PACS highpass filtered maps

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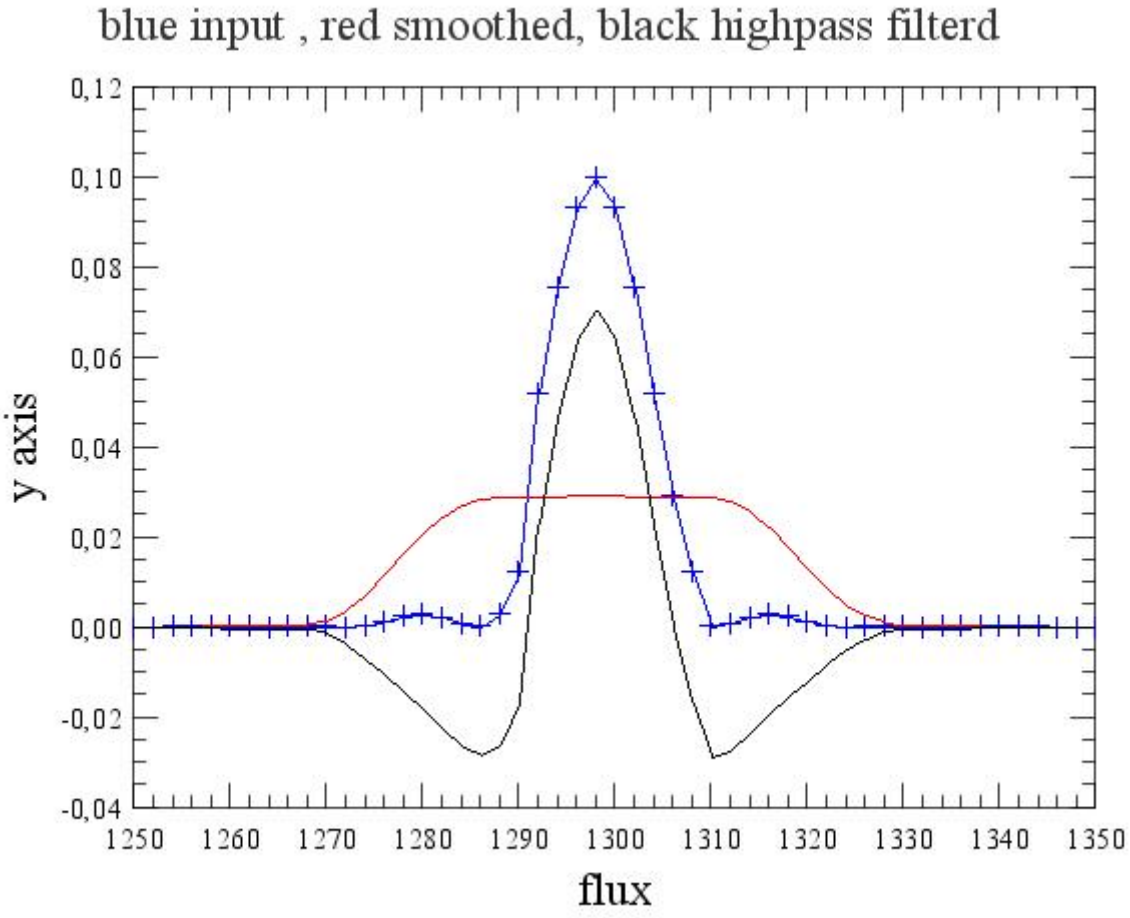
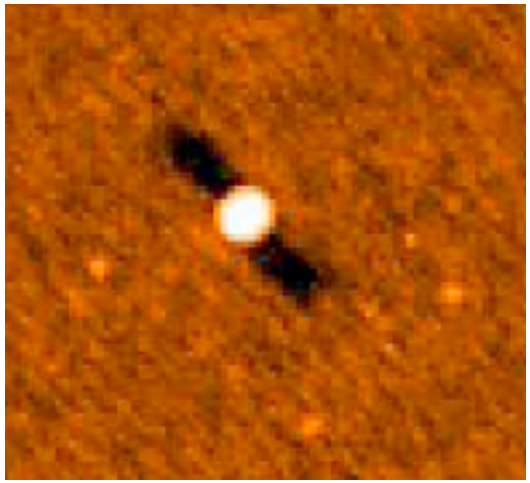
Why highpass filtering ?

