

Effelsberg sensitivity problem

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Effelsberg sensitivity problem

- problem with DE601HBA
 - ★ low sensitivity
 - ★ position dependent sensitivity
 - ★ best measurements with pulsars
- result of bad station calibration?
- would not cause variations with position
- There must be some other problem!

Beam mapping

- want to know more than sensitivity in beam centre
- try mapping the beam
- options
 - ★ interferometric (George Heald)
scheduling not trivial, less signal on long baselines
 - ★ single-station pulsar (Masaya Kuniyoshi)
may need several subbands per beam
 - ↪ single-station with bright (non-pulsar) sources
disadvantage: maybe contamination from other sources

Beam mapping experiments

- 21/22 August 2012 single station DE601 HBA
- > 200 beamlets around CygA/CasA to map the beam shape
- same subband for all, switch subbands
- record beamlet statistics, subband statistics and local correlations in parallel
- hope: find something weird that can be fixed easily
- 27/28 August 2012 for comparison: DE603, DE605
- many more details here: http://www.astro.uni-bonn.de/~wucknitz/wiki/doku.php/lbg:single:start#effelsberg_hba_sensitivity_problem

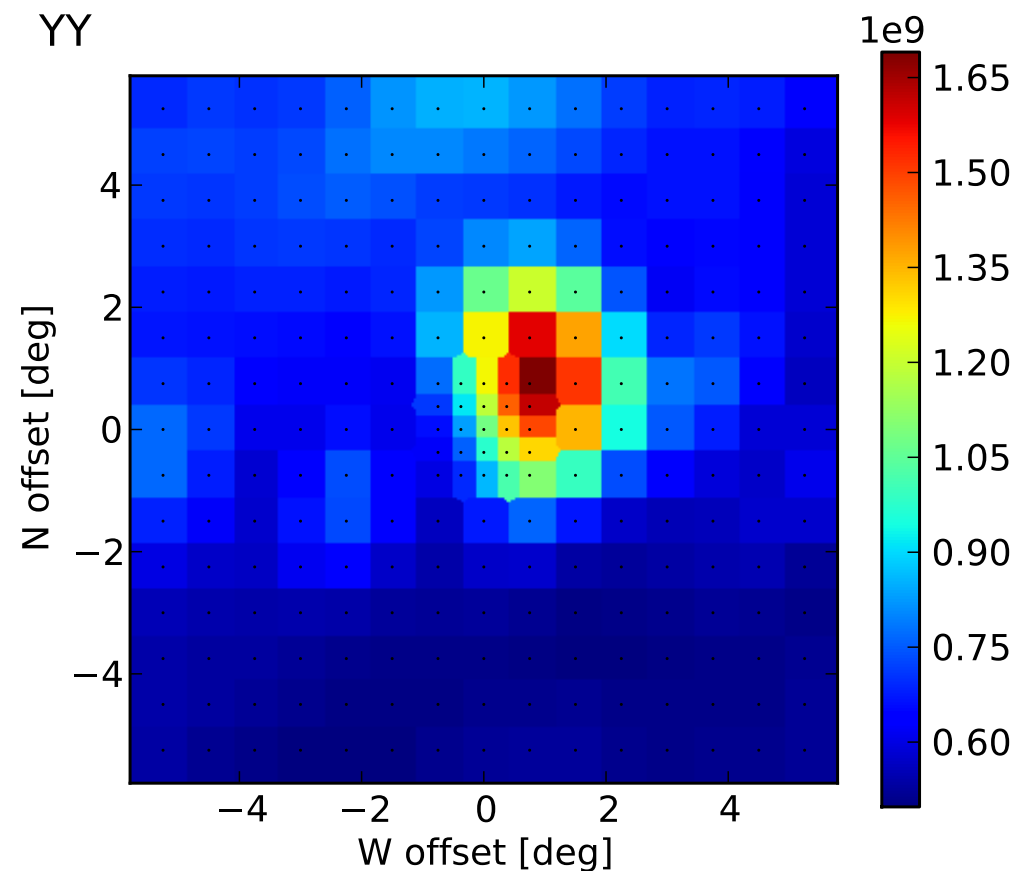
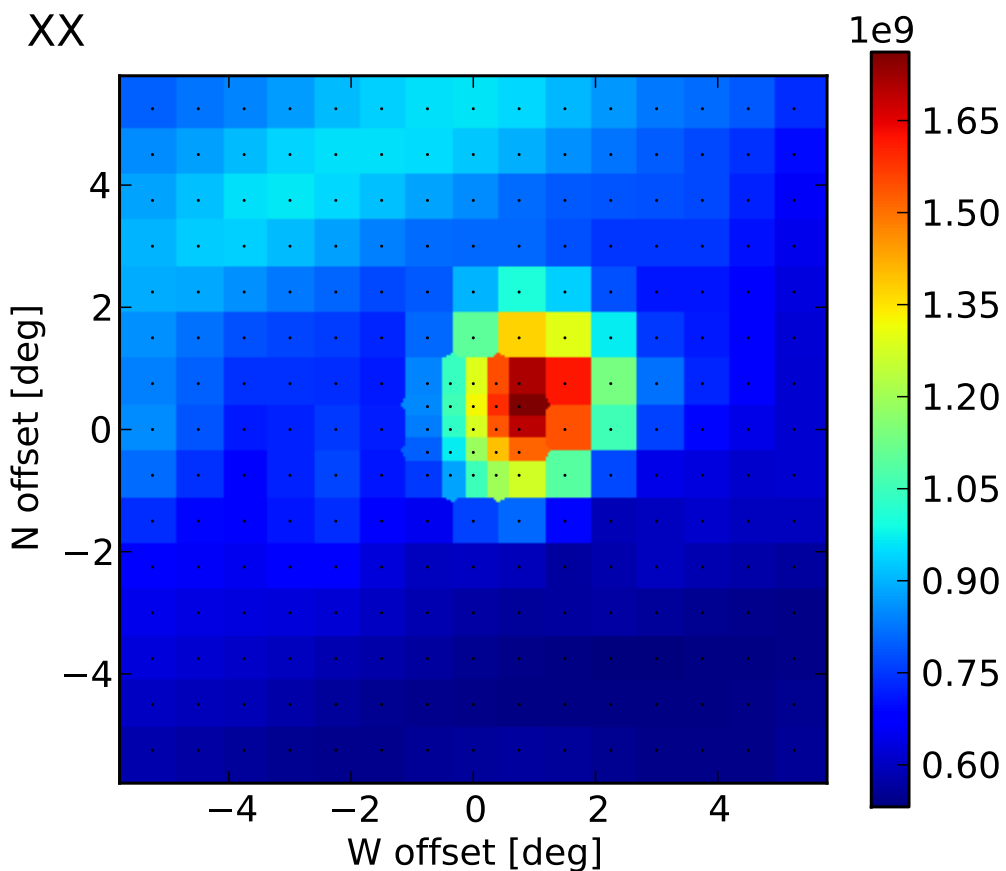
CasA subband 310 (160.5 MHz) in RA/DEC, every 3 h

