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!

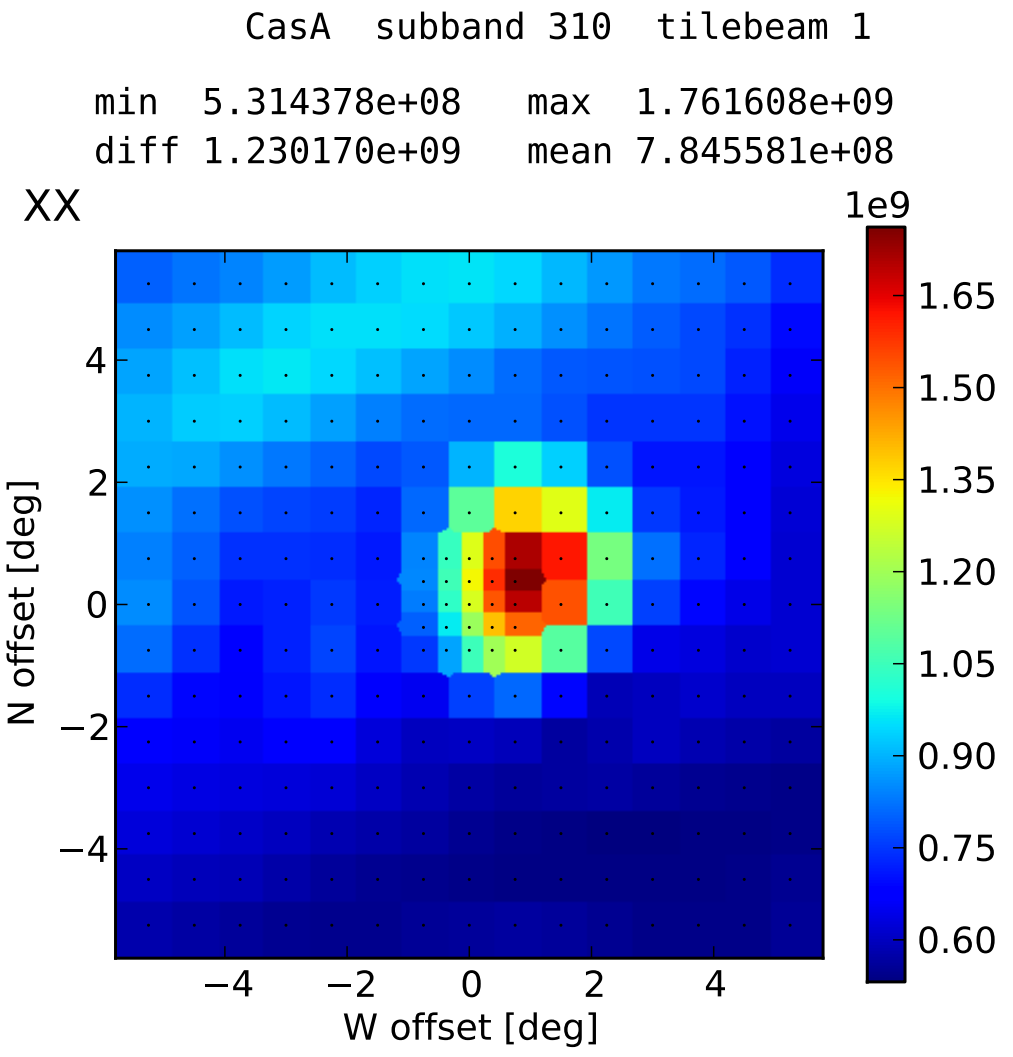
Beam mapping

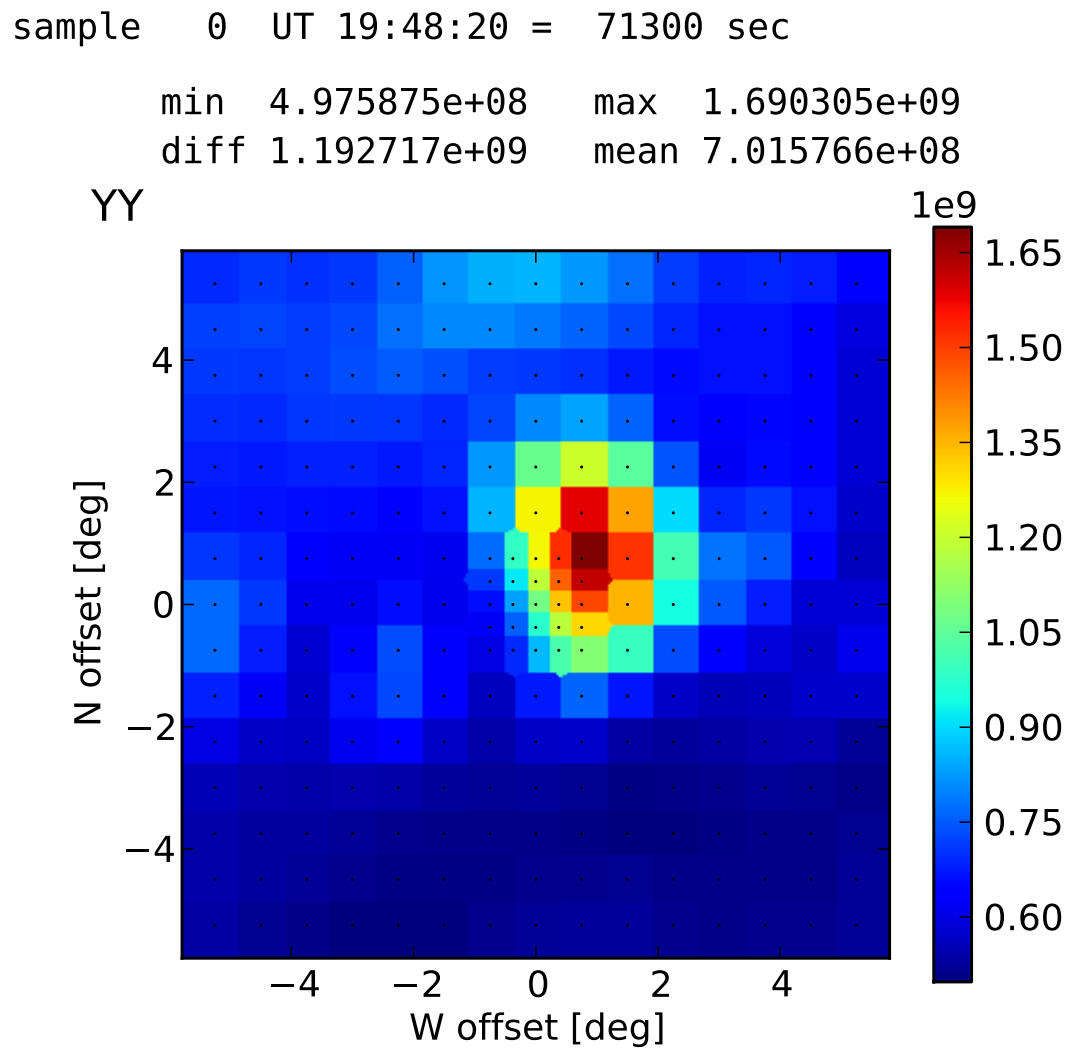
- want to know more than sensitivity in beam centre
- try mapping the beam
- options
  - ⋆ interferometric (George Heald)
    scheduling not trivial, less signal on long baselines
  - ⋆ single-station pulsar (Masaya Kuniyoshi)
    may need several subbands per beam
  - ⇝ single-station with bright (non-pulsar) 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





