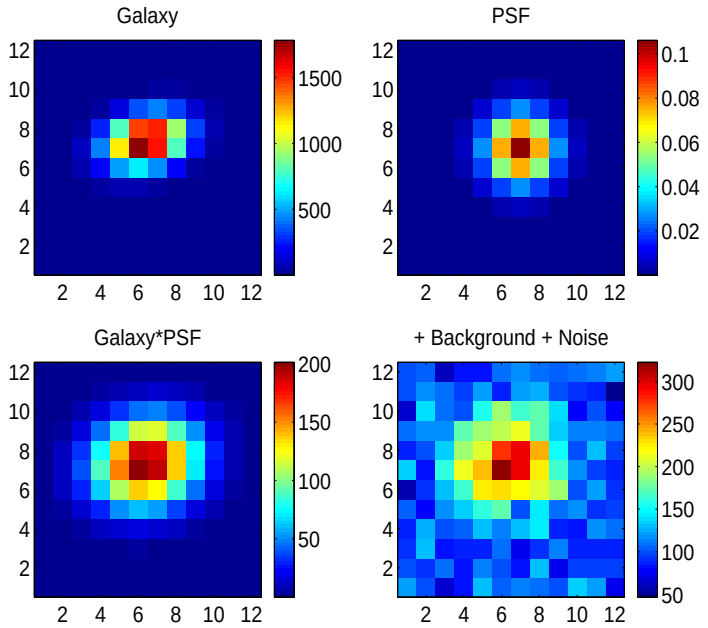
The im2shape code: overview

- Input:
  - Fits file
  - Catalogue list (x, y)
  - PSF file
  - Parameters file
- Output
  - Catalogue, one line per galaxy
    - Parameters of Gaussians, and errors
  - Optionally: residuals image, samples

