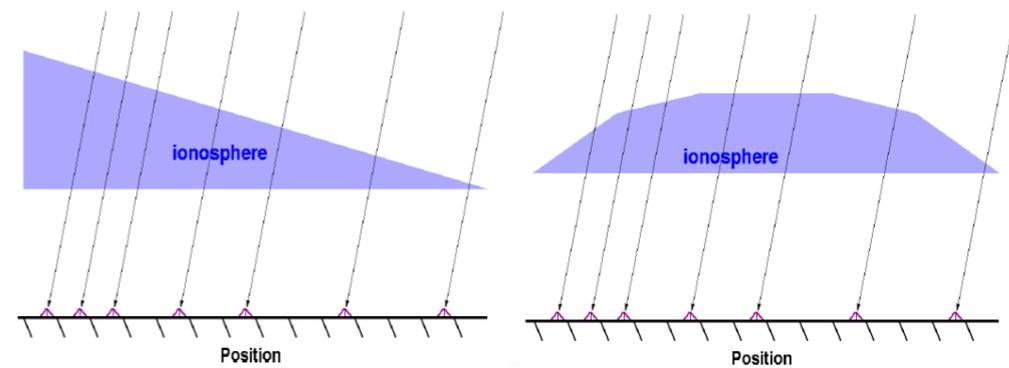
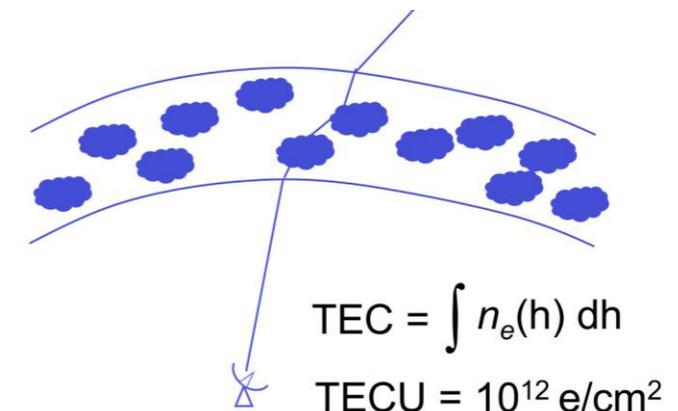


Fitting and testing ionospheric phase screens with MSSS data

David Rafferty
and Bas van der Tol

Introduction

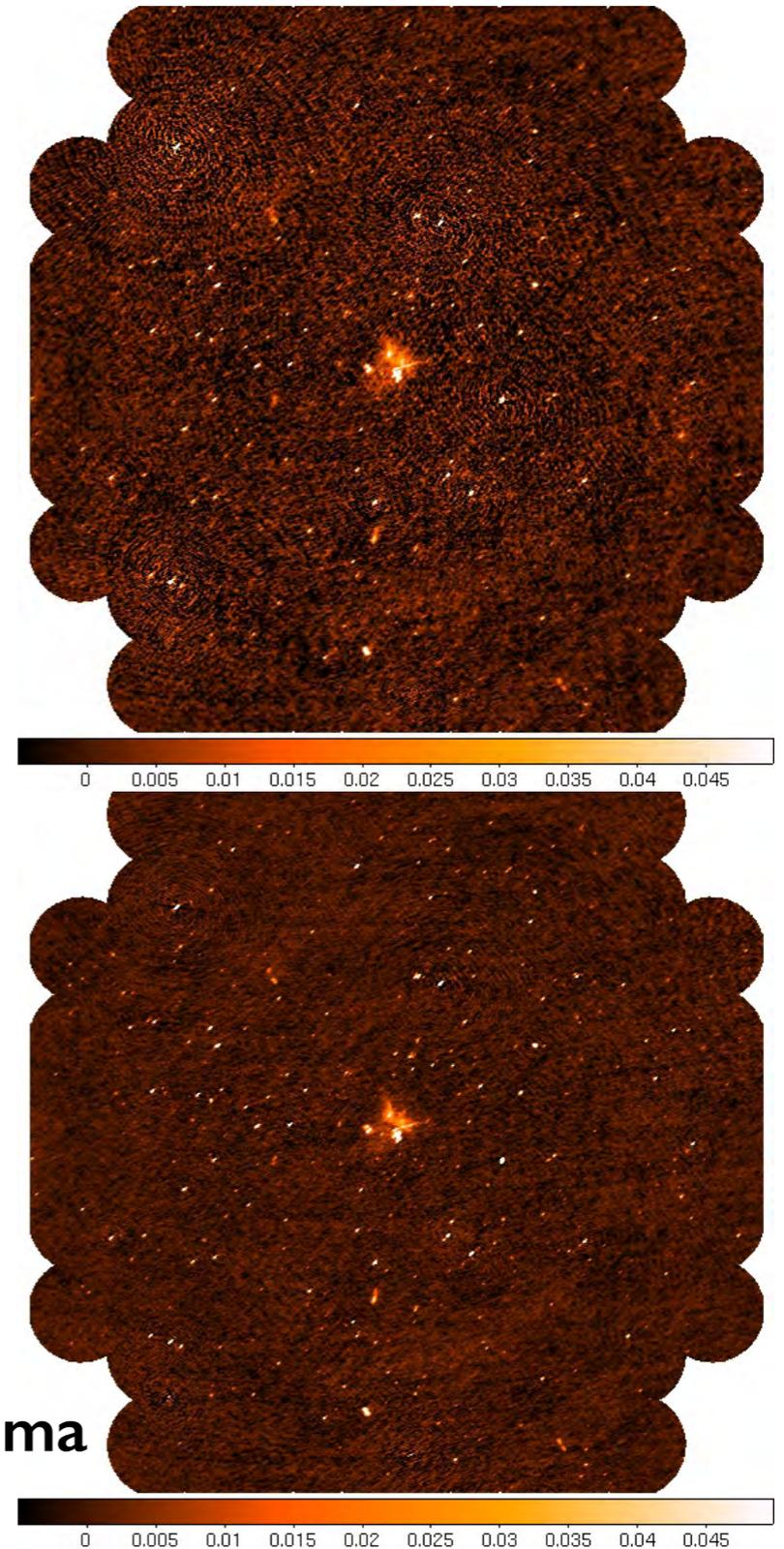
- The ionosphere can cause time- and position-dependent phase shifts
- The SPAM approach assumes that instrumental effects are known and removed, but (so far) this has not been possible with LOFAR
- One solution: use phase differences between sources