CasA subband 310 tilebeam 1

sample 0 UT 19:48:20 = 71300 sec

min 5.314378e+08 max 1.761608e+09
diff 1.230170e+09 mean 7.845581e+08

min 4.975875e+08 max 1.690305e+09
diff 1.192717e+09 mean 7.015766e+08



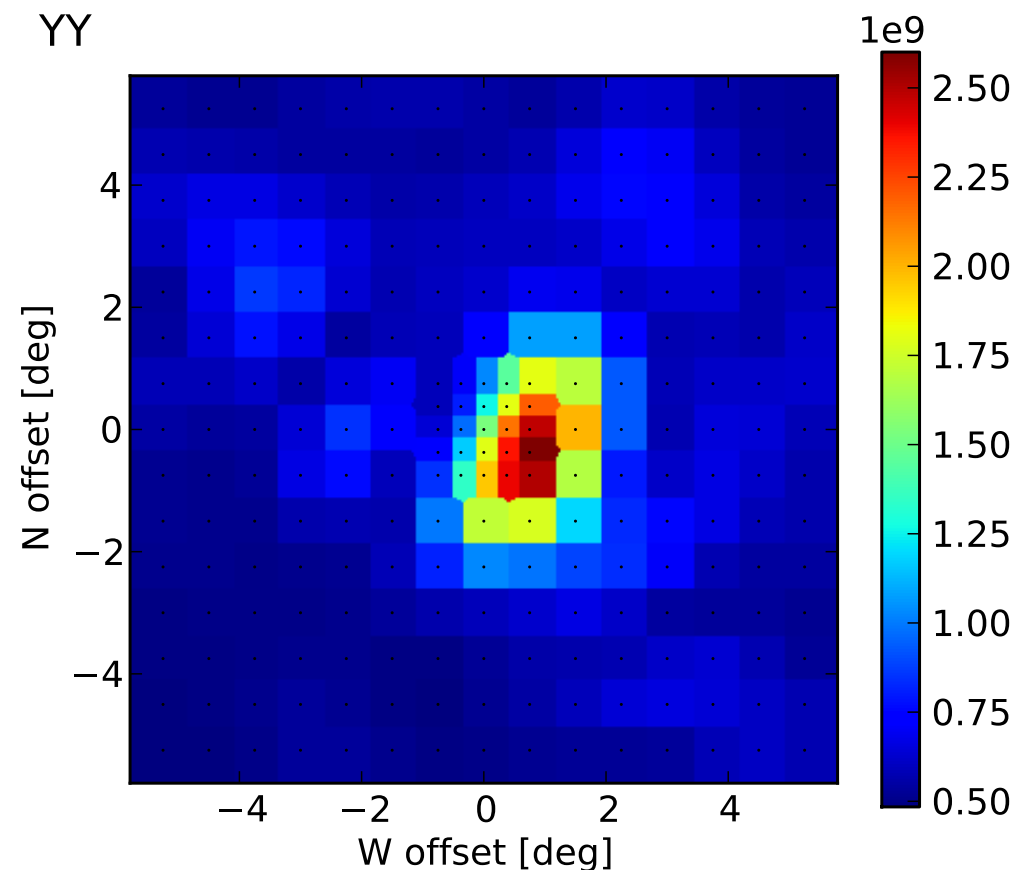
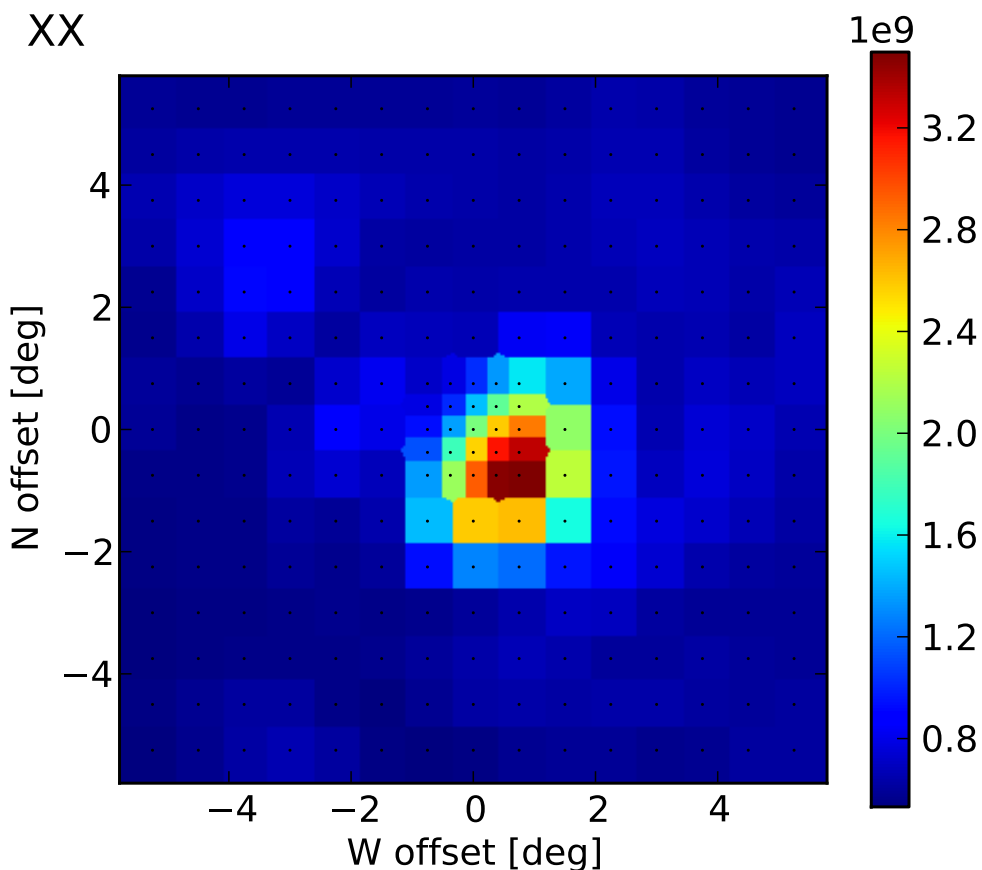
CasA subband 310 (160.5 MHz) in RA/DEC, every 3 h

