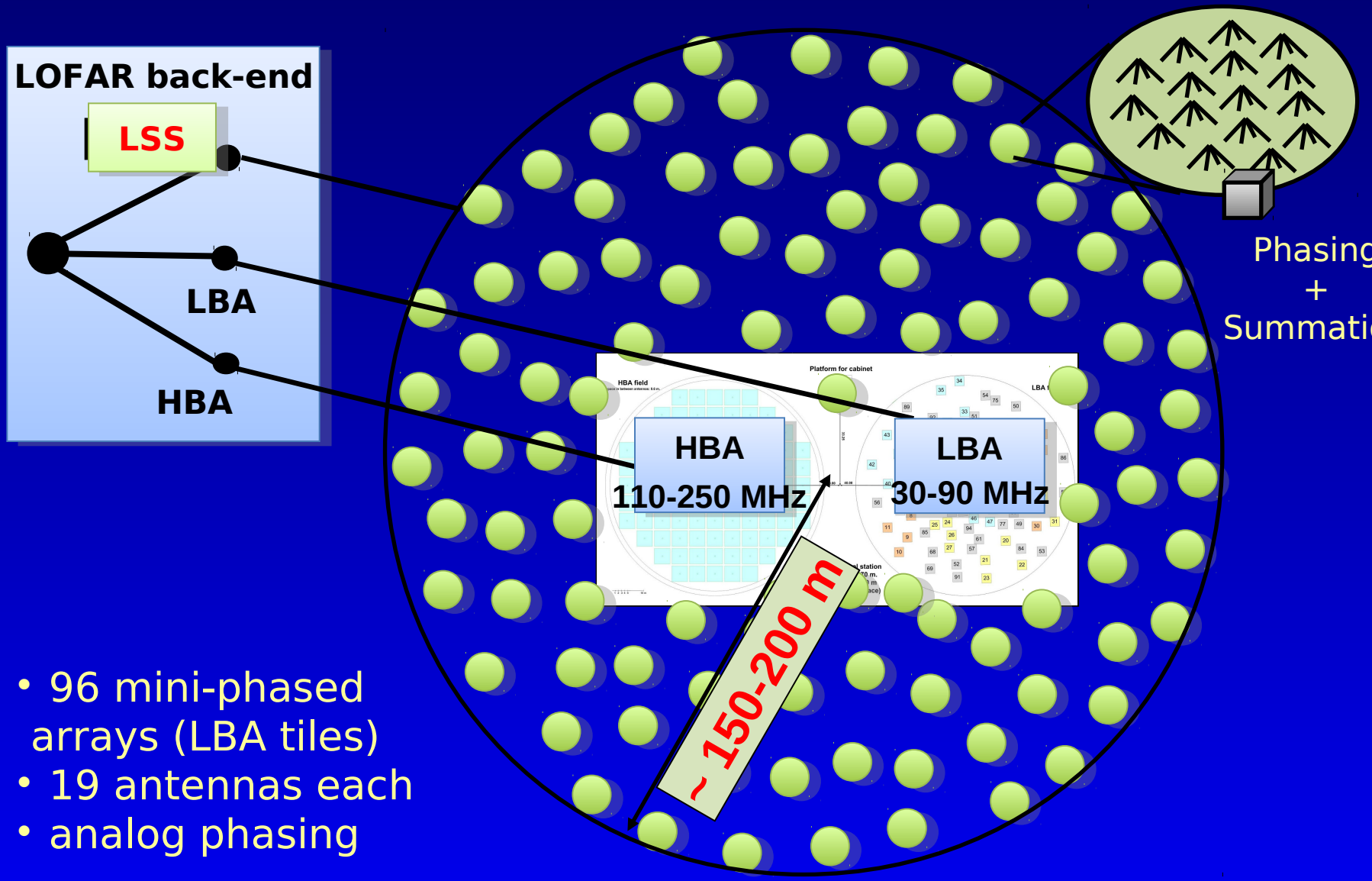
NenuFAR

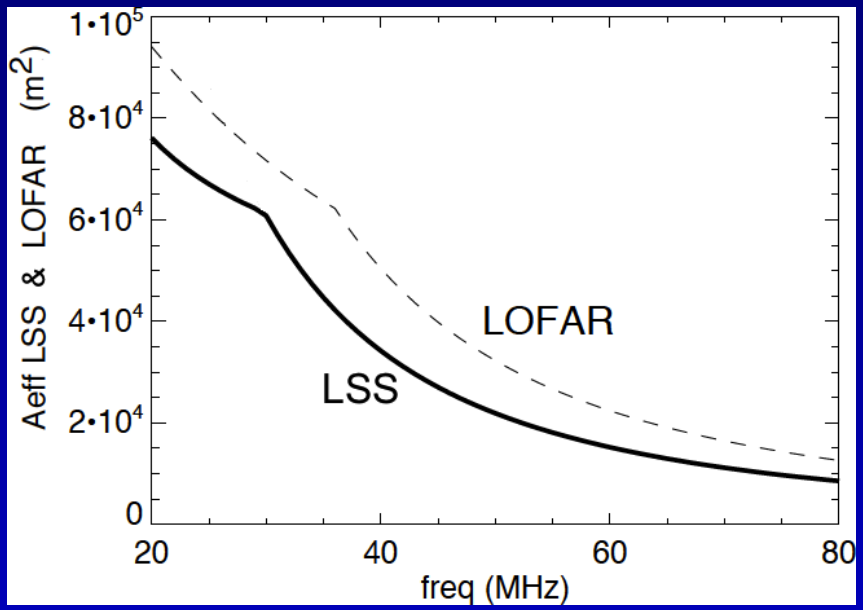
J.-M. Grießmeier for the NenuFAR team

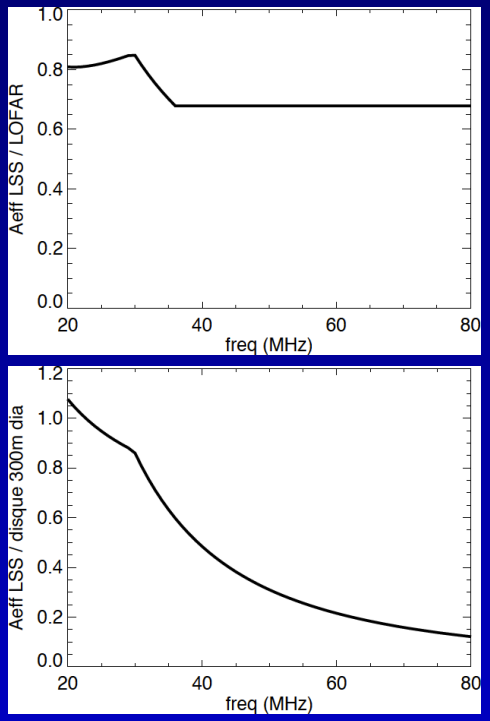
Superstation concept



- 96 mini-phased arrays (LBA tiles)
- 19 antennas each
- analog phasing

Superstation concept





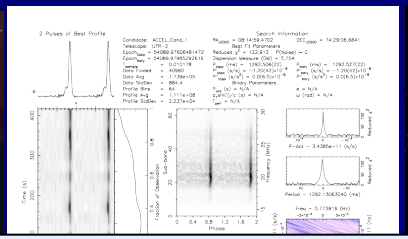
Large independent instrument: sensitivity 19x int. station (LBA)

