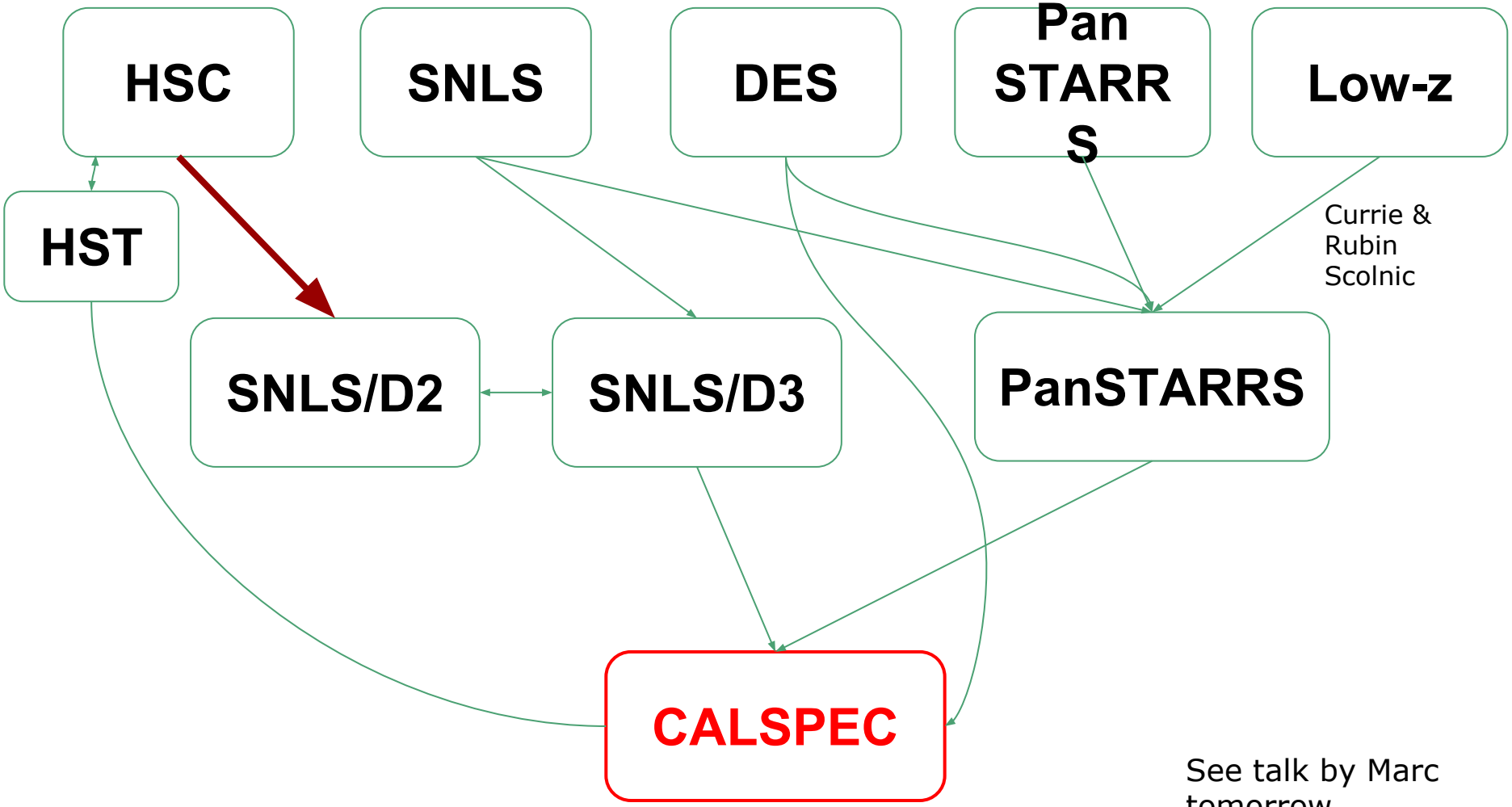
(Preliminary)

