

# HBA-DUAL-INNER mode: pros and cons

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# Some history

In 2003-2006 LOFAR consisted of 77 stations of 96 antennas

- 32 CS in core and 45 RS in 5 arms of 9
- 8 international stations (planned)

Rescope in Summer 2007, led to a new configuration:

- 18 CS + 18 RS
- 48 HBA tiles and 96 LBA antennas
- 48 RCU's

This threatened uv-coverage in core (e.g. for EoR application)

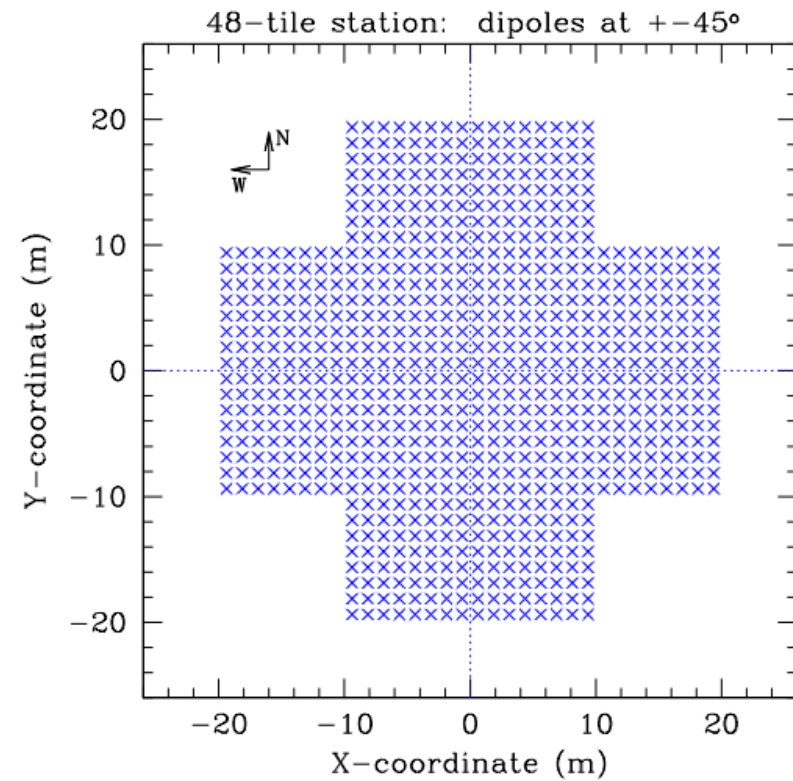
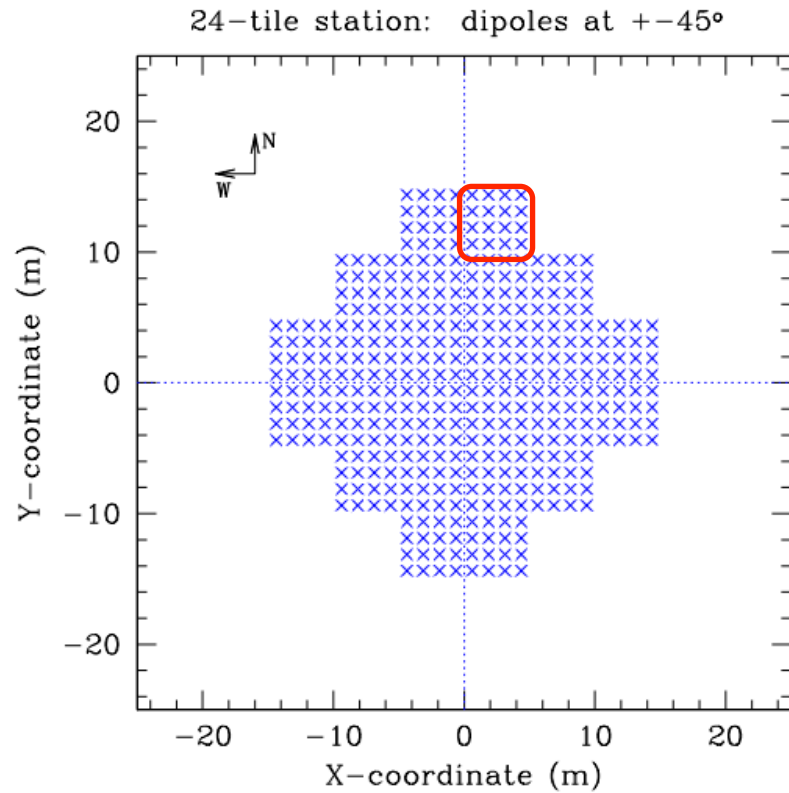
→ all CS split into 24 +24 tile substations

Current situation:

- (22+2) x 2 CS
- 13 → 15 or 16 RS (also CS302 and CS103 are 'remote' stations)

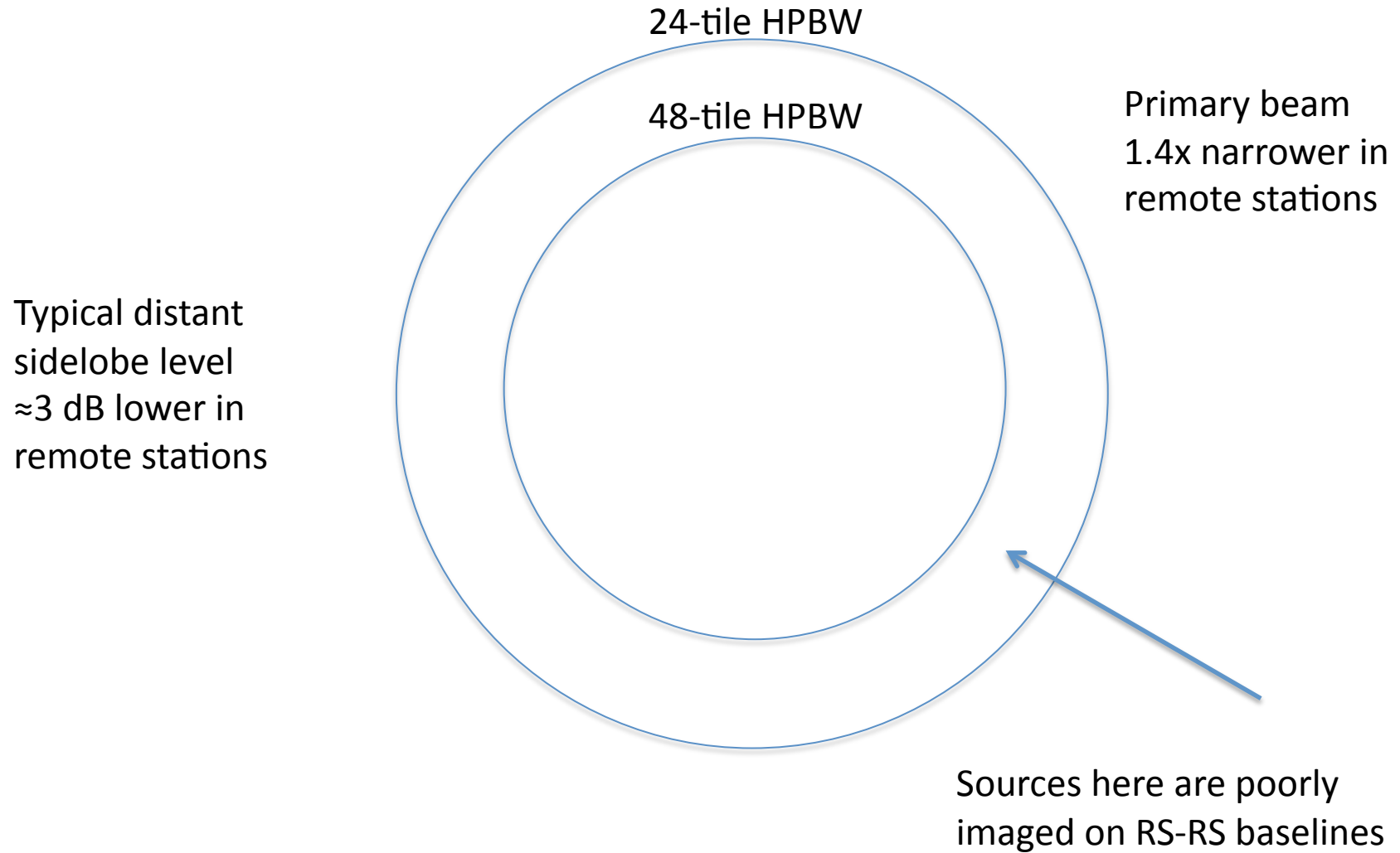
**Note that all of the following does not effect LBA !**

# Two station sizes in NL: 24-tile (CS) and 48-tile (RS)



600 m <sup>2</sup>	physical area	1200 m <sup>2</sup>
~ 2600 Jy	SEFD (150 MHz, zenith)	~ 1300 Jy

# Effects from different HBA-station ('primary') beams



# Some aspects of varying beams (HBA-DUAL)

There are 3 types of baselines -- CS-CS, CS-RS , RS-RS which affect calibration/imaging

## Negative aspects:

- this leads to change of the 'effective' PSF at the edge of the beam  
CS-CS baselines (large PSF) dominate the response
- loss of sensitivity related to uv-weighting scheme (uniform, Briggs-robust, natural,..)
- how to deal with this in the AW imager ??