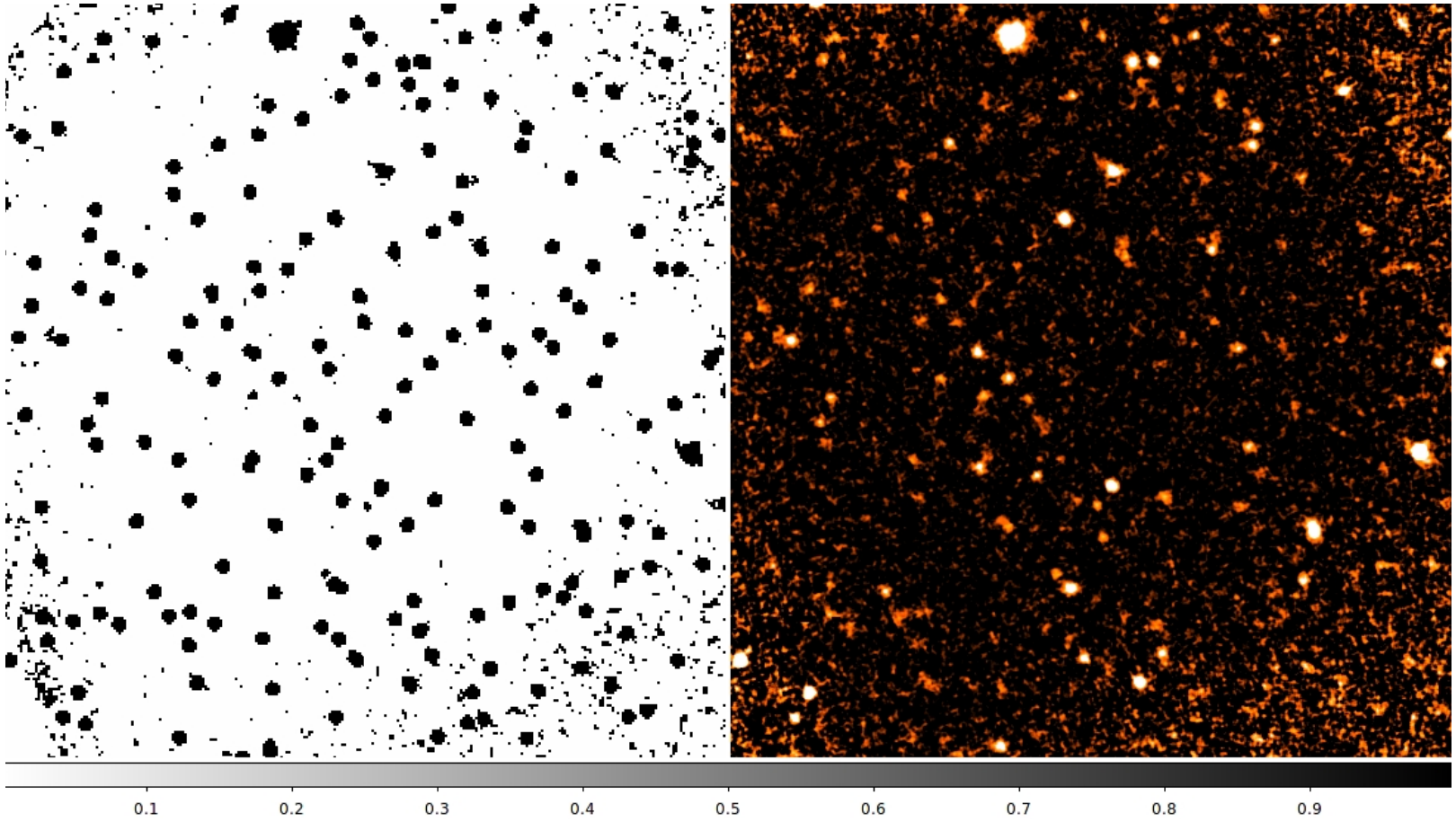
- Highpass filtering of the bolometer detectors timelines filters to the maximum the 1/f noise – and other types of artifacts – hence allows the highest sensitivity for point-sources.
- Typical highpass filter radius (hpfradius = half width)
    - blue channel: 15 (10) , ie. 30” on the sky
    - blue channel: 25 (20), ie., 50” on the sky
- Most important is to mask the sources themselves, otherwise significant flux loss, iterative process
    - Thresholding the map by signal to noise
    - Source detection and putting circular patch on the sources.
- Drawback: extended emission filtered out.
- Works for slightly extended sources up to 20-30” extend