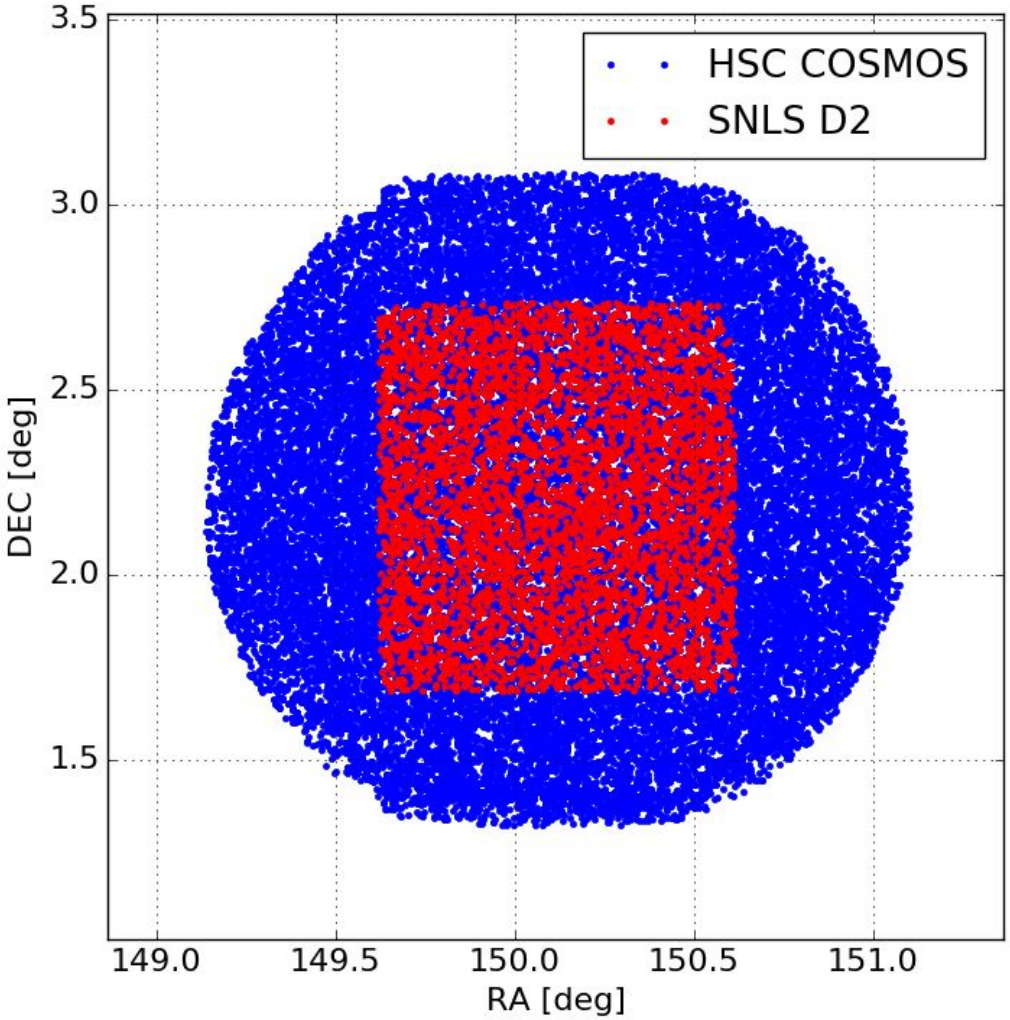
Calibration of the COSMOS field

Flux metrology chain



See talk by Marc tomorrow for all the details

COSMOS



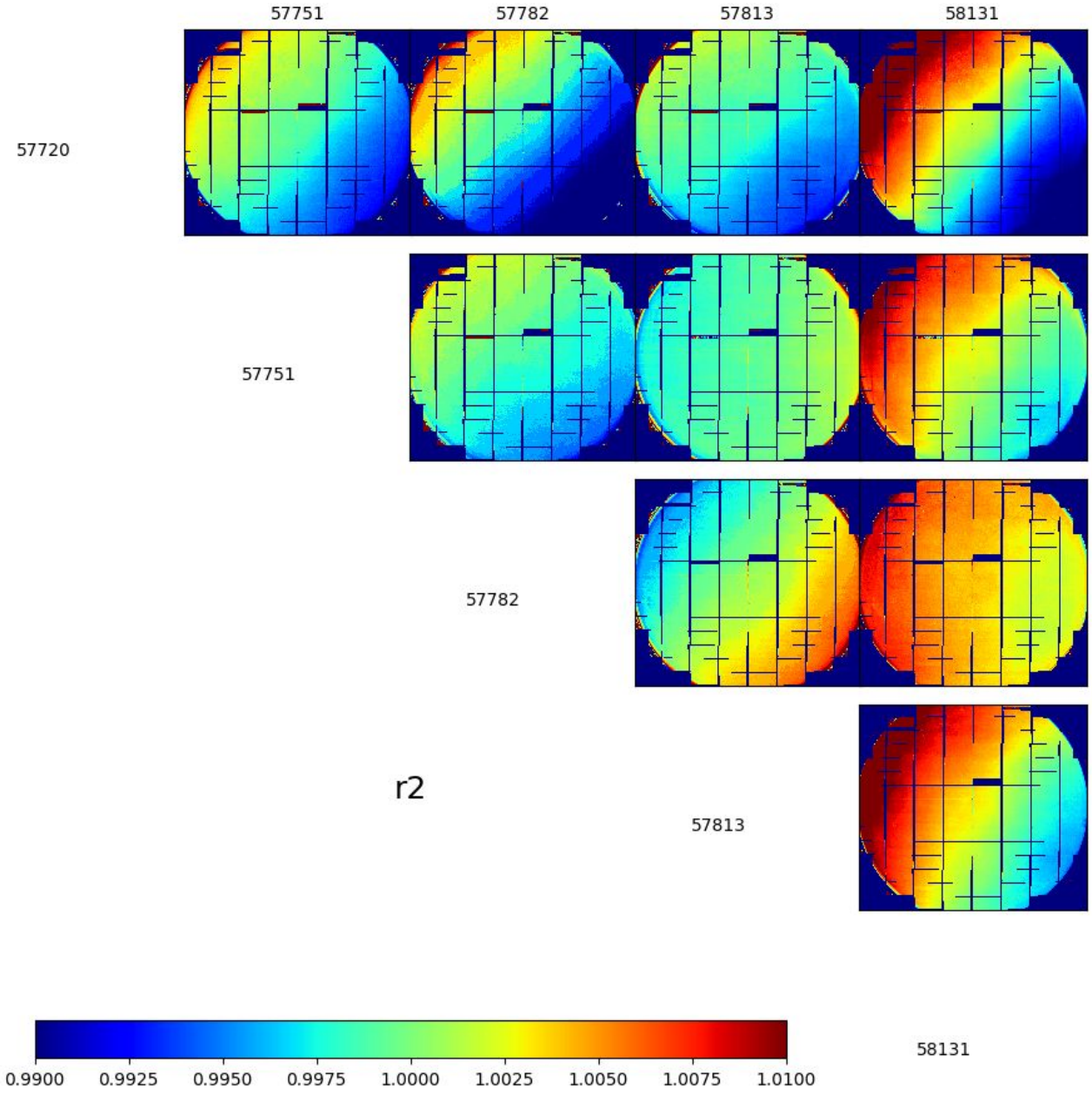
- HSC/COSMOS flux calibration currently anchored to JLA calibration
- JLA tertiaries in the field (great!)
- Extending JLA calibration to the full COSMOS footprint requires good control of
  - HSC uniformity
  - HSC passbands
  - ...