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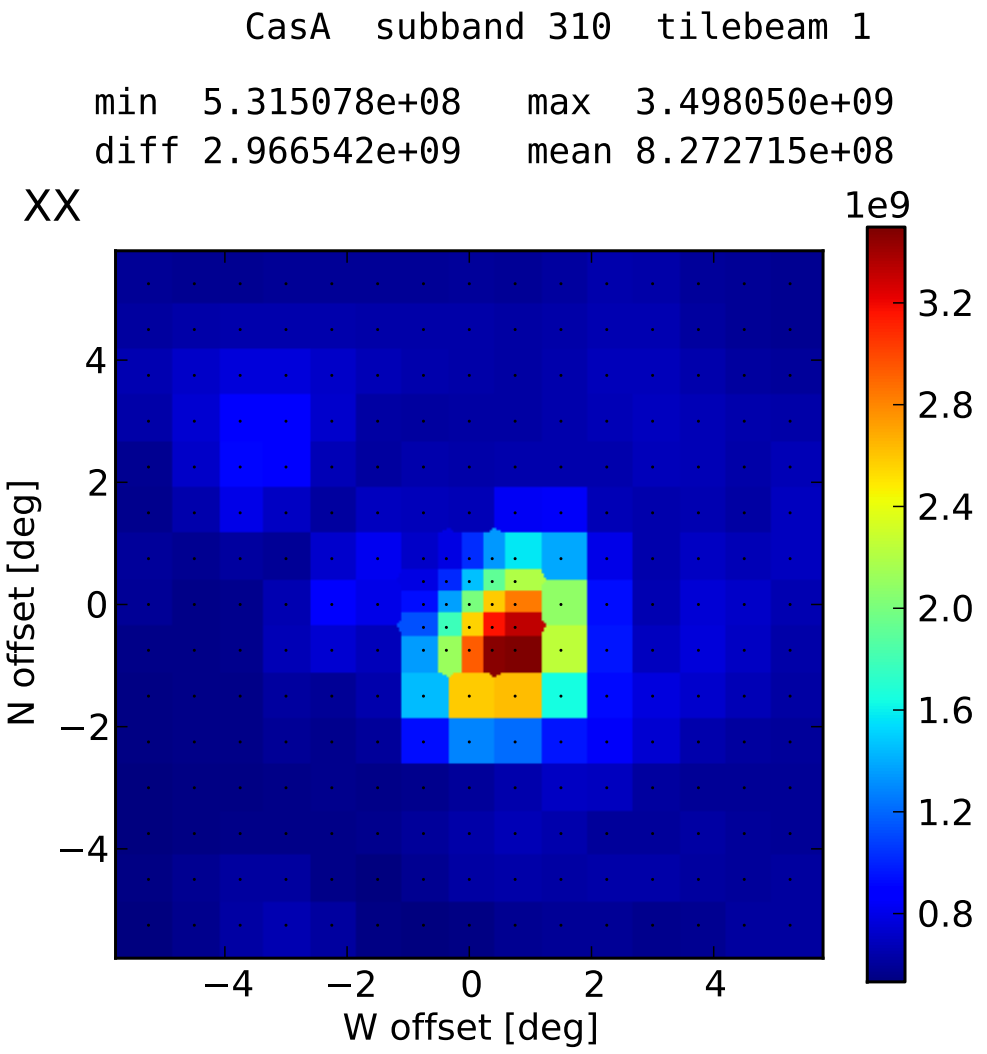

