LOFAR

Towards a French participation

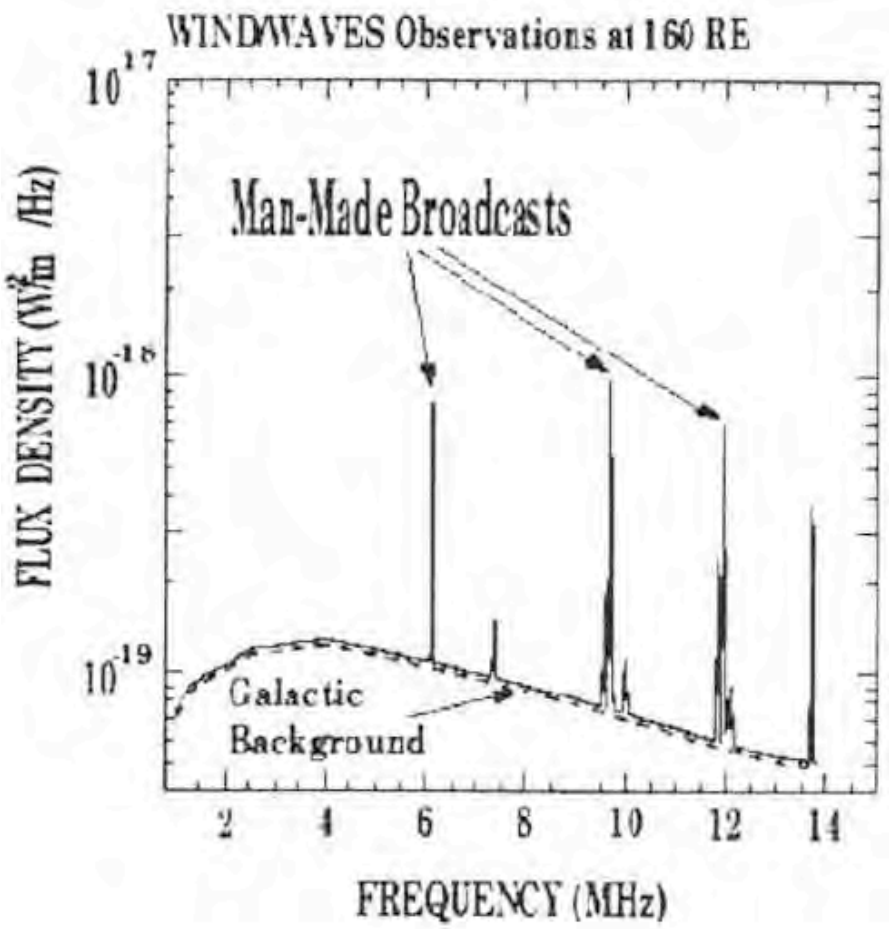
Introduction

Philippe Zarka, LESIA, CNRS/Obs. Paris, Meudon

- Radioastronomy born in decameter range
  (~22 MHz) [*Jansky, 1930-33*]

but

- LF largely unexplored due to 4 main difficulties
  - Bright galactic background : T_B [K] ~$10^8/f^{2.5}$ with f in [MHz]