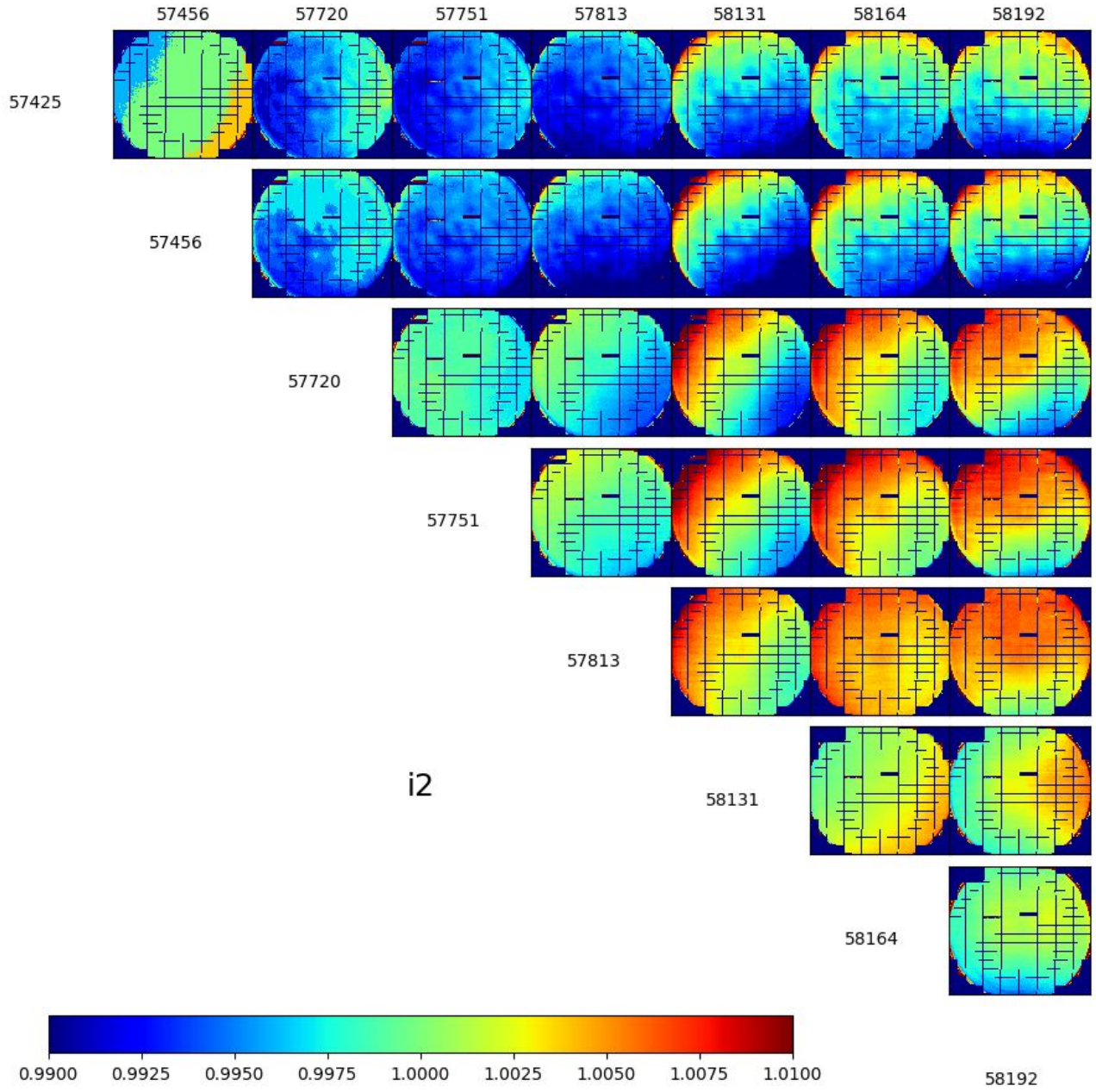
Method

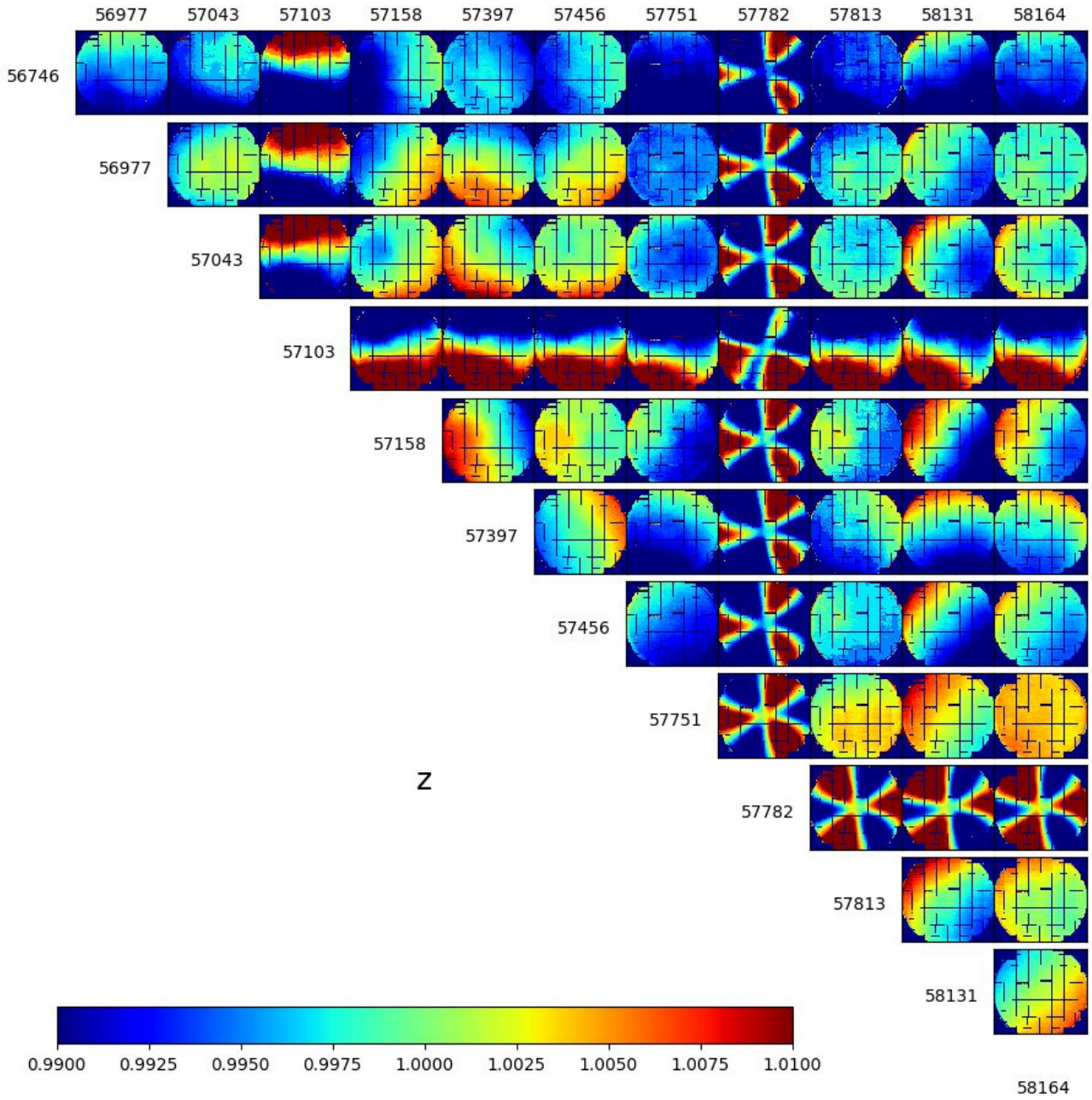
- Fit simultaneously for
  - Field star magnitudes
  - Exposure zero points
  - HSC uniformity map (aka “star flat” or “grid” solution)
  - MegaCam <-> HSC color terms
- Using SNLS tertiaries as anchors
- Use the fact that COSMOS observations are dithered
  - to constrain the HSC uniformity map
- Number of dithers per epoch varies
  - many in z
  - fewer in r2 and i2 => fit all epochs simultaneously

pays if photometric response of HSC is stable

1 master flat
per lunation




57456
57720
57751
57813
58131
58164
58192
57425
57456
57720
57751
57813
i2
58131
58164
58192
0.9900
0.9925
0.9950
0.9975
1.0000
1.0025
1.0050
1.0075
1.0100


56977
57043
57103
57158
57397
57456
57751
57782
57813
58131
58164
56746
56977
57043
57103
57158
57397
57456
57751
Z
57782
57813
58131
58164
0.9900
0.9925
0.9950
0.9975
1.0000
1.0025
1.0050
1.0075
1.0100

Model

- For measurements

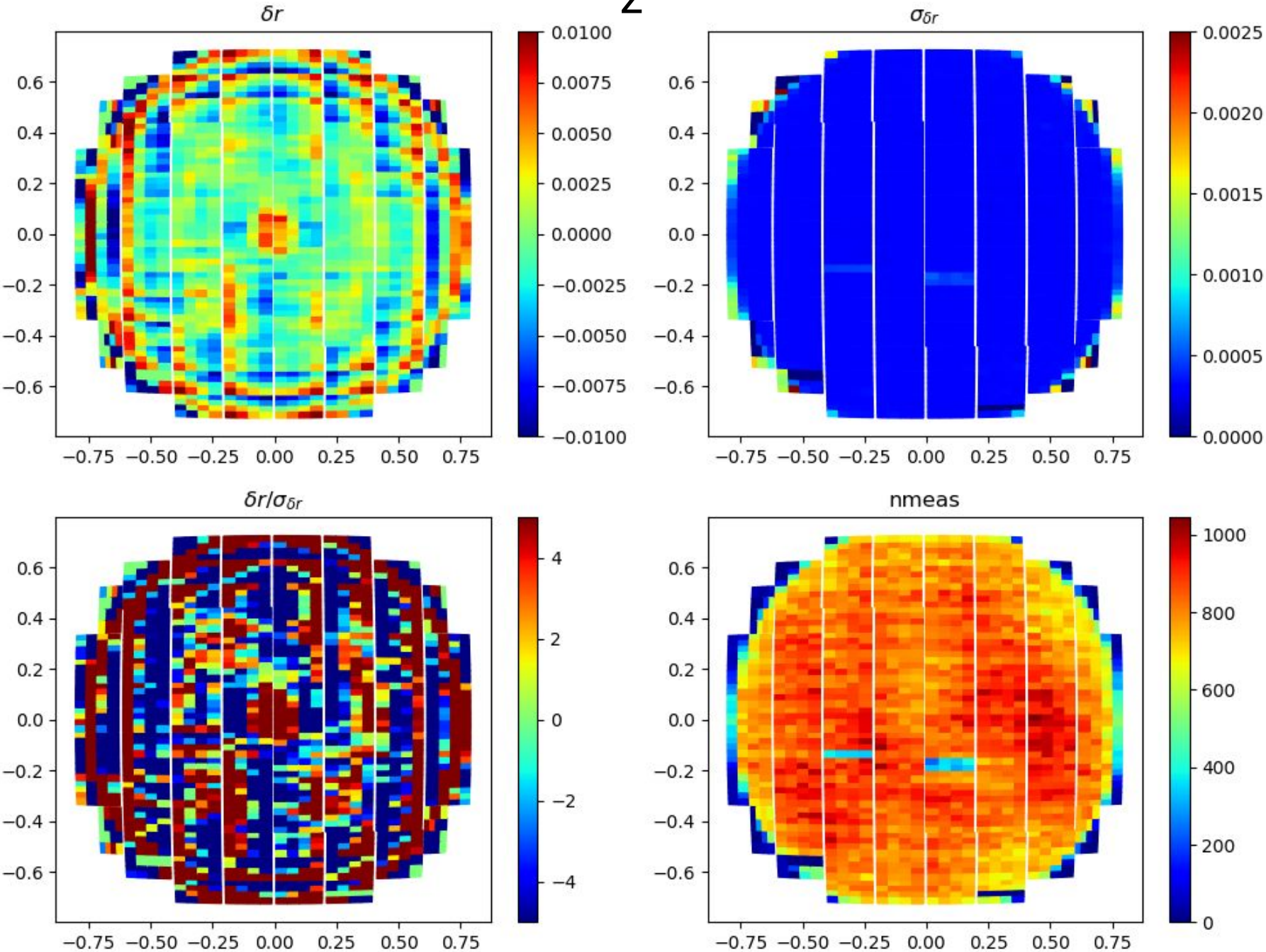
$$m_{ADU} = m + ZP_{exp} + \underbrace{ps(x,y) + \delta zp(\mathrm{ccd}) + \delta\mathrm{tilt}(\mathrm{epoch})}_{\text{Imager response map}} + n$$