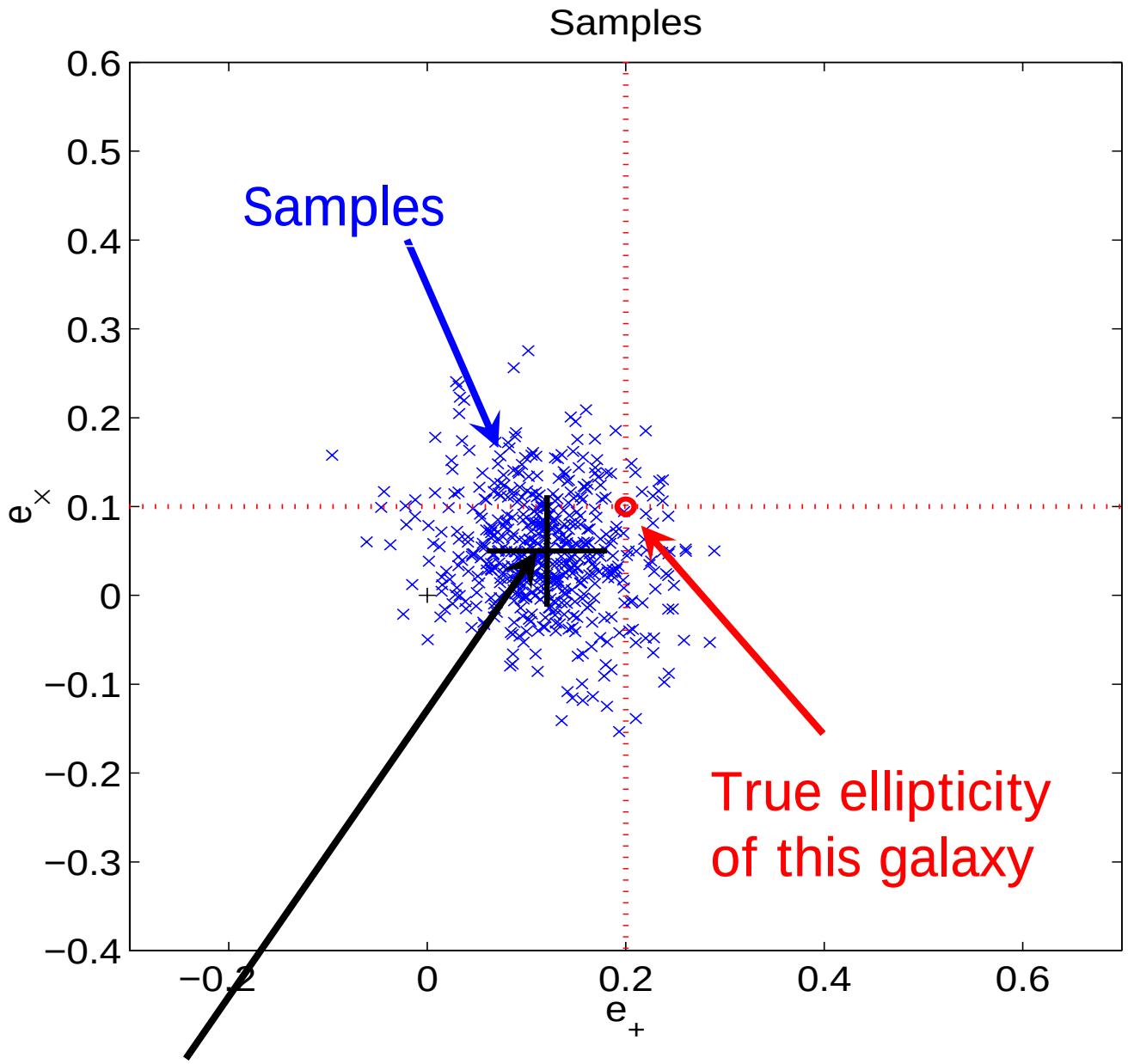
www.sarahbridle.net/im2shape

How im2shape works

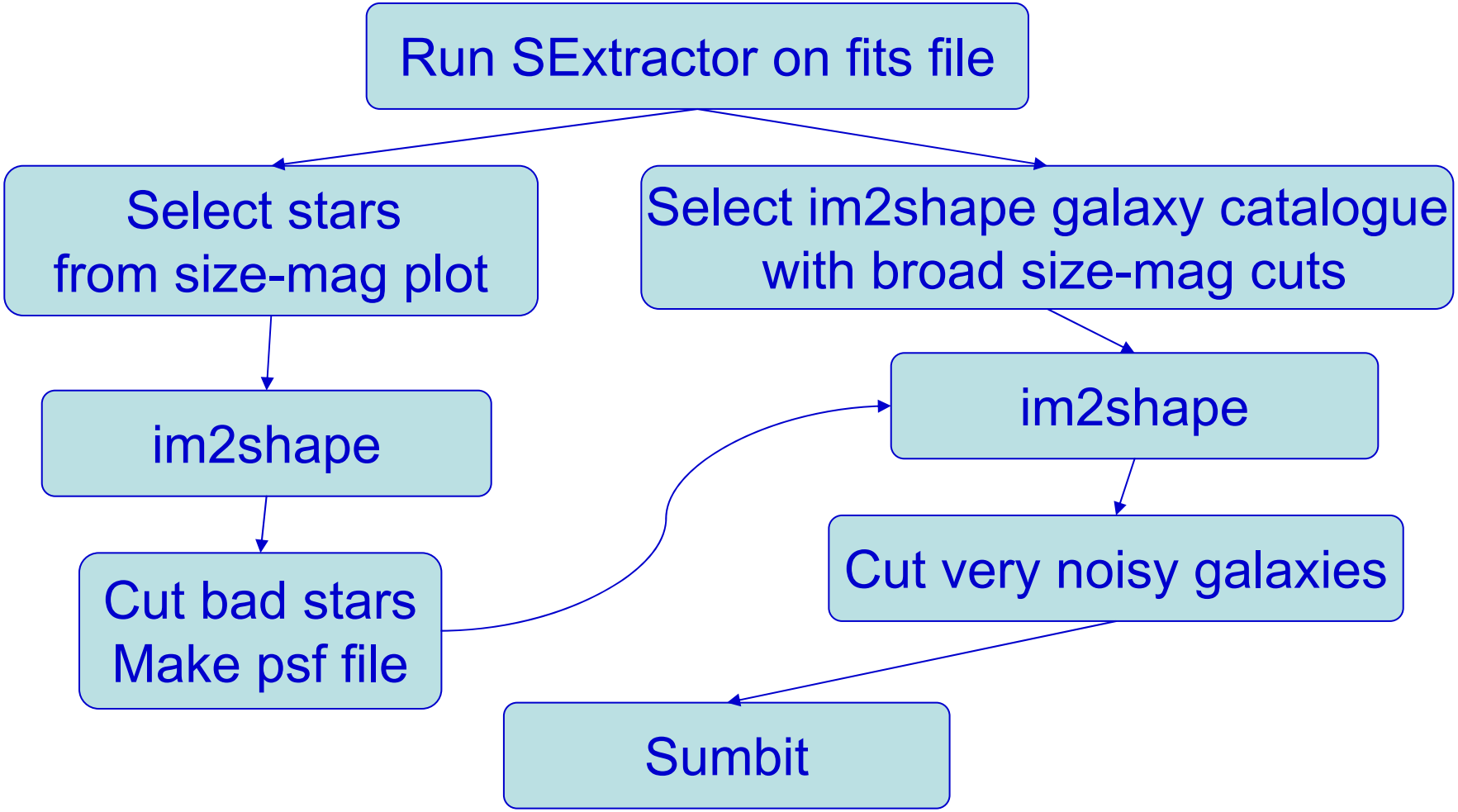
- Cut postage stamp at x, y ~16x16
- Guess from within ranges
  - Parameters of n Gaussians
  - Constant background level
  - Constant uncorrelated noise level
- Convolve with nearest psf
- Make trial image
- Find probability of guess = $\exp(-\chi^2/2)$
  - Accept or reject guess according to MCMC rule
- Average parameters of all accepted guesses
  - Optionally run a minimiser to optimise best fit point