CasA subband 310 tilebeam 1

sample 9 UT 22:48:20 = 82100 sec

min 5.315078e+08 max 3.498050e+09
diff 2.966542e+09 mean 8.272715e+08

min 4.842694e+08 max 2.600468e+09
diff 2.116199e+09 mean 7.317169e+08



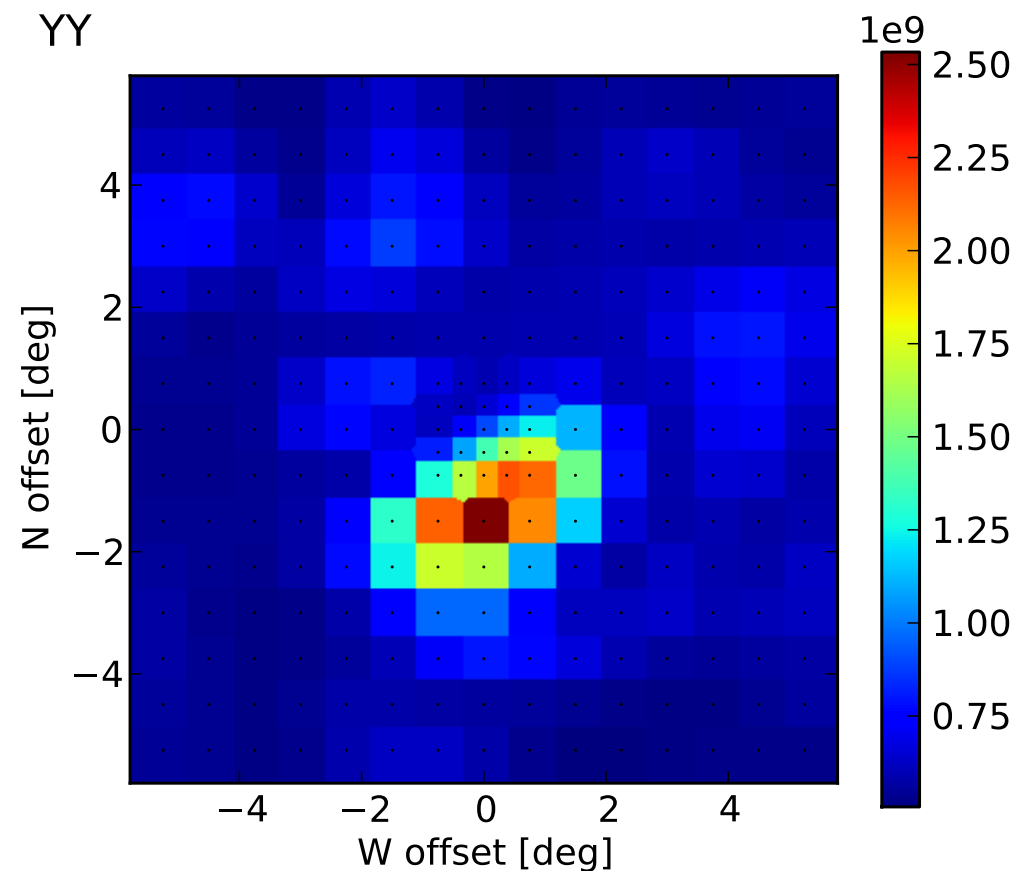
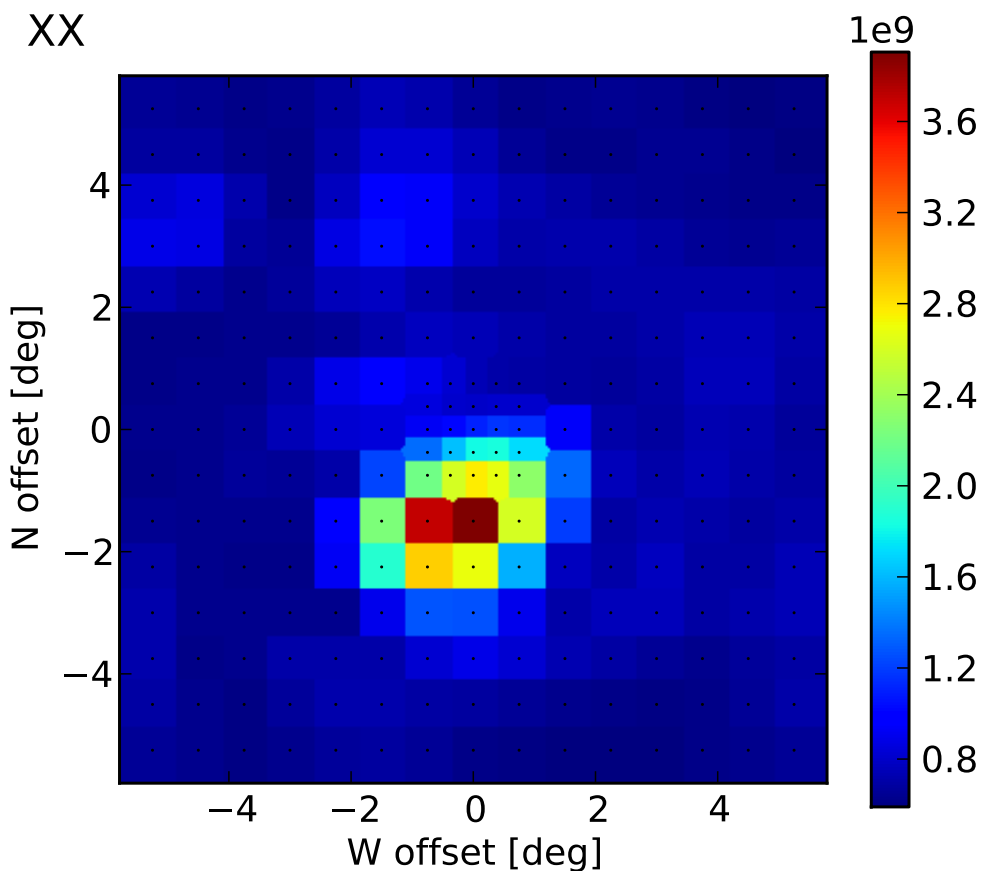
CasA subband 310 (160.5 MHz) in RA/DEC, every 3 h

CasA subband 310 tilebeam 1

sample 18 UT 01:48:20 = 92900 sec

min 5.898789e+08 max 3.904897e+09
diff 3.315018e+09 mean 8.527233e+08

min 5.057916e+08 max 2.533360e+09
diff 2.027568e+09 mean 7.069368e+08



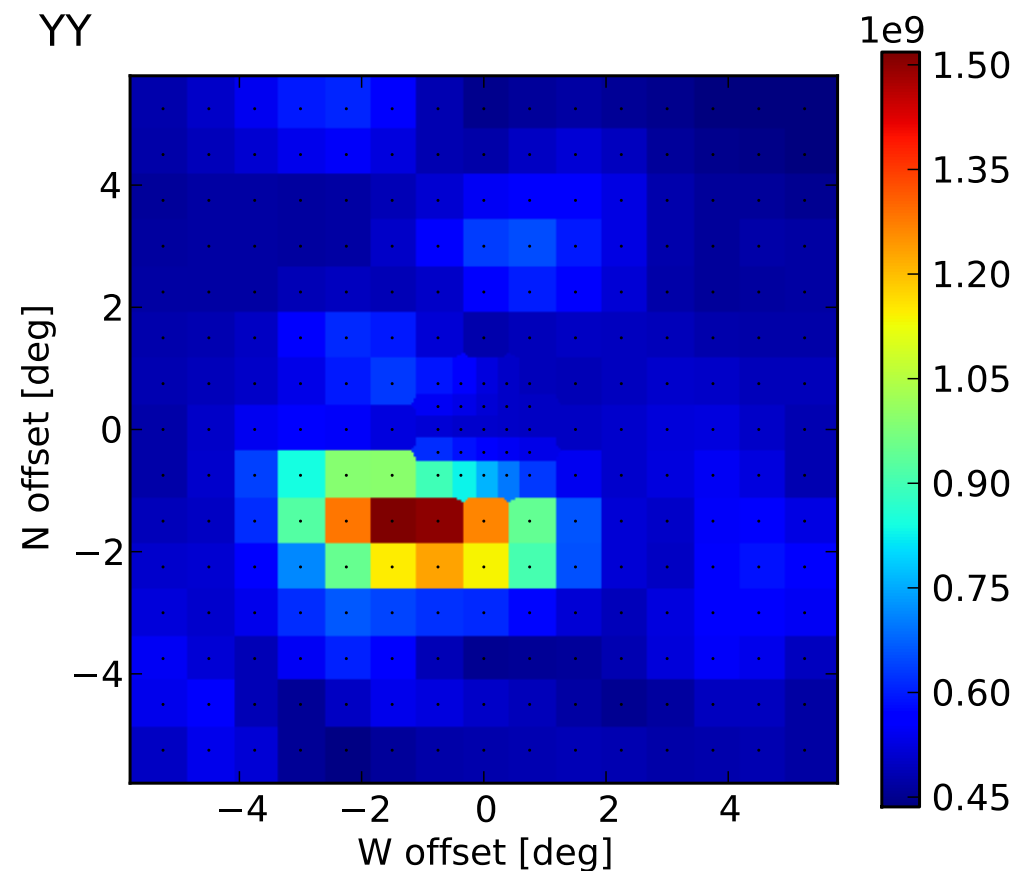
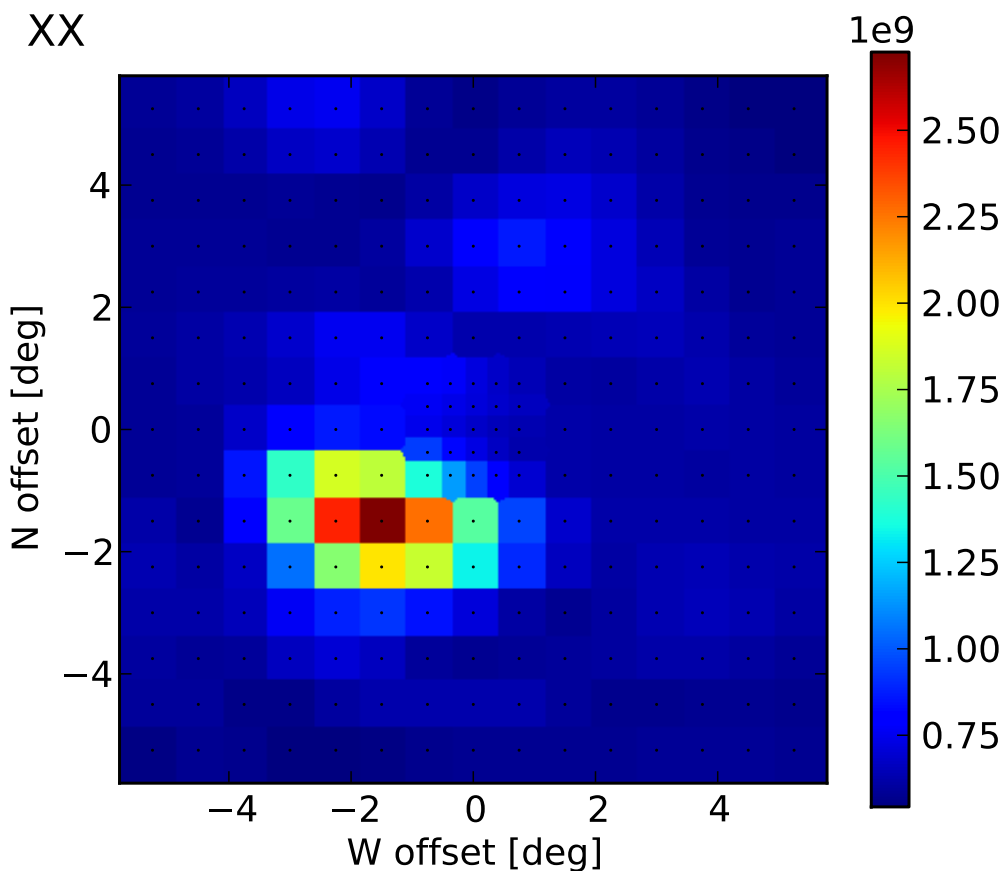
CasA subband 310 (160.5 MHz) in RA/DEC, every 3 h