- For stars in common with SNLS

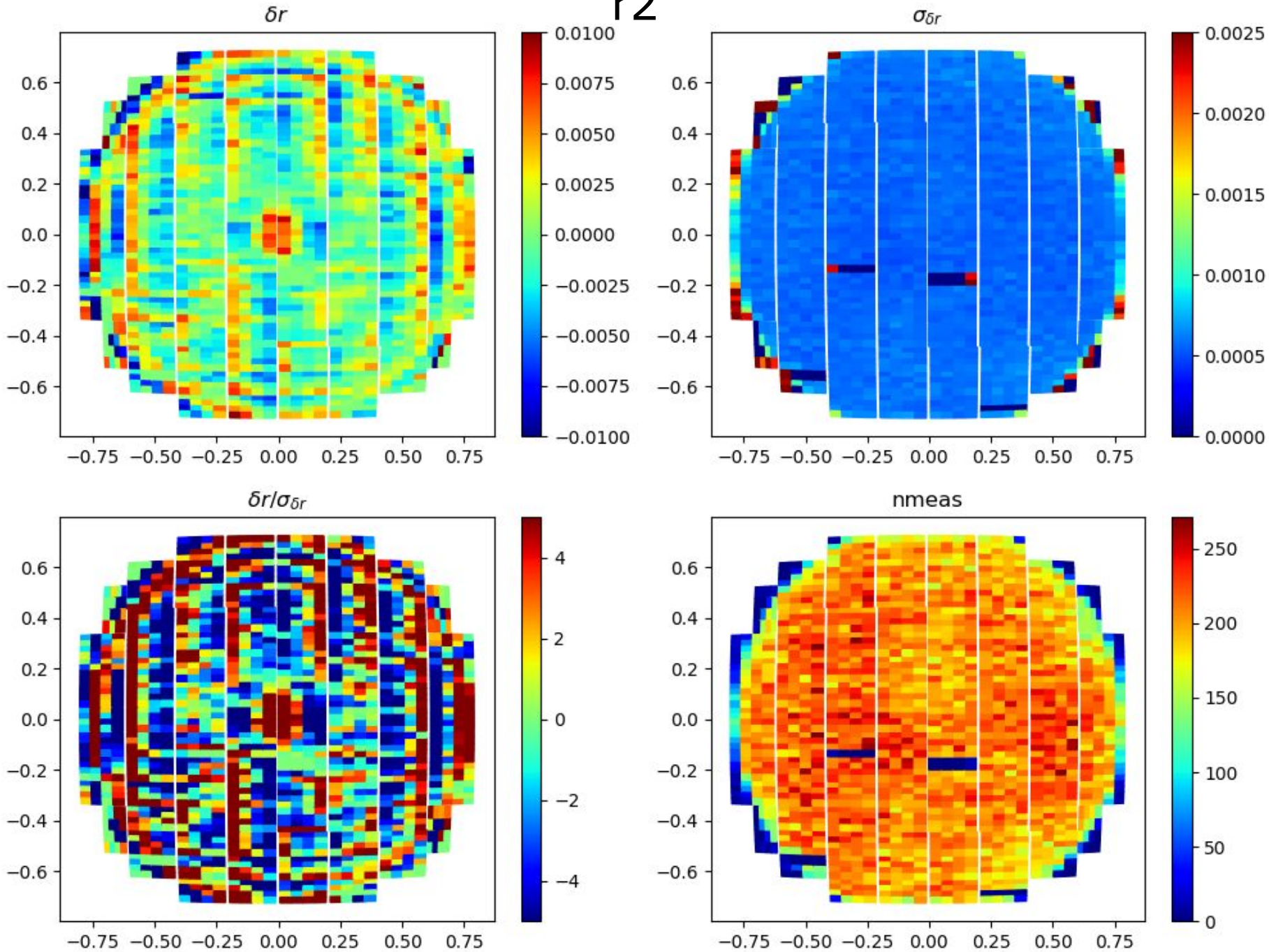
$$m = m_{SNLS} + k \times (g-i)_{SNLS} + n$$

- Combine all the survey visits in a global fit and solve for
  - Star magnitudes
  - Calibration parameters (ZP and uniformity map(s))

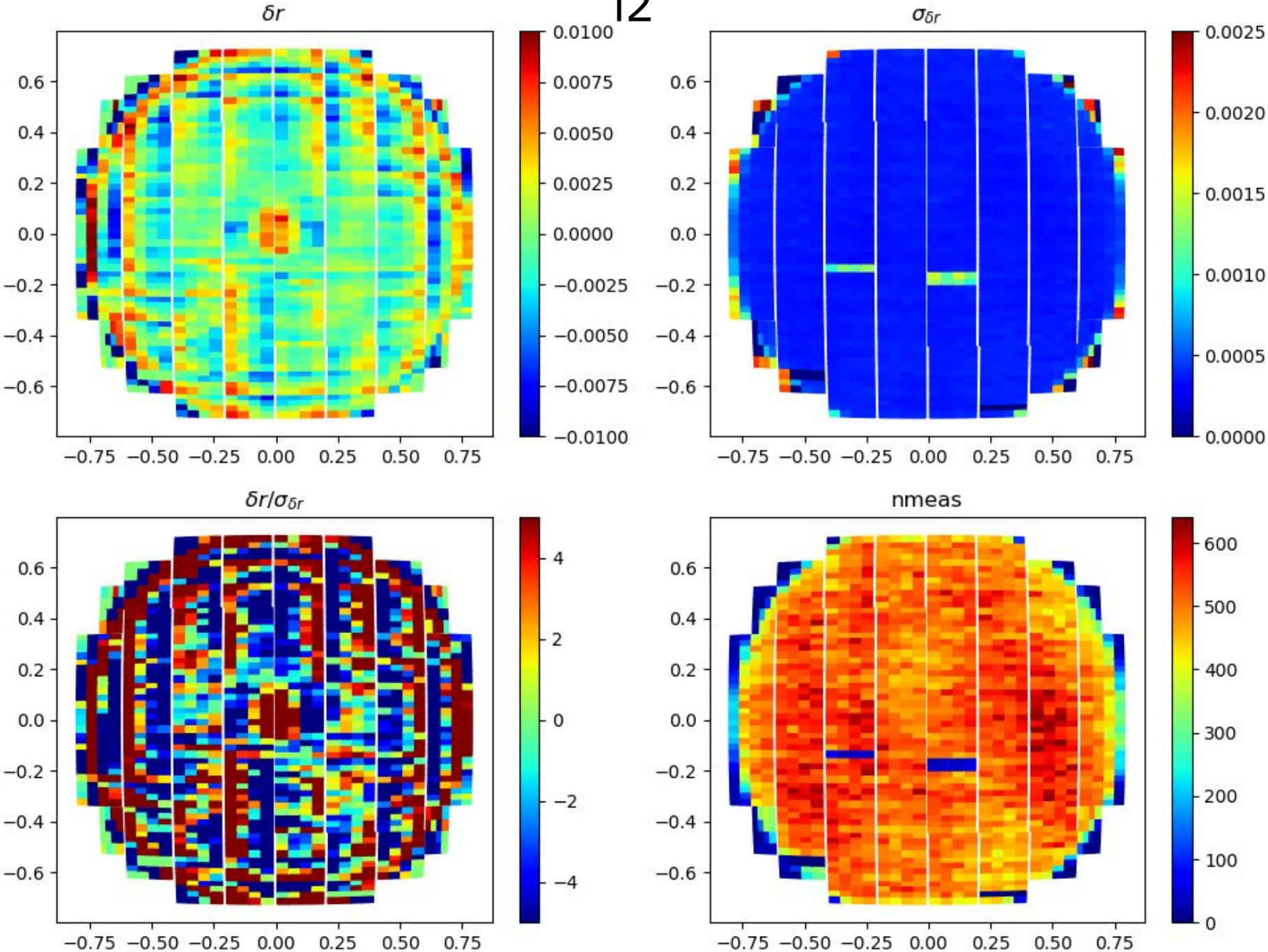
Z


δr
$\sigma_{\delta r}$
$\delta r/\sigma_{\delta r}$
nmeas
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
4
2
0
−2
−4
1000
800
600
400
200
0