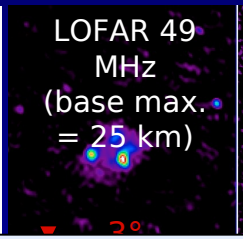
⇒ A_{eff} = 70-80% x A_{eff} LOFAR LBA

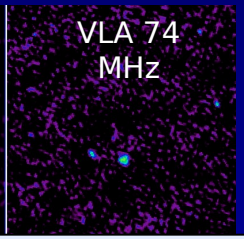
⇒ A_{eff} = 190% x A_{eff} core LOFAR LBA

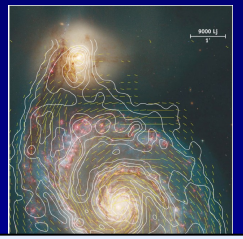
Access to low frequencies (15-80 MHz)

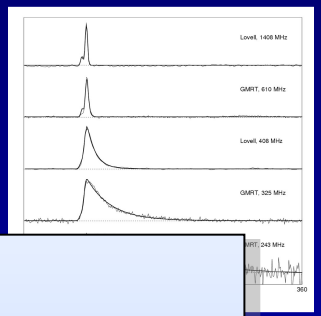
Superstation science case









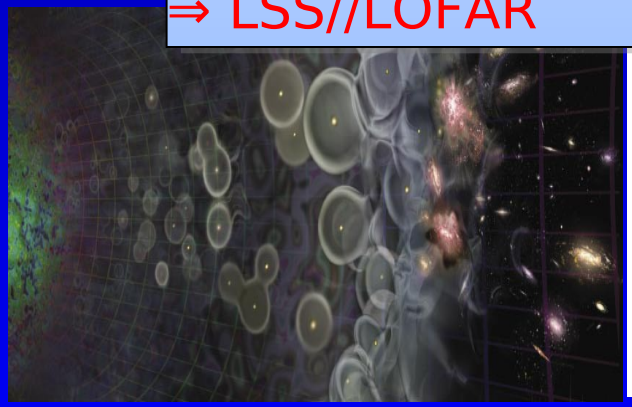


- flare stars, binary stars, exoplanets
- pulsars & Rotating radio transients (RRATs)
- structure of ISM
- galaxy formation
- impulsive universe
- lightning flashes in planetary atmospheres

⇒ LSS stand alone,

⇒ LSS+LOFAR,

⇒ LSS//LOFAR



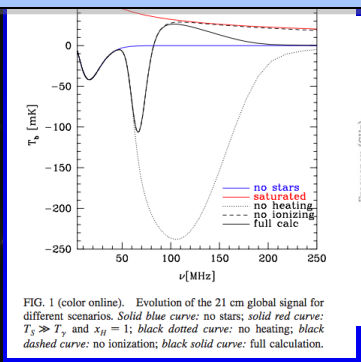
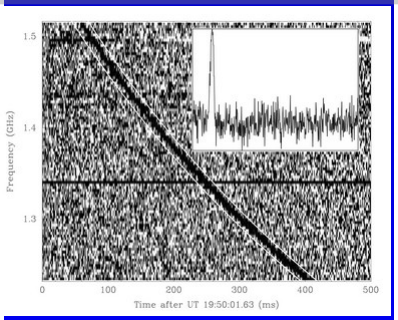
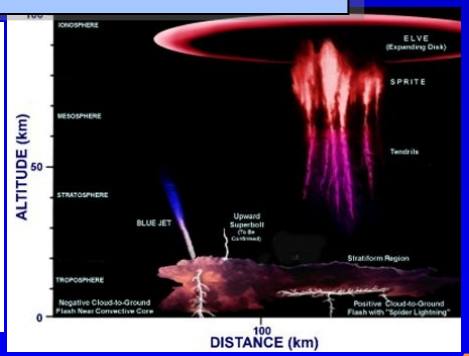
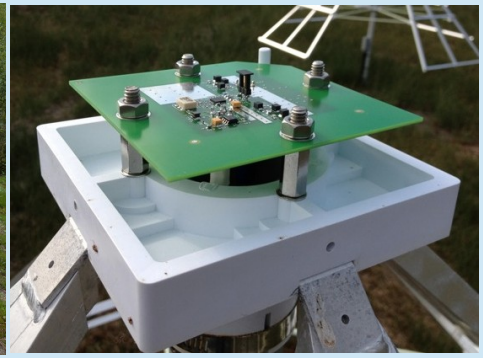


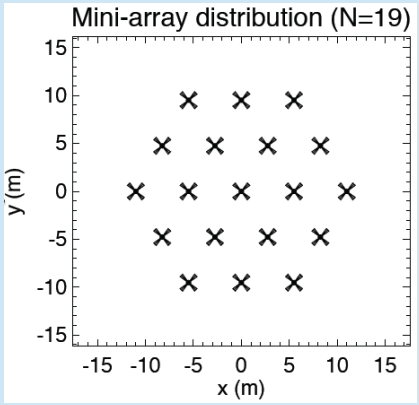
FIG. 1 (color online). Evolution of the 21 cm global signal for different scenarios. *Solid blue curve:* no stars; *solid red curve:* $T_S \gg T_\gamma$ and $x_H = 1$; *black dotted curve:* no heating; *black dashed curve:* no ionization; *black solid curve:* full calculation.



