

LOFAR commissioning results for the FAN region

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Sky region and data set info

LOFAR id : L41885

- * 12 h HBA observation @ 110-174 MHz on 07-08 Jan 2012
- * 244 SBs (0.18 MHz bandwidth, 2 sec)
- * CR(48) + RS(9)

Fan region:

- * mostly located in the 2nd Galactic quadrant at low positive Galactic latitudes
- * spatially extended ($\sim 100^\circ \times 30^\circ$), highly polarized and synchrotron bright region

Target field:

- * the phase center of the FOV @ $(l,b) = [137^\circ, +7^\circ]$
- * no bright sources ($< 2\text{Jy}$)
- * earlier deep (noise @ 1 mJy/beam) and low freq WSRT observation of the same field @ 110-174 MHz (see Bernardi et al. 2009)

 Initial skymodel based on WSRT primary beam corrected map:

- * list of clean components describing only point sources (and Stokes I info)
- * using a constant spectral index of $\alpha = -0.8$

Reduction strategy

- * Initial RFI flagging + time/freq avg to 1 channel and 2 sec
- * Removal of the two A-team sources CAS and CYG A
but from DATA avg to 1 channel and 20 sec; subtraction of visibilities from full time resolution data provided maps with a noise level about 2.5 times higher
- * BBS (single direction) calibration of the target field visibilities
- * Identification and removal of bad data per antenna,
- * RFI flagging of CORR DATA column
- * Imaging with CASA (no uv-taper) and extraction of a new skymodel
- * SAGEcal self-calibration to correct for direction dependent effects
- * RFI flagging of CORR DATA column
- * Imaging with CASA (widefield, no uv-taper) and AW-imager (main beam field)

Imaging (CASA)

Continuum emission
map @145-174 MHz
(144 SBs)