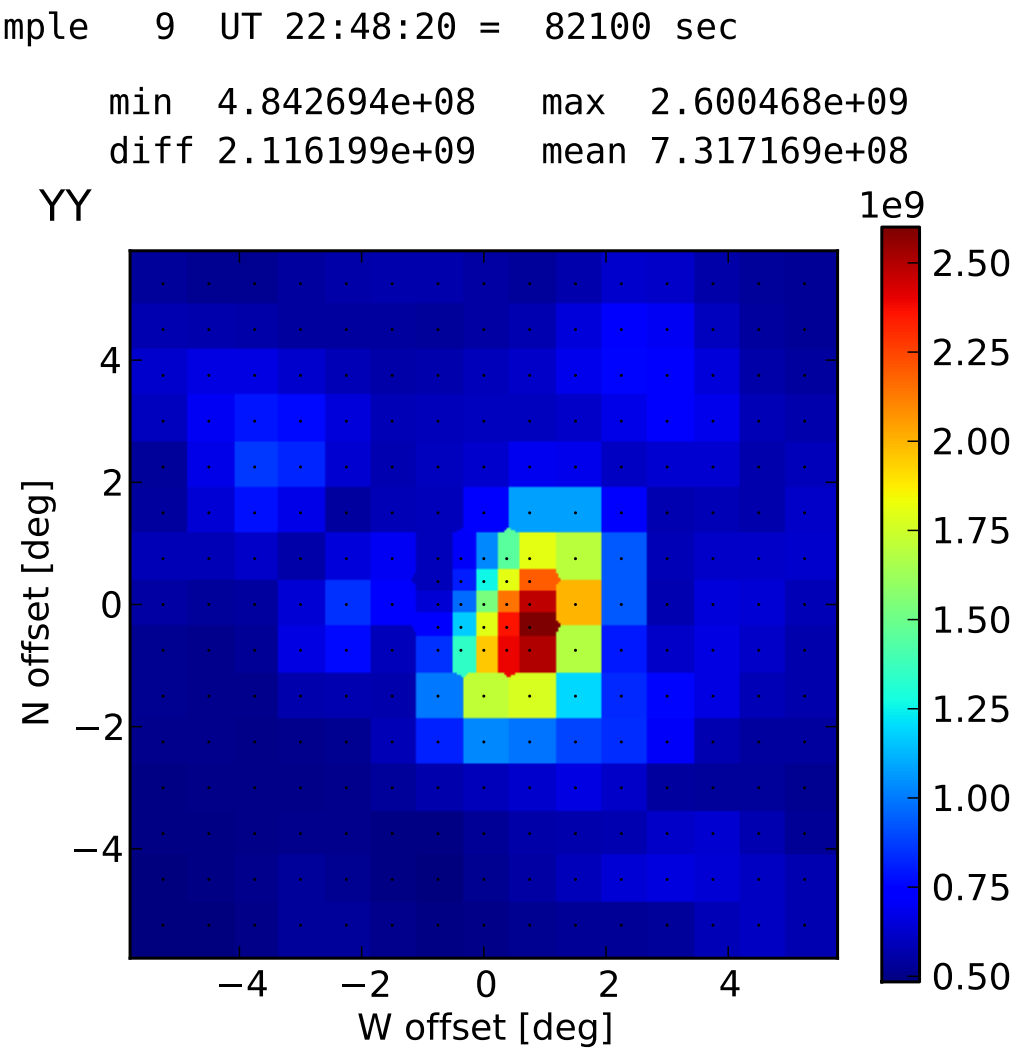

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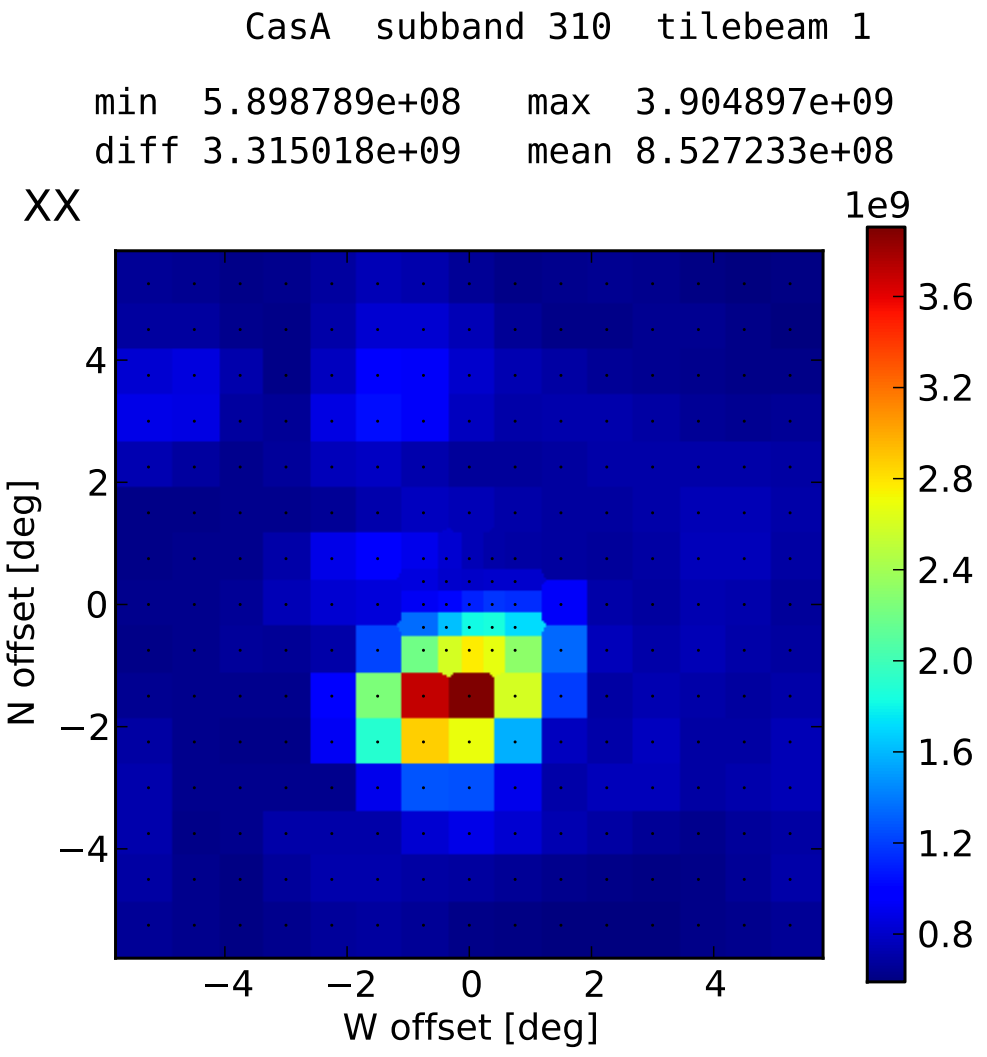