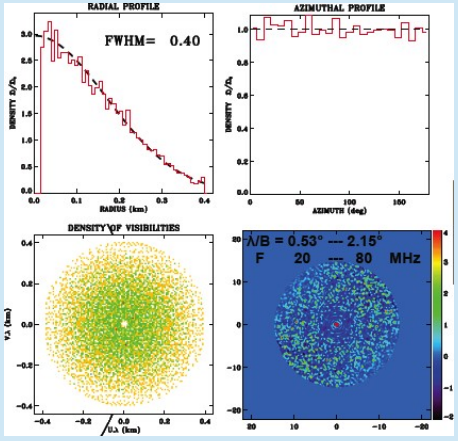


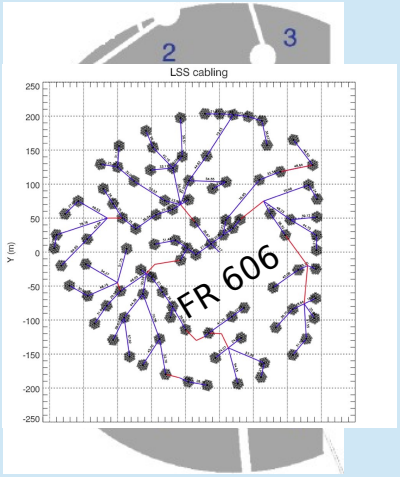
Prototype study (9/2009-2/2013)

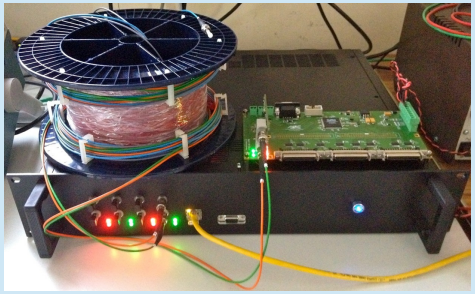


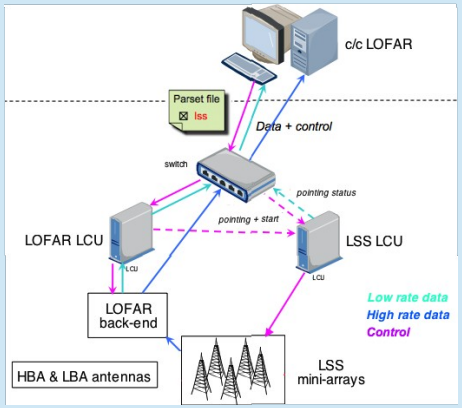


Study of all aspects of the project : antenna, preamplifier, distribution mini-arrays & global, phasing, cabling/trenches, silent control/command, dialog with LOFAR



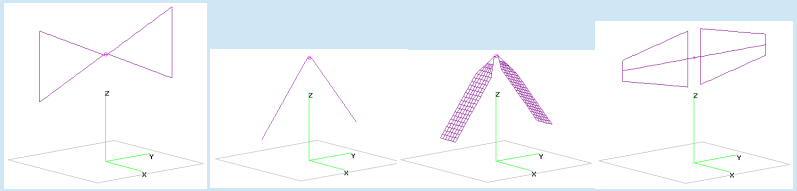


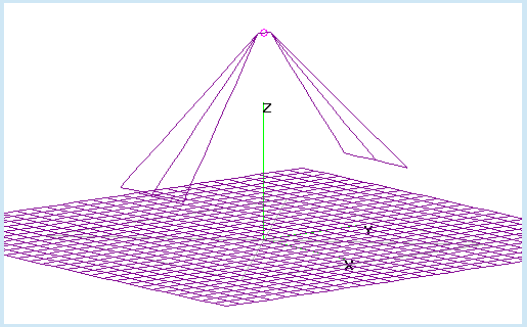


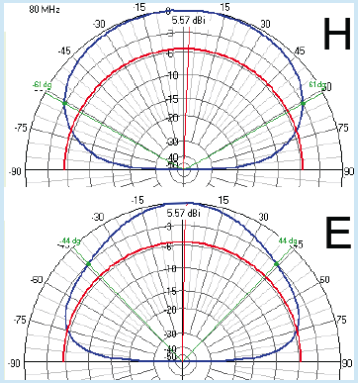


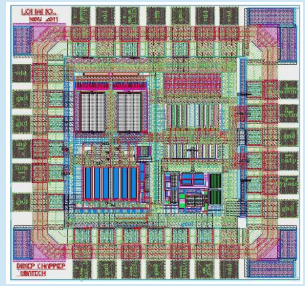
industrialization, site study (ONF), costing, sub-contracting, schedule