Credit: Huib Intema

Introduction

- The ionosphere can cause time- and position-dependent phase shifts
- The SPAM approach assumes that instrumental effects are known and removed, but (so far) this has not been possible with LOFAR
- One solution: use phase differences between sources



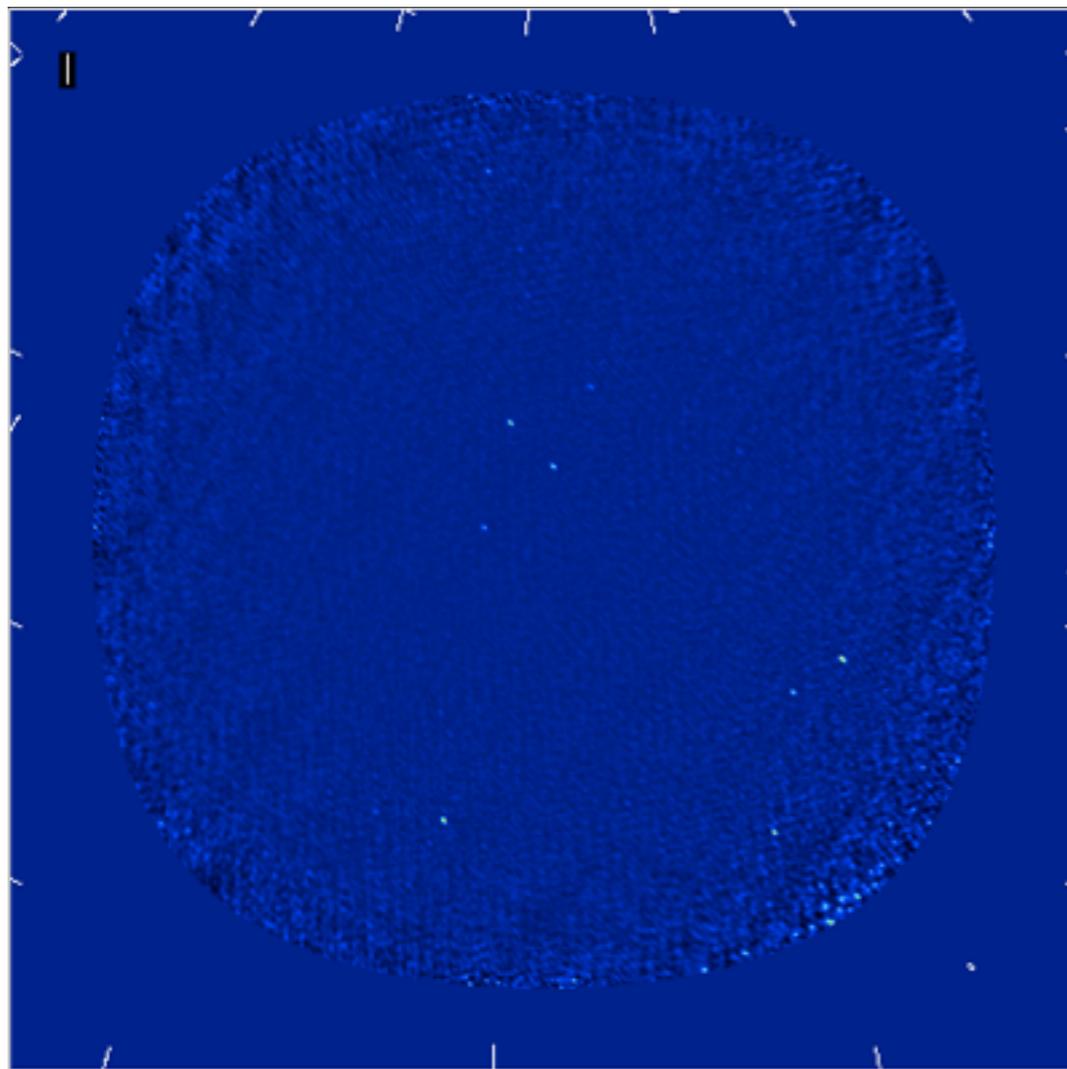
Credit: Huib Intema