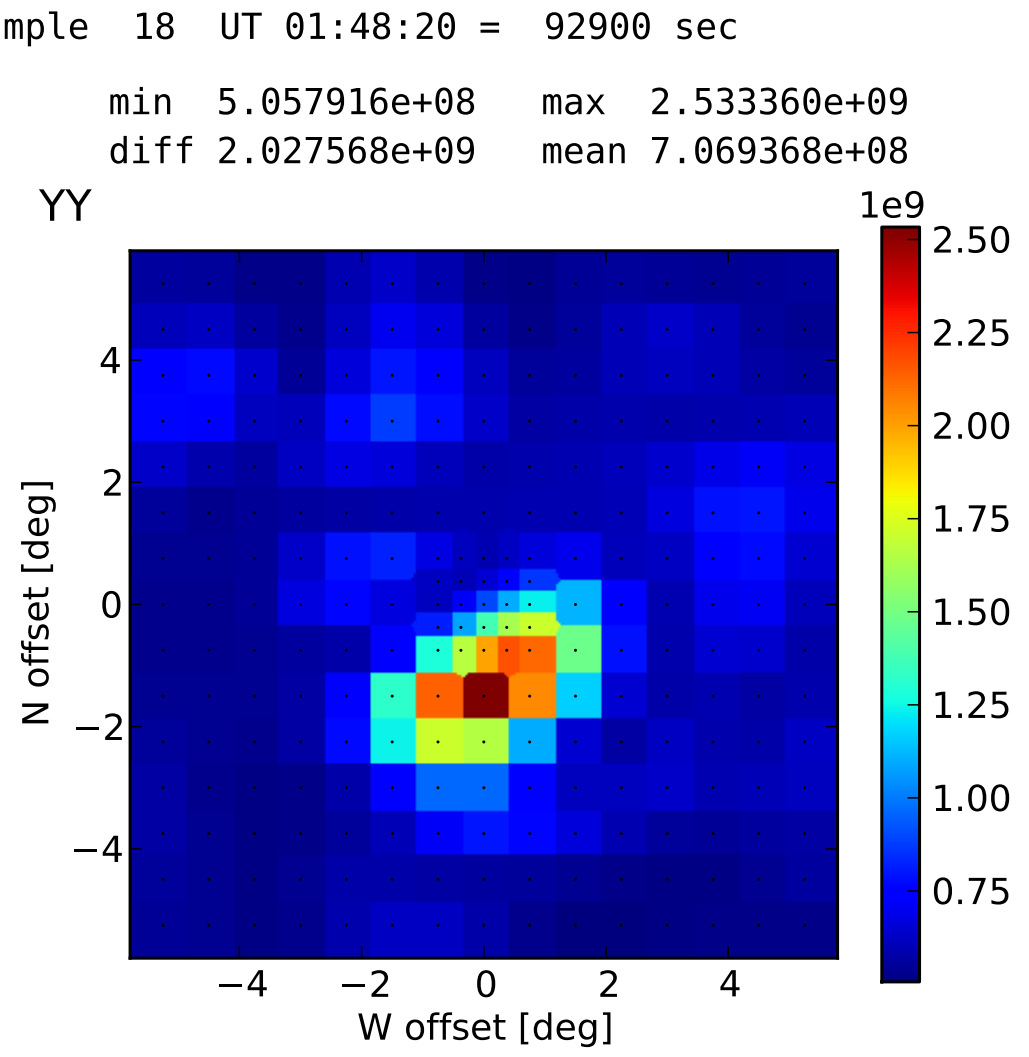

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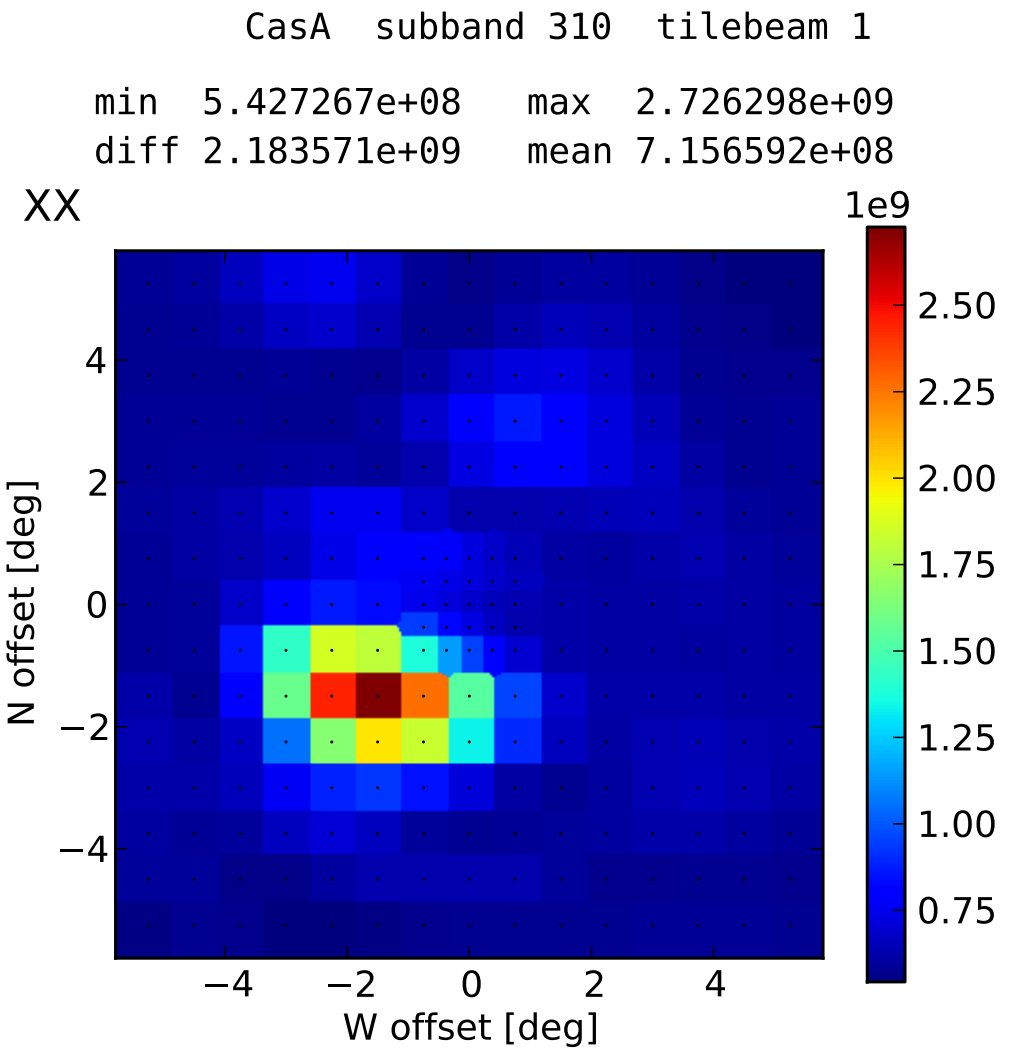