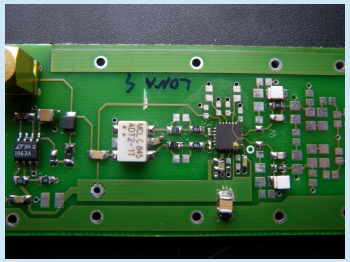
Prototype study: Antenna

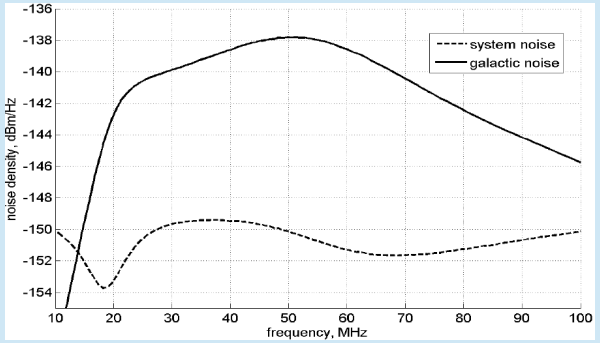


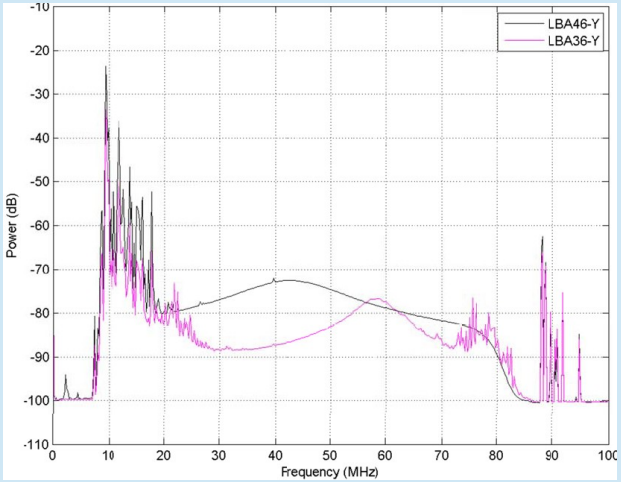






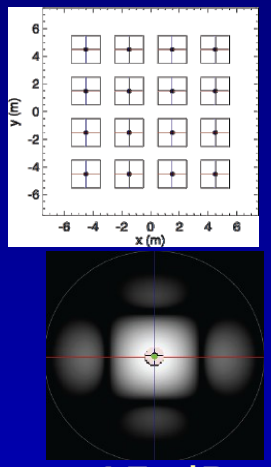




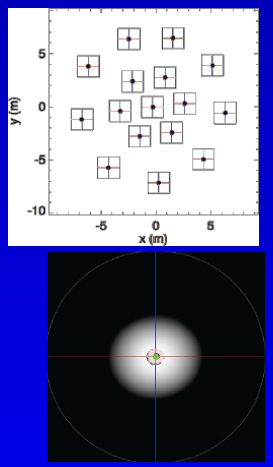


Prototype study: Mini-array

