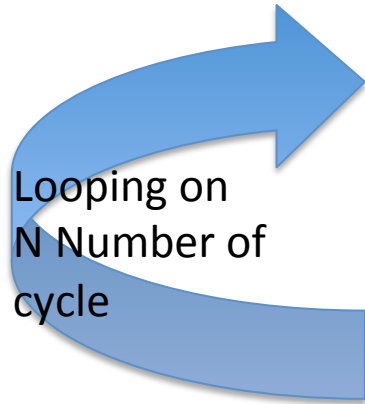# Phase only Self-Calibration tool for LOFAR HBA data (core and remote stations only)

LOFAR Status Meeting,
Wednesday 11 December 2013, By Nicolas Vilchez for the Imaging Tiger Team

What is Self-Calibration ?

- Global strategy:

  - Calibrate in phase the HBA output data
    with a skymodel (Start with GSM model: VLSS catalogue)
  - Flag datas (NDPPP)
  - Imaging (AWimager)
  - Extract the Sky model (Pybdsm)

Looping on
N Number of
cycle

- At each cycle:

  - Improvements of the image resolution
  - Robust parameter go to more uniform weighting
    - Including more and more long baselines

Why HBA remote & core Stations only ?

- ## The Field of view ….
    - LBA's fov ~ 40°
    - HBA's fov ~5°

- ## Needs:
    - Phase calibration of each neighbors must be present in the fov
      at each step … => need to take in account all the fov
        - Imaging all the fov
        - Means for baseline ~ 100km in HBA: (Λ~2m)
        - Pixel size ~ 10 000 x 10 000 pixels for the full fov with ~ 1-2''
    - Memory limitations ….
        - Impossible to image 40° fov
        - Impossible to image full fov with international stations resolutions …

Selfcal tool: A generic tool

- Input parameters:
  - Data directory
  - Output directory
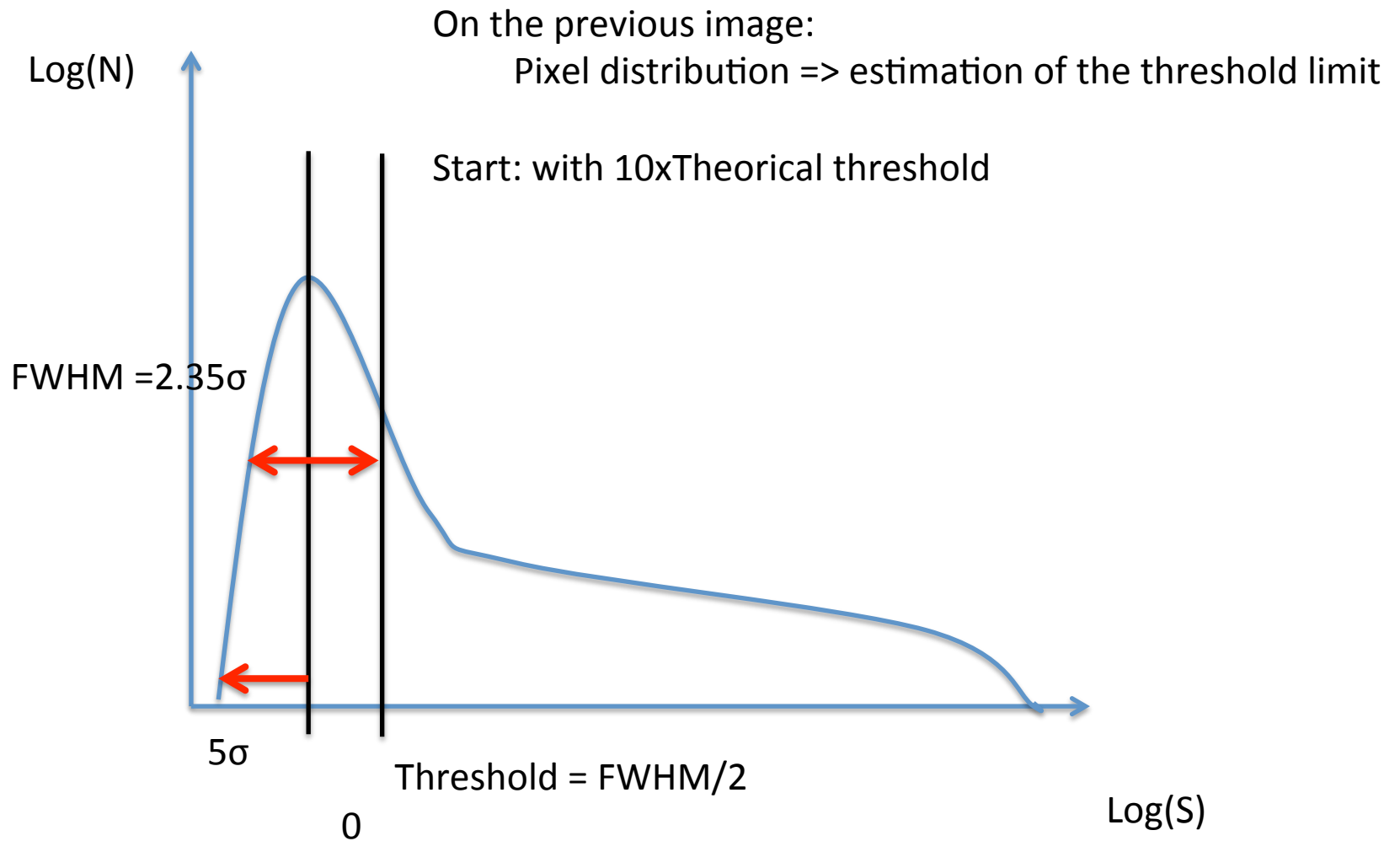 - Number of Cycles