Source Differencing

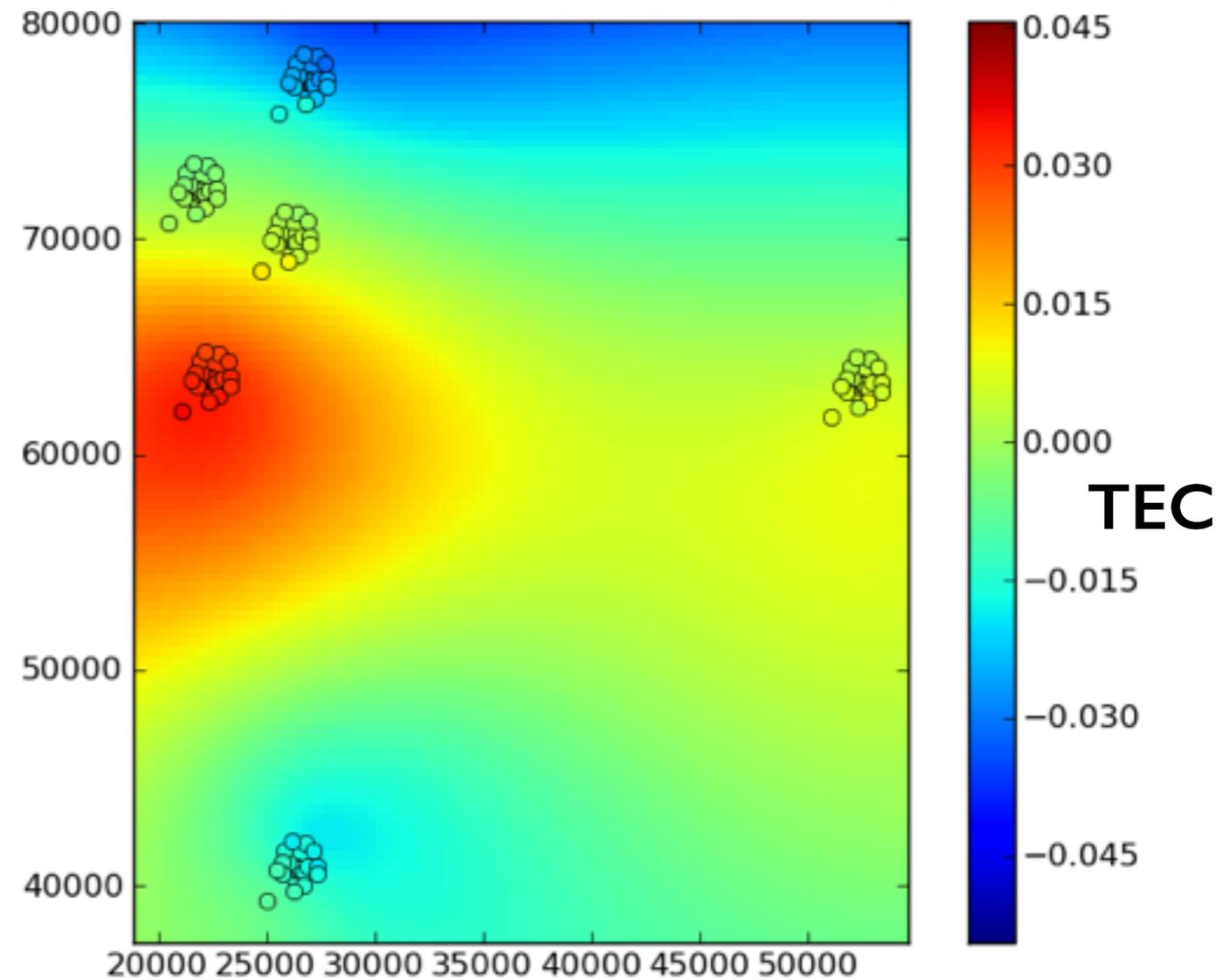
- Perform direction-dependent calibration for bright sources
- Assume that instrumental effects are the same in all directions
- ➔ Subtracting phase solutions for two sources will result in purely direction-dependent (ionospheric) effects
- Test with MSSS (MVF) LBA data