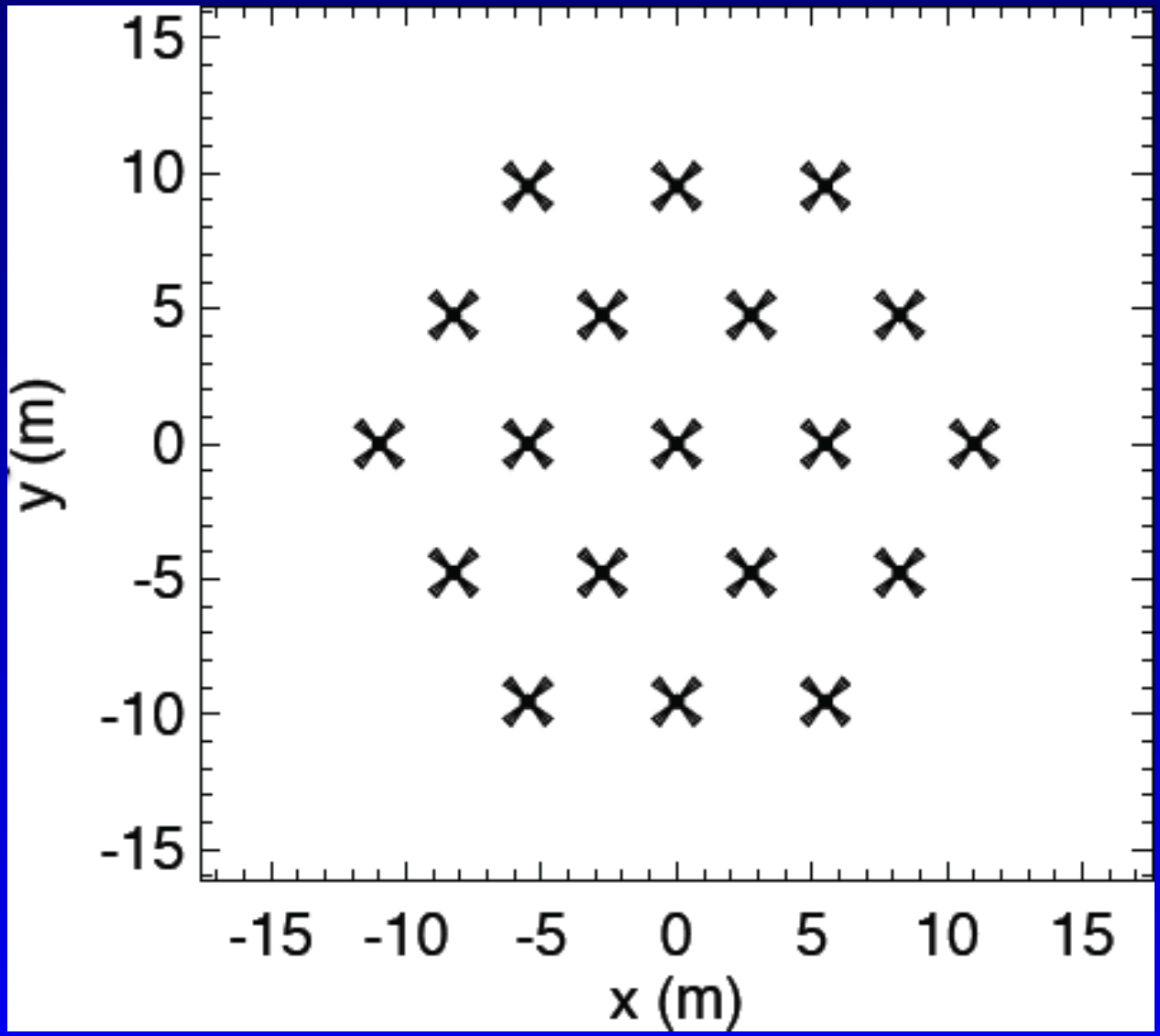
40 MHz



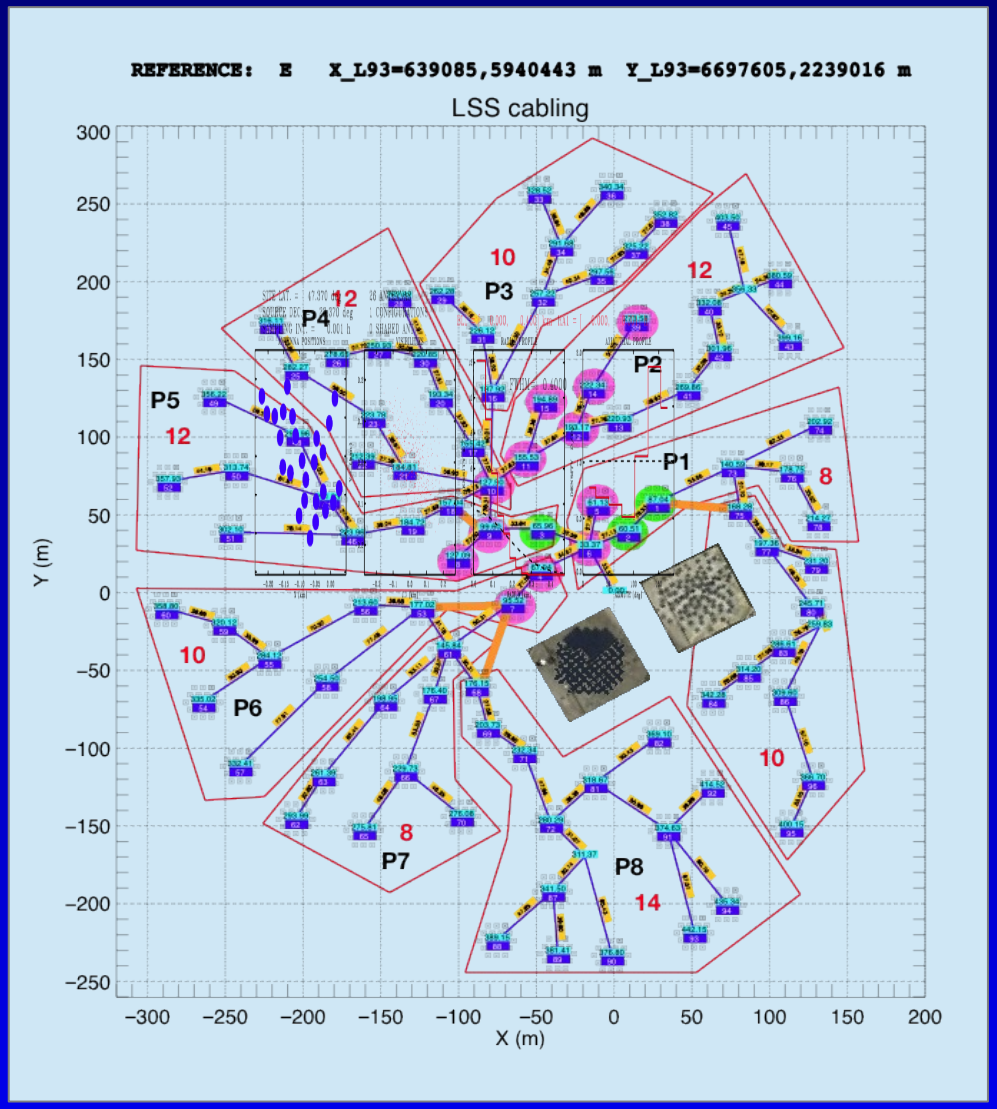
-15 dB sidelobes



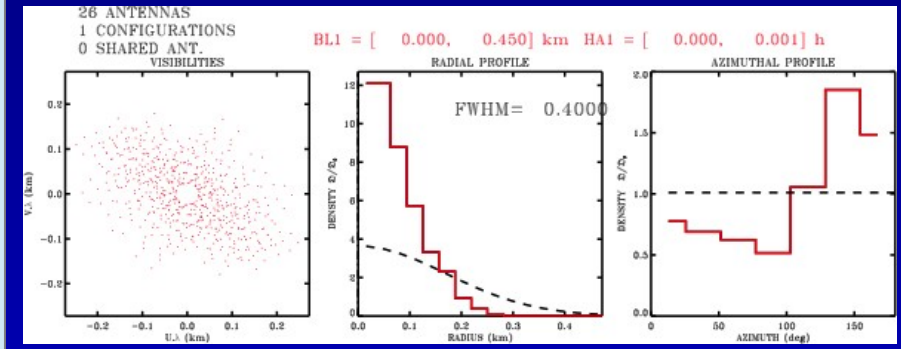
-32 dB sidelobes



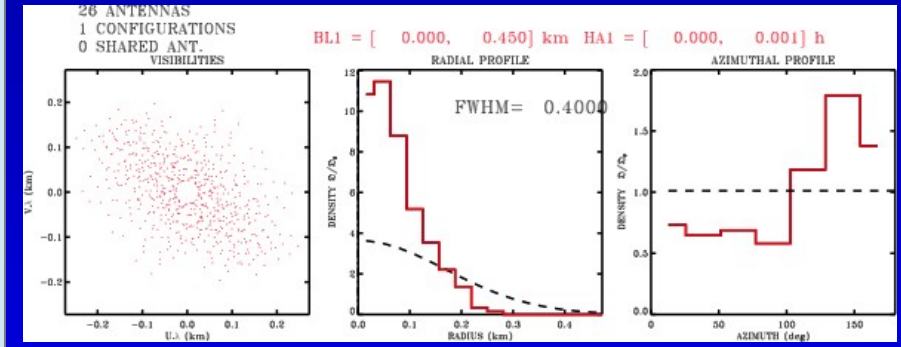
Prototype study: Array



66°