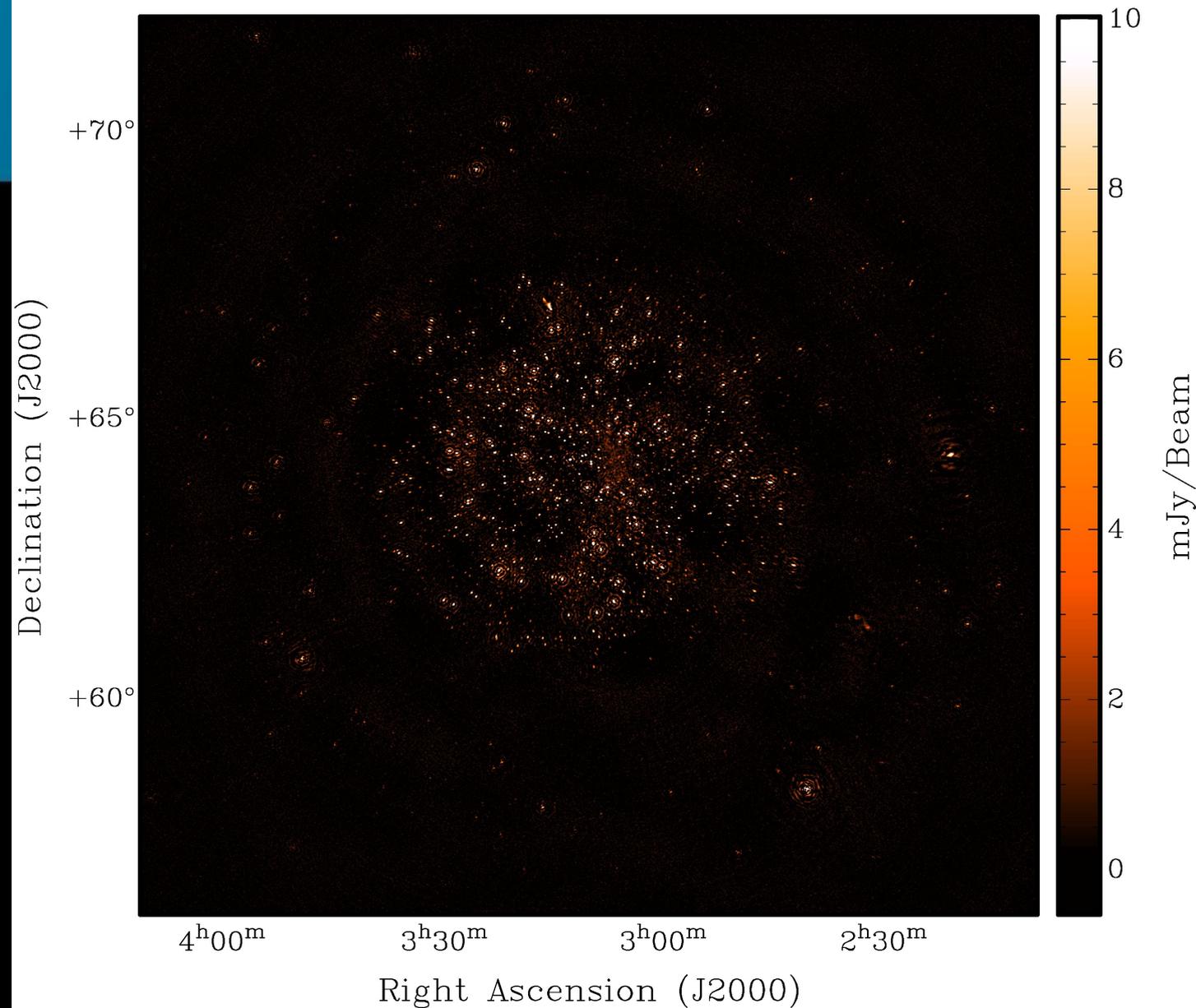
Ref. Freq ~160 MHz

Pixel size 20"

Psf size 86"x74"

Noise 0.4 mJy/beam

Brightest sources in
the imaged field out of
the main beam with
evident artifacts:
4C+58.08, 4C+62.02.



Imaging (CASA)

Continuum emission map @145-174 MHz
(144 SBs)