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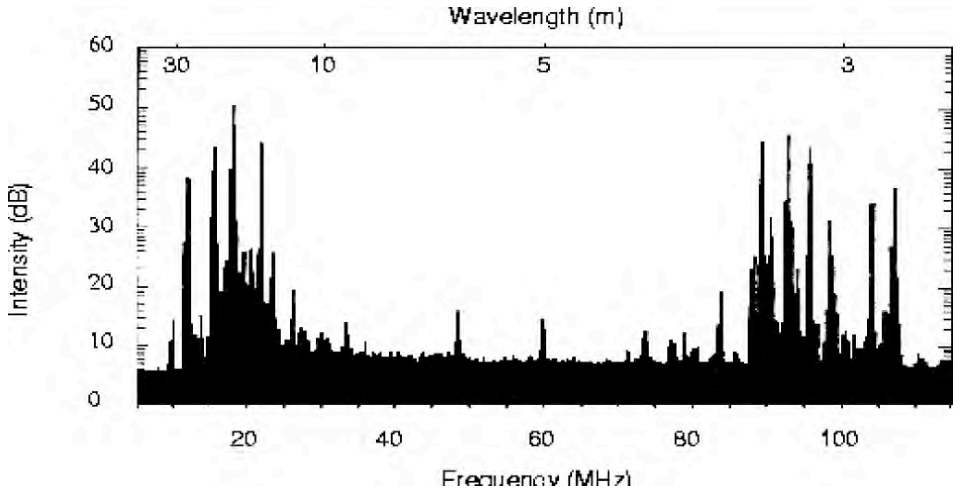
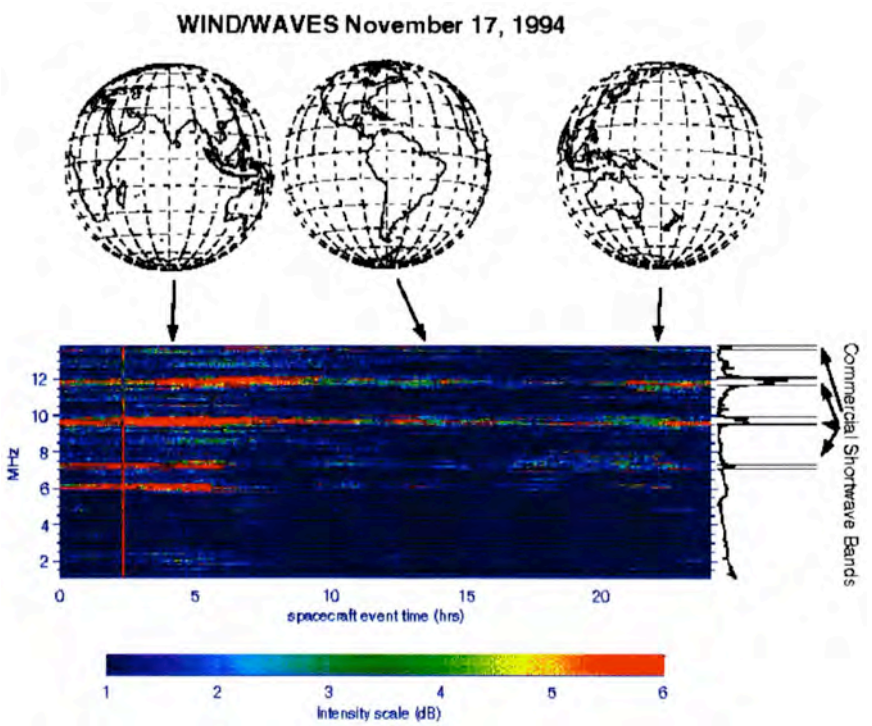
  - RFI = Radio Frequency Interference