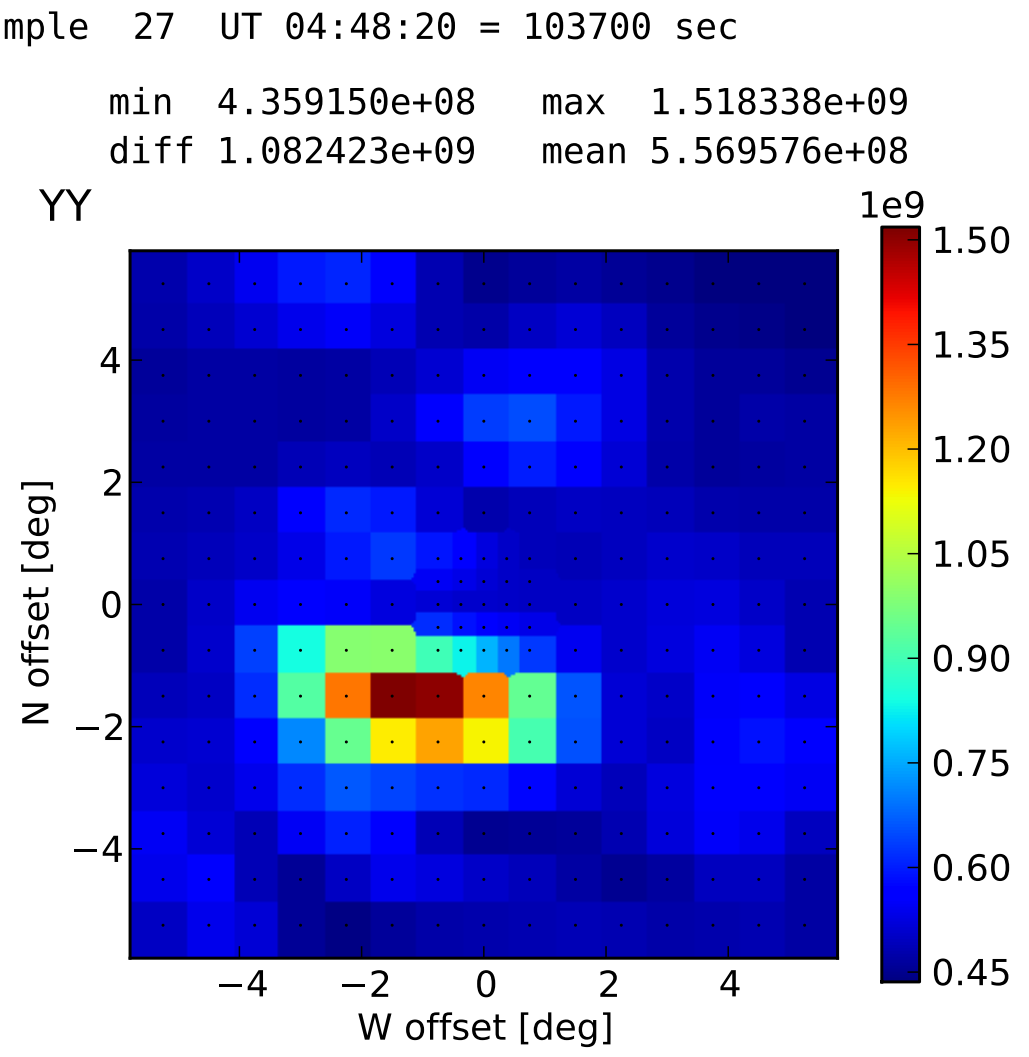
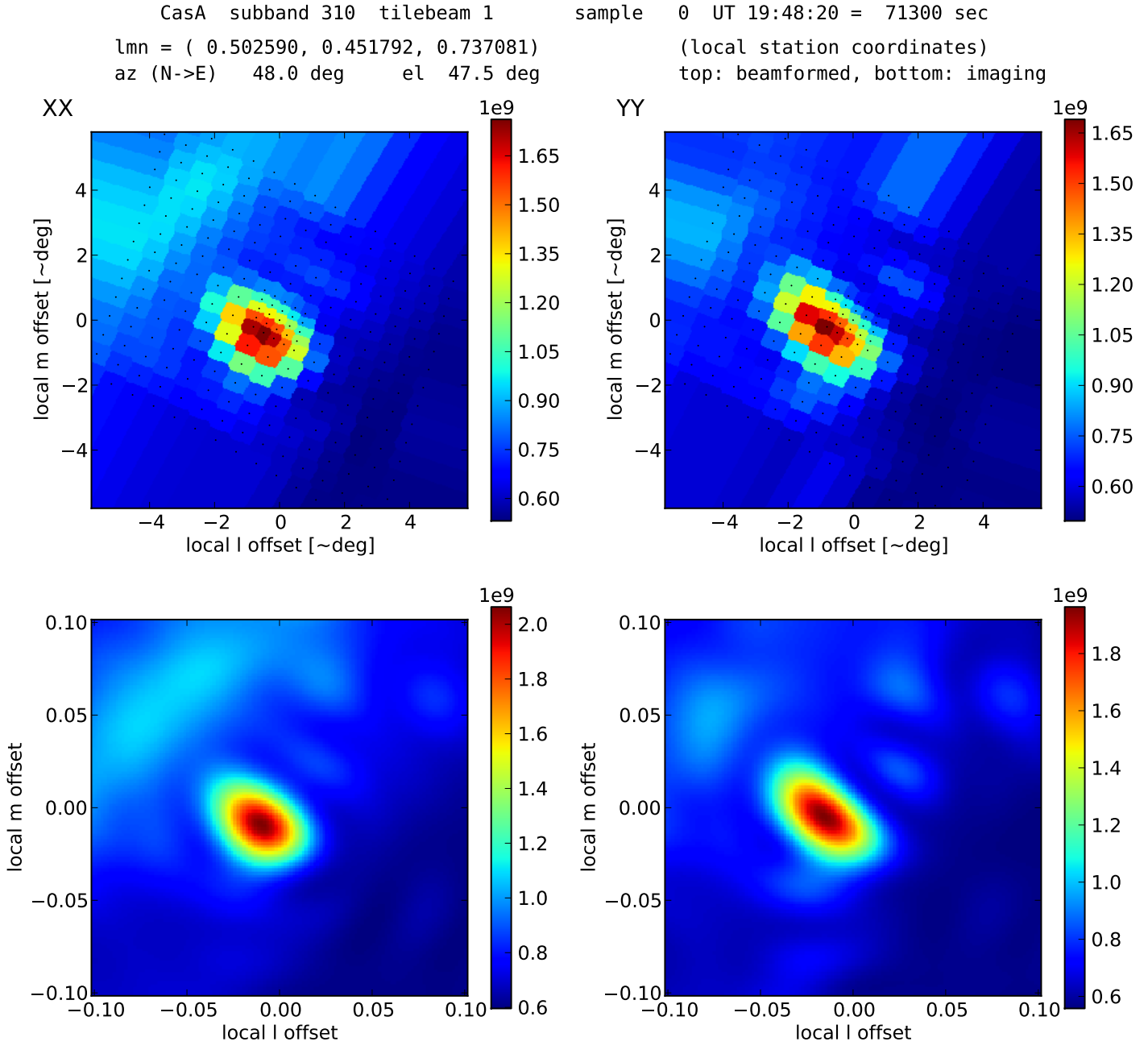
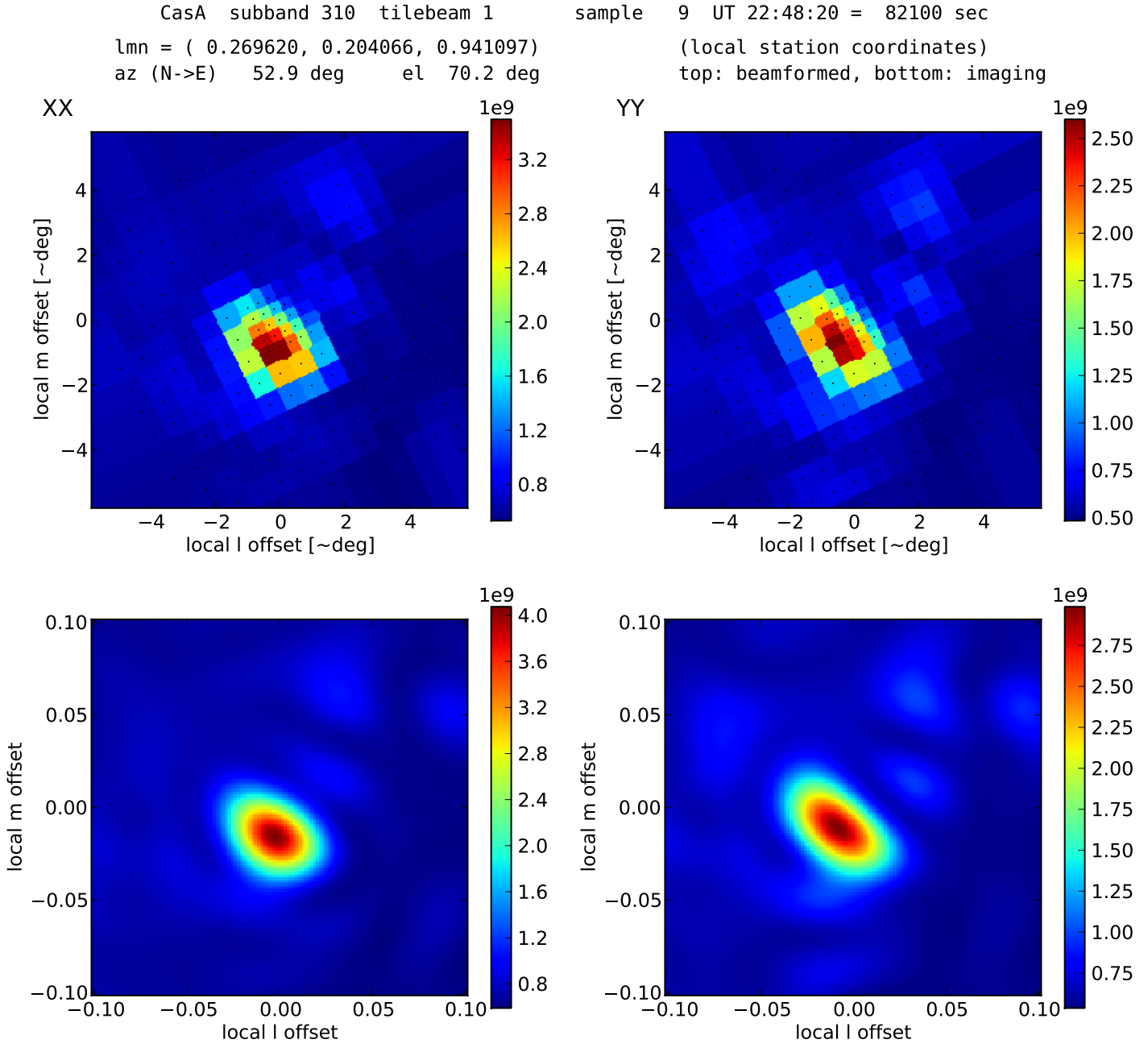