Follows ideas in Kuijken 1999

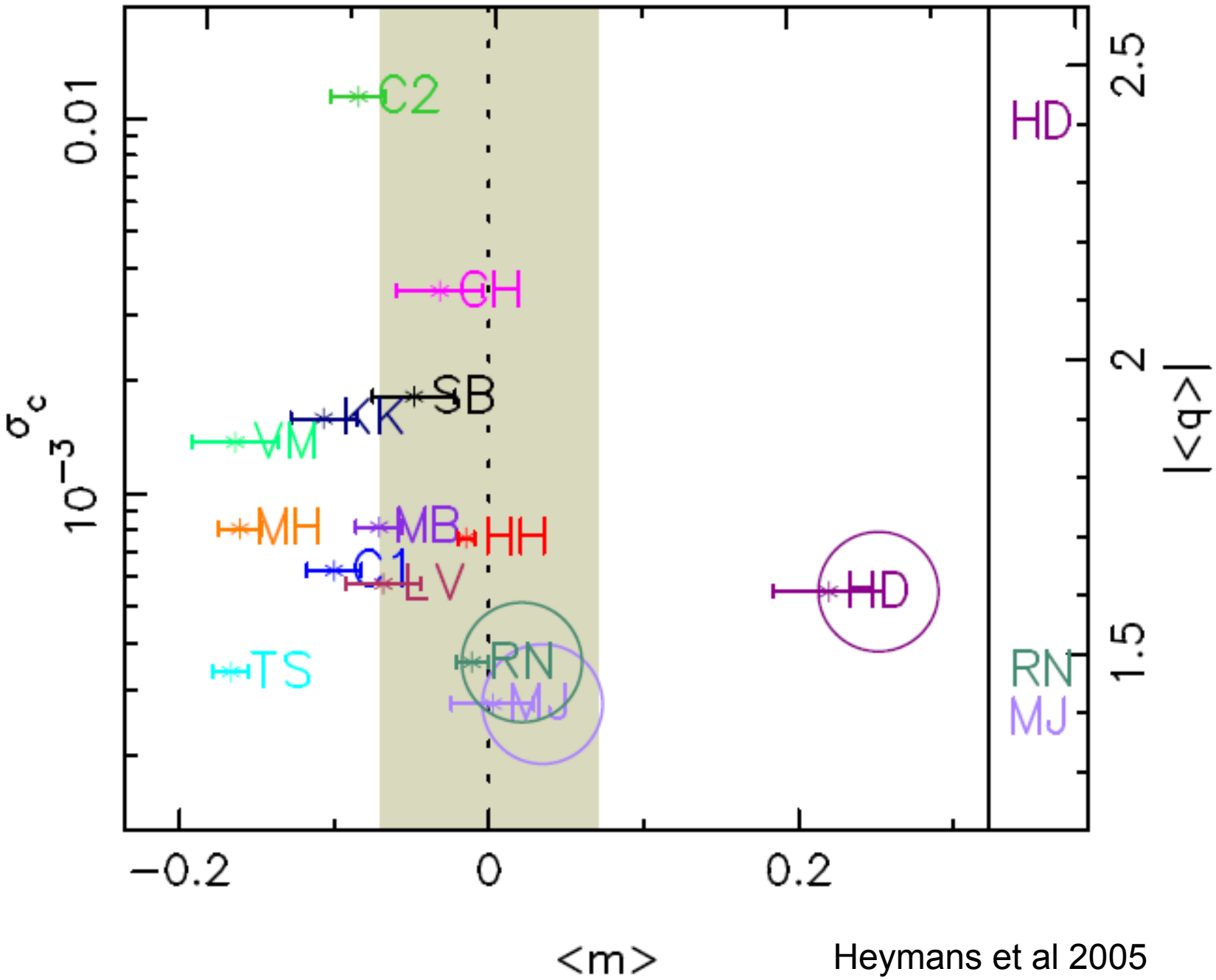

Samples
Samples
True ellipticity
of this galaxy
Mean of samples → ellipticity
0.6
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.2
0
0.2
0.4
0.6
e×
e+