r2

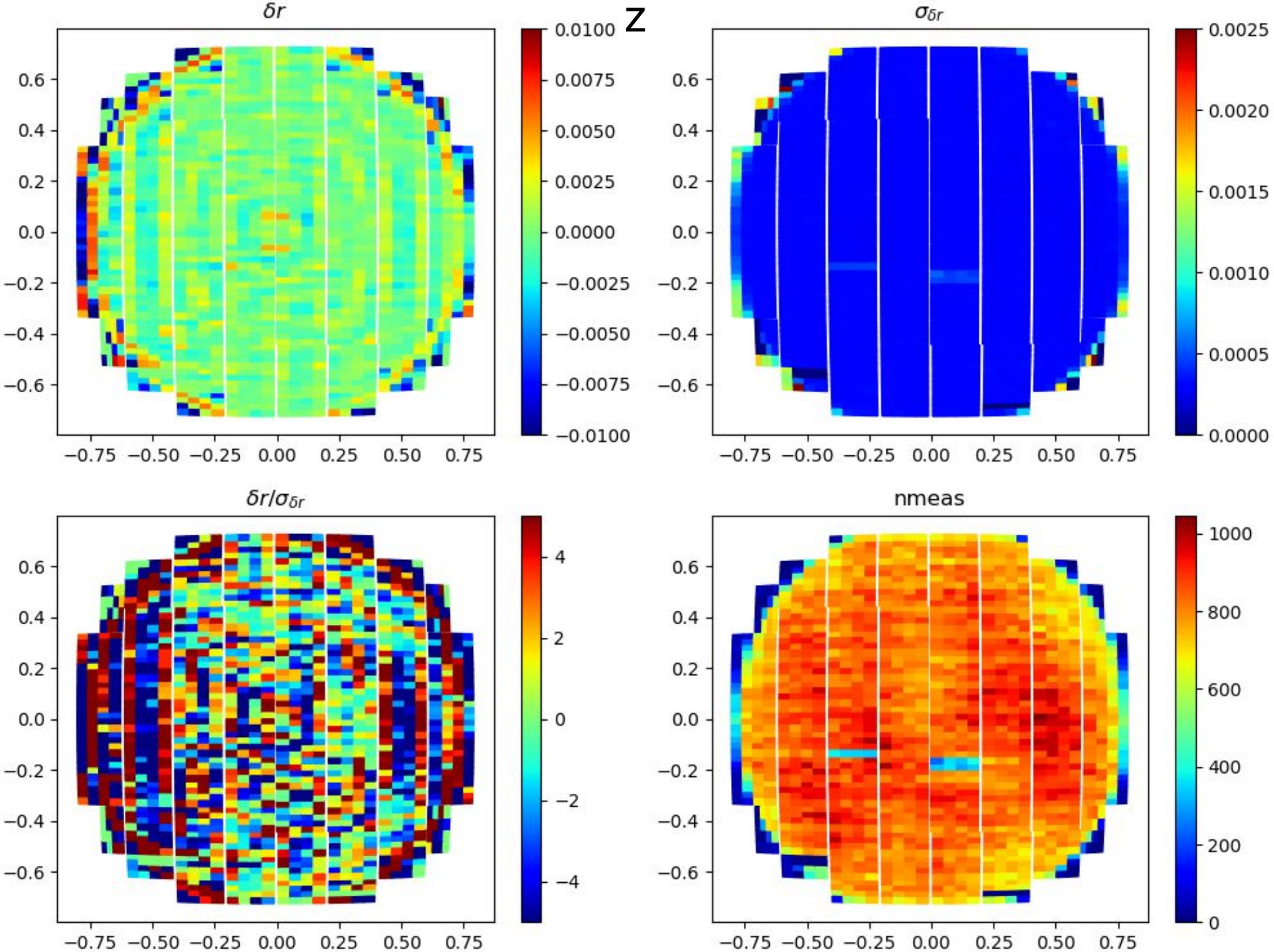

δr
$\sigma_{\delta r}$
$\delta r/\sigma_{\delta r}$
nmeas
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
4
2
0
−2
−4
250
200
150
100
50
0

i2


δr
$\sigma_{\delta r}$
$\delta r/\sigma_{\delta r}$
nmeas
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
4
2
0
−2
−4
600
500
400
300
200
100
0

Model

- Radial structure in the calibration residuals
  - ~ 8 mmag peak-to-peak
  - filter non uniformities ?
  - ghosting in the flat fields ?
- Updated model (for now)
  - add variable tilts to the CCD response
  - Investigating better parametrizations of the effect
    - Depends on whether residuals are chromatic or not


Z
δr
$\sigma_{\delta r}$
$\delta r/\sigma_{\delta r}$
nmeas
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
4
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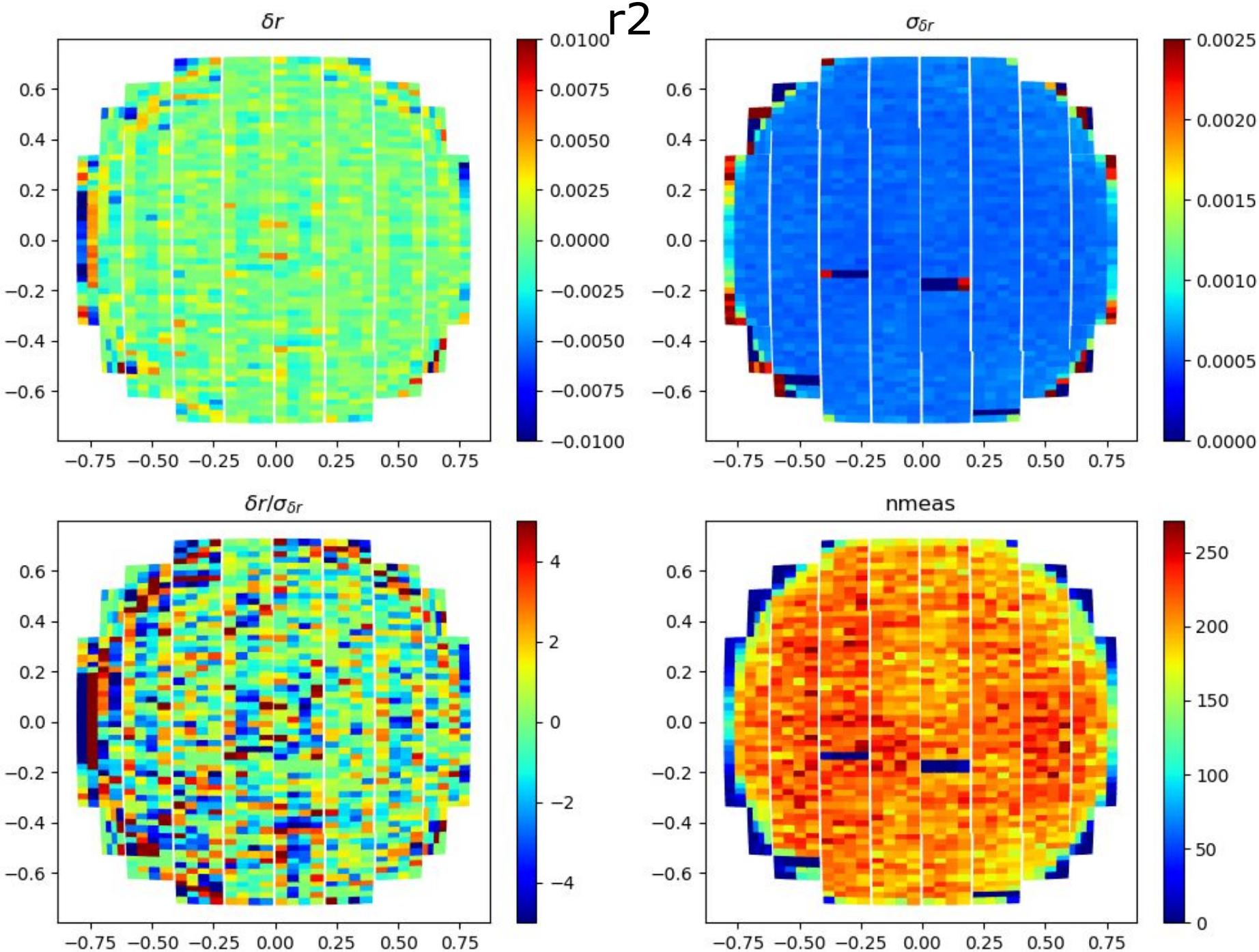
−2
−4
1000
800
600
400
200
0