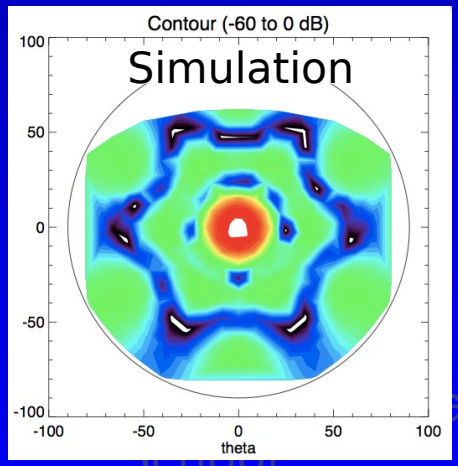


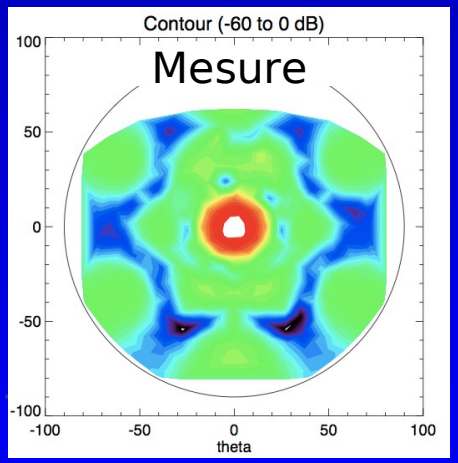
zenith

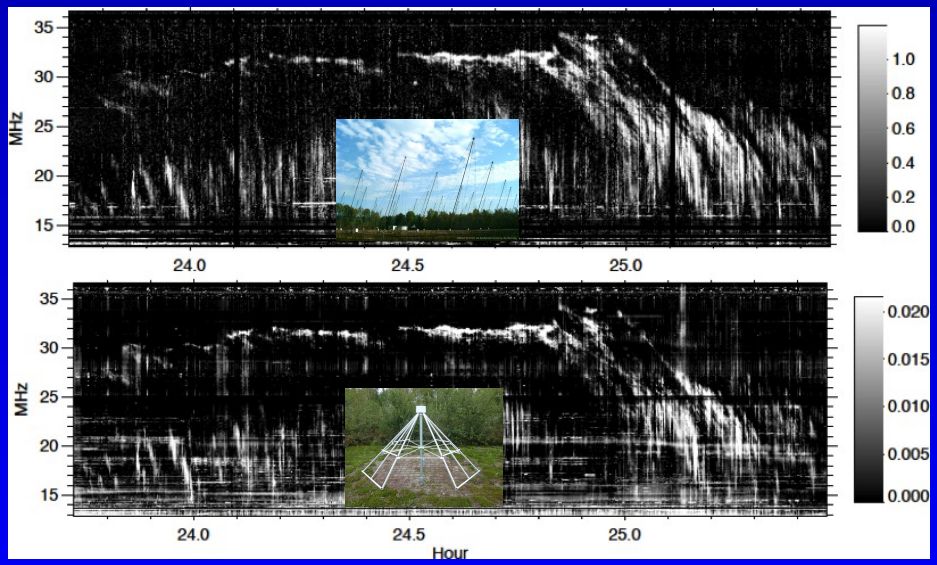


Prototype study: Tests

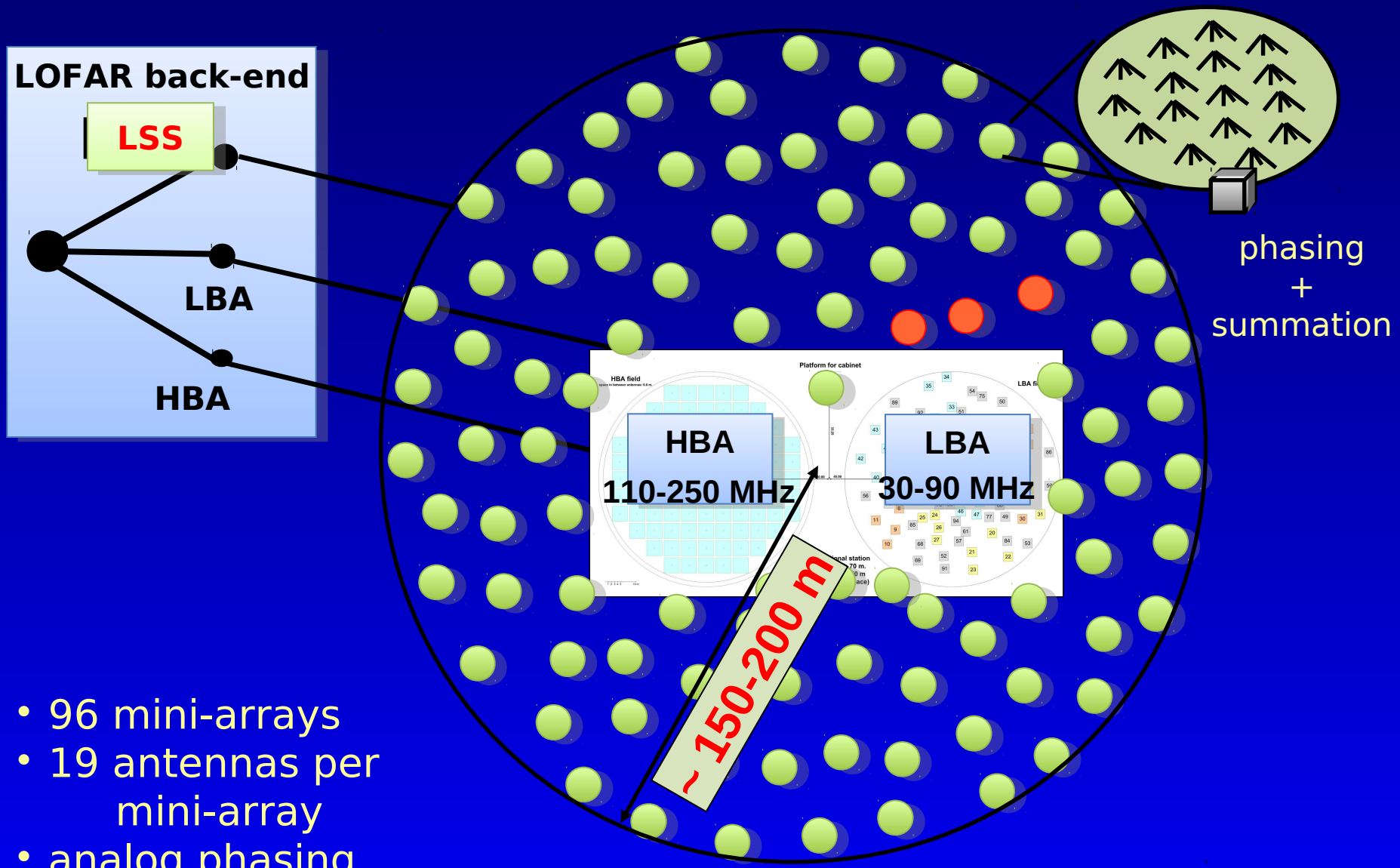
- construction & test of 3 mini-arrays (x 2 polarizations)
- dedicated receiver