  Only 3 parameters !!

- Start:
  - Warnings (check all time chunks are coherent: frequency, number of channels/subbands , etc …)
  - Calculate the longest baseline:
    - Determine automatically: robust parameter, pixel resolution, image size for each cycle
  - Start with GSM calibration
  - No iteration limit (AWimager): calculate the treshold limit
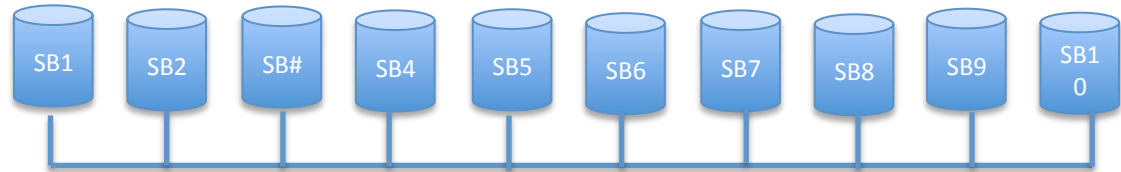
Automatic threshold determination

On the previous image:
  Pixel distribution => estimation of the threshold limit

Log(N)

Start: with 10xTheorical threshold

FWHM =2.35σ

5σ

Threshold = FWHM/2

0

Log(S)

Example with 5 cycles:

Example with LCO12 data: HBA: 140 MHz, 10 Subbands, 31 time chunks, Beam max~5''

Step 0

Preprocessing:
Merging data

SB1 SB2 SB# SB4 SB5 SB6 SB7 SB8 SB9 SB10

Step 1
Robust=1

Processing starts on each time chunk:

MS1 MS2 ... MS31

NDPPP

BBS: GSM calibration

Imaging
Beam=75'') ← Time concatenation ←

Source
extraction → LSM 1

NDPPP

BBS: LSM 1 calibration
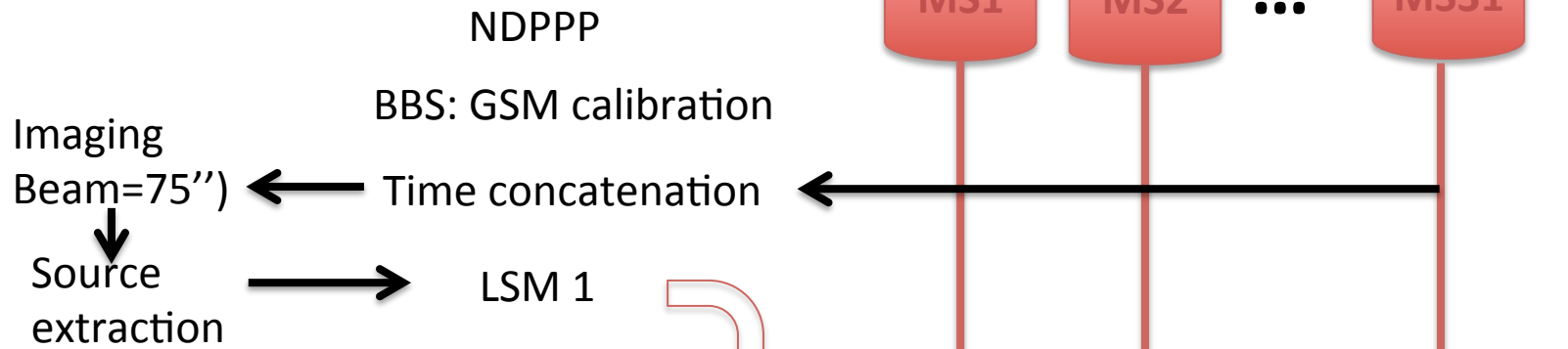
Step 2
Robust=0

Imaging
Beam=30'' ← Time concatenation ←

Source
extraction → LSM 2
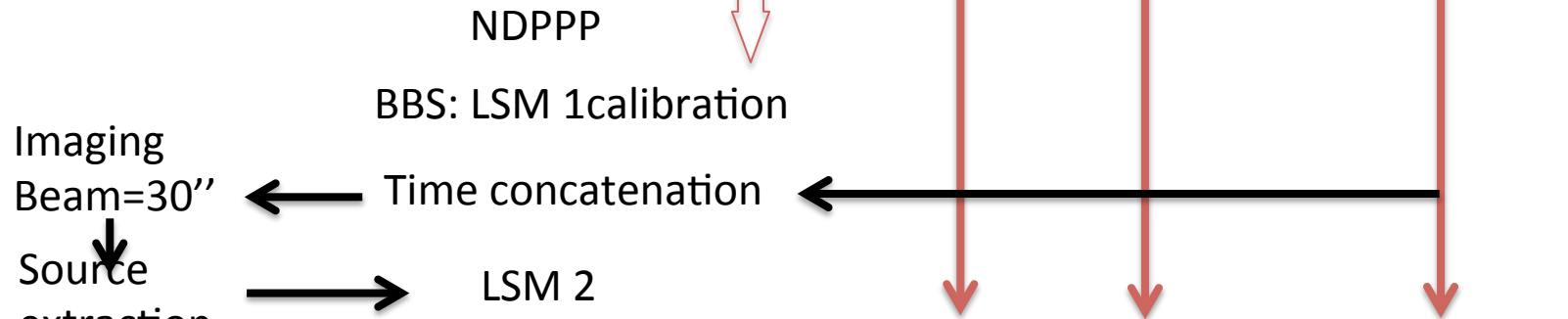
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Example with 5 cycles:

MS1 MS2 ... MS31

Step 3
Robust=-1

NDPPP

BBS: LSM 2 calibration

Imaging
Beam=20'') ← Time concatenation ←

Source
extraction → LSM 3

NDPPP

BBS: LSM 3 calibration

Step 4
robust=-1.5 Imaging
Beam=10'' ← Time concatenation ←

Source
extraction → LSM 4

NDPPP

BBS: LSM 4 calibration

Step 5
Robust=-2 Imaging
Beam=5'' ← Time concatenation ←

Source
extraction → LSM 5

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Example with 5 cycles:

MS1 MS2 ... MS31
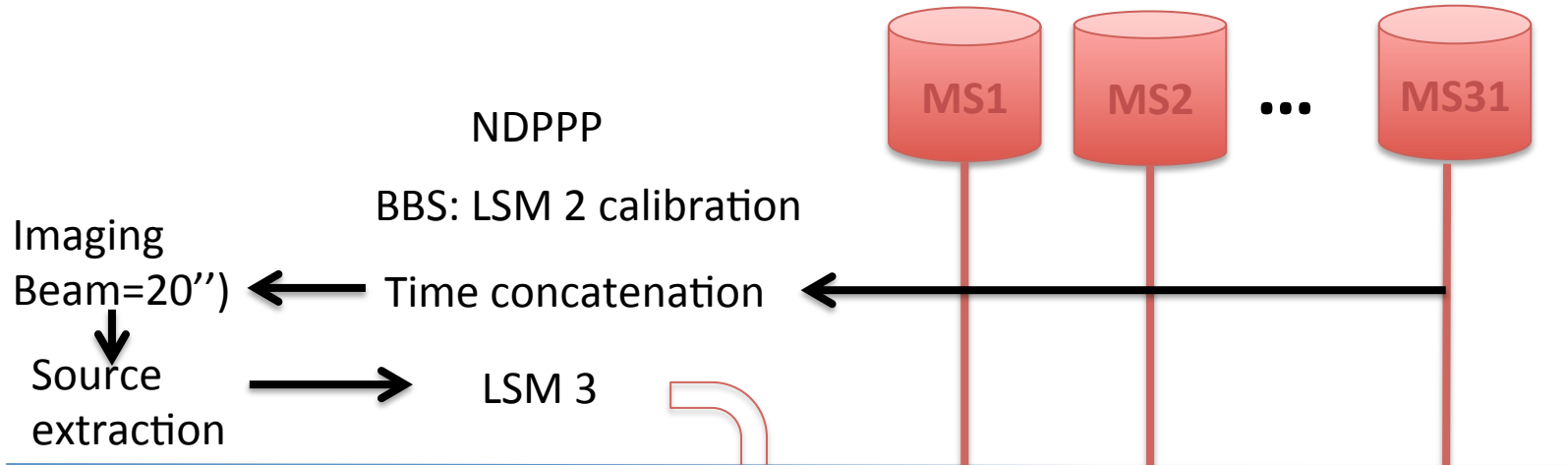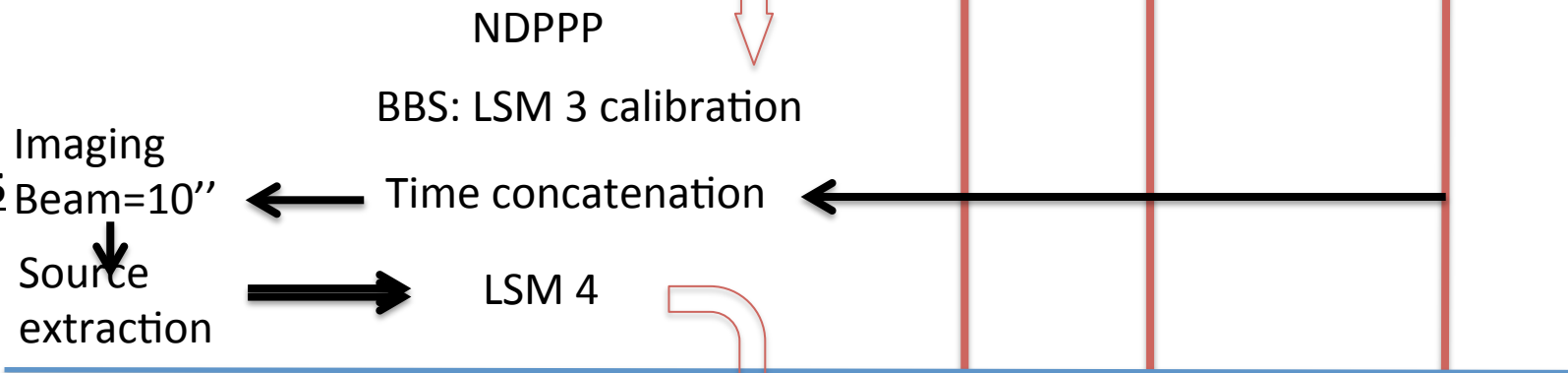