CasA subband 310 tilebeam 1

sample 27 UT 04:48:20 = 103700 sec

min 5.427267e+08 max 2.726298e+09
diff 2.183571e+09 mean 7.156592e+08

min 4.359150e+08 max 1.518338e+09
diff 1.082423e+09 mean 5.569576e+08

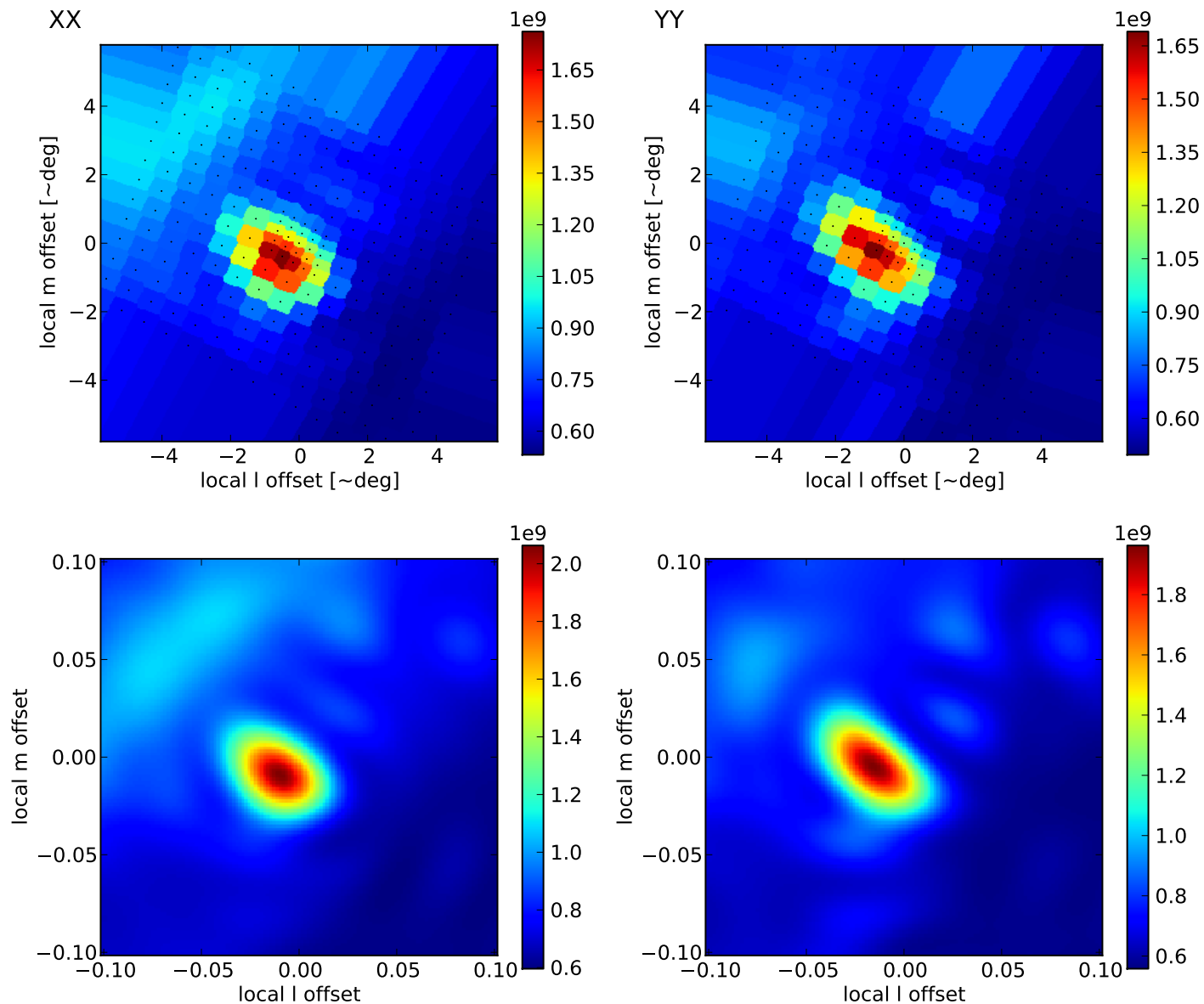


CasA subband 310 (160.5 MHz) in I/m, every 3 h

CasA subband 310 tilebeam 1 sample 0 UT 19:48:20 = 71300 sec

lmn = (0.502590, 0.451792, 0.737081)
az (N->E) 48.0 deg el 47.5 deg

(local station coordinates)
top: beamformed, bottom: imaging