Example Screen

60 MHz image



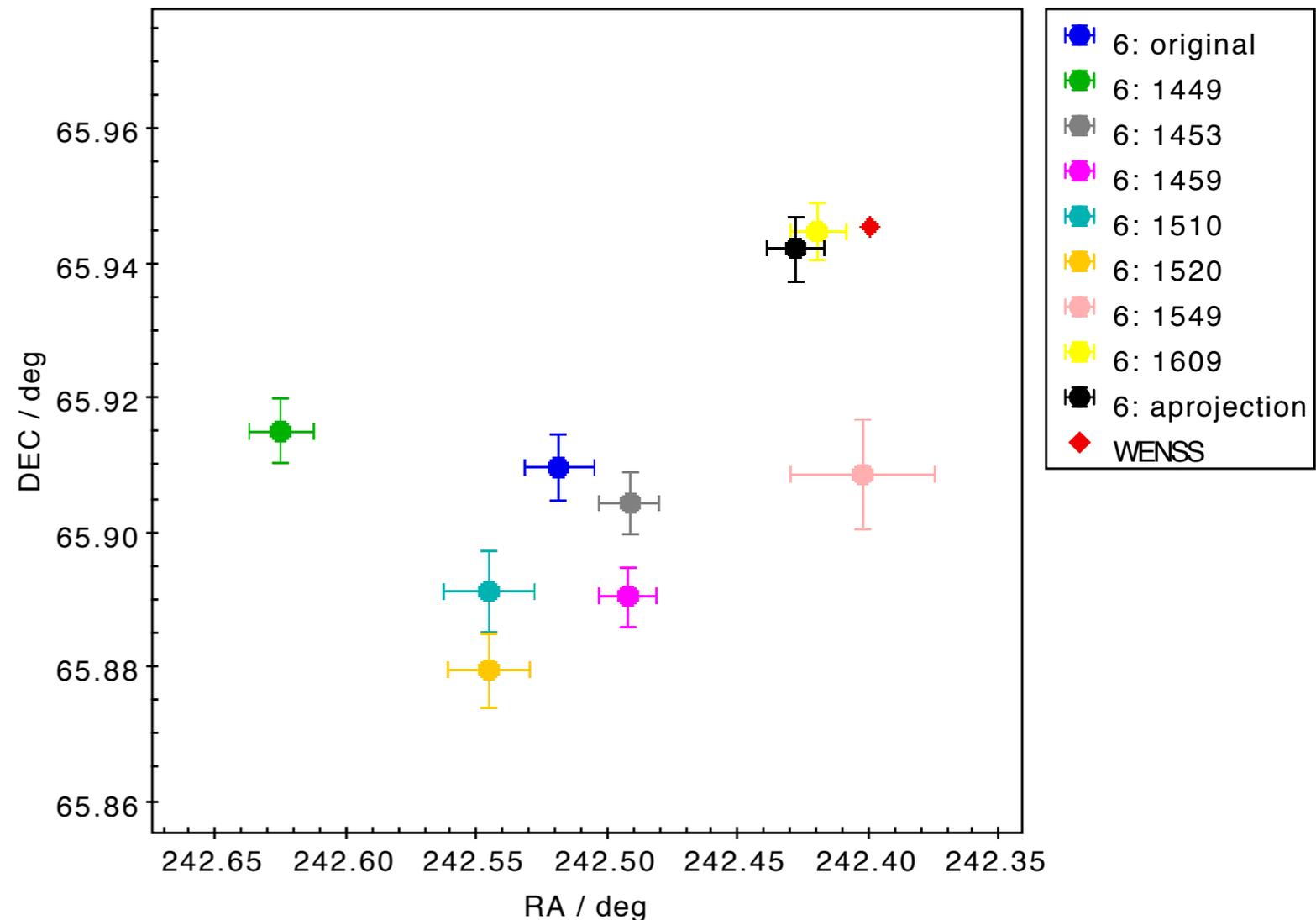
TEC screen (one timeslot)