r2


δr
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nmeas
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
0.0025
0.0020
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0.0000
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50
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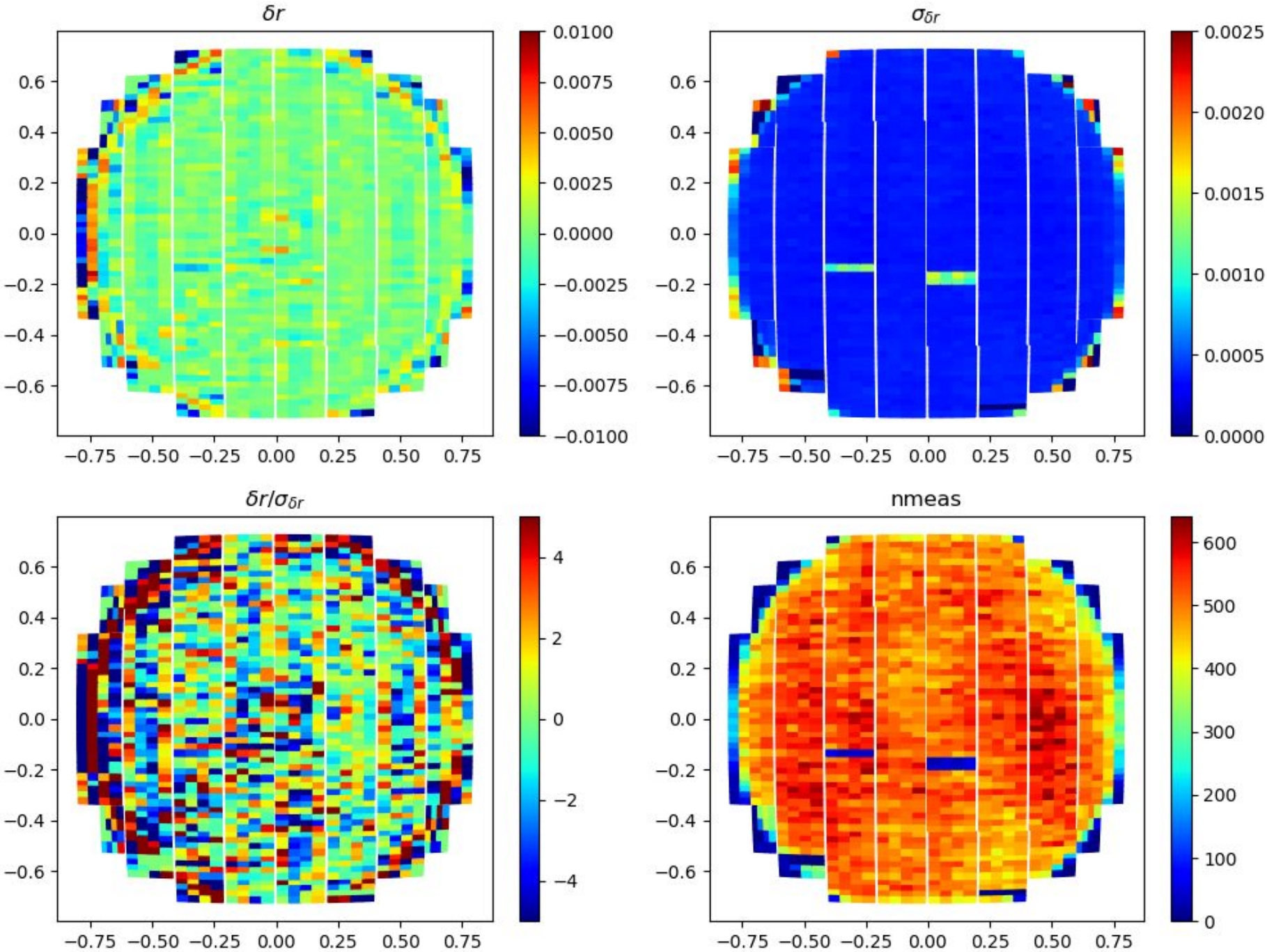
δr
$\sigma_{\delta r}$
$\delta r/\sigma_{\delta r}$
nmeas
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
0.0100
0.0075
0.0050
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
4
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0
−2
−4
600
500
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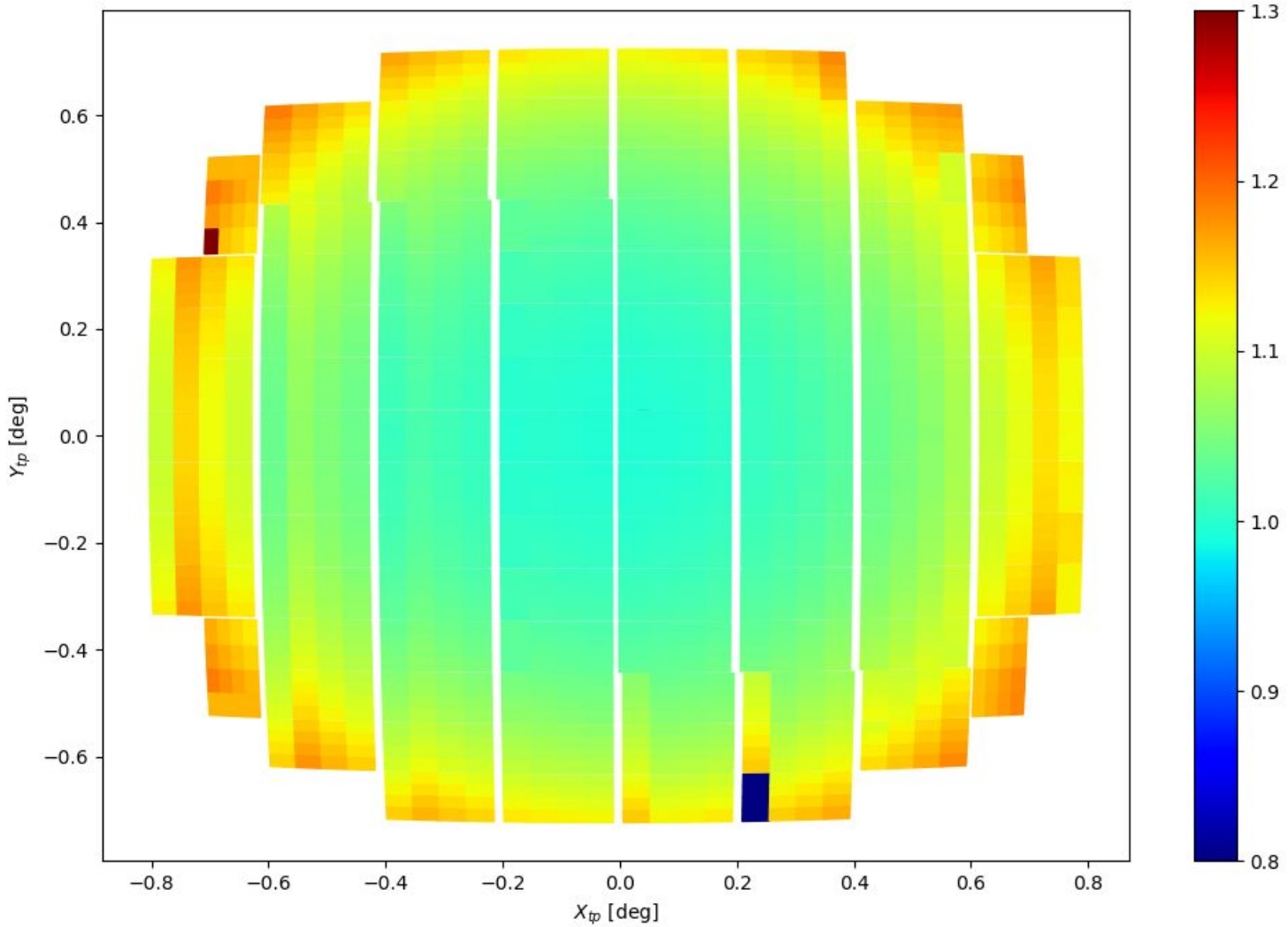
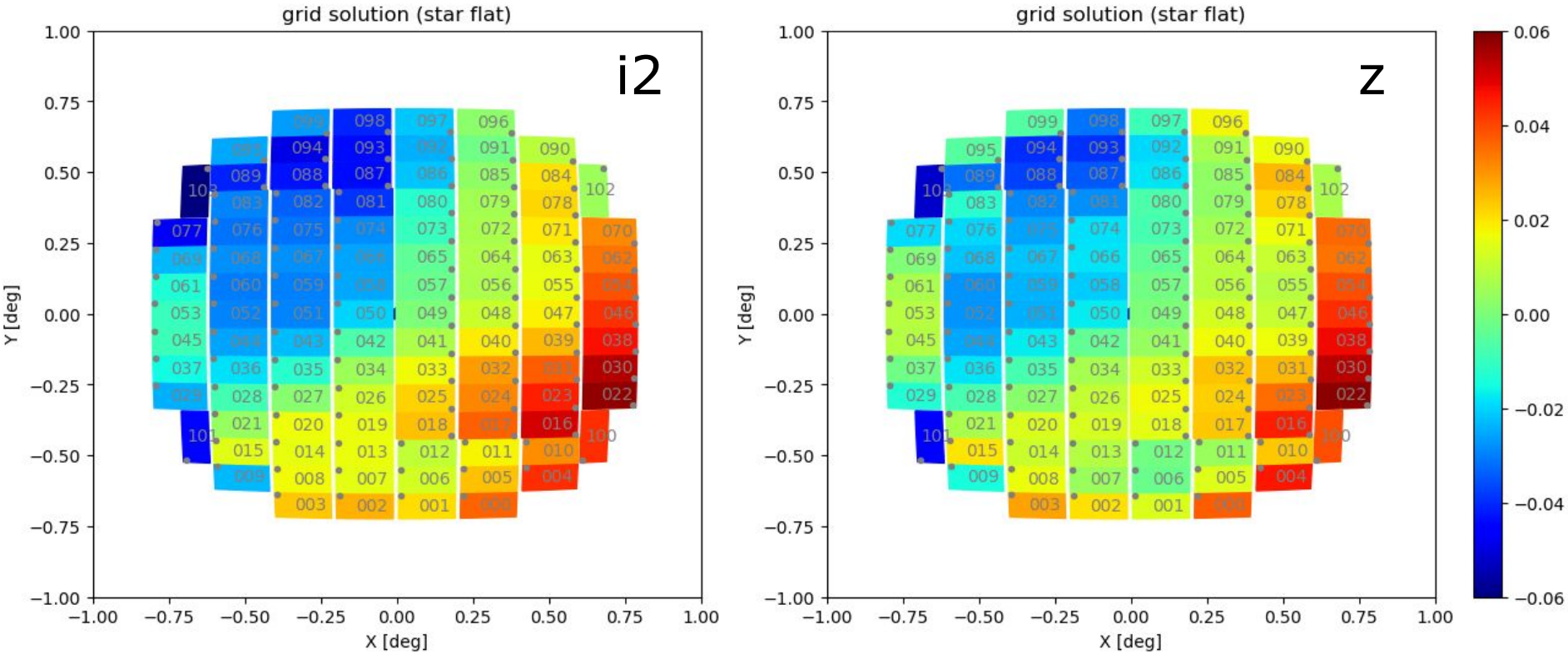
300
200
100
0