Description of im2shape method as used on STEP1 and STEP2



Critical decisions

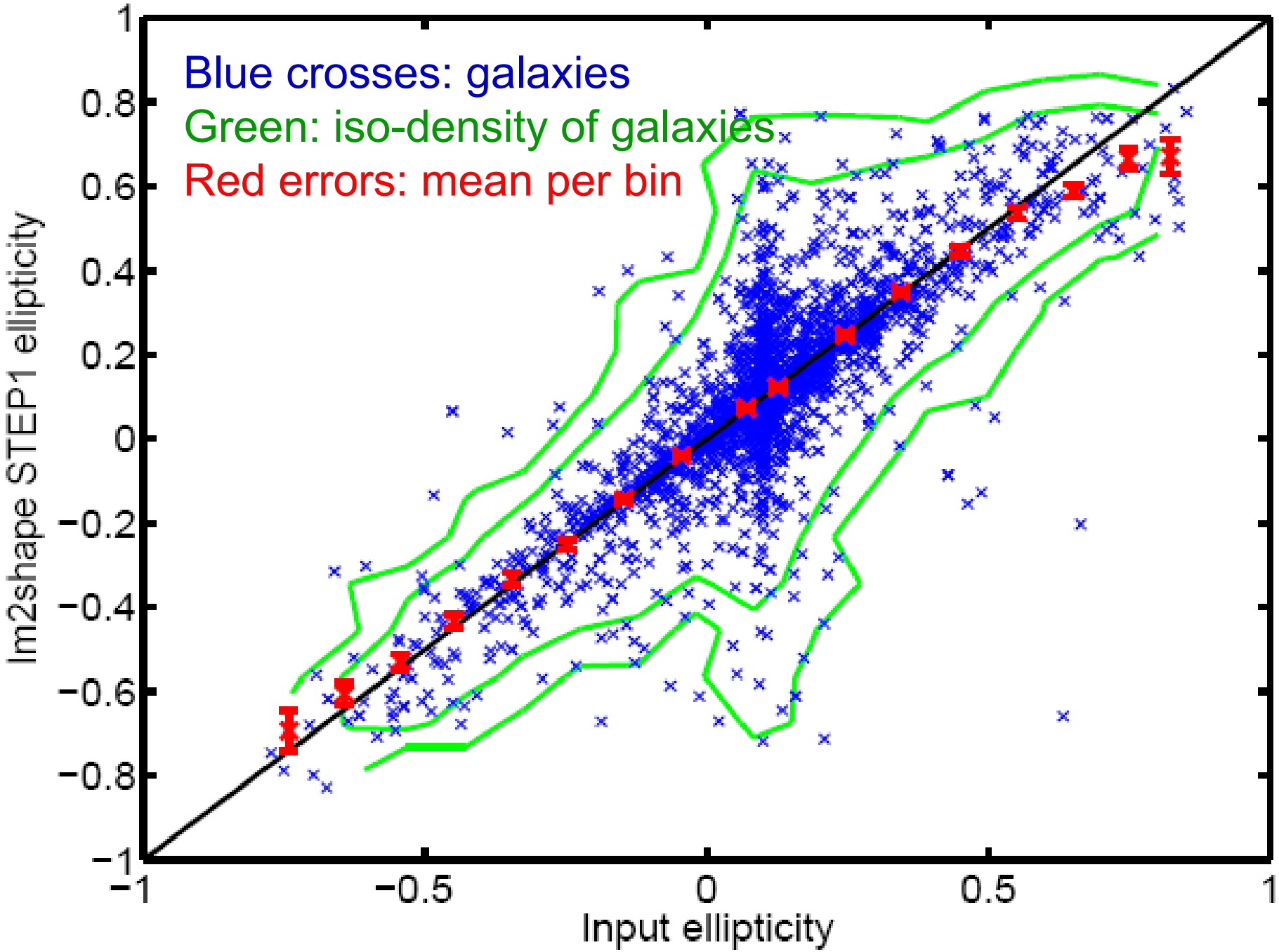
- How many Gaussians?
  - 2 per star, 2 per gal for STEP1
  - 3 2 STEP2
- Are the Gaussians independent?
  - Yes for stars
  - No, concentric for galaxies, i.e. x, y, e, θ common
- PSF interpolation
  - STEP1 average parameters of 5 nearest stars
  - STEP 2 none – use nearest star
- Cuts
  - Im2shape errors less than 0.25 for galaxies