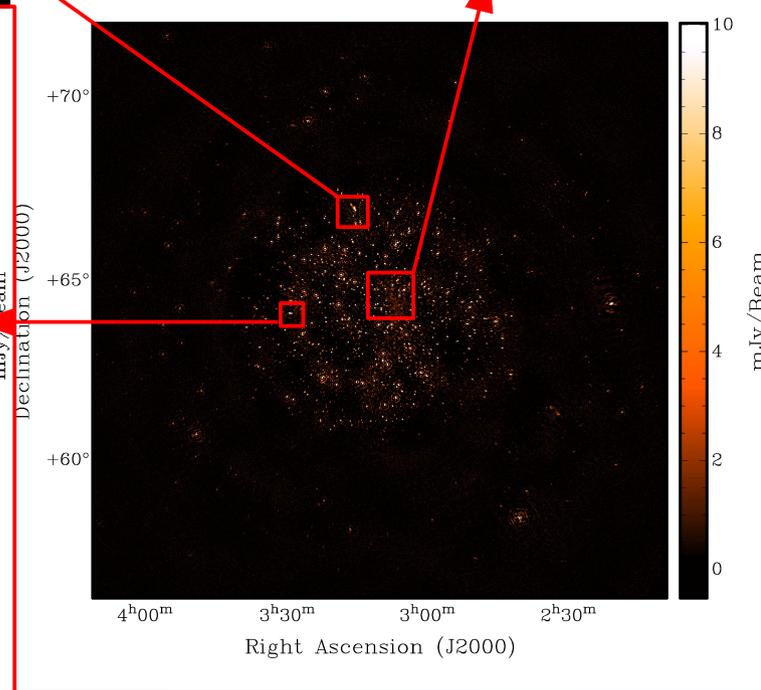
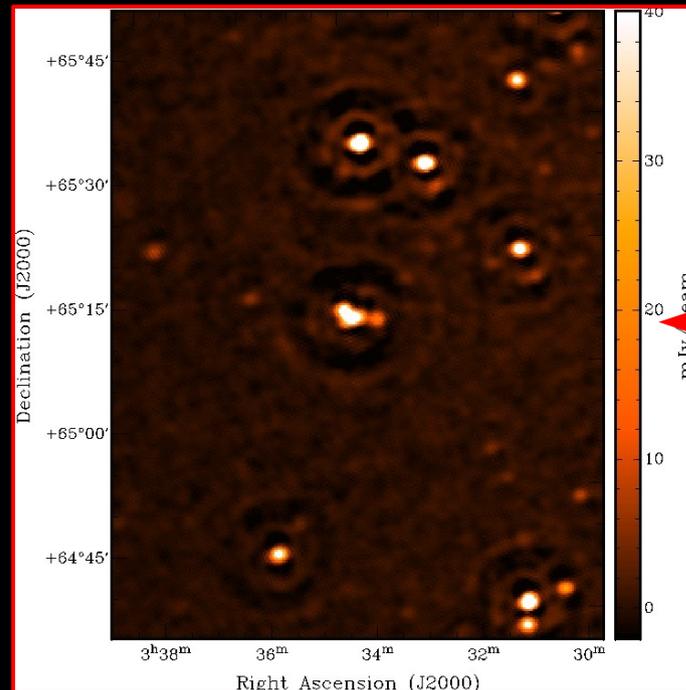
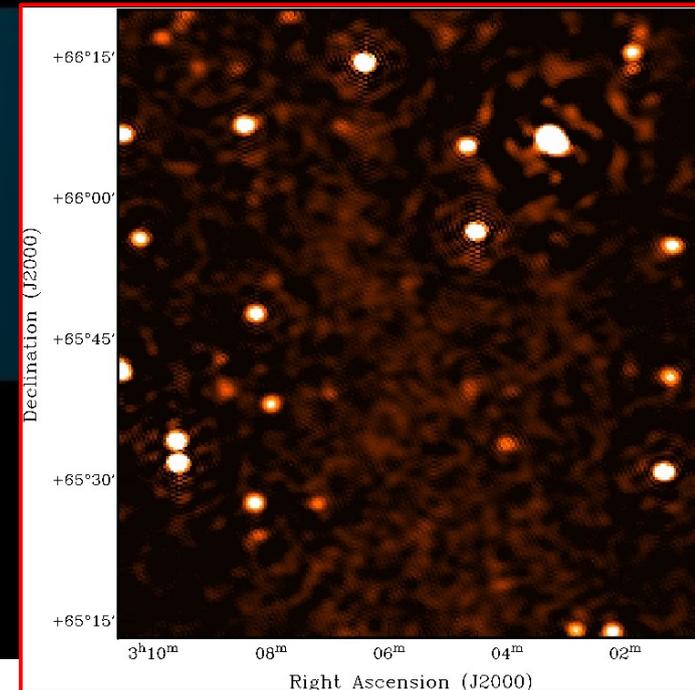
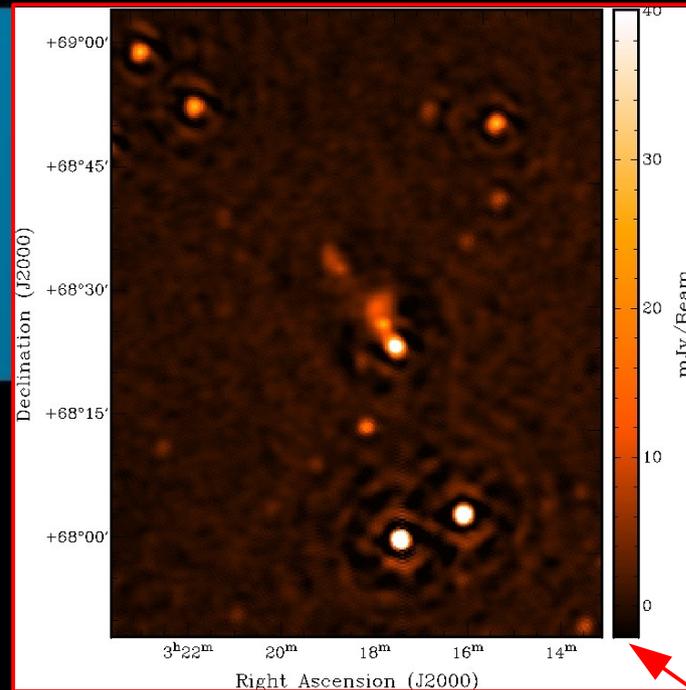
Ref. Freq ~160 MHz