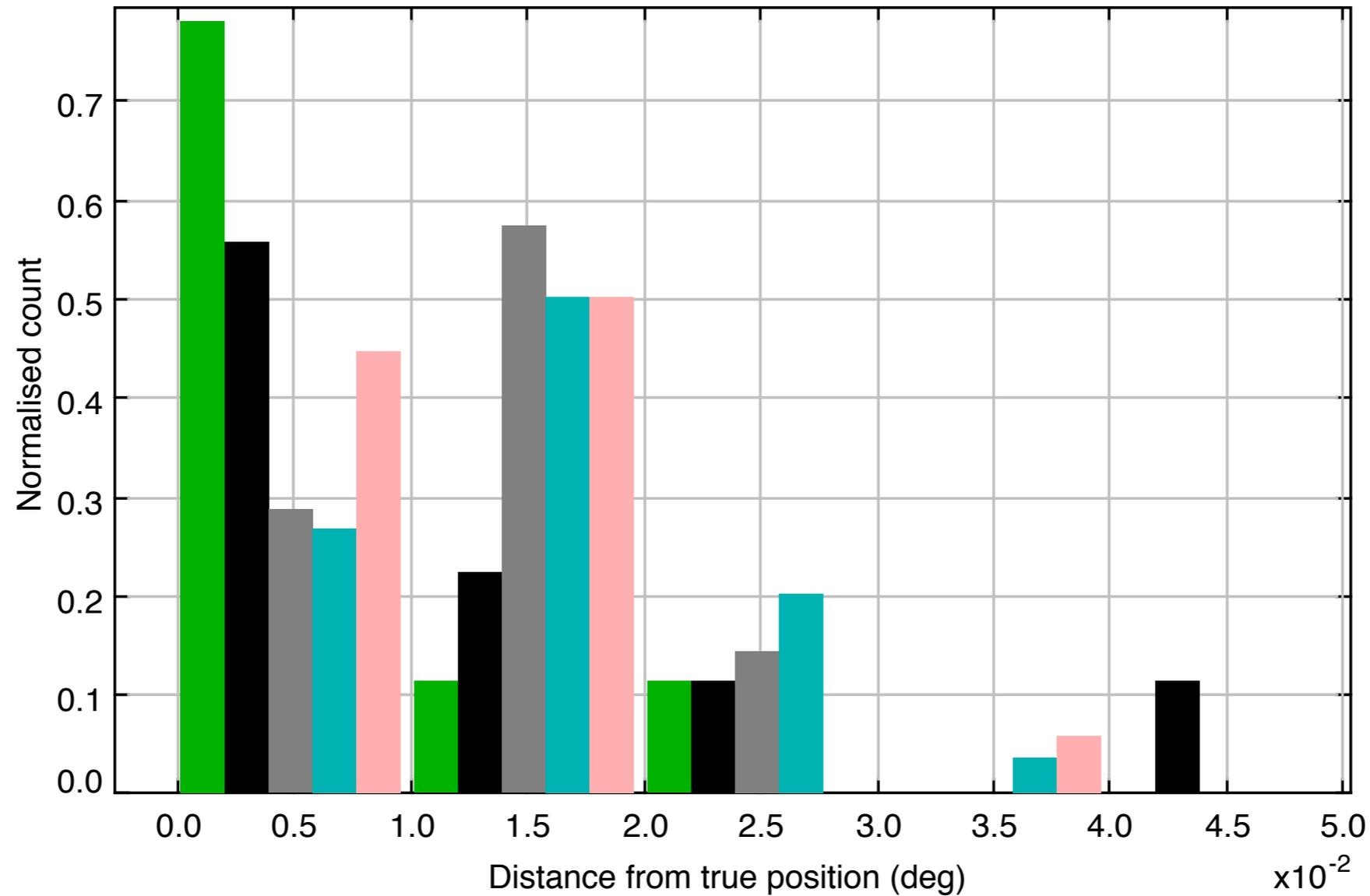
Positional Test

- Use PyBDSM to find positions from Gaussian fits
- Positional error:

$$\sim \frac{FWHM}{2.35 \times SNR}$$



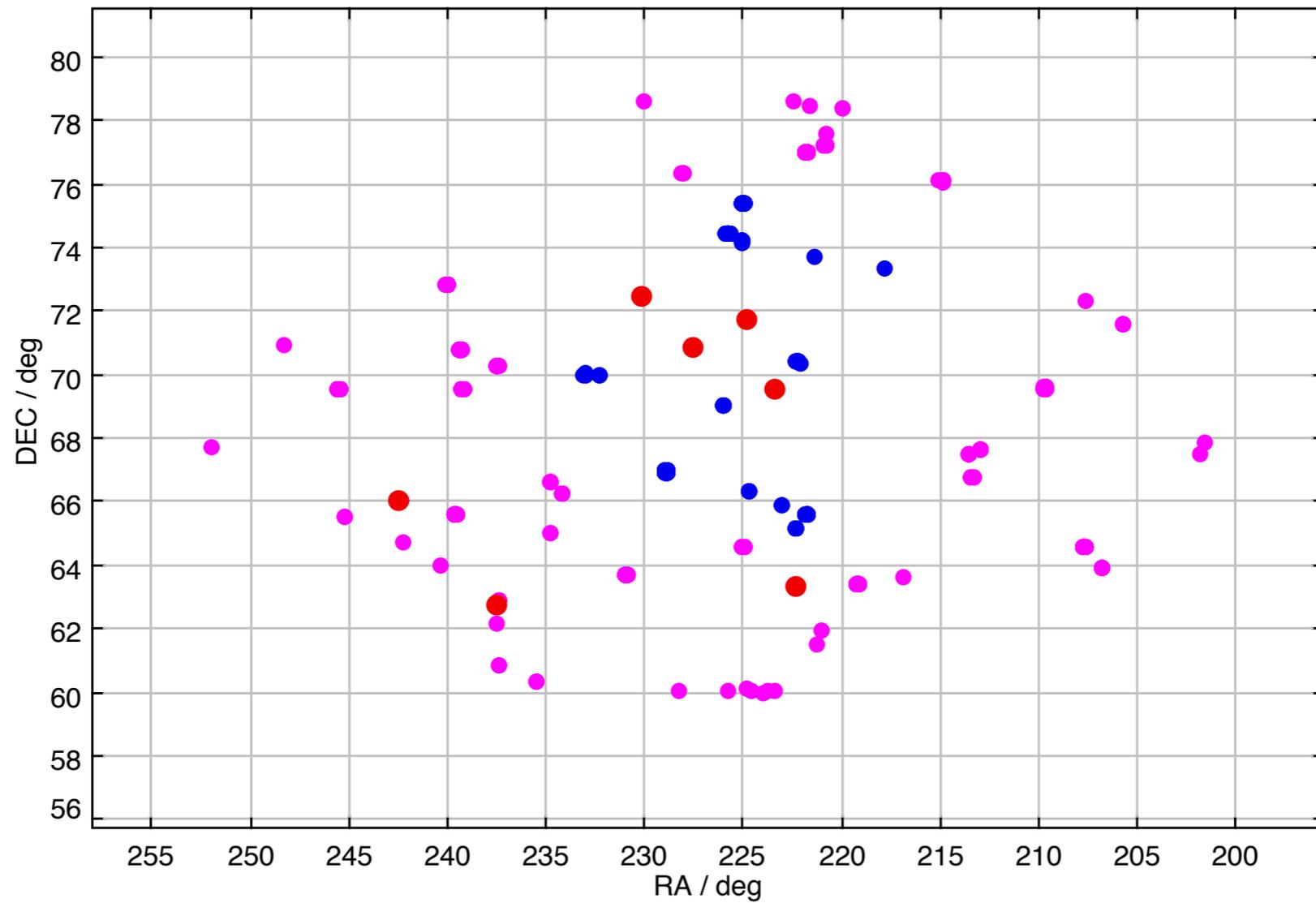
Positional Tests



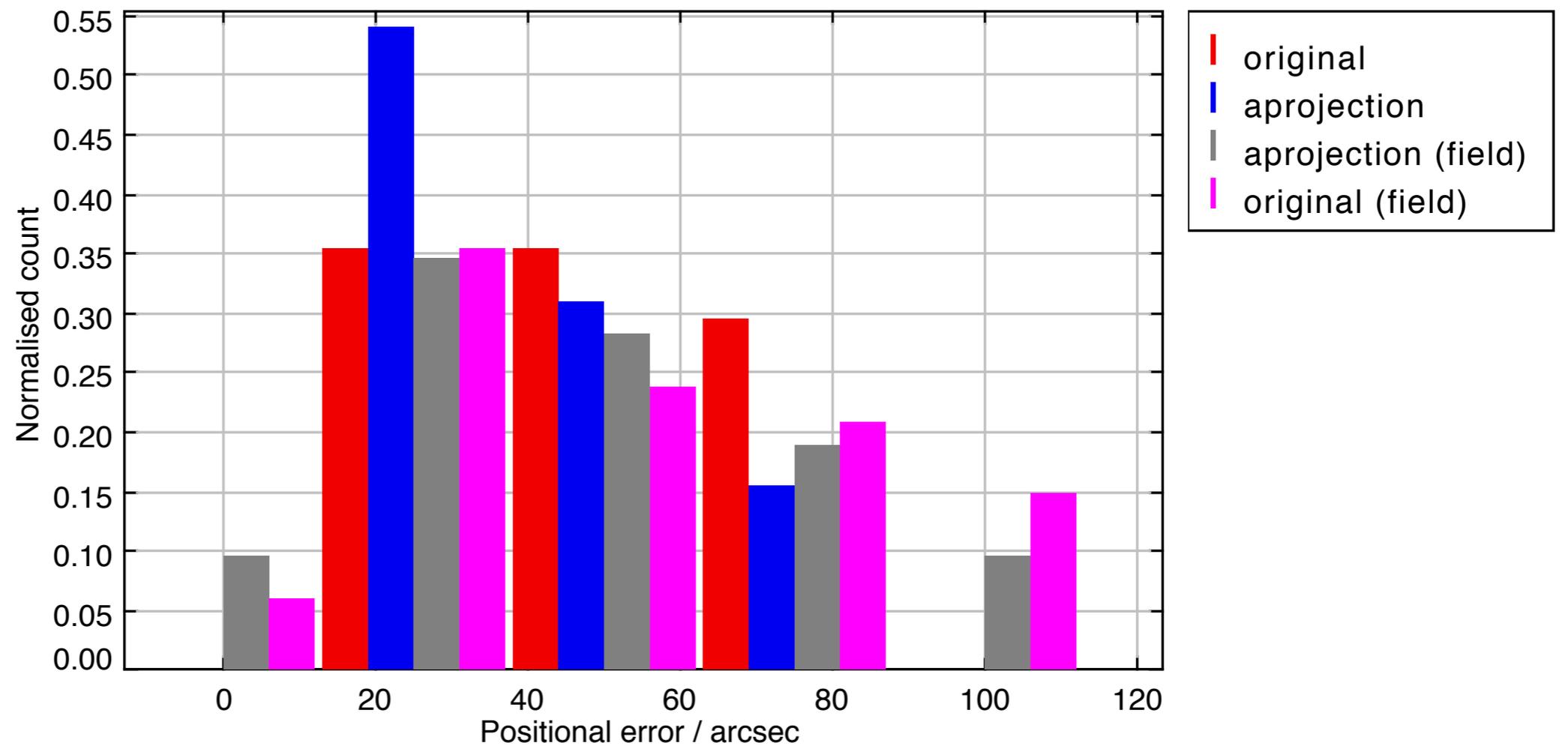
- D < 5000 arcsec
- D < 5000 arcsec (orig)
- 5000 < D < 10000 arcsec
- 10000 < D < 15000
- D > 15000 arcsec