CasA subband 310 (160.5 MHz) in l/m, every 3 h

CasA subband 310 tilebeam 1

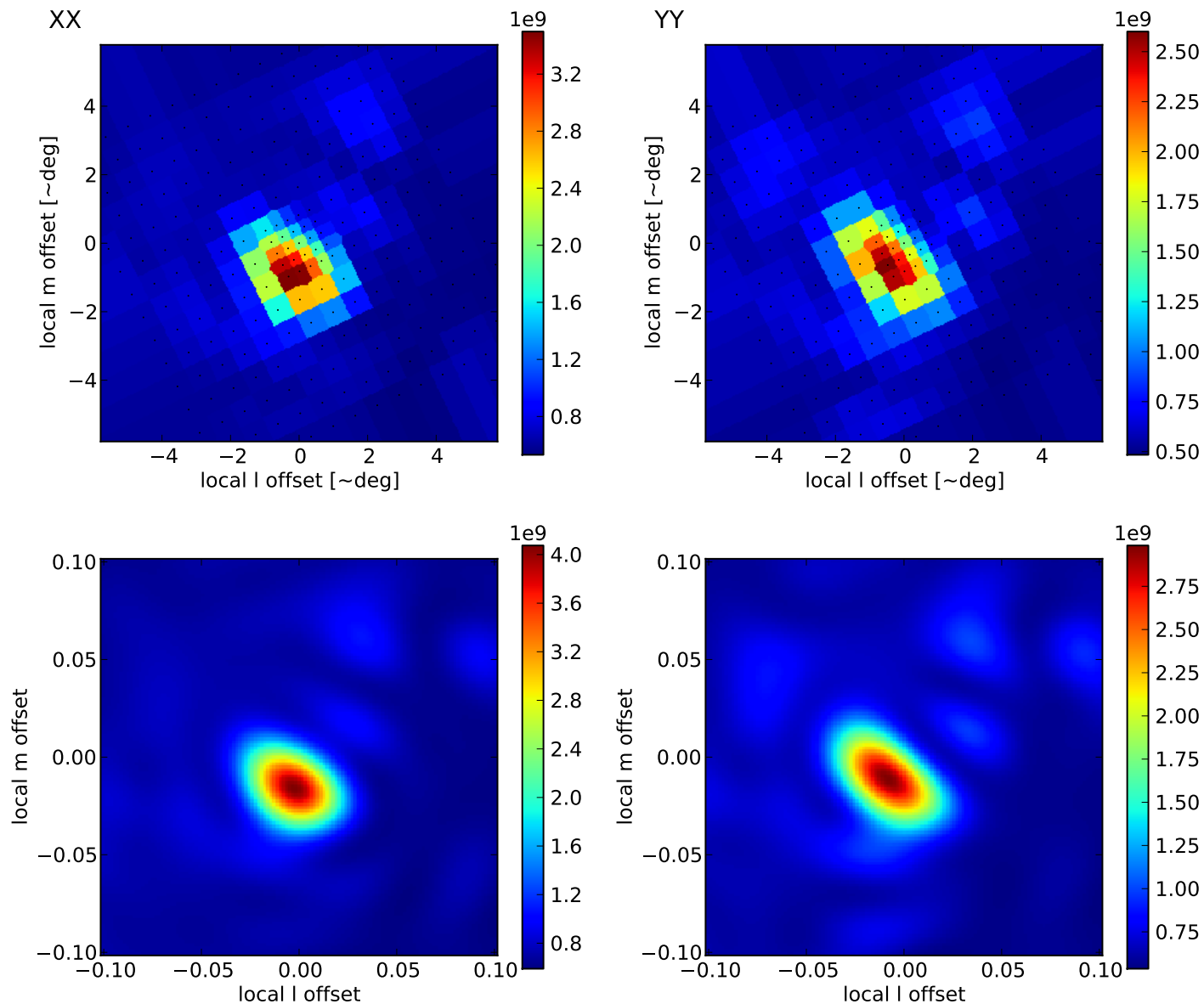
sample 9 UT 22:48:20 = 82100 sec

l_{mn} = (0.269620, 0.204066, 0.941097)

(local station coordinates)

az (N->E) 52.9 deg el 70.2 deg

top: beamformed, bottom: imaging



CasA subband 310 (160.5 MHz) in I/m, every 3 h

CasA subband 310 tilebeam 1

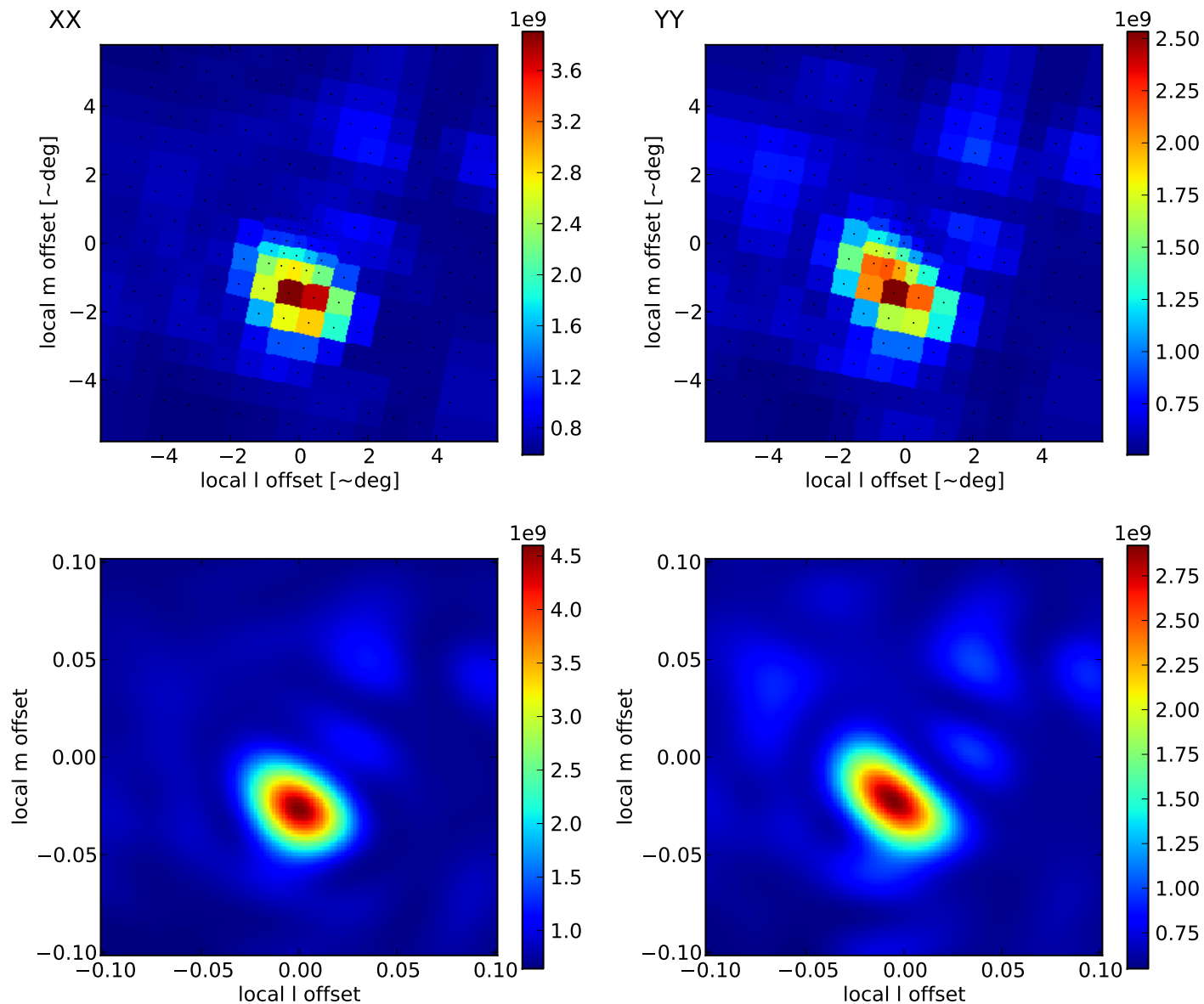
sample 18 UT 01:48:20 = 92900 sec

lmn = (-0.122173, 0.156682, 0.980064)