Pixel size 20"

Psf size 86"x74"

Noise 0.4 mJy/beam

Brightest sources in the imaged field out of the main beam with evident artifacts:
4C+58.08, 4C+62.02.



Imaging (AW-imager)

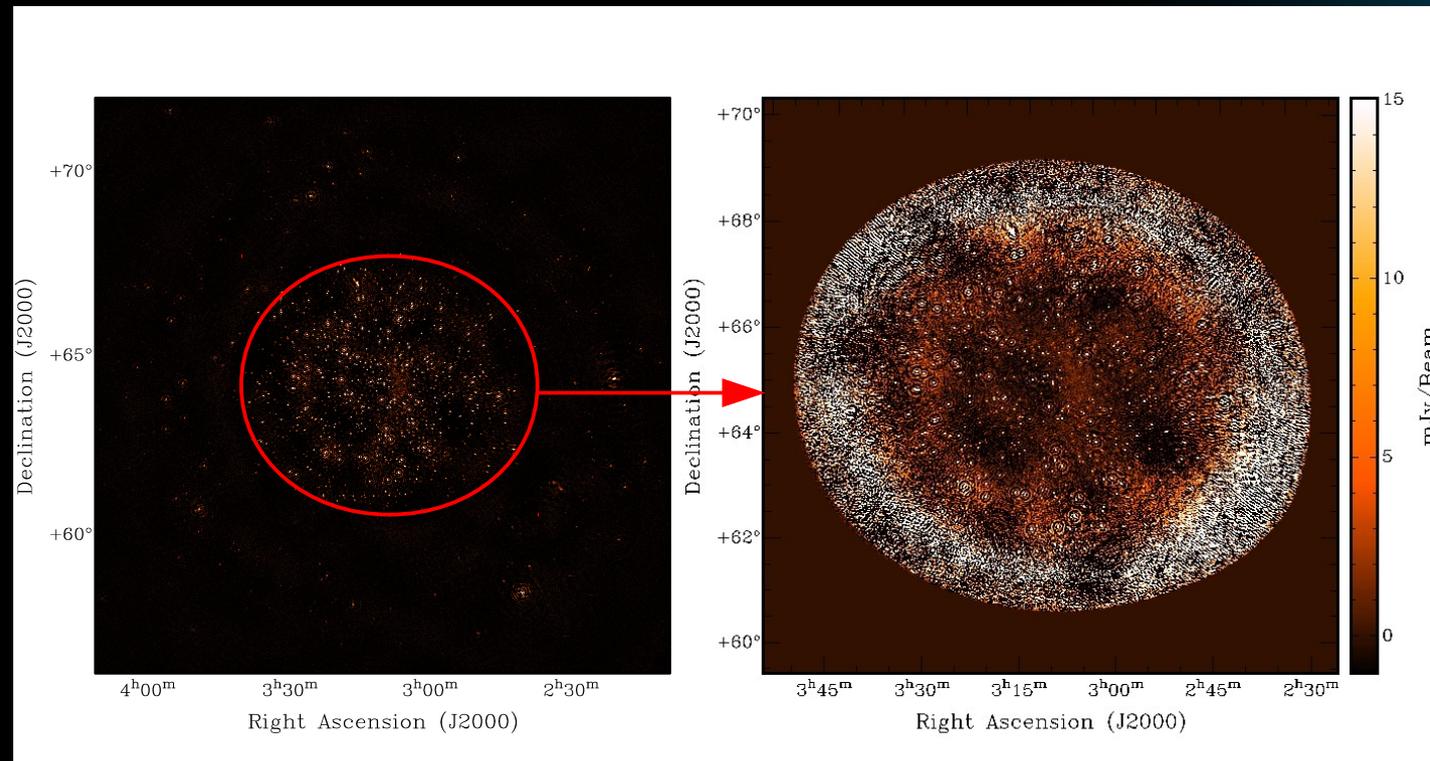
Continuum emission map @145-174 MHz (126 SBs) and corrected for the beam attenuation