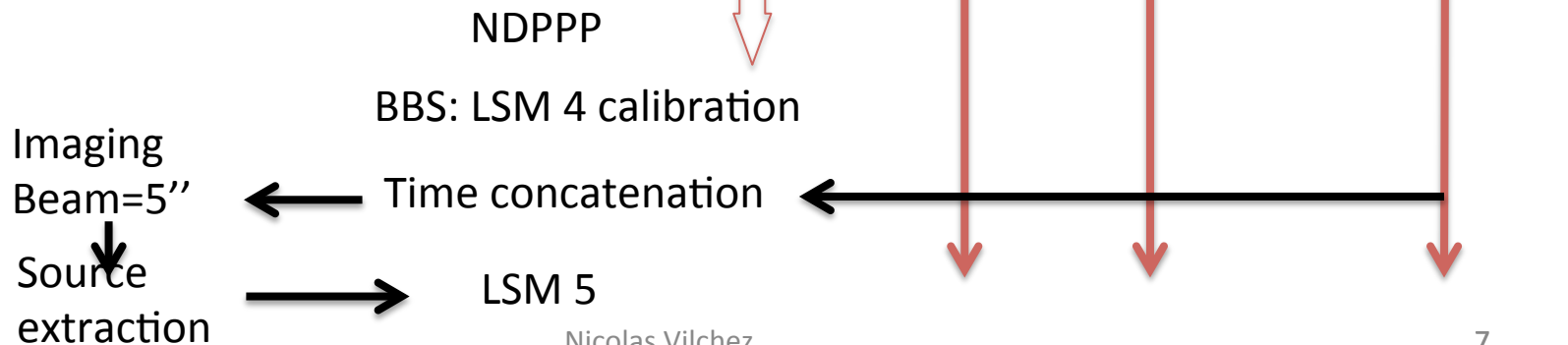
Step 6
Robust=-2