Artefact of high-pass filter on bright sources

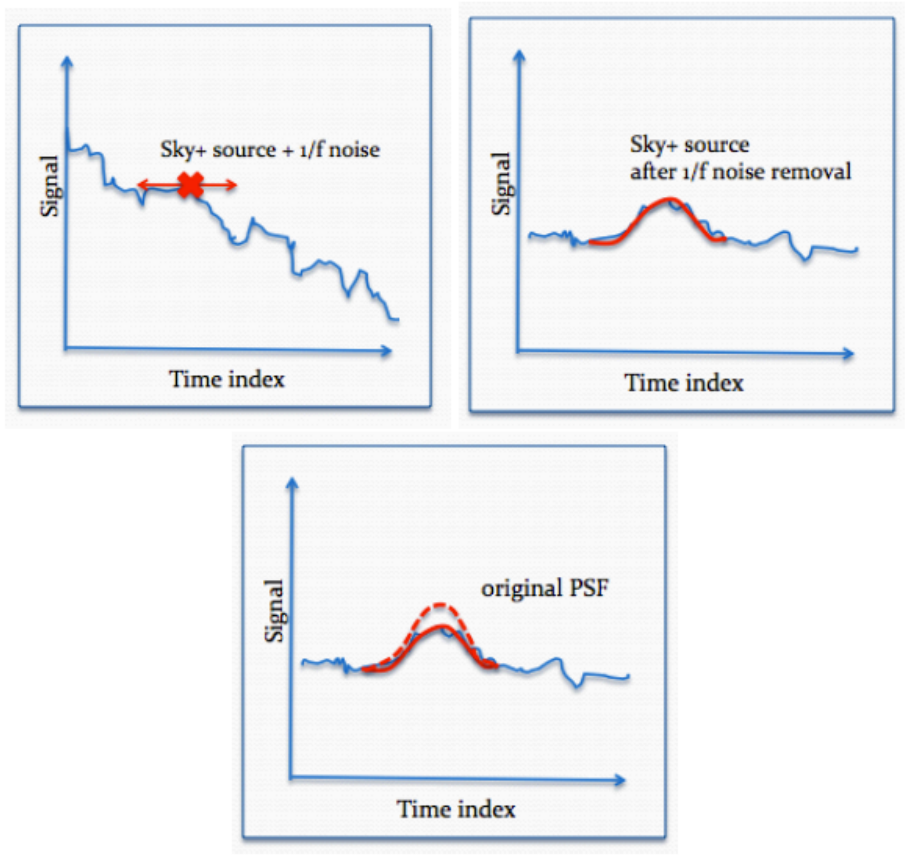




Source masking



Highpass filtering affects PSF / flux

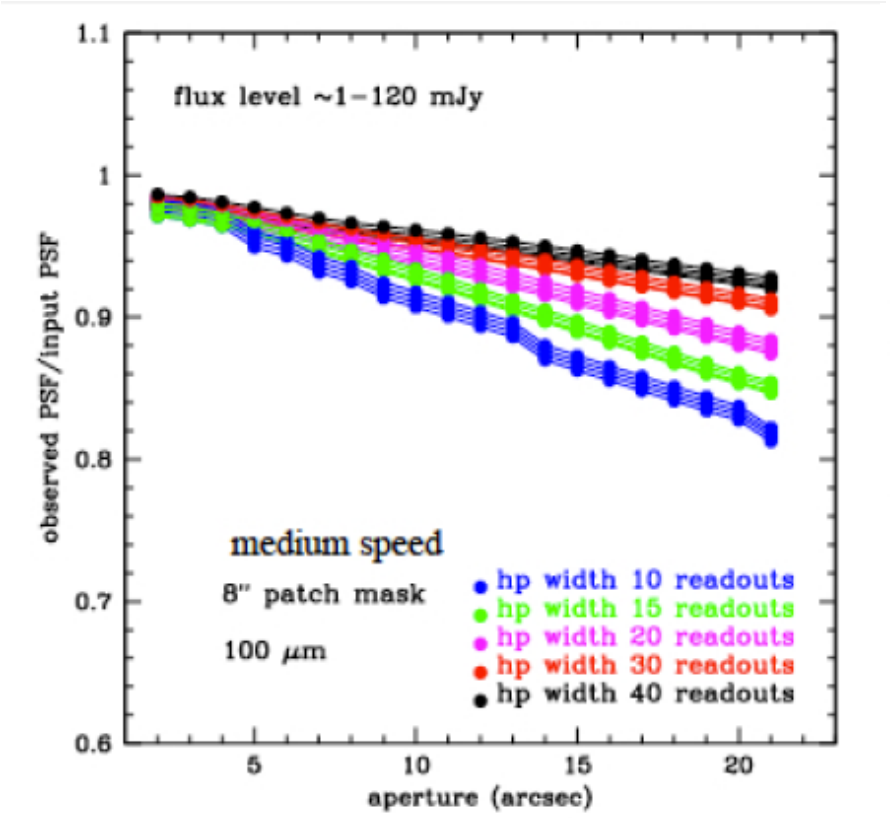


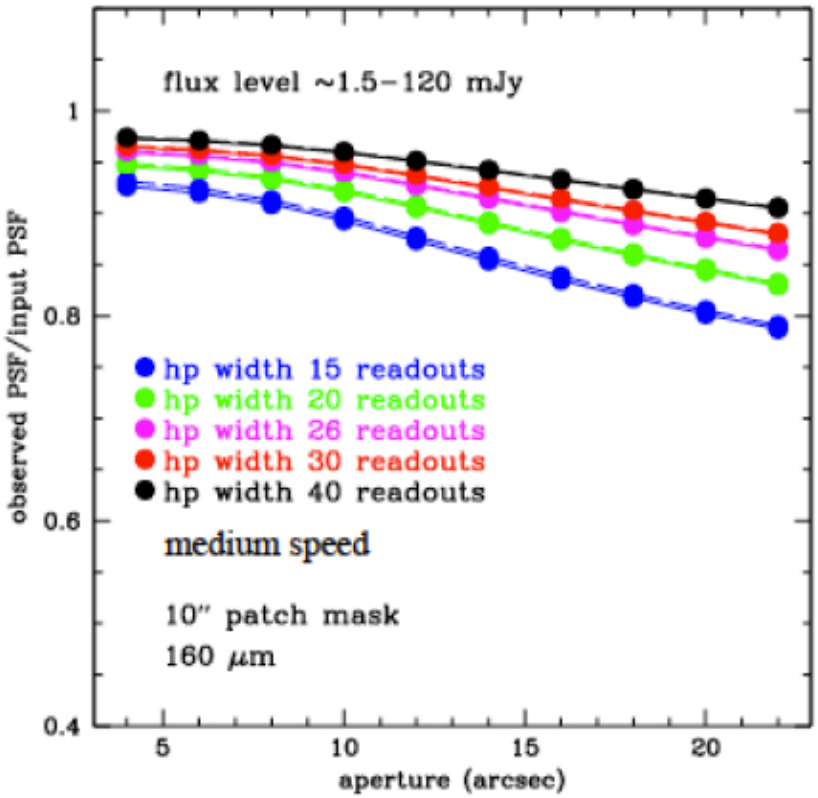
Popesso+2013 A&A (submitted)

Photometry correction

- ✓ Even with masked highpass filtering there is a residual flux loss that can be calibrated with simulations (Popesso+2013)
  - Typically 3-5% depending on size of circular area and highpass filter width.