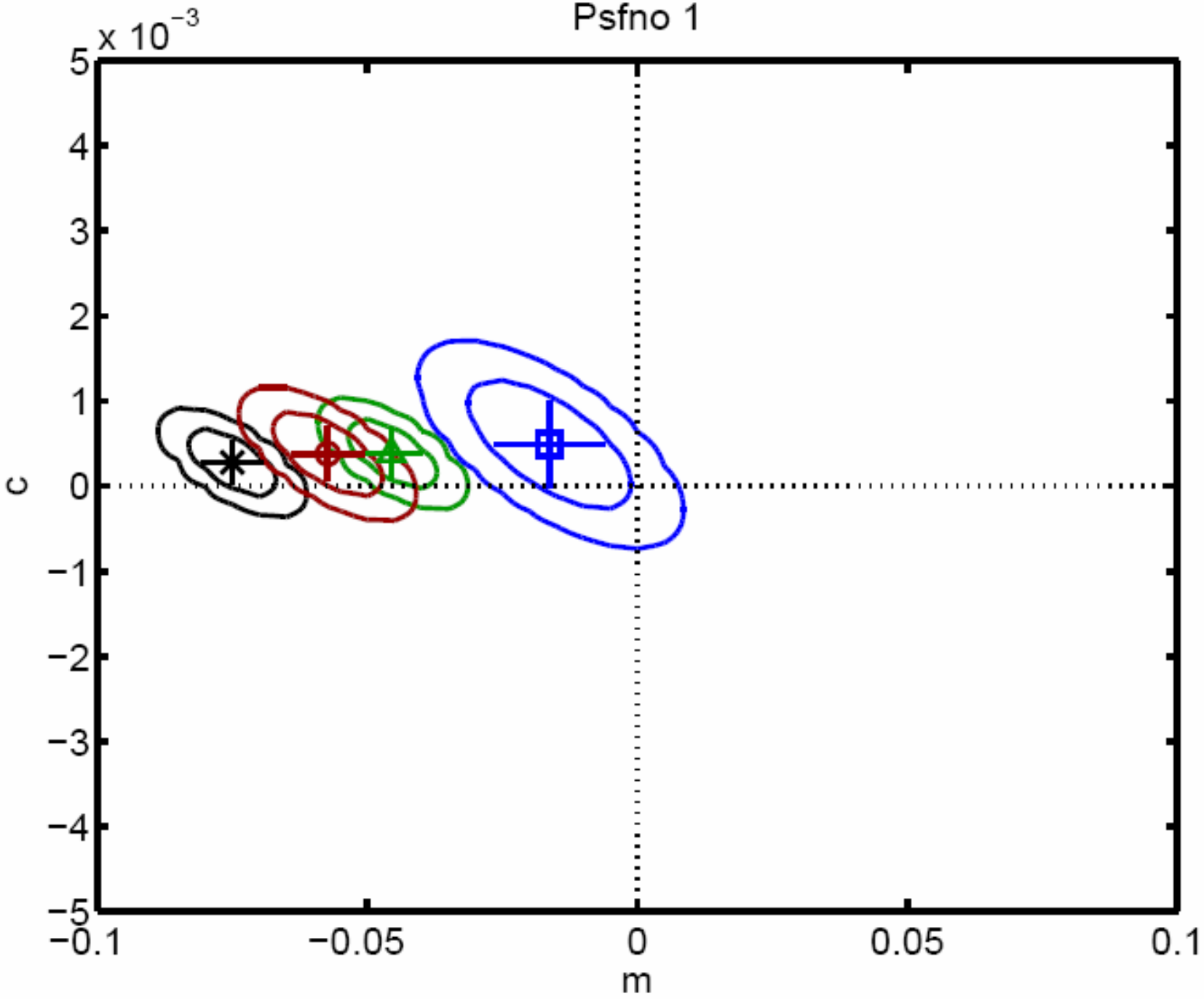


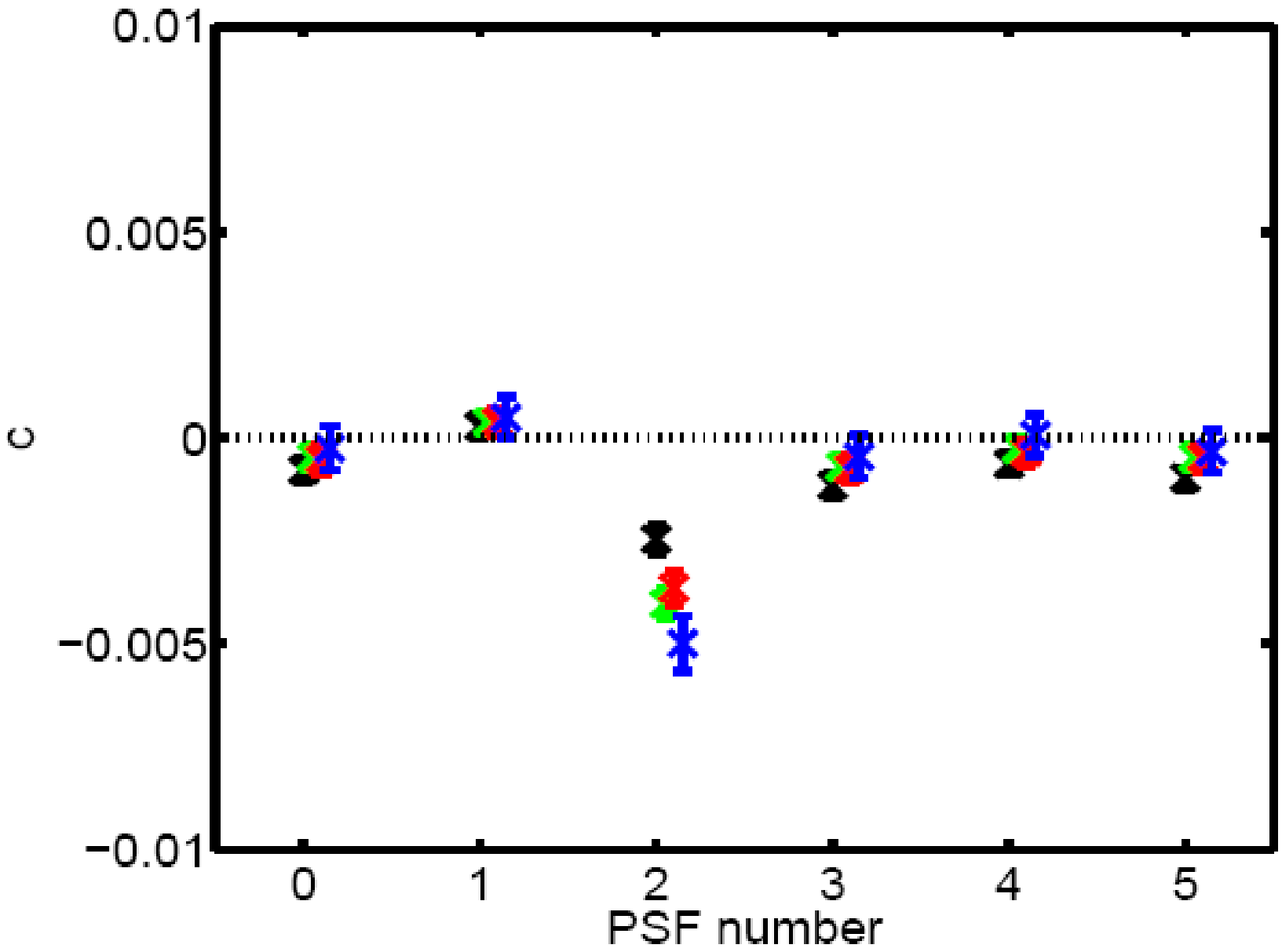
Heymans et al 2005

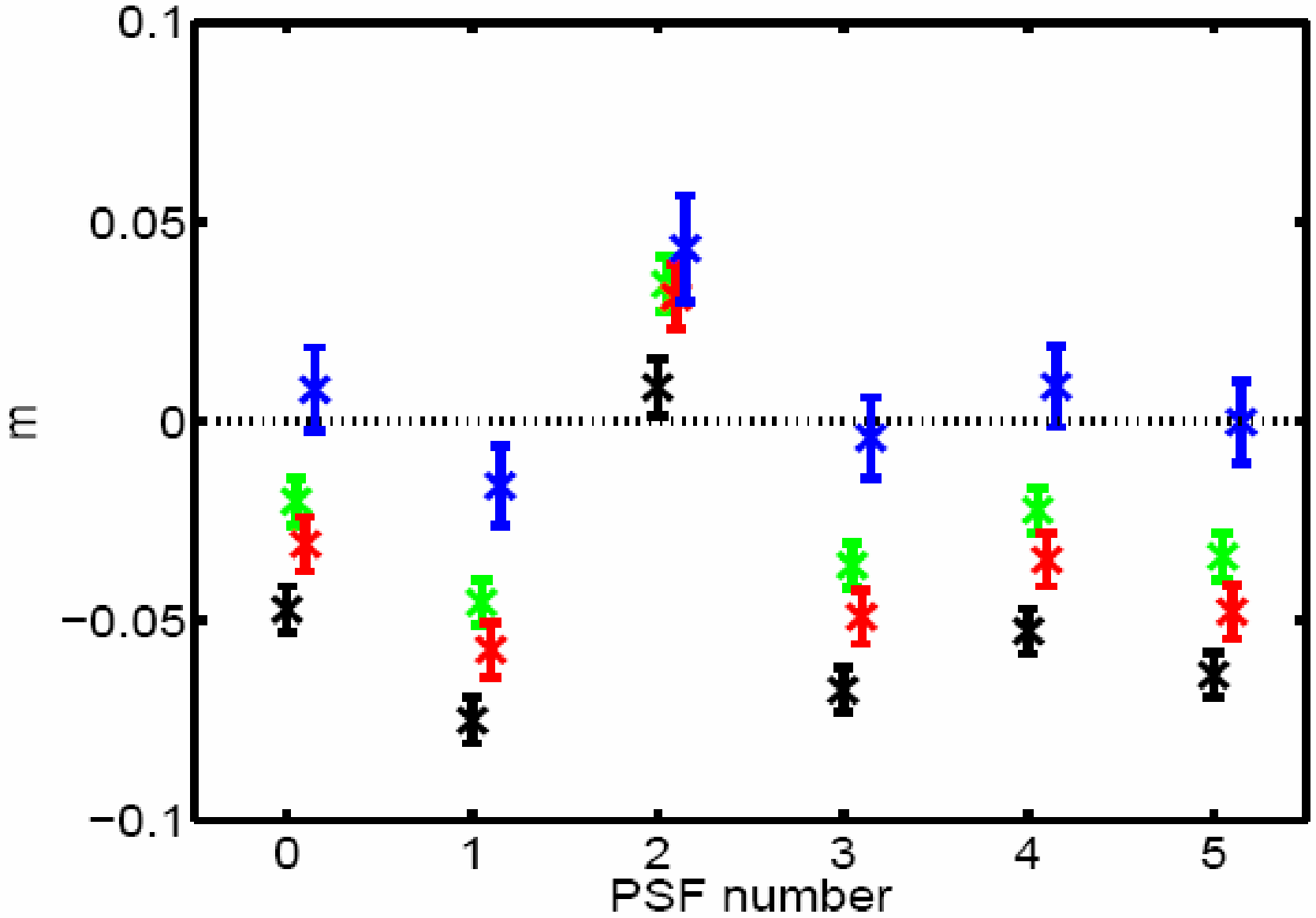
Questions

- Why the large error bar?
- Why the large c?
- Why not perfect? STEP1 was quite simple…
- Why the bias to negaive m?