Ref. Freq ~160 MHz

Pixel size 20"

Psf size 80"x70"

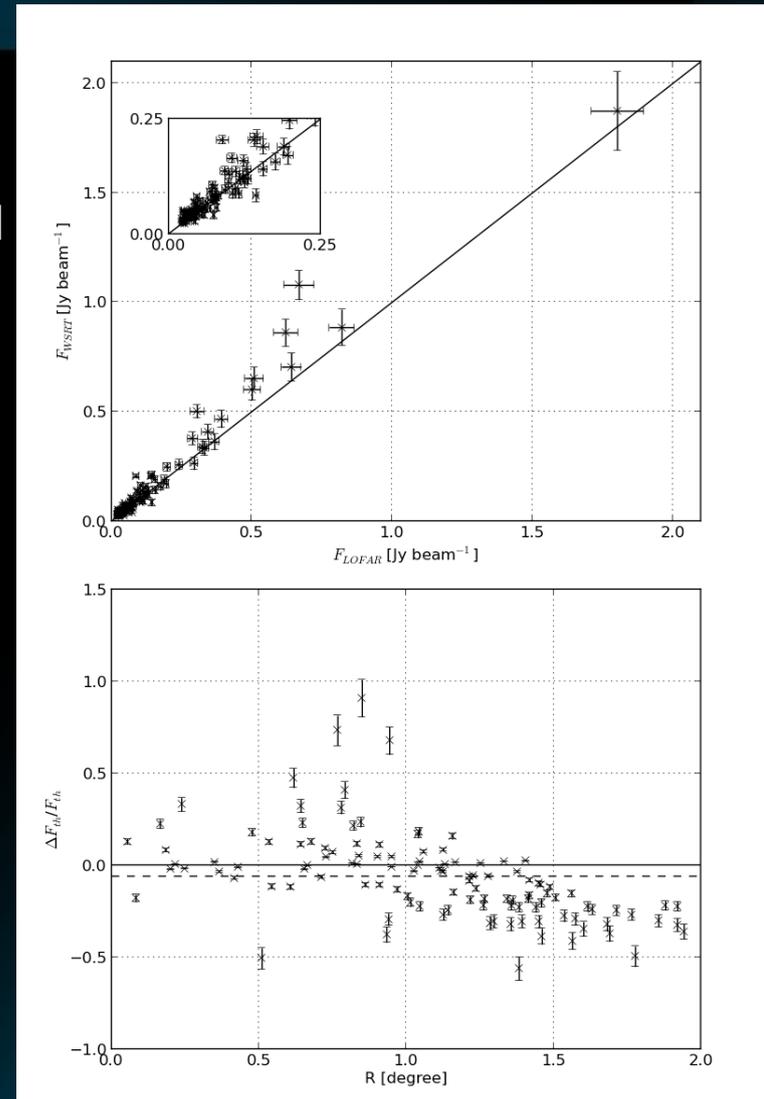
Noise 0.55 mJy/beam



LOFAR vs WSRT data: point sources

Comparison between the LOFAR peak fluxes rescaled to 150 MHz and the WSRT fluxes at 150 MHz within a $3^\circ \times 3^\circ$ region around the phase center.