Correction factors from simulations



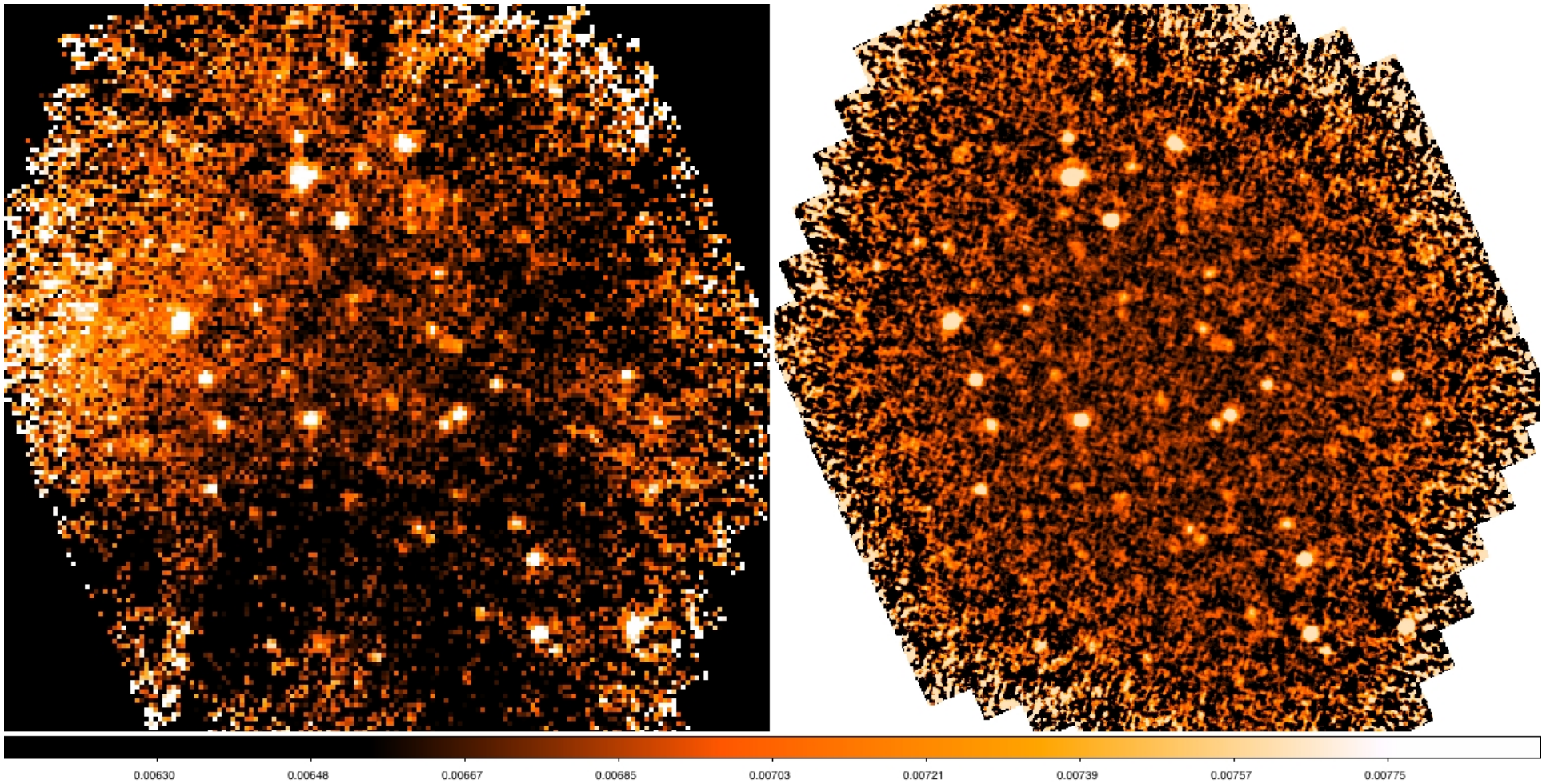


Popesso+2013 A&A (submitted)