Grid solution (I) : plate scale

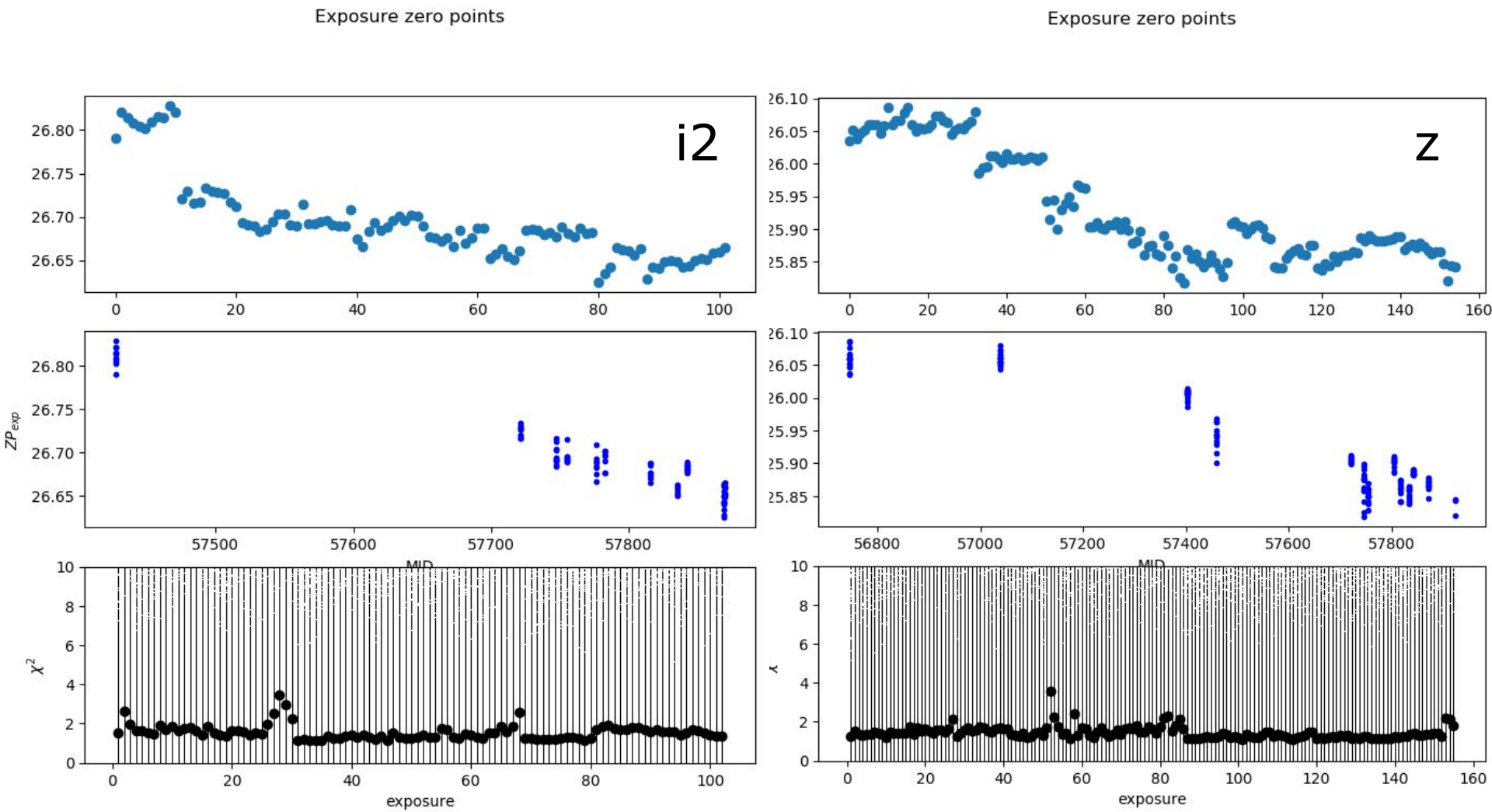
~ 15 % center to side



Grid solution (II)