(local station coordinates)

az (N->E) -37.9 deg el 78.5 deg

top: beamformed, bottom: imaging

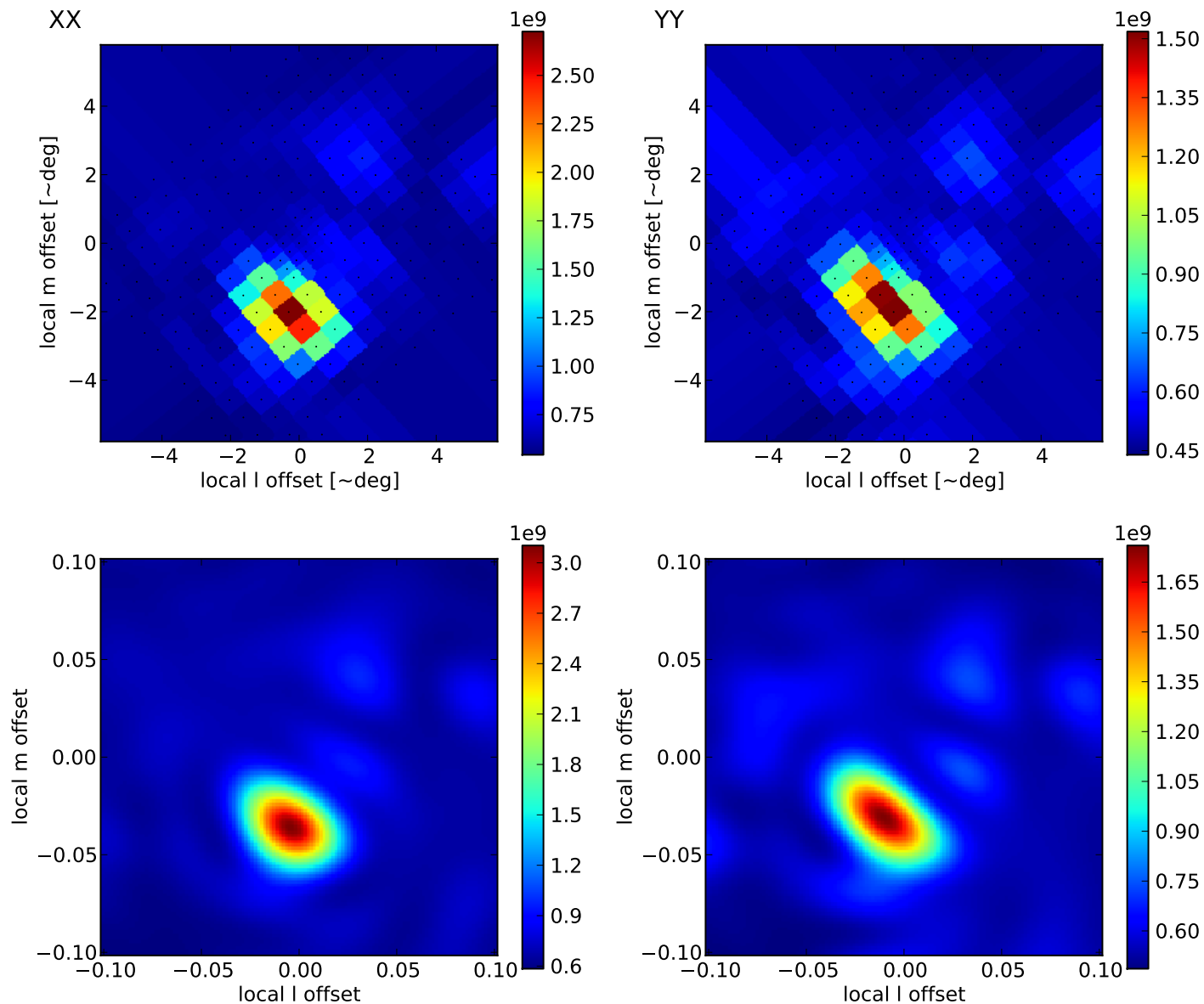


CasA subband 310 (160.5 MHz) in l/m, every 3 h

CasA subband 310 tilebeam 1 sample 27 UT 04:48:20 = 103700 sec

l_{mn} = (-0.442089, 0.337540, 0.831038)
az (N->E) -52.6 deg el 56.2 deg

(local station coordinates)
top: beamformed, bottom: imaging



Results of beam mapping

- bad beam shape
 - ★ moves around (even in local coordinates)
 - ★ but shapes stays constant
 - ↪ no fatal bug in beam-former, no permutation of elements
- beam-forming and imaging consistent
 - ★ tests do not need new observations!
- problem with coordinate systems?
- fit of possible rotation matrix
- ↪ horizontal rotation of 1.6 ± 0.05 deg

corrected CasA subband 310 (160.5 MHz)

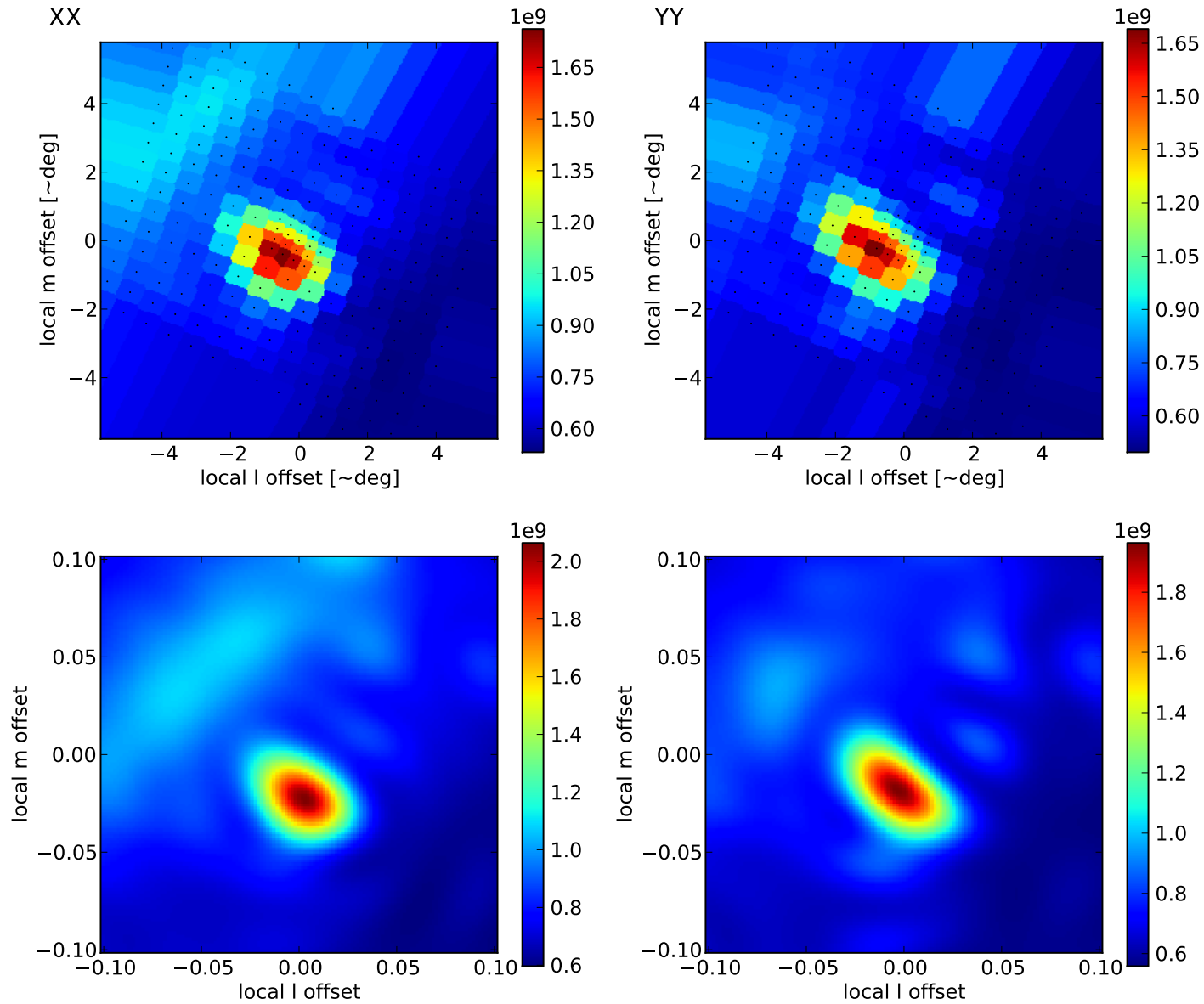
CasA subband 310 tilebeam 1 sample 0 UT 19:48:20 = 71300 sec