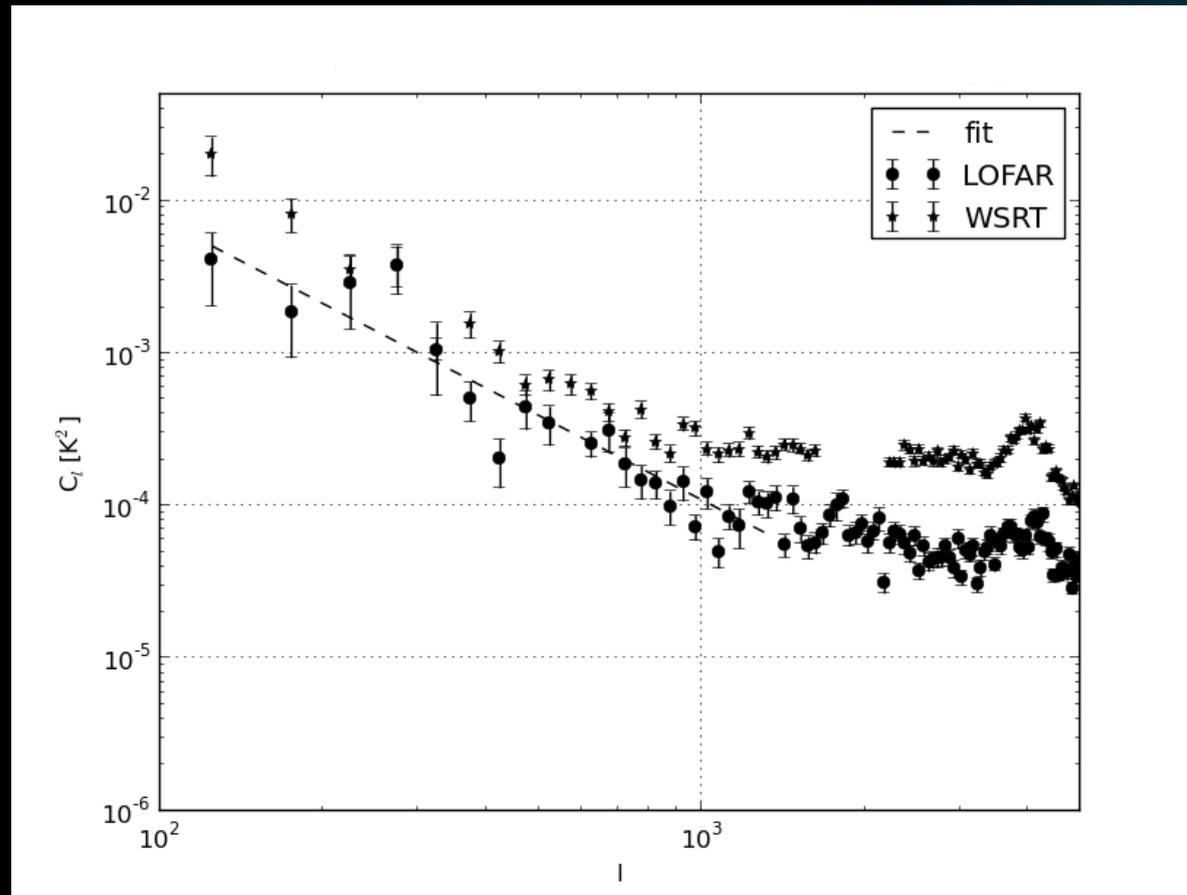
The normalized peak flux differences between point sources in the LOFAR and WSRT observations as a function of radial distance.



LOFAR vs WSRT data: (Galactic) diffuse emission

Point sources identified and extracted using the PyBDSM software.

The residual map: an extended pattern of fluctuations + evident artifacts around bright sources.



Summary

- * We present the first LOFAR detection and imaging of the Galactic diffuse synchrotron emission around 160 MHz from the highly polarized Fan region.
- * Such a diffuse and faint 160 MHz continuum is seen in both CASA / AW maps, at a level of about 3 mJy/beam in agreement with the earlier WSRT detection.
- * The differences in flux of point sources in the LOFAR and WSRT data vary as a function of their radial distance from the field center.
- * The normalized flux difference as a function of the radial distance from the field centre shows a systematic decrease at scales larger than 1° . An evident scatter of data points is also seen over the entire range of radial distances, indicating a limited accuracy of the calibration procedure and/or the LOFAR beam model (e.g. a non negligible azimuthal dependence).