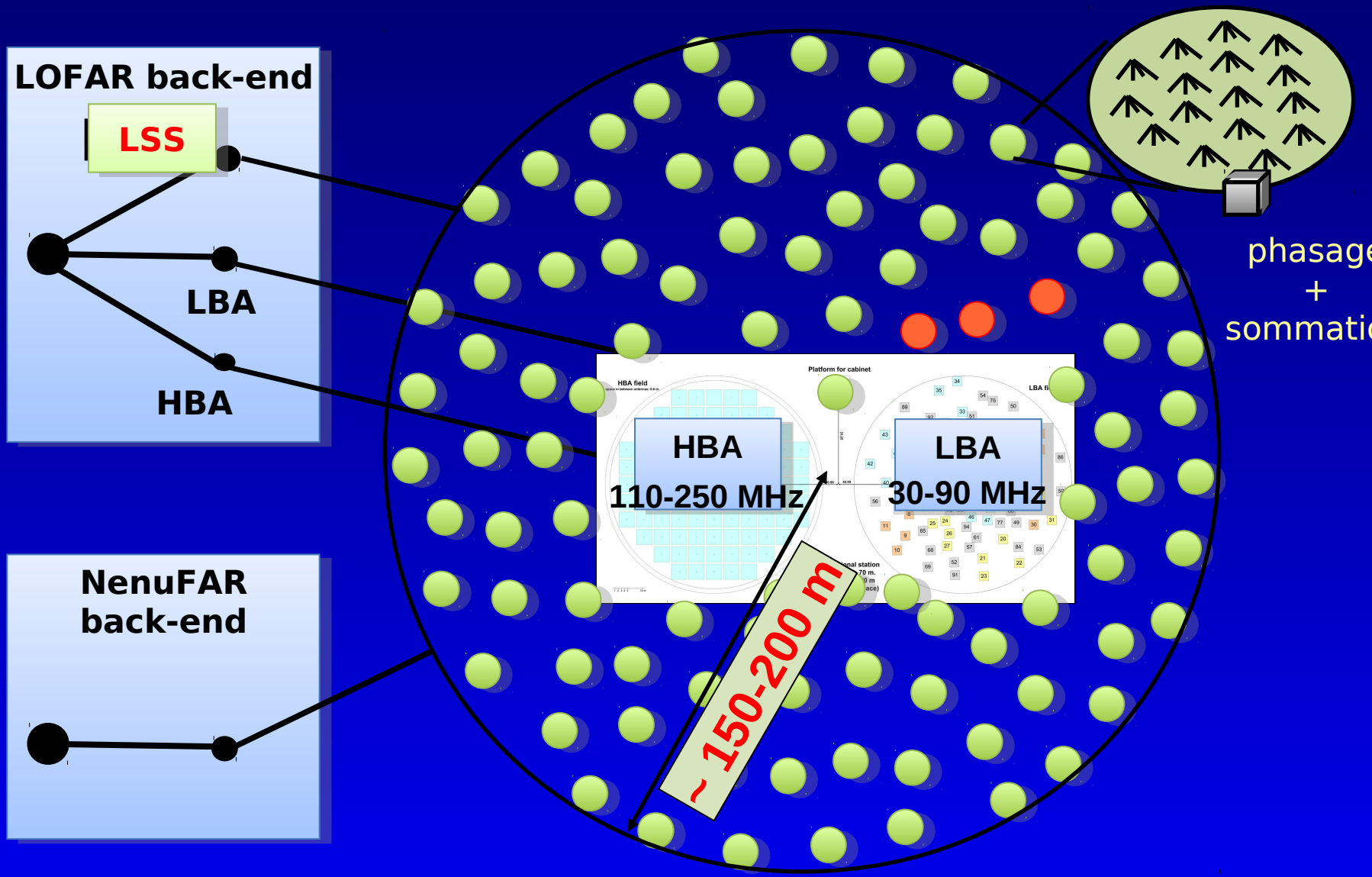


From LSS to NenuFAR



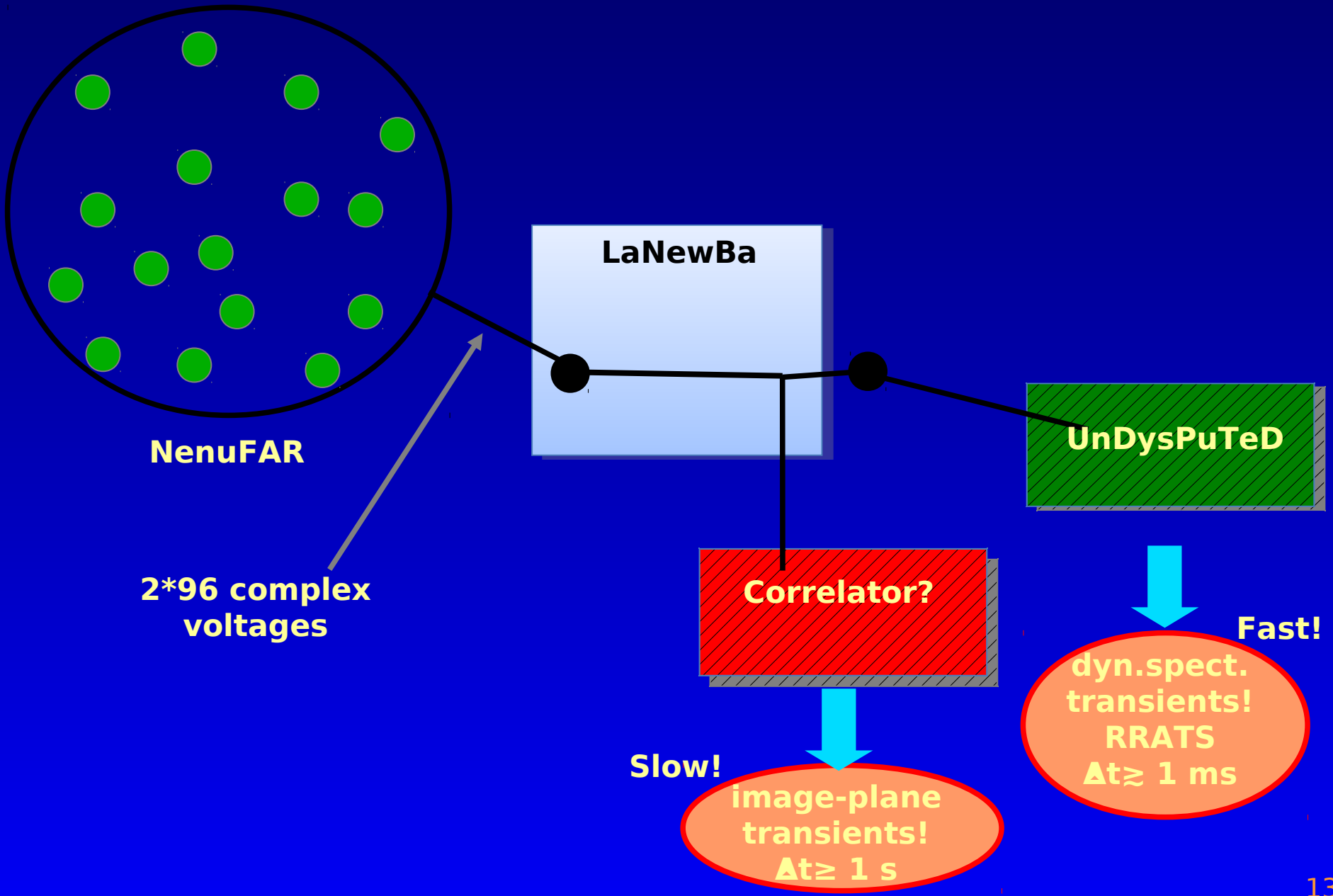
- 96 mini-arrays
- 19 antennas per mini-array
- analog phasing

From LSS to NenuFAR



2 instruments in 1!