CasA subband 310 (160.5 MHz) in l/m, every 3 h



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



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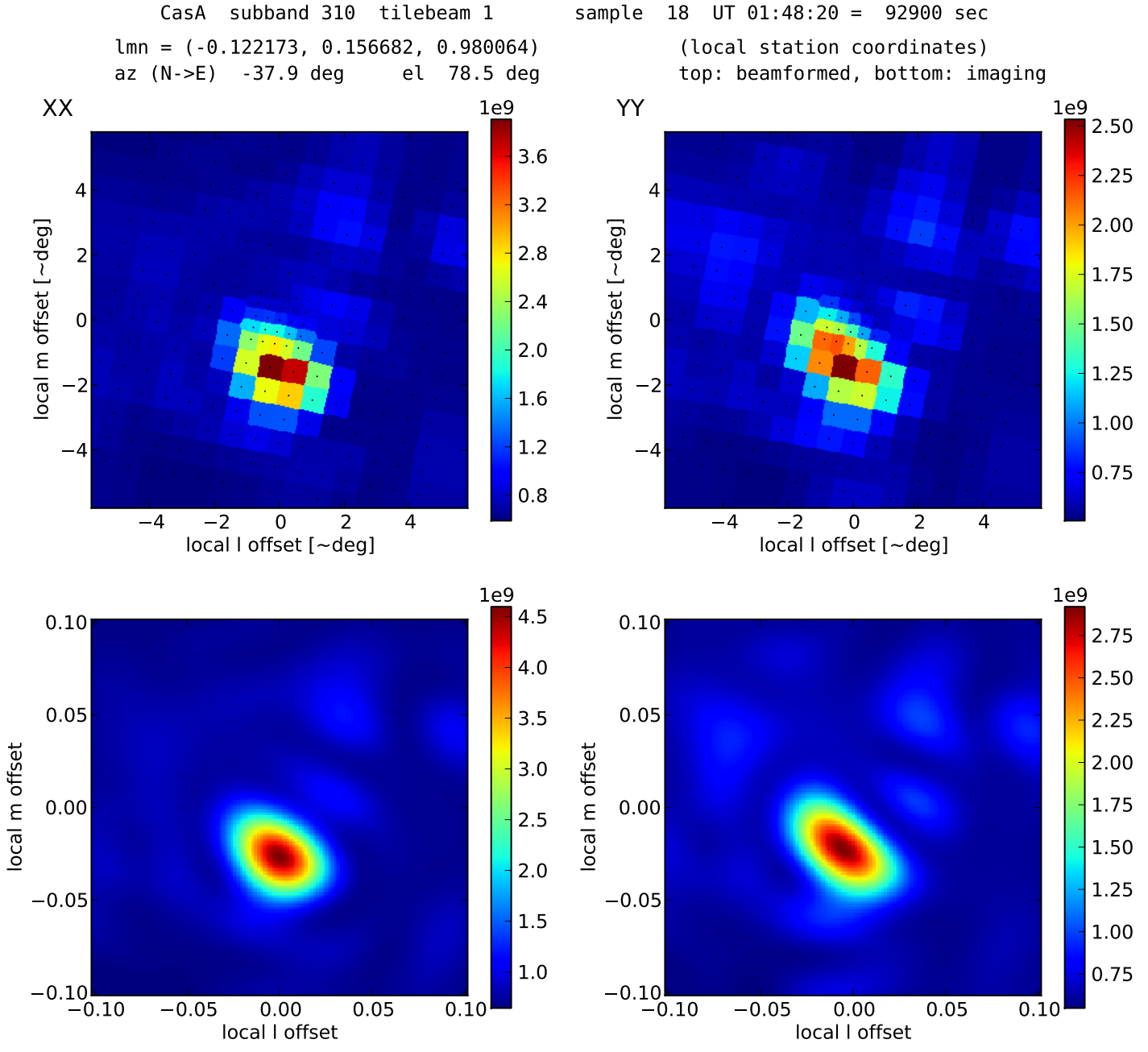

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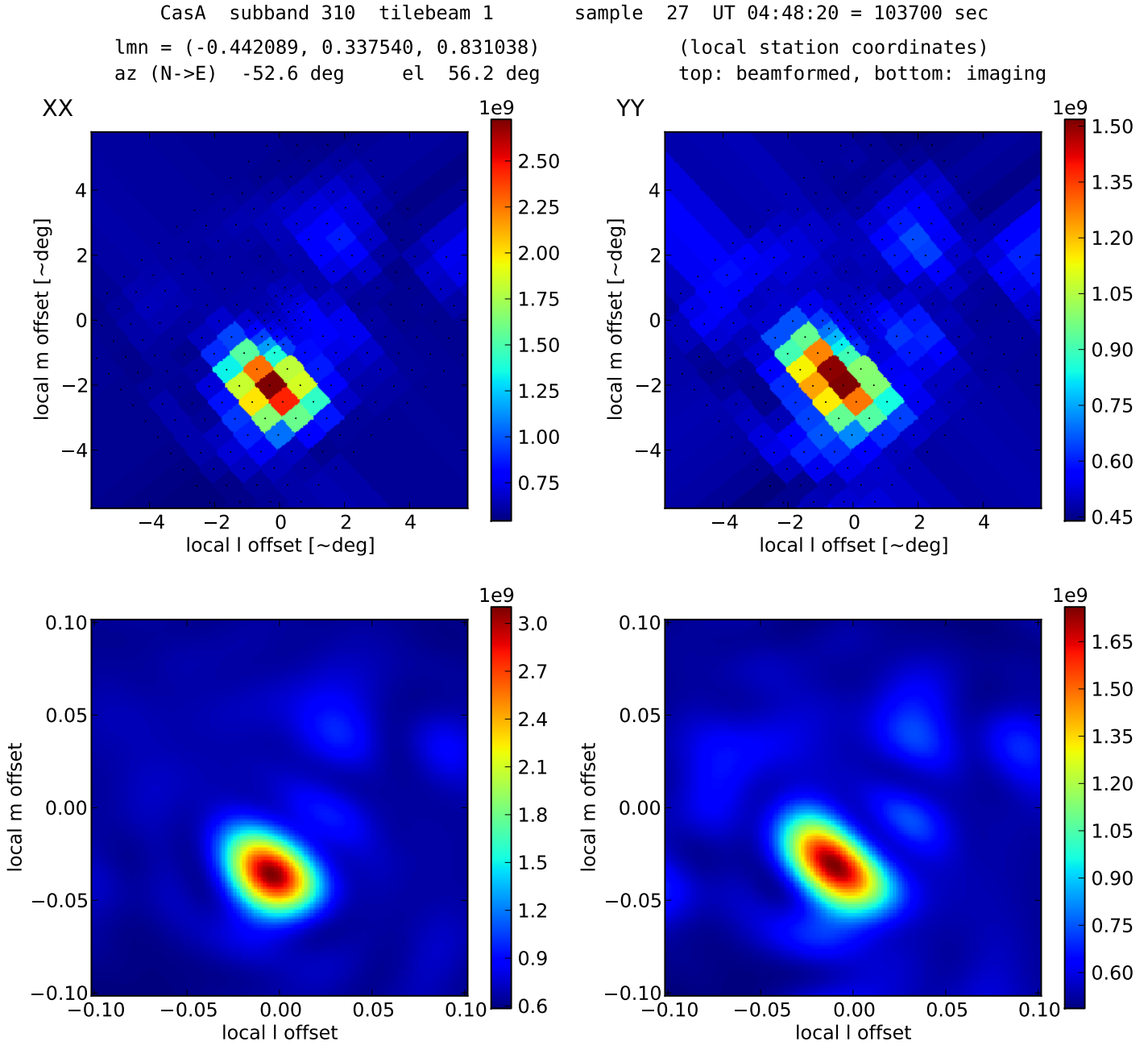
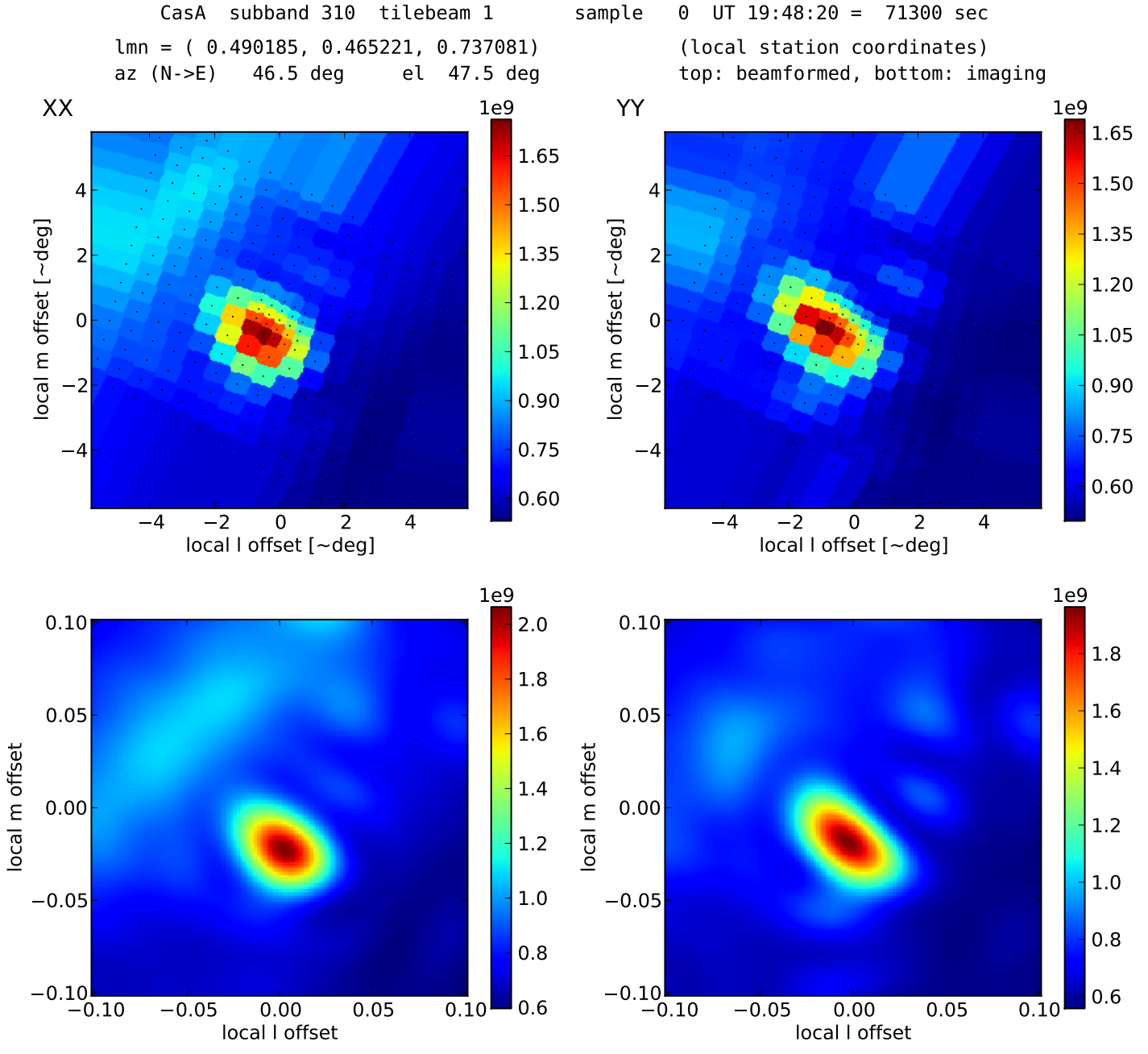


