Calibration with an external star catalog

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LSST calibration stars

Stars must be
non-variable, visible through most filters, abundant:
=> sample of main sequence (MS) stars

not saturating the CCDs: $m_b > 16.5$

bright enough to give photometry with few mmag stat. precision per exposure

F too variable, M too faint
=> promising sample: G and K dwarves with $16 < m_b < 20$

Possible uses of Gaia catalog

Gaia will provide a catalogue of G & K stars identified as non-variable with precise photometry and color information, up to $m \approx m_r = 20.5$

Potential uses:

⇒ Fix relative Zero points for different filters (at least *g, r, I, z*)
⇒ provide some absolute standards
⇒ verify the whole calibration procedure
⇒ use Gaia stars as starting point for overall calibration χ^2 fit

Test of the method

Take CFHT-LS images used for the SNLS programme

Process these images with the LSST stack

Filter *r*, D3 field, 36 CCDs, 4 nights : 24/05 to 02/06/2006

Compare with an “external” catalogue : Betoule et al (2013)

⇒ 1 deg field, 3300 stars

⇒ precision : 0.4 mmag at m = 16 to 4 mmag at m = 22

Use natural mag, so colour/position effects are included

Use stars from m = 17 to m = 18.5 as reference

Stack calibration done with SDSS catalog

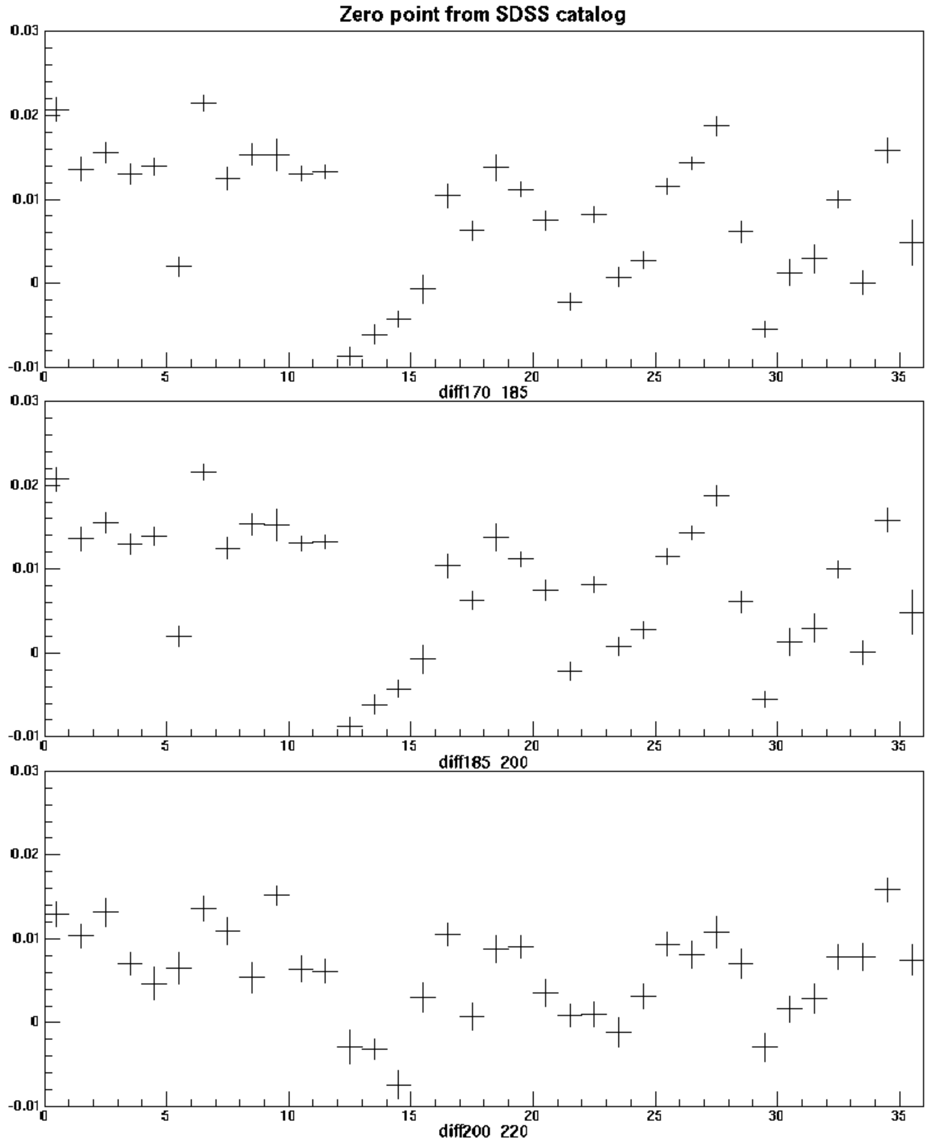
Differences between CFH and LSST

	CFH	LSST	
CCDs	36/sq. deg.	16/sq. deg.	nr of stars per CCD
exp.	250 s	15 s	effect of rapid changes in atmosphere

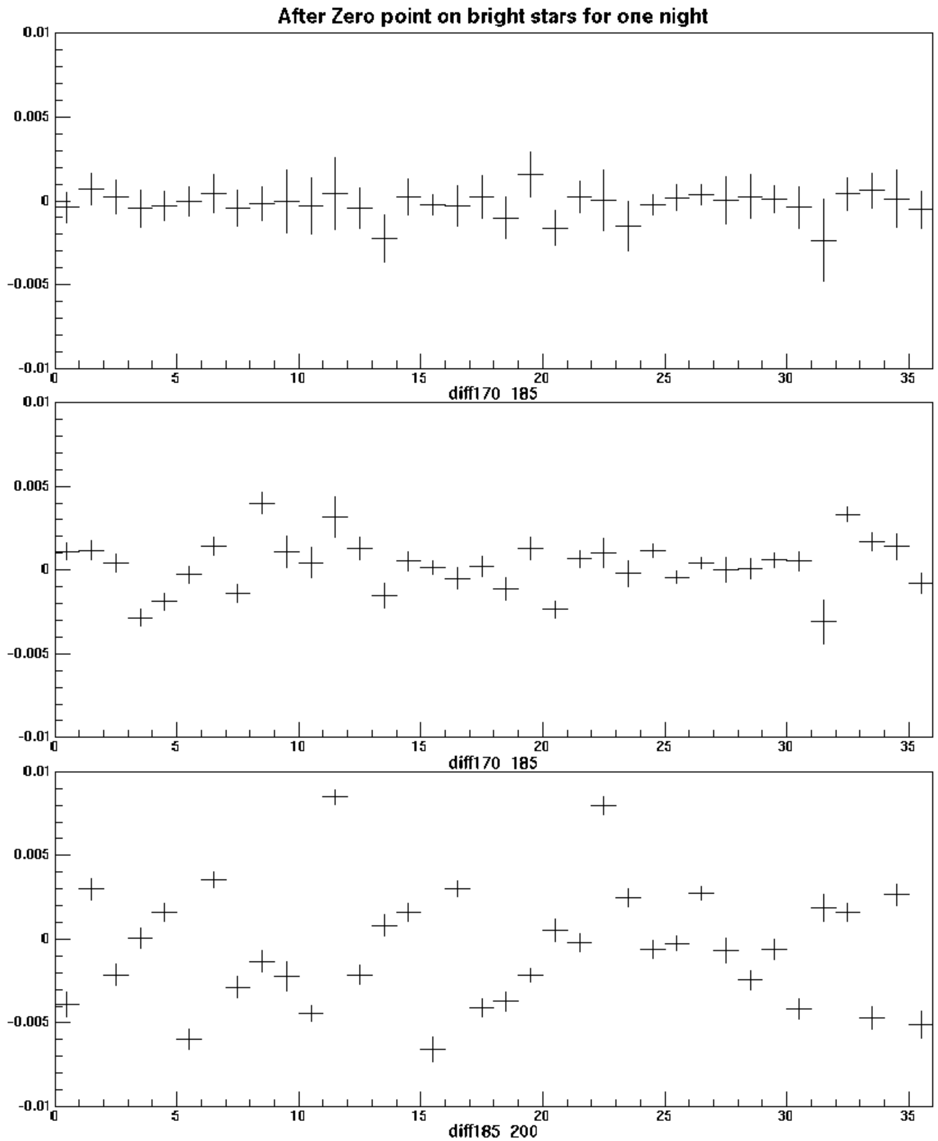
I use the 6 pix. radius LSST stack photometry, which is less fluctuating than the 17 pix. one.