MADmap versus photProject on deep fields

HSA SPG8.3 L2.5 MADmap

HSA SPG8.3 L2.5 photProject



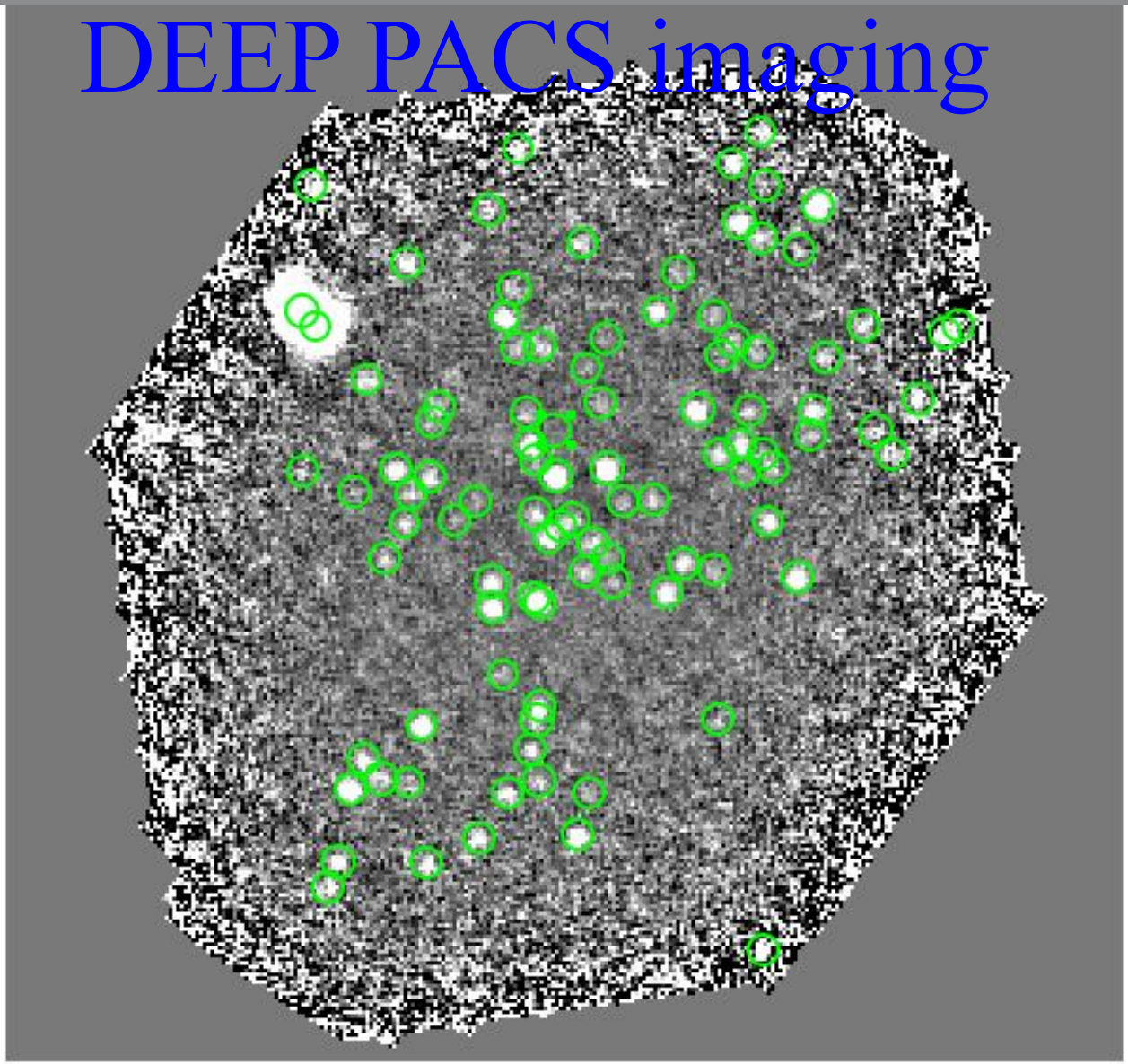
Comparison to other mappers

- Identical (aperture) photometry
- Better sensitivity to faint point-sources, typically 20-40% lower than MADmap, but to be measured/confirmed with other mappers.

	HPF	Scanam	JPScanam	Unimap	Tamasis	Madmap
offset	0.997	0.995	1.002	0.907	1.001	0.968
sigma	0.164	0.213	0.275	0.172	0.200	0.194

Z. Balog e-mail 26/01/13

DEEP PACS imaging



Source flux errors

- Cross-correlated noise between pixels (1/f noise + projection)

- How to derive source flux errors ?
  - ✓ Aperture photomety :
    - Source error in Sextractor not reliable (daophot?)
    - Blank sky aperture photometry (‘noise per beam’)
    - add 5% systematic in quadrature
  - ✓ PSF-fitting tools gives photometry error directly

Conclusion

- **Advantages** of highpass filtered maps:
  1. optimum sensitivity to faint sources
  2. clean flat (zero) background maps without artifacts
  3. can be used for moderately extended sources, a few PSF
  4. fast processing in HCSS with small memory requirements
     - RAM memory need reduced by a factor 2 in Hipe10
  5. consistent photometry with other mappers
- **Drawbacks**
  1. Extended emission filtered out
  2. Cross-correlated noise
     - Significantly mitigated by small drop size
  3. No analytical propagation of the error map
     - But can now be derived from coverage, from P.Popesso simulation: photCoverage2Noise()
     - How to derive source flux errors ?

Acknowledgements

- ✓ **Dieter Lutz**: PSF characterization and focal plane geometry)
- ✓ **Michael Wetzstein**: photProject pipeline and related modules
- ✓ **Paola Poppeso**: simulations of highpass filtering on PSF and photomety and derivation of error map
- ✓ Photometry calibration: **Thomas Müller, Markus Nielbock, Zoltan Balog** et **MPIA** et al.