Results of beam mapping

- 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)



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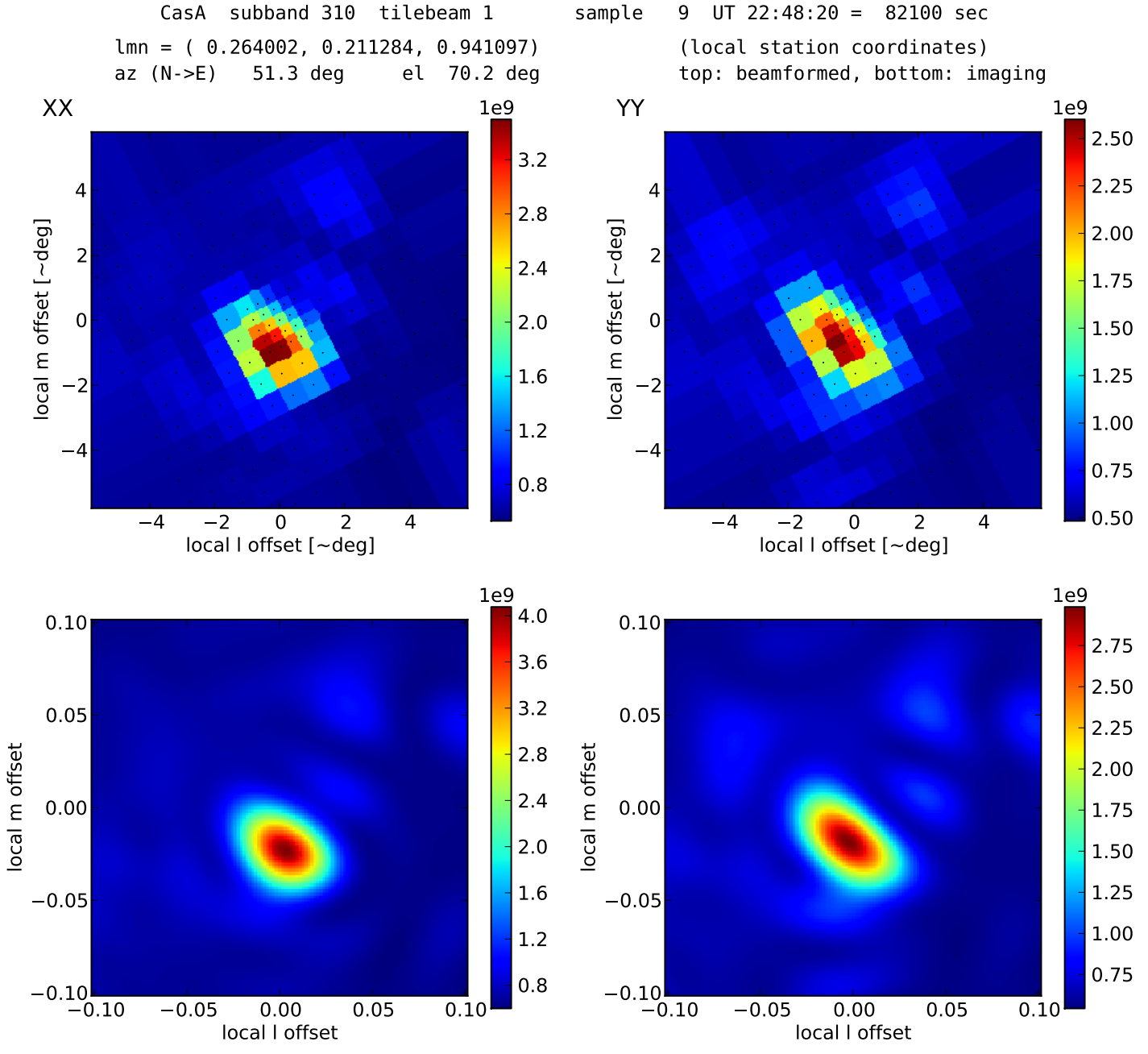