l_{mn} = (0.490185, 0.465221, 0.737081)

(local station coordinates)

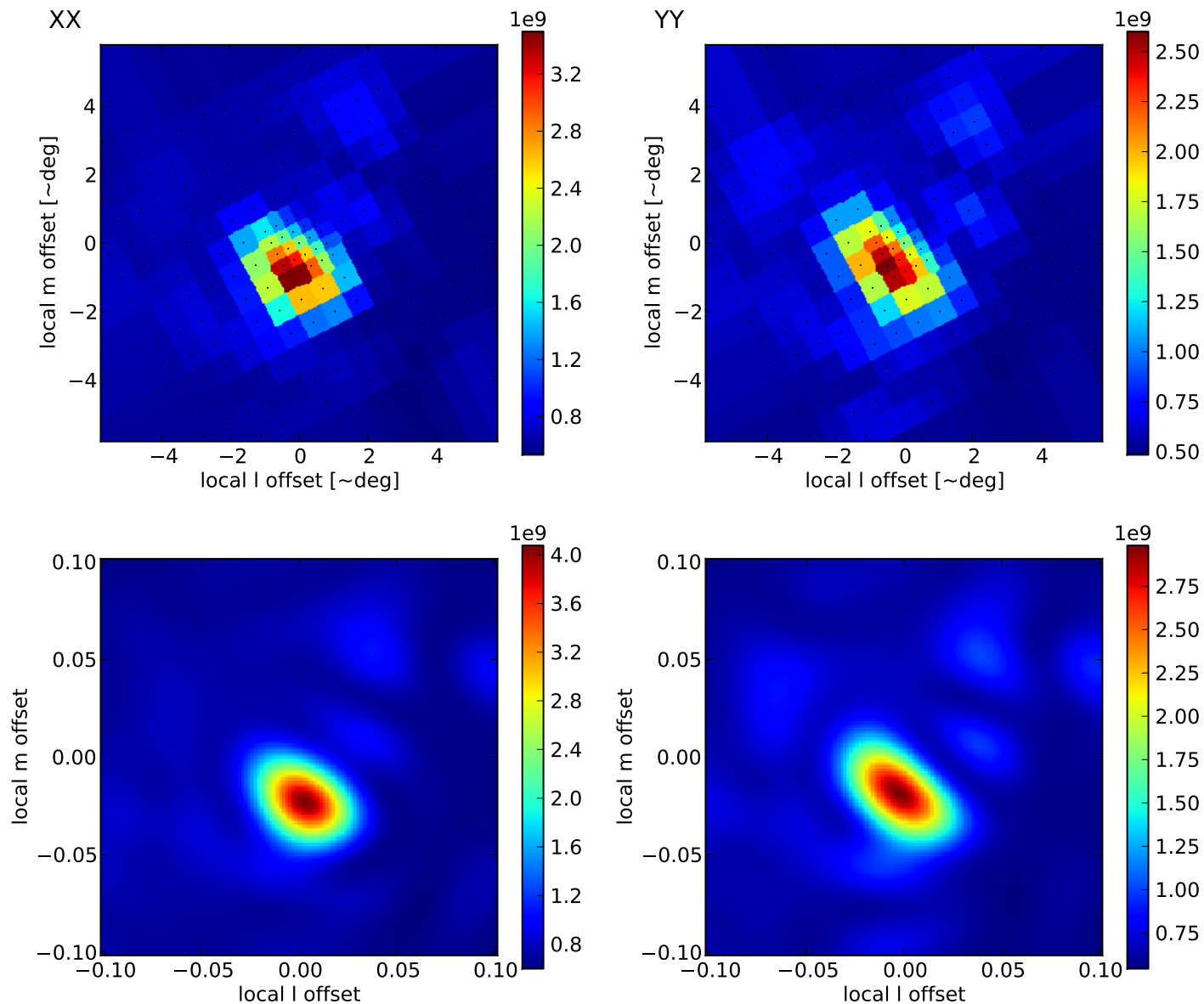
az (N->E) 46.5 deg el 47.5 deg

top: beamformed, bottom: imaging



corrected CasA subband 310 (160.5 MHz)

CasA subband 310 tilebeam 1 sample 9 UT 22:48:20 = 82100 sec
l_mn = (0.264002, 0.211284, 0.941097)
az (N->E) 51.3 deg el 70.2 deg
(local station coordinates)
top: beamformed, bottom: imaging



corrected CasA subband 310 (160.5 MHz)