NenuFAR receiver



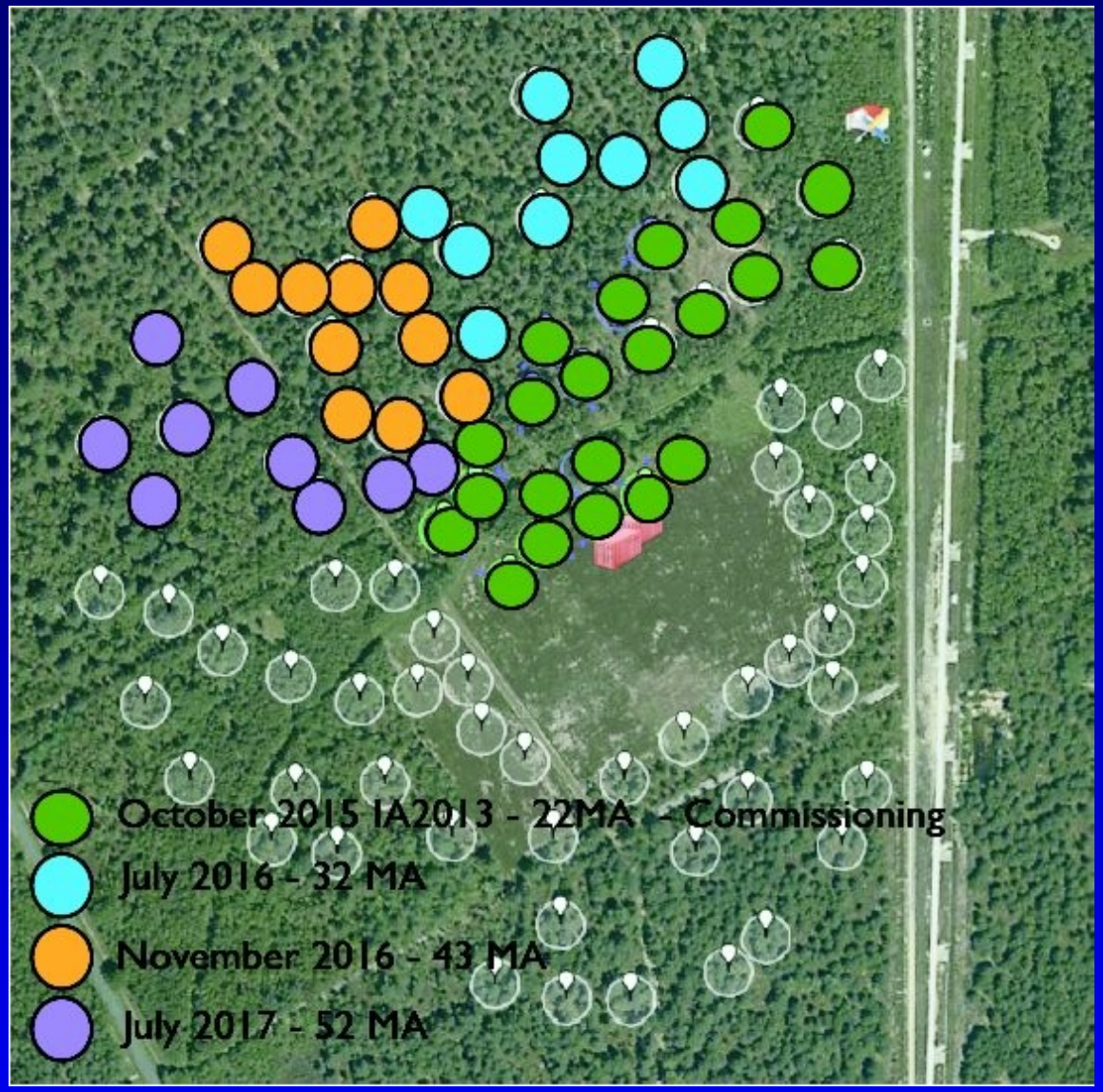
NenuFAR in numbers

- LOFAR-compatible phased array & interferometer
- 1824 antennas : 96 mini-arrays of 19 antennas
- Diameter ~400 m
- Collecting area ~ 62 000 m^2 @ 30 MHz ($\propto\lambda^2$)
- Frequency range = 10-85 MHz (λ=3.5-30m)
- Broad FoV (8°-60°), pointing -23° → +90°
- Resolution 0.5-4° (standalone) - 0.1 " (LSS)
- Resolutions <1 msec × 1-100 kHz
- Full polarization (4 Stokes)
- Sensitivity <10 mJy (10^{-28} $Wm^{-2}Hz^{-1}$) [+confusion]
- SKA-Low pathfinder

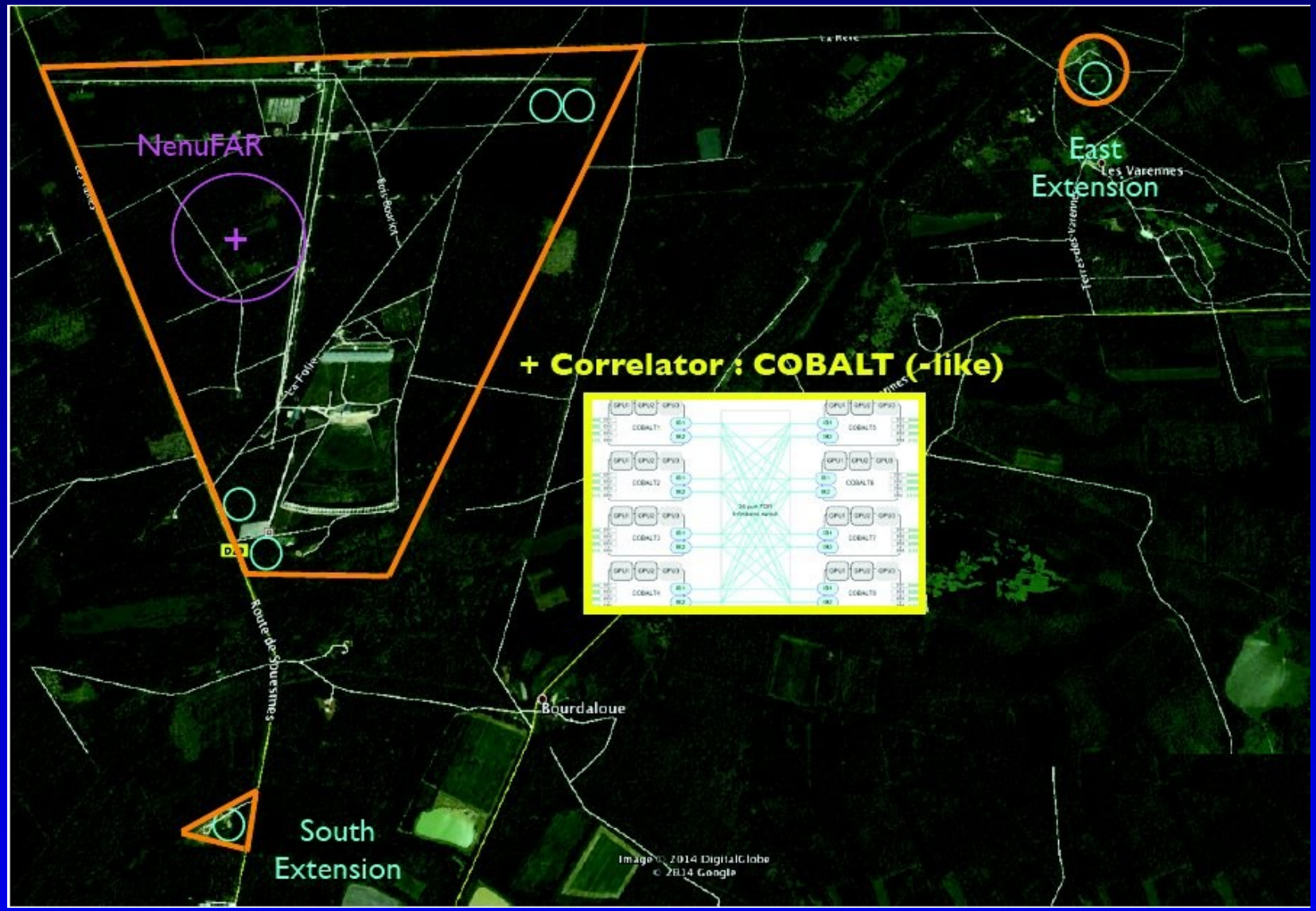
NenuFAR status

- construction cost : ~5 M€
- >60% funded
- Phase 1 construction started 11/2013
- 22 mini-arrays built
  (418 antennas ; ≥ 4 int.LOFAR stations)
- by end 2016: 41 mini-arrays
- receiver LaNewBa: 05/2016
- backend UnDysPuTeD: 12/2016
- science operations: early 2017
- PhD student (?) to work with NenuFAR (09/2016)

Mini-array distribution



« Remote » stations



… ongoing work!