SNLS uses a larger aperture and averages over many images

CDD alignment

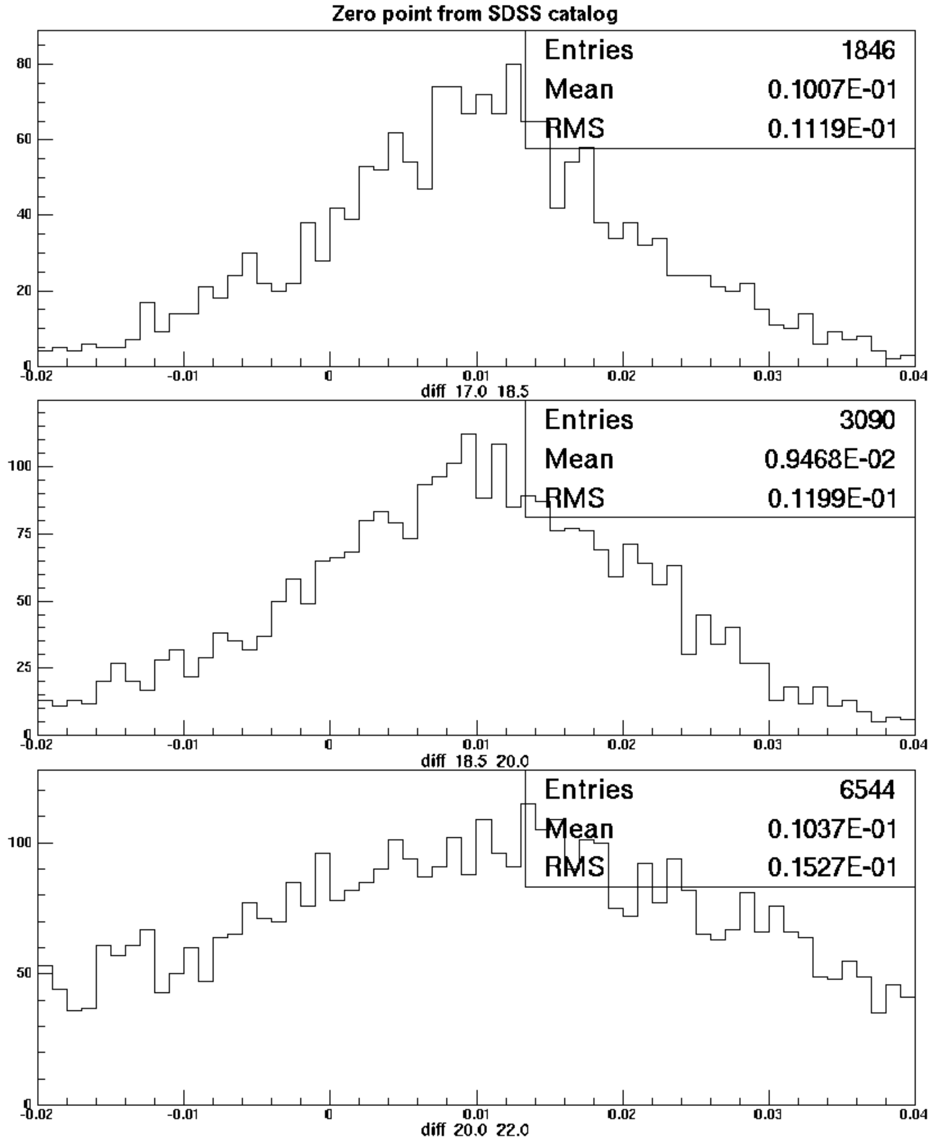


CDD alignment

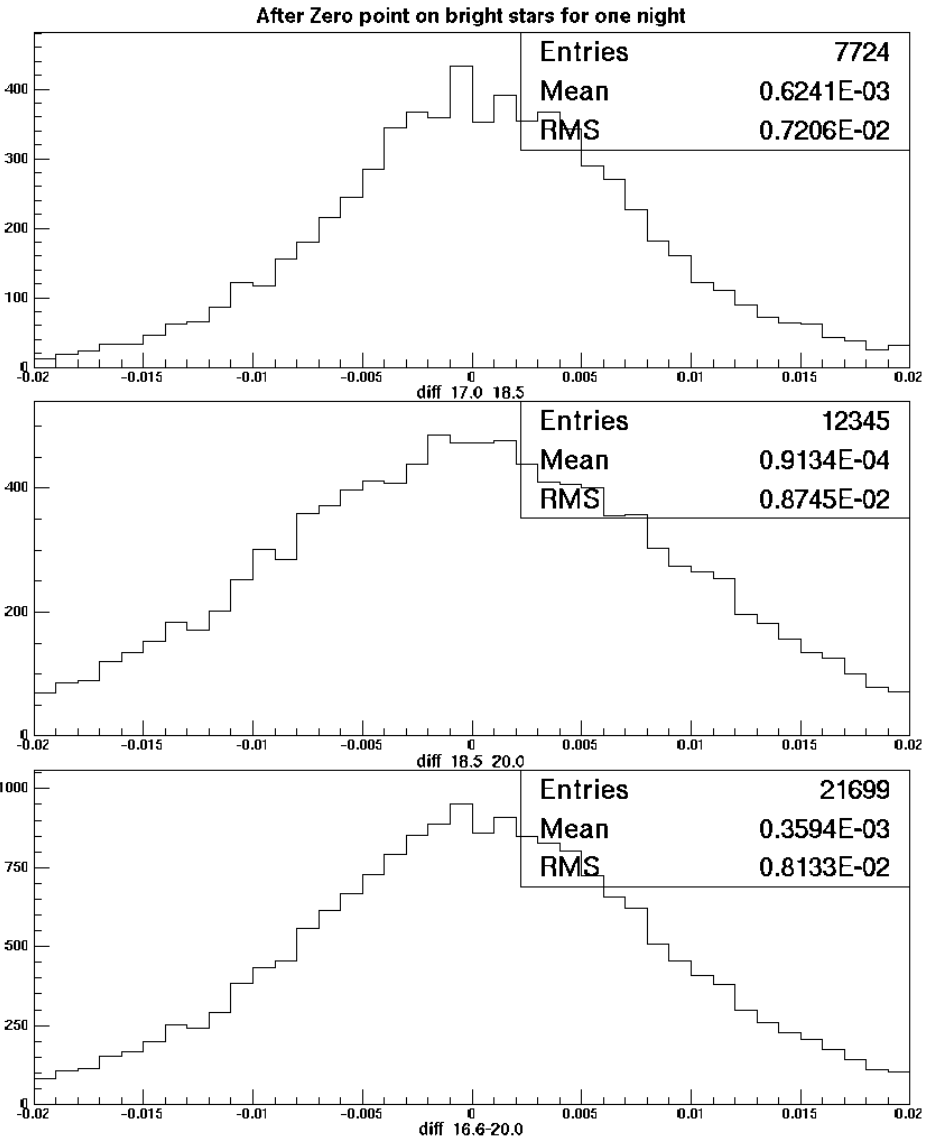


Dispersion before alignment

RMS = 12 mmag
for *m* = 17 to 20



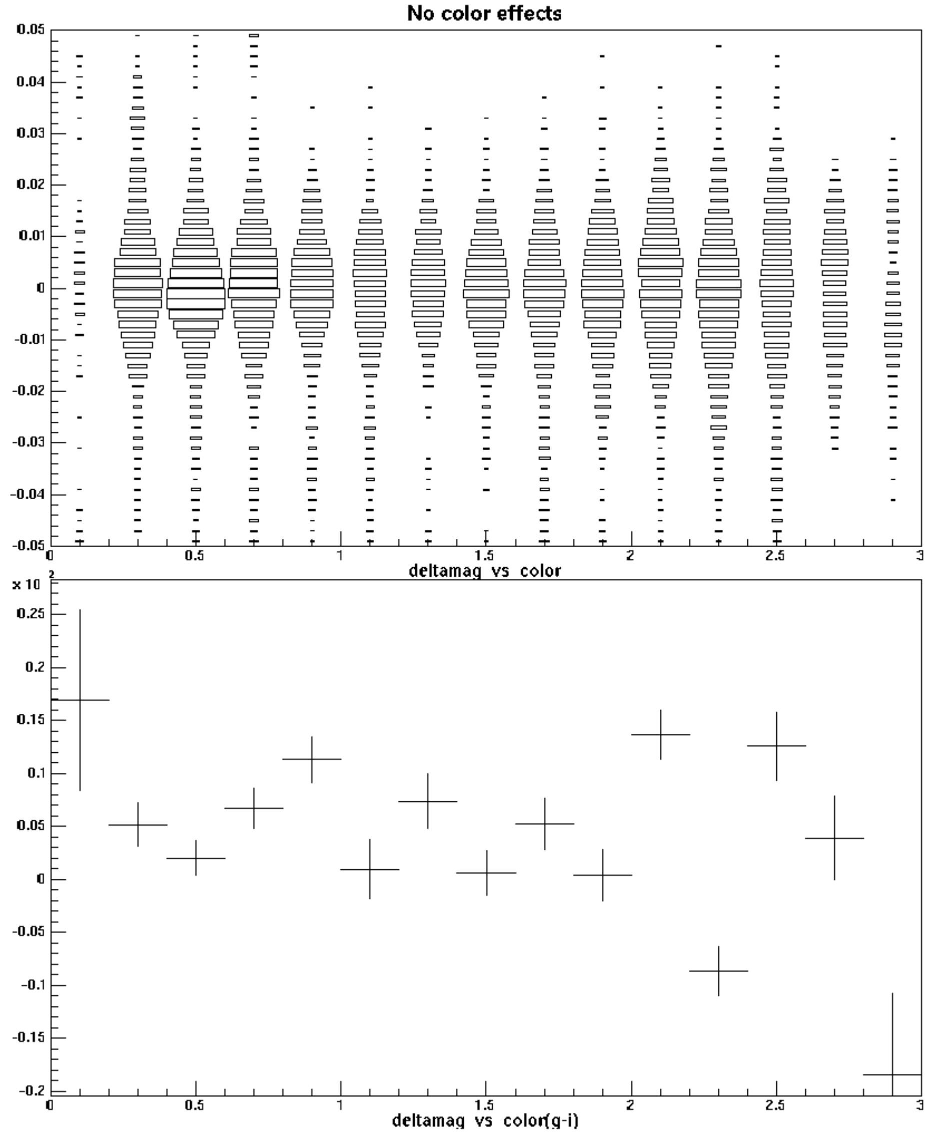
Dispersion after alignment



RMS = 8 mmag
for *m* = 16.6 to 20

Magnitude dispersion vs color

no effect in *g - i*
at 1 mmag level



Conclusions

Aperture photometry with the stack works.

Corrections of Zero points using bright stars (*m* =17. to 18.5) work.

=> dispersion reduced on all stars (*m* =16.6 to 20)

Corrections of Zero points on 1 night are valid over 4 nights

⇒ repeatability of field stars = 8 mmag

⇒ compatible with Regnault 2009

No significant color dependence when using natural magnitudes

Dispersion on mag in 1 exp. = 8 mmag : spatial variations ?

Lots of NaN and a few negative fluxes when using 17 pix. aperture

What next ?

Use half the SNLS catalog as input for stack
Evaluate precision on the other half

Understand and correct the NaN magnitudes and neg. fluxes

Extend study to other filters

Extend to non-photometric nights

Explore PSF flux measurement