D is distance to nearest phase-screen calibrator

Positional Tests

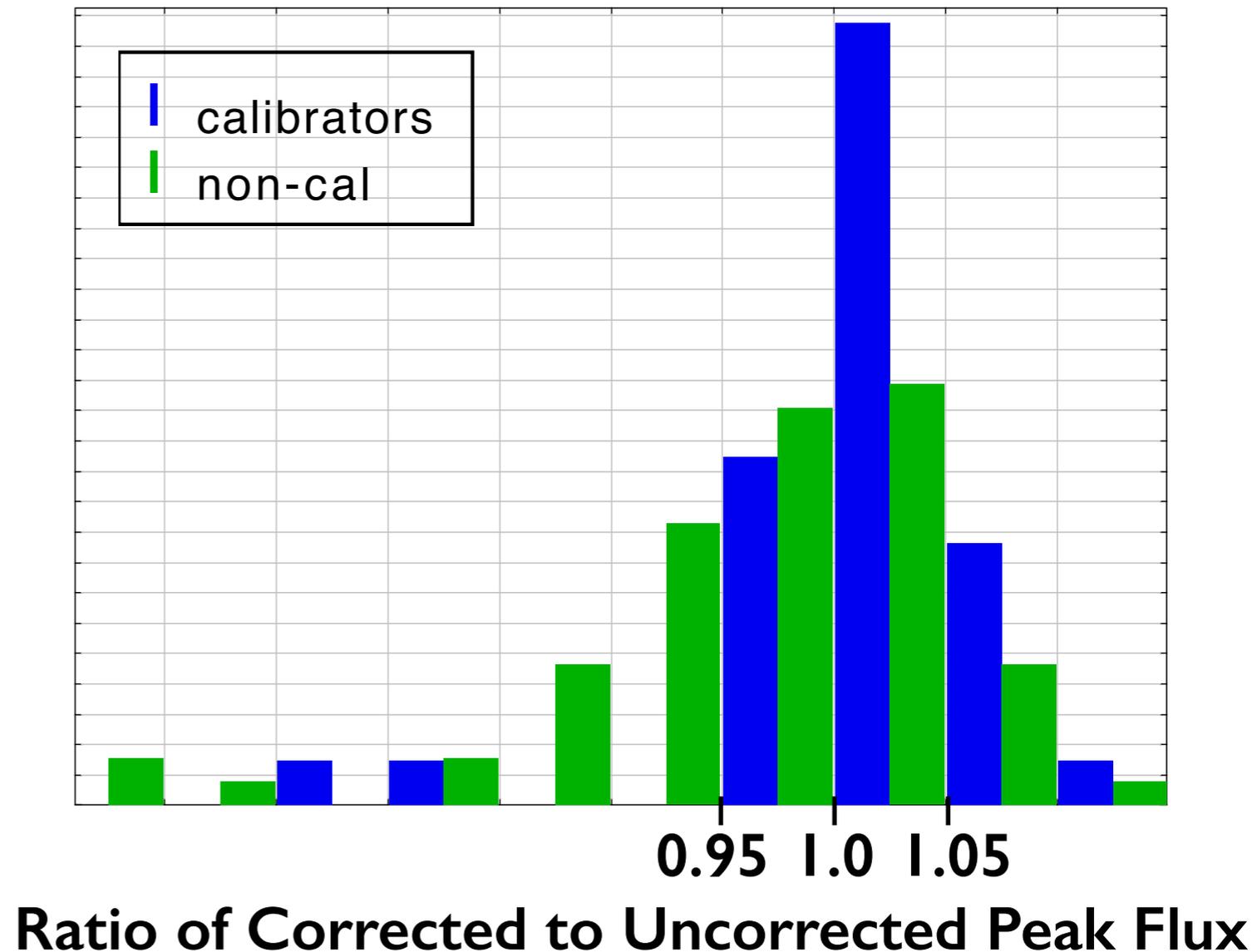


Positional Tests



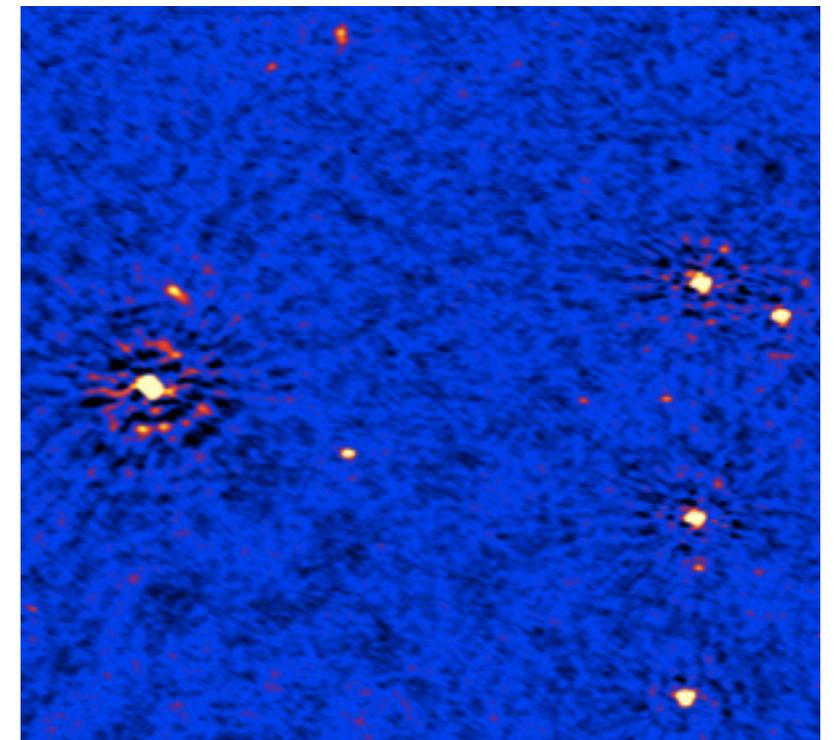
Peak Fluxes

- Peak flux in final image decreases as source moves around
- However, peak flux is not as easy to compare, due to flux offsets from snapshot to snapshot that are not known accurately



LBA Wide-field Science

- Example of wide-field LBA image (3C295):
 - Formal rms ~ 5 mJy/beam \Rightarrow 5-sigma point source sensitivity limit of 25 mJy
 - But, “real” limit is ~ 50 – 75 mJy due to smearing (and other calibration issues)
 - Complicates cataloging (completeness, etc.)



60 MHz image of 3C295 field
Credit: Reinout van Weeren

Future Work

- Source differencing approach looks promising, but phase screens do not improve sources $\approx 1-2$ degrees away from the calibrators
- Recalibration with flanking fields to obtain more calibrators + adding remote stations = more pierce points = better phase screens