Final
Imaging
Beam=5'')

Source
extraction

NDPPP

BBS: LSM 5 calibration

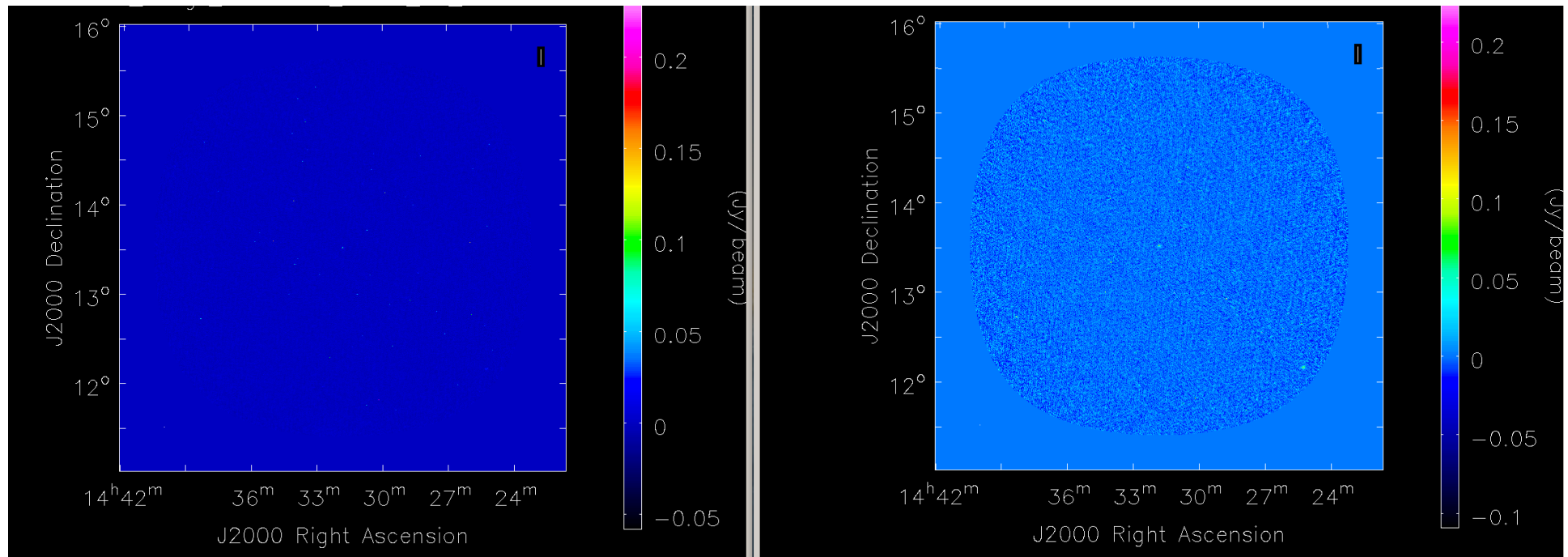Time concatenation

Final LSM 6
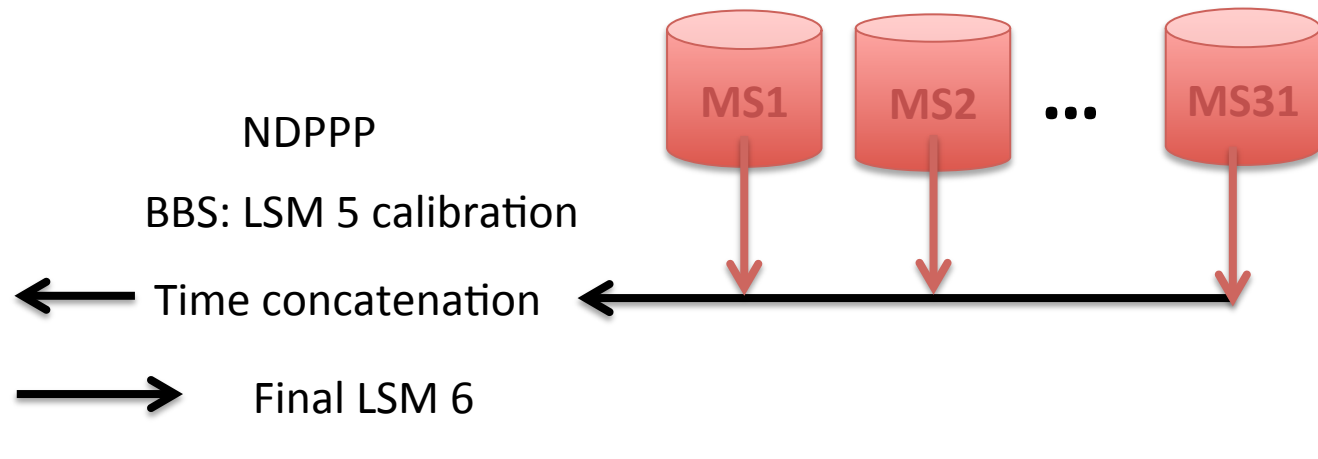
We obtain at the end, our final image, and our final sky model, All is self-calibrated

Results:

Selfcalibrated
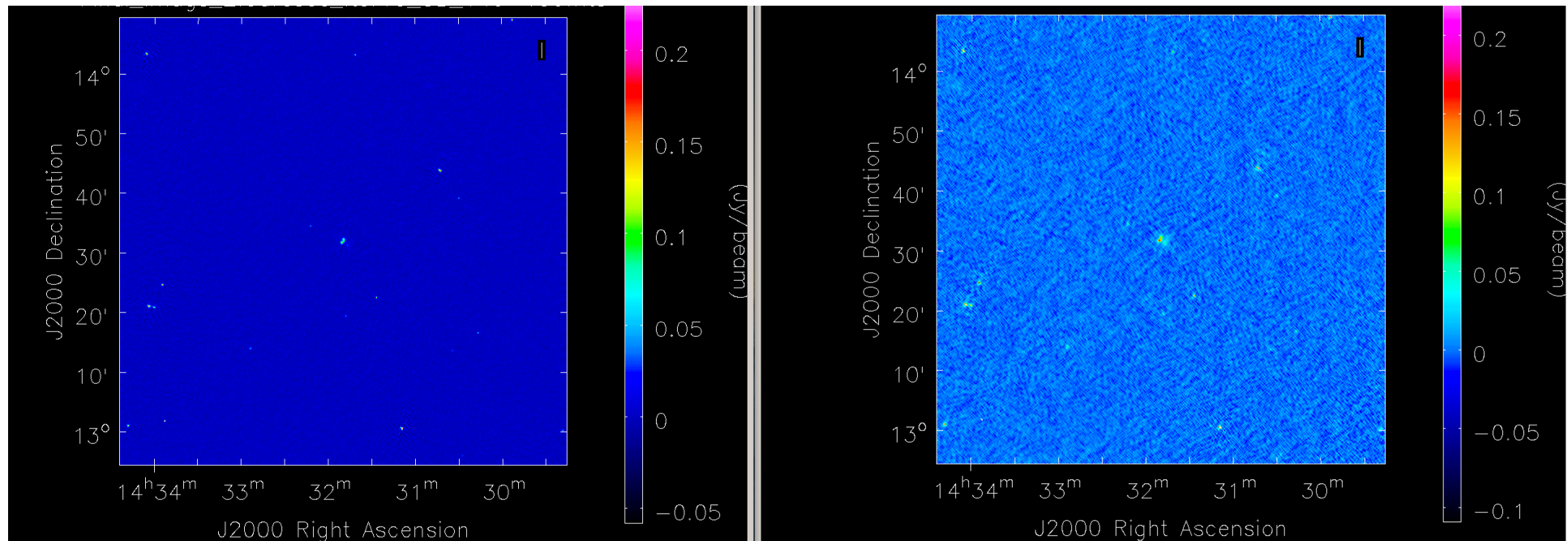
GSM calibration Only

Same scale, same fov

Results:
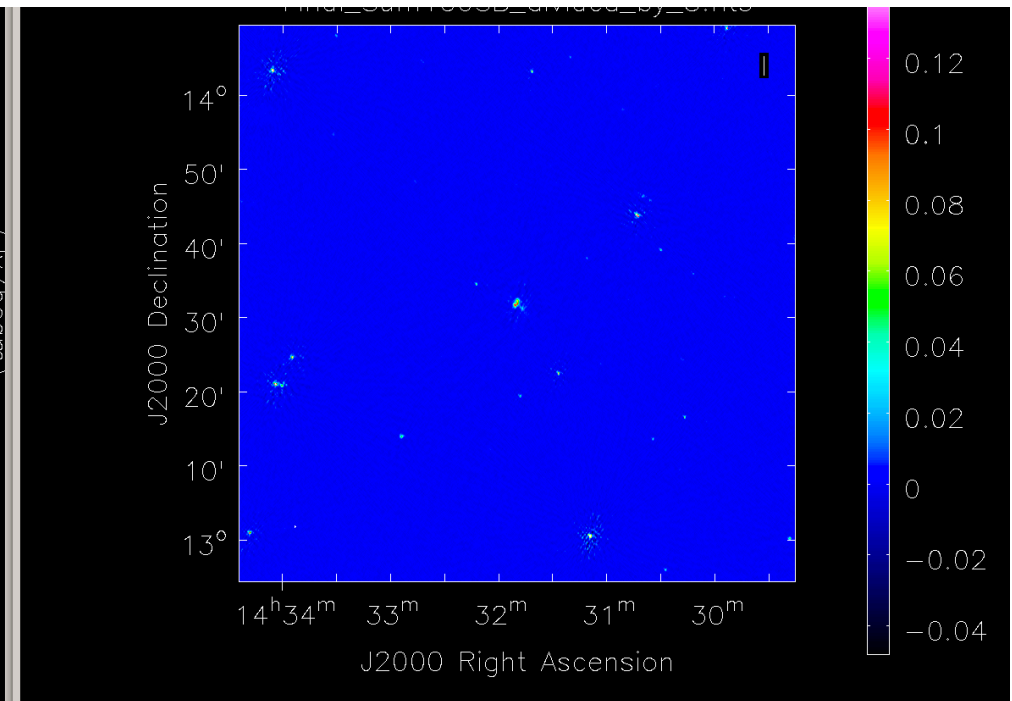
Selfcalibrated
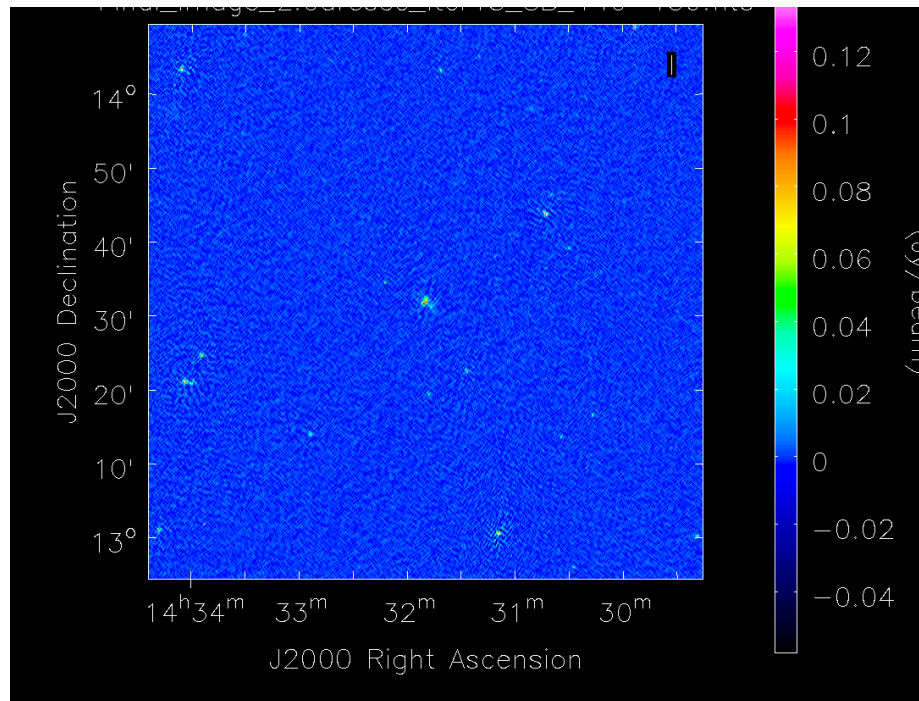
GSM calibration Only

Zoom to the target of the fov:
Same scale, same fov

Results:

Selfcalibrated: 20 SB

Selfcalibrated: 100 SB

Zoom to the target of the fov:
Same scale, same fov

And now …

- Selfcal tool is installed on CEP1 and on Flits server
- Finalization of the fixed version:
    - Test during the Busy week (last October)
    - Last implementation (mask, threshold …)
    - User testing
    - Documentation writting

    ⇒Froze the final version before Christmas

- Final delivery in January before implementation in the Observatory imaging pipeline