    ⇒ limited sensitivity





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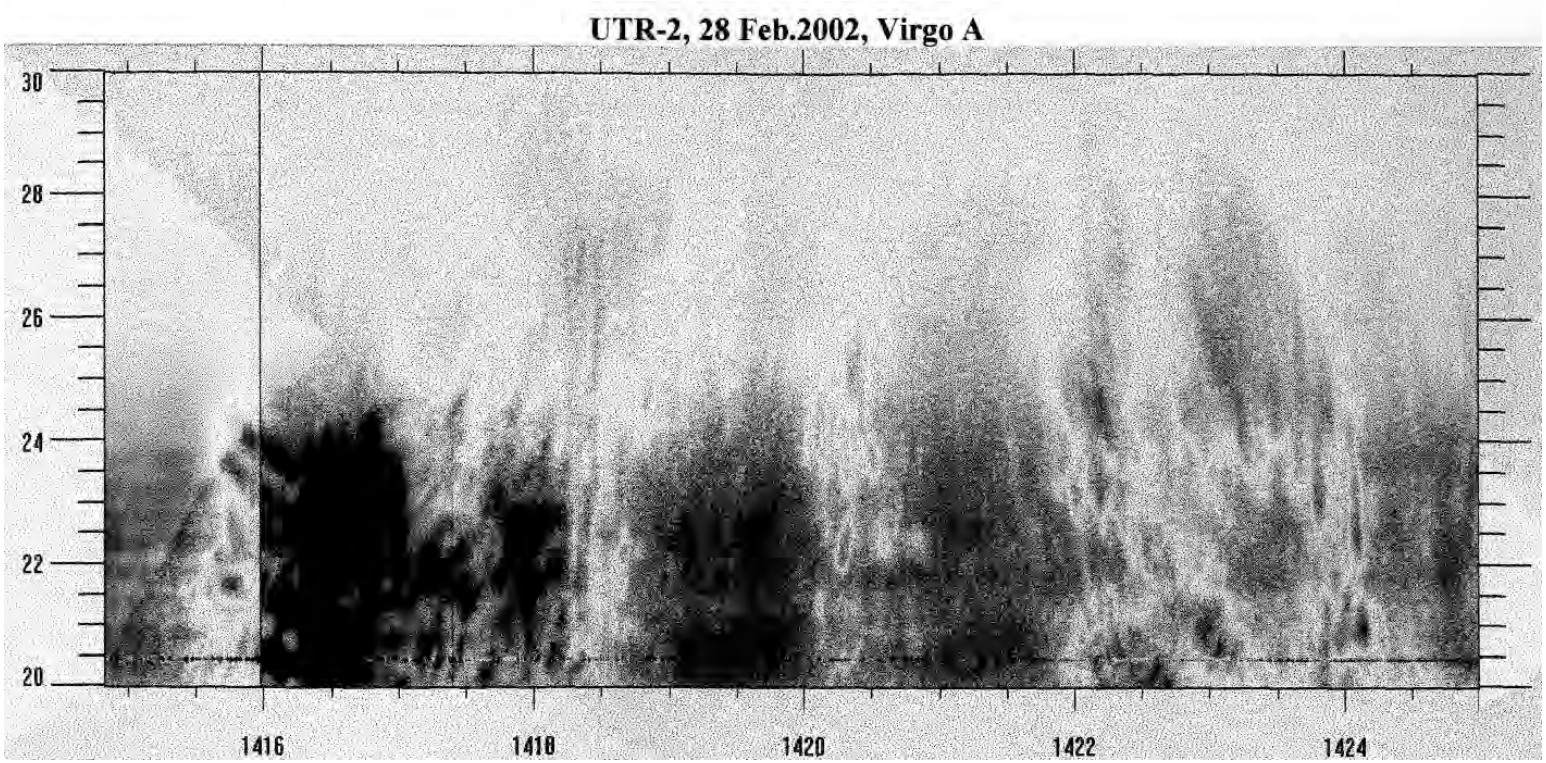

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  - Terrestrial ionosphere
  - λ = m – dam
    ⇒ limited angular resolution

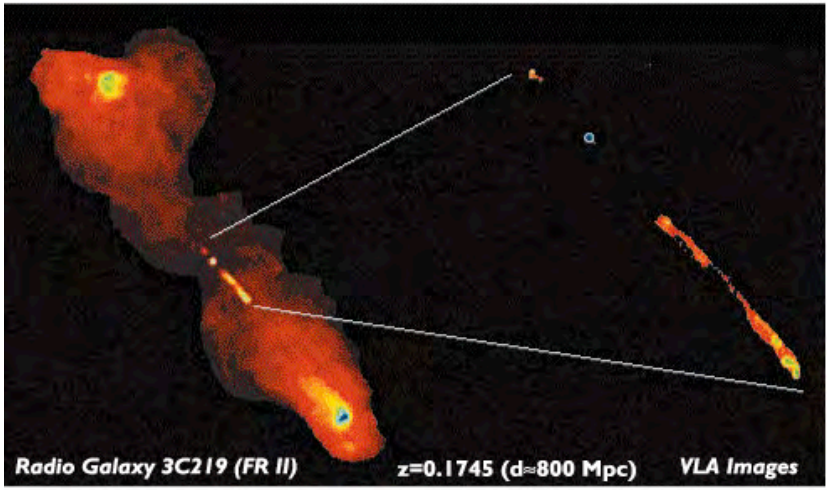
⇒ HF imaging (dm – cm)

Radio Image of Cygnus-A (FR-II)

z=0.056 (d≈300 Mpc)

5 GHz image ; ∅ 200 kpc