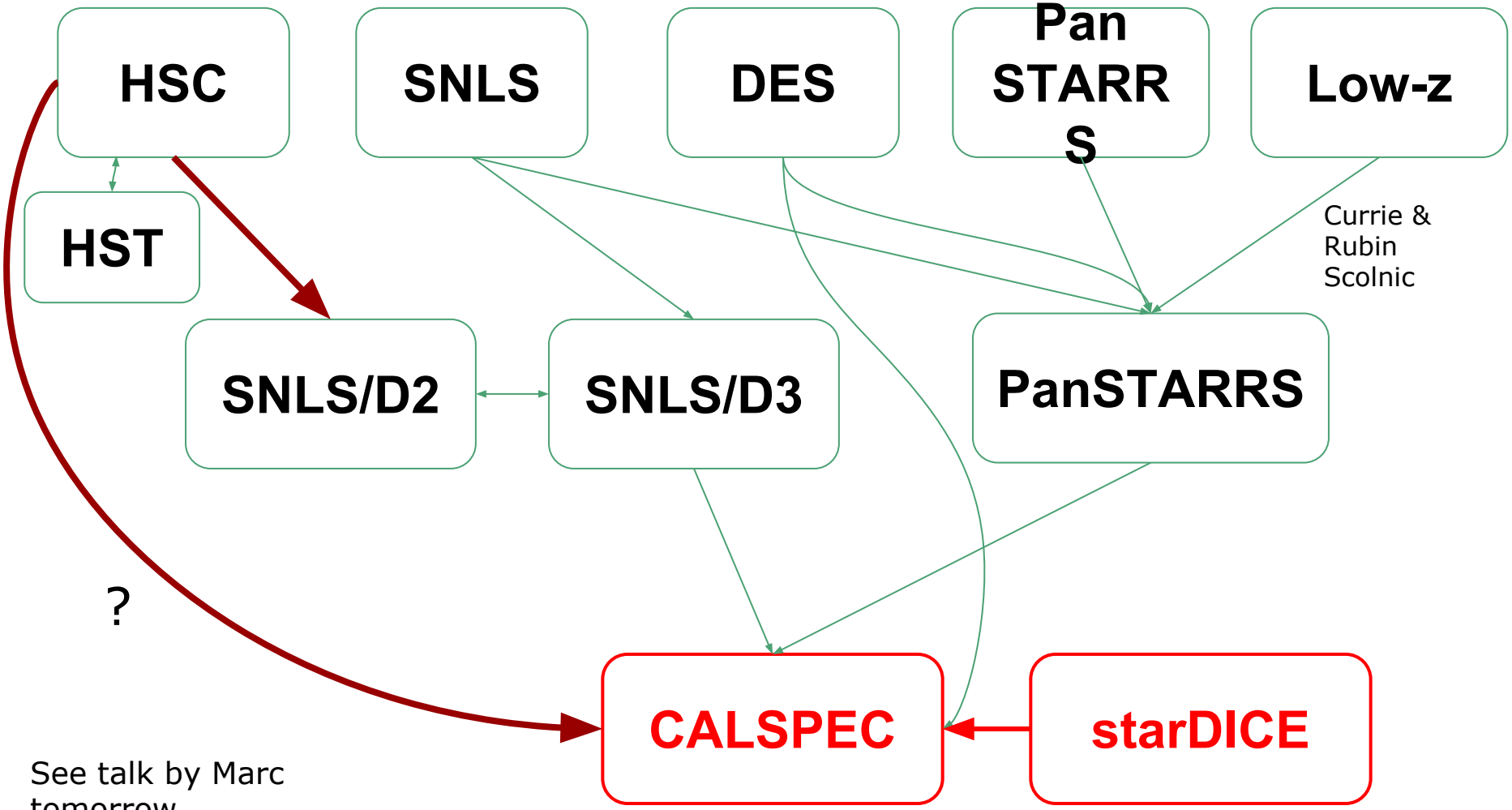
Throughput


Exposure zero points
i2
Exposure zero points
z
ZP_{exp}
MJD
χ^2
exposure
MJD
χ
exposure

Work ahead

- Refine imager uniformity model
  - flat field variability model (ongoing)
  - understand radial structure in residuals
  - study chromaticity of imager response (ongoing, thanks to Naoki for filter measurements)
  - empirical measurement error model (ongoing)
  - extend to the DEEP footprint (not started)
  - comparison of aperture fluxes (calib) <-> PSF/scene modeling fluxes
- Compare with
  - Princeton/IPMU photometry (E. Rykoff FGCM)
  - DES observations of COSMOS (not released yet)
  - PanSTARRS observations of COSMOS (ongoing)
- Intercalibration HST <-> HSC (having HSC-Y would help)
- Switch to SNLS5 / non-CALSPEC calibrations

Flux metrology chain



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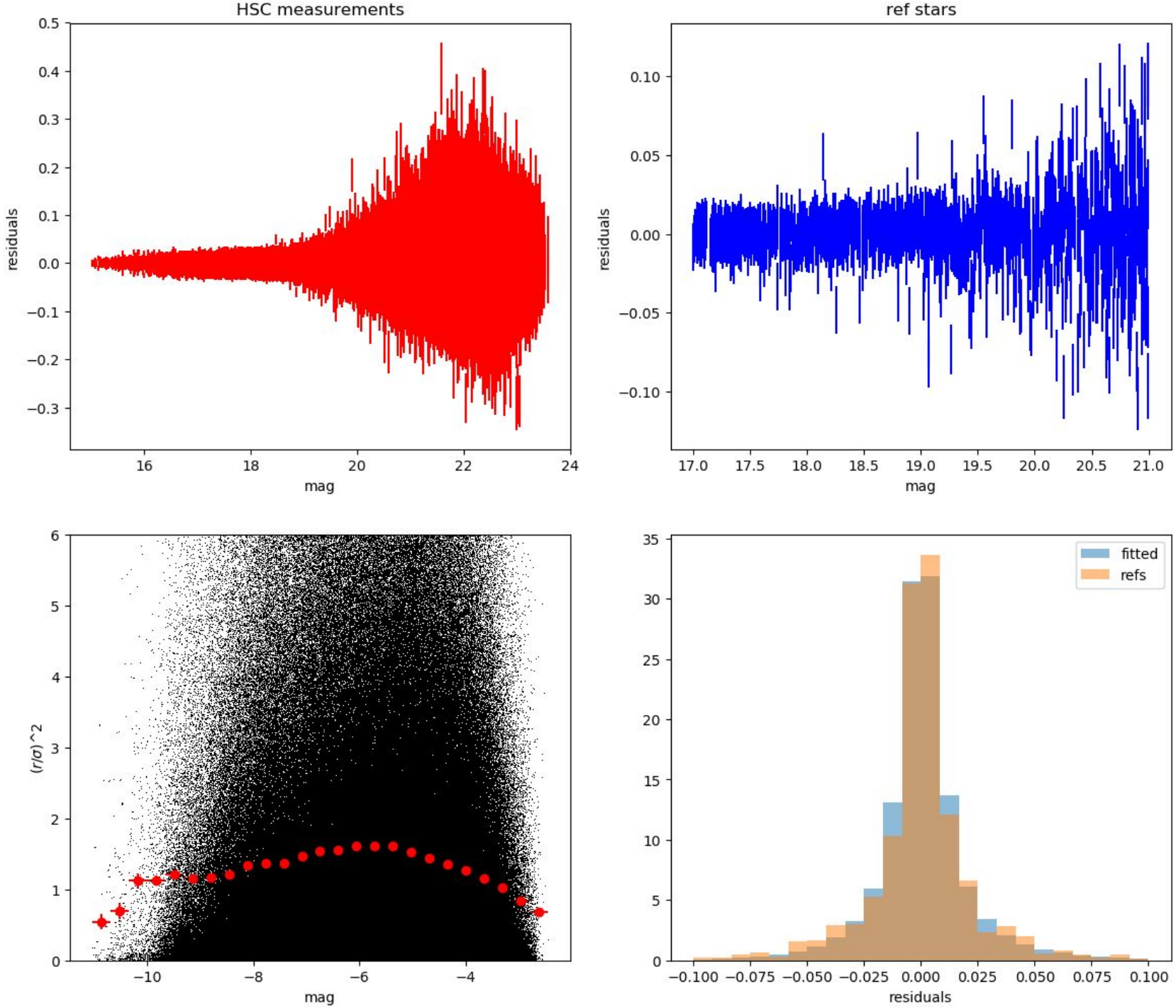
HSC measurements
residuals
mag
ref stars
residuals
mag
(r/σ)^2
mag
fitted
refs
residuals