## Positive aspects:

- (Much) better quality images (as evidenced in NCP observations, Sarod)
- Wider fields of view (improving survey speed)

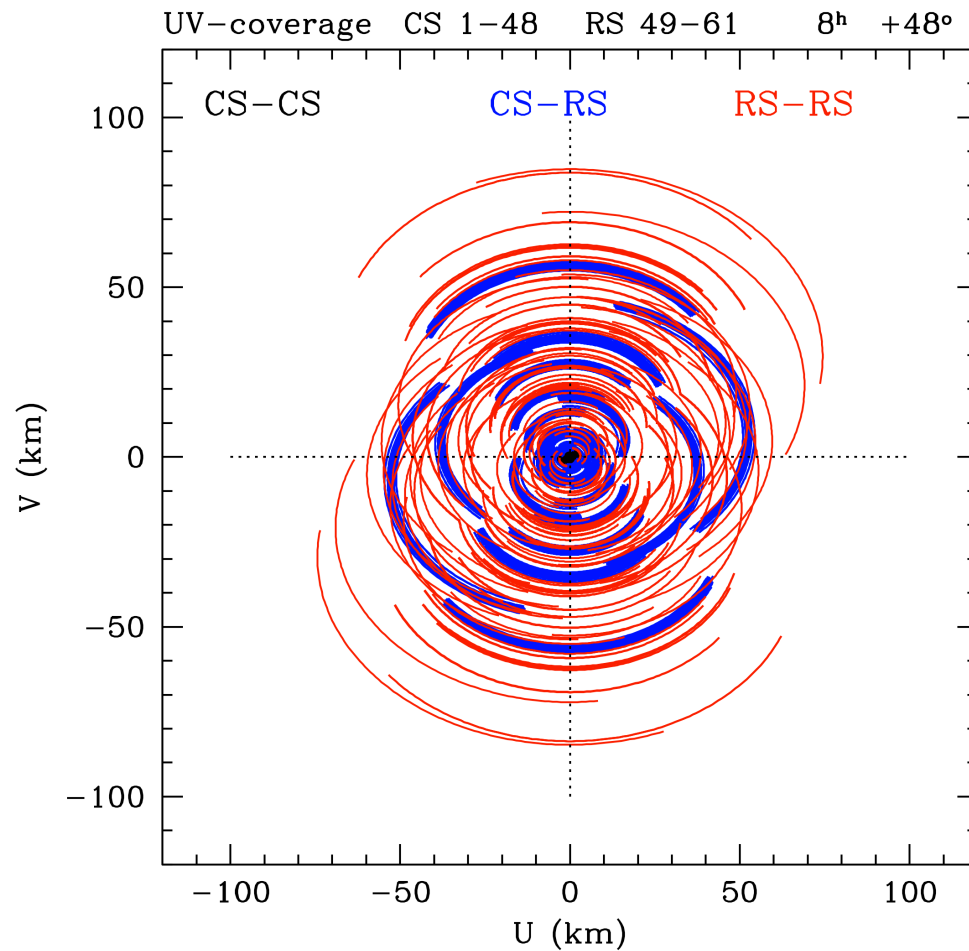
# UV-coverages with different station combinations

# baselines (currently)

1128 CS-CS

624 CS-RS

78 RS-RS



# Raw sensitivity aspects

Currently 48 CS + 13 RS  $\rightarrow 61 \times 60 / 2 = 1830$  baselines

1128 CS-CS baselines

624 CS-RS baselines

78 RS-RS baselines

With natural weighting (taking station sensitivity into account) we will suffer only a small loss in point source sensitivity.

Note that we give up  $13 \times 24 = 312$  tiles = 18% of total (1128 in core and 624 in remote = 1752 tiles)

But of course loss in sensitivity for high (50-100 km) angular resolution imaging is more severe up to factor 1-.5-2, depending on used weighting scheme !

# The future ?    A possible approach

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How to get maximum sensitivity in the future on long NL-baselines

- 1) Acquire a good intrinsic model for the field, to calibrate and remove from uv-data
- 2) Start with the MSSS GSM followed by one  $\approx 8$ h synthesis in HBA-DUAL-INNER mode to construct good model over wide field of view
- 3) Make additional HBA-DUAL datasets with narrower field of view



# Conclusions

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I advise to use HBA-DUAL-INNER, because

- It produces better quality images (NCP, Sarod)
- Loss of sensitivity is still acceptable (we are still not at thermal noise)
- There are still no calibration SNR-issues with when using only 24 tiles

This begs the question: when should we use 48-tile RS ?

Once we have good models and beams, and we need better sensitivity on 10-100 km baselines, then we can use 48 tile stations again.