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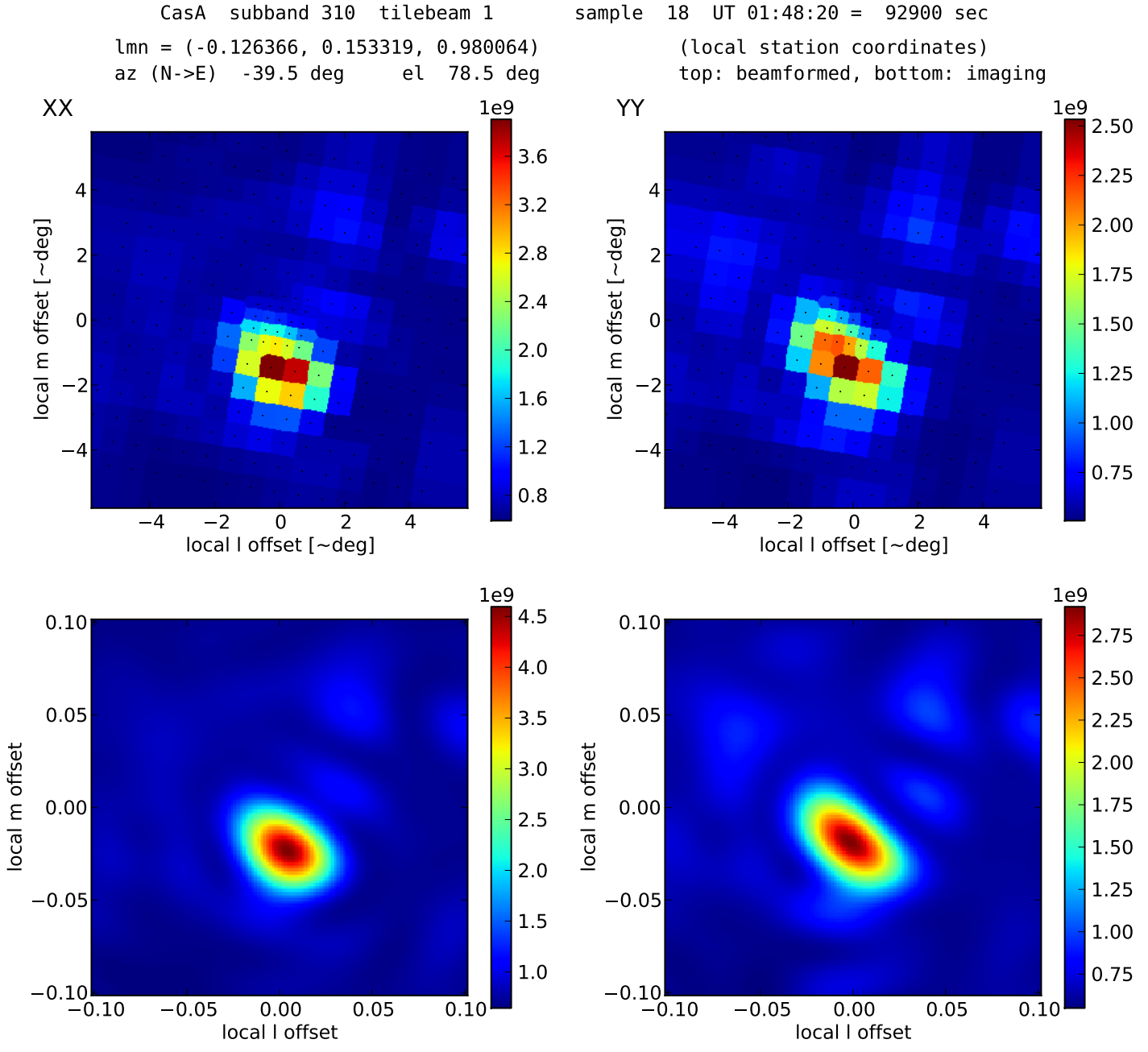

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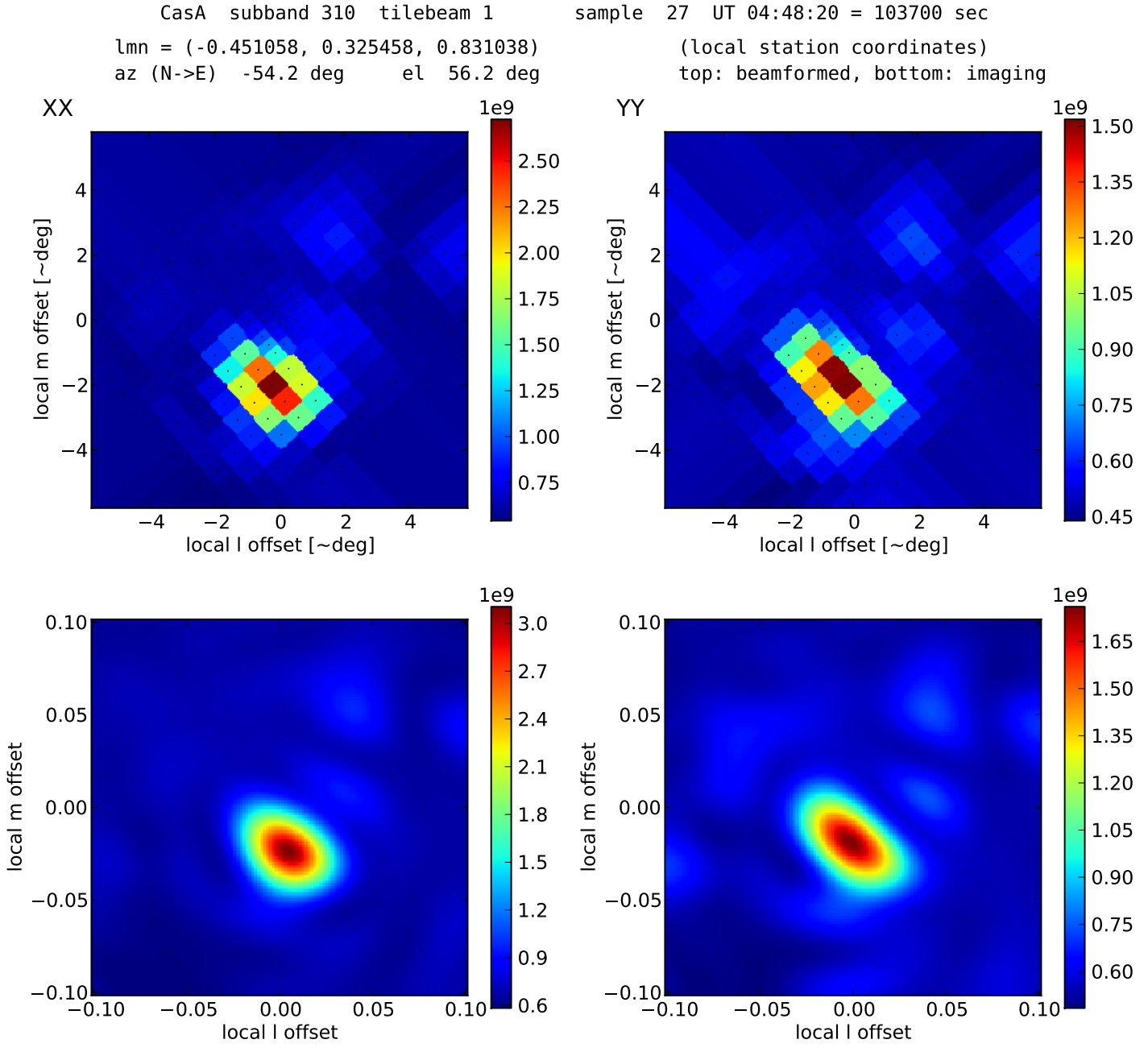

New element positions

- 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