Blue crosses: galaxies
Green: iso-density of galaxies
Red errors: mean per bin
Im2shape STEP1 ellipticity
Input ellipticity
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1
−0.5
0
0.5
1


Psfno 1
x 10^−3
5
4
3
2
1
0
−1
−2
−3
−4
−5
c
−0.1
−0.05
0
0.05
0.1
m


0.01
0.005
0
−0.005
−0.01
c
0
1
2
3
4
5
PSF number


0.1
0.05
0
−0.05
−0.1
ε
0
1
2
3
4
5
PSF number

Questions

- Why the large error bar?
  - psf 2
- Why the large c?
  - psf 2
- Why not perfect? STEP1 was quite simple…
  - Is more sophisticated than im2shape assumptions
- Why the bias to negaive m?
  - Contamination by spurious objects
  - Bias from b+d galaxies

The future

- Understand psf 2
- Improve selection to remove spurious objects
- Finish im2shape paper

- Speed up code
- Generalise to non-concentric Gaussians
- psf interpolation simultaneous with star fits
- Simultaneous psf and shear estimation

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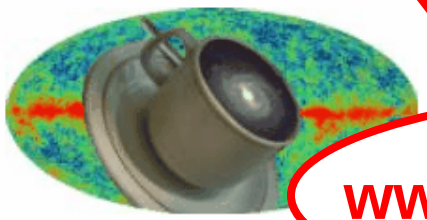

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[hep-th/0503117] Primordial inflation explains why the universe is accelerating today

Goto page Previous 1, 2

Authors: Edward W. Kolb, Sabino Matarrese, Alessio Notari, Antonio Riotto

Abstract: We propose an explanation for the present accelerated expansion of the universe that does not invoke dark energy or a modification of gravity and is firmly rooted in inflationary cosmology.

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Robert J. Scherrer Joined: 28 Mar 2005 Posts: 1 Affiliation: Vanderbilt University	Posted: Mon Mar 28, 2005 4:56 pm quote edit A very interesting idea, to be sure. Does anyone have any comments on the paper by David Wiltshire, gr-qc/0503099 ? He seems to take a very different approach (and gets different answers).
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Niayesh Afshordi	Posted: Mon Mar 28, 2005 7:17 pm quote edit