CasA subband 310 tilebeam 1

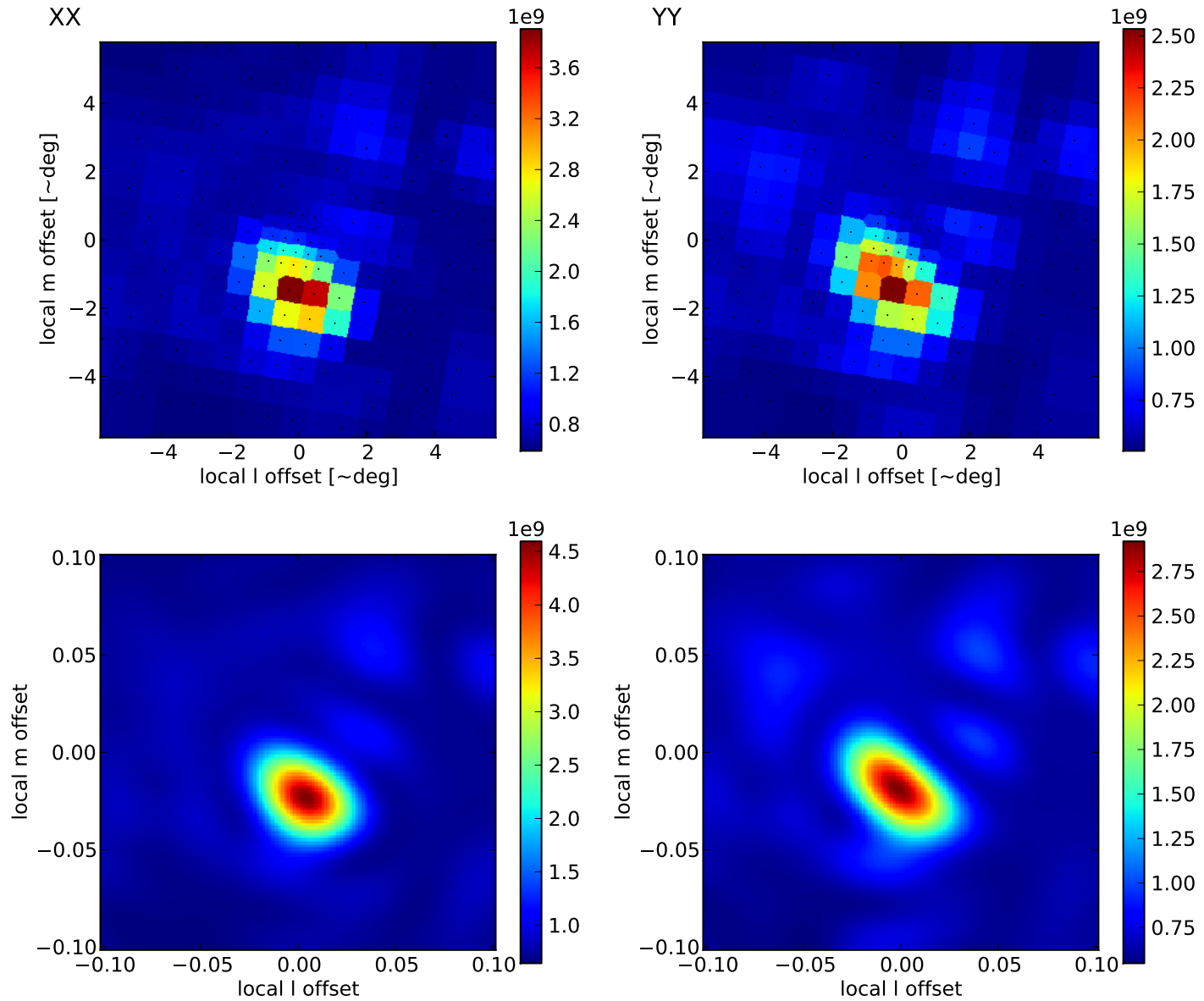
sample 18 UT 01:48:20 = 92900 sec

l_{mn} = (-0.126366, 0.153319, 0.980064)

(local station coordinates)

az (N->E) -39.5 deg el 78.5 deg

top: beamformed, bottom: imaging

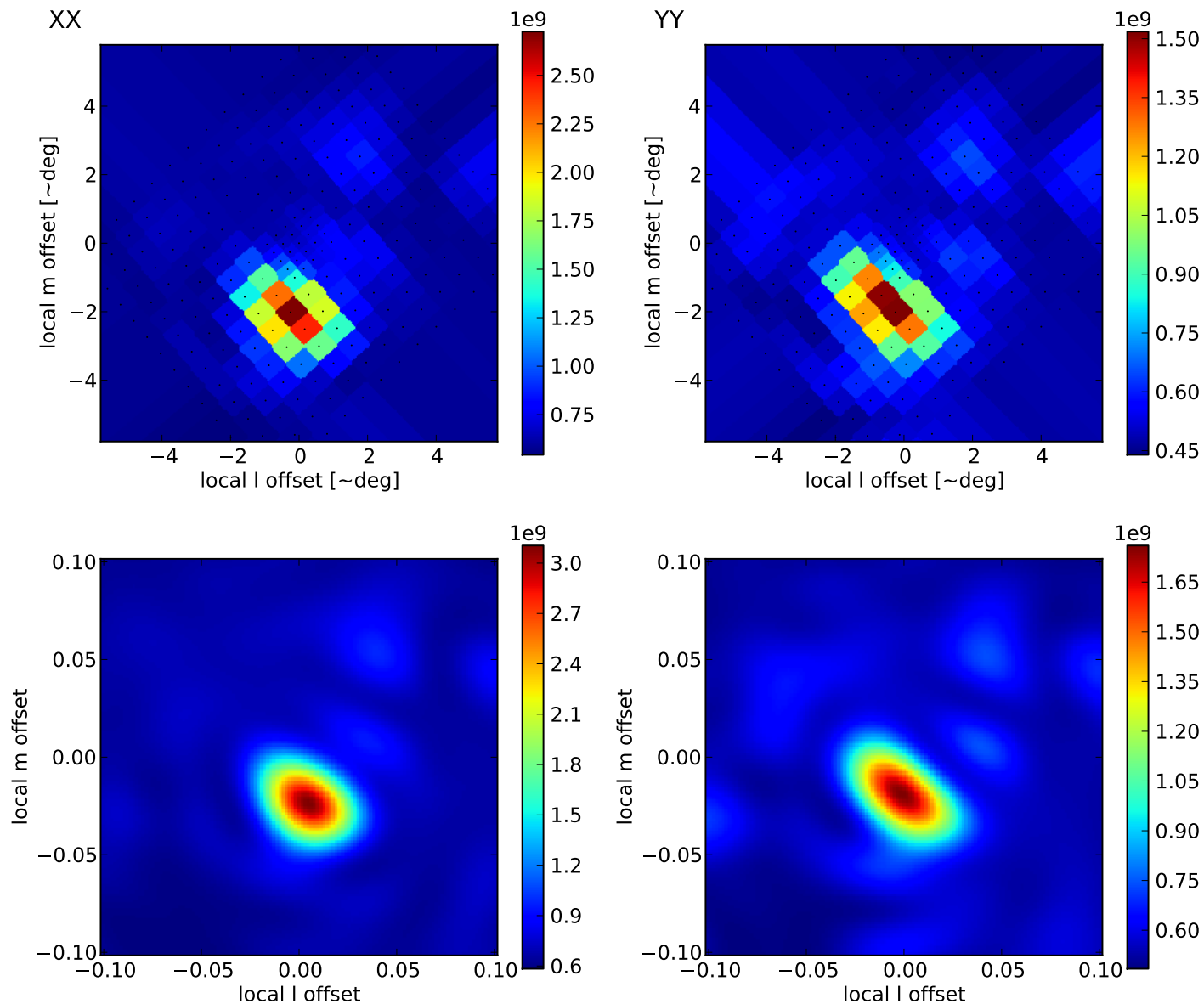


corrected CasA subband 310 (160.5 MHz)

CasA subband 310 tilebeam 1 sample 27 UT 04:48:20 = 103700 sec

lmn = (-0.451058, 0.325458, 0.831038)
az (N->E) -54.2 deg el 56.2 deg

(local station coordinates)
top: beamformed, bottom: imaging



New element positions

- new survey of DE601 element positions in May 2012
- conversion to usual system by James Anderson
- comparison with old coordinates
 - ★ horizontal rotation of 1.6 ± 0.05 deg !
- discussions with James, Michiel Brentjens and others
- likely cause
 - ★ rotation of local UTM system w.r.t. north: 1.63 deg

Summary

- Problem solved!
- rotation of HBA element positions by 1.6 deg, caused by different coordinate systems
- new AntennaField.conf available, need new station calibration
- thanks to Masaya Kuniyoshi, Andreas Horneffer, James Anderson, Jana Koehler, Eva Juette, Matthias Hoeft, Roberto Pizzo, Teun Grit, Michiel Brentjens
- see http://www.astro.uni-bonn.de/~wucknitz/wiki/doku.php/lbg:single:start#effelsberg_hba_sensitivity_problem