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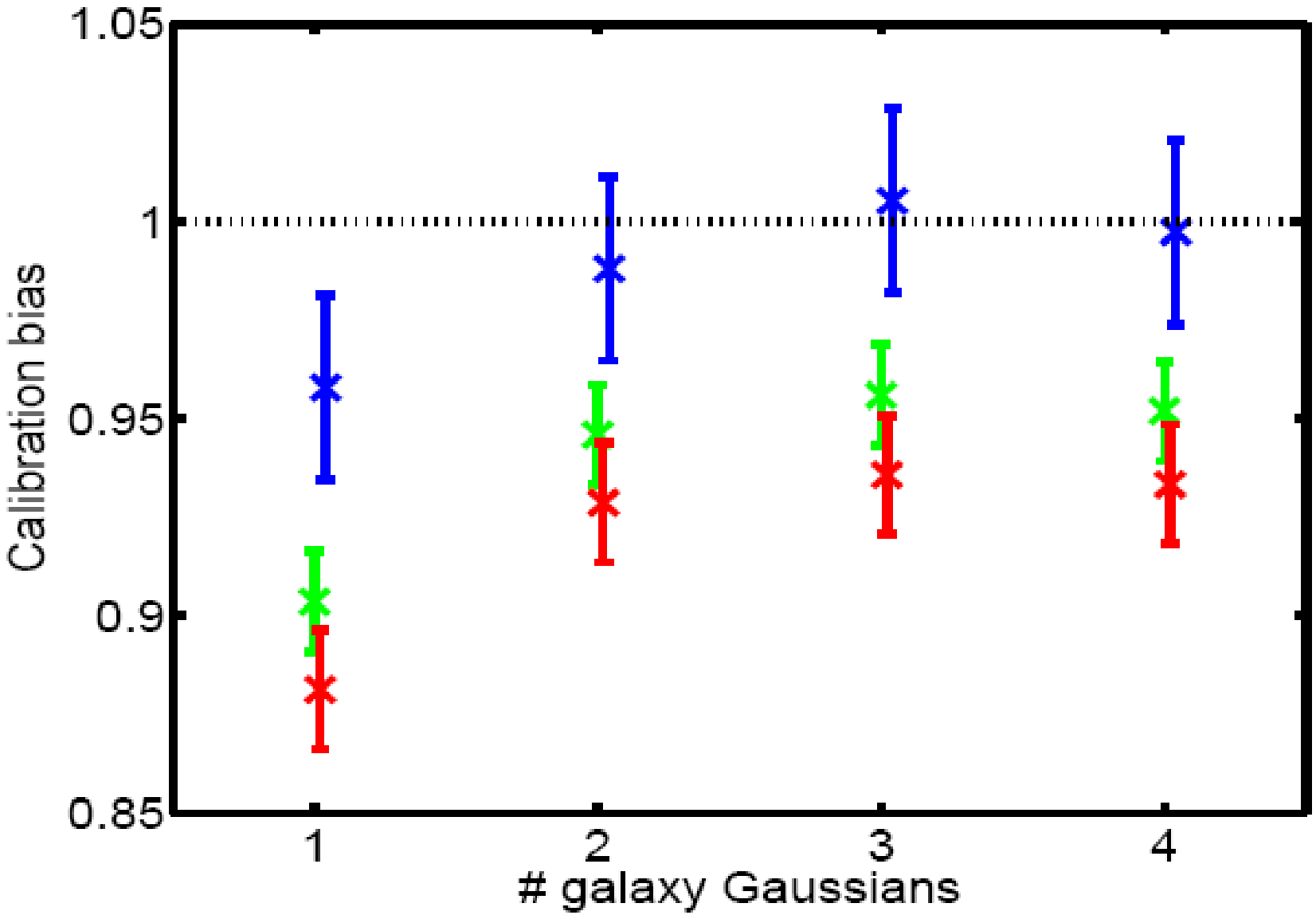
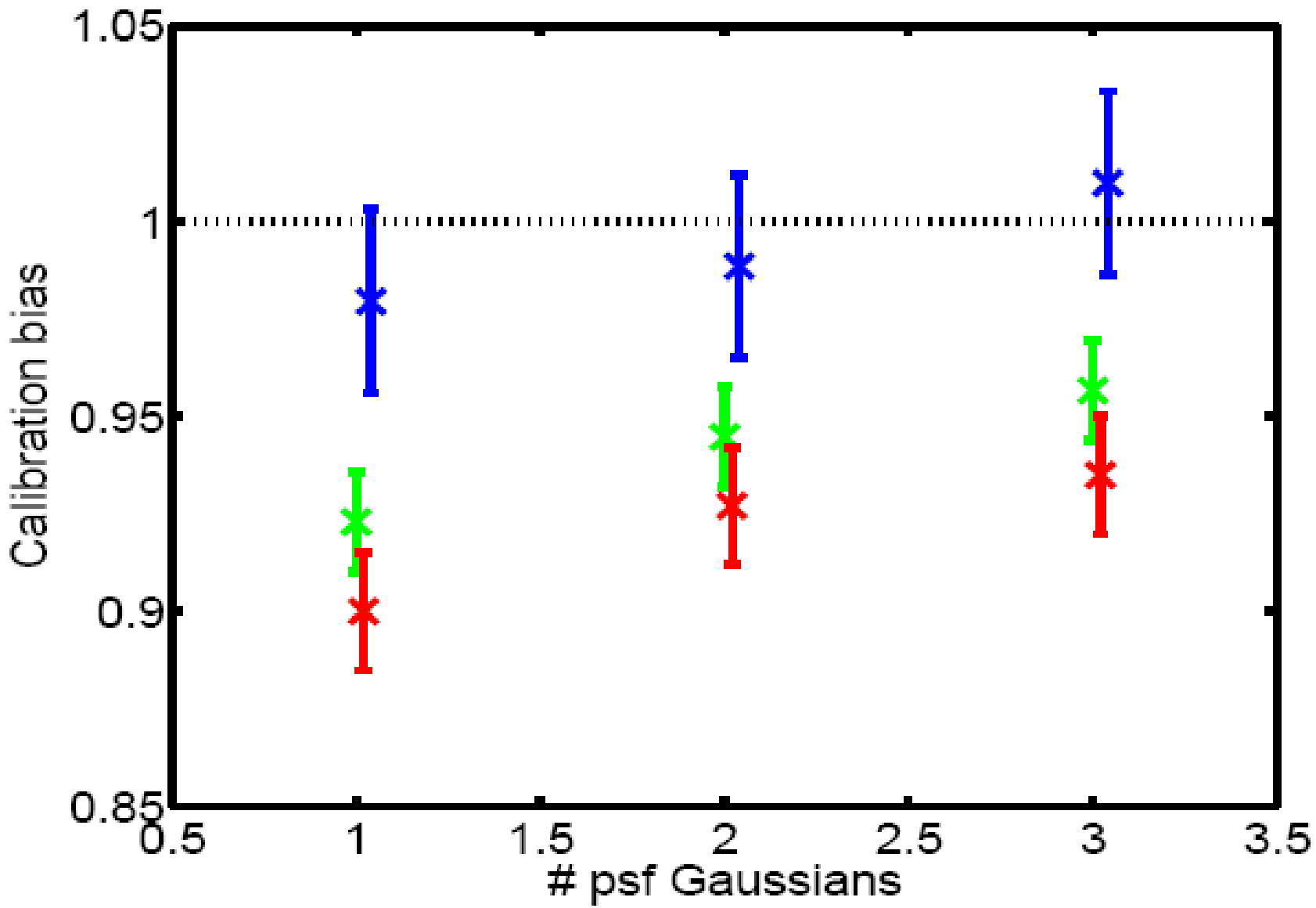
END


1.05
1
0.95
0.9
0.85
Calibration bias
1
2
3
4
galaxy Gaussians


1.05
1
0.95
0.9
0.85
Calibration bias
0.5
1
1.5
2
2.5
3
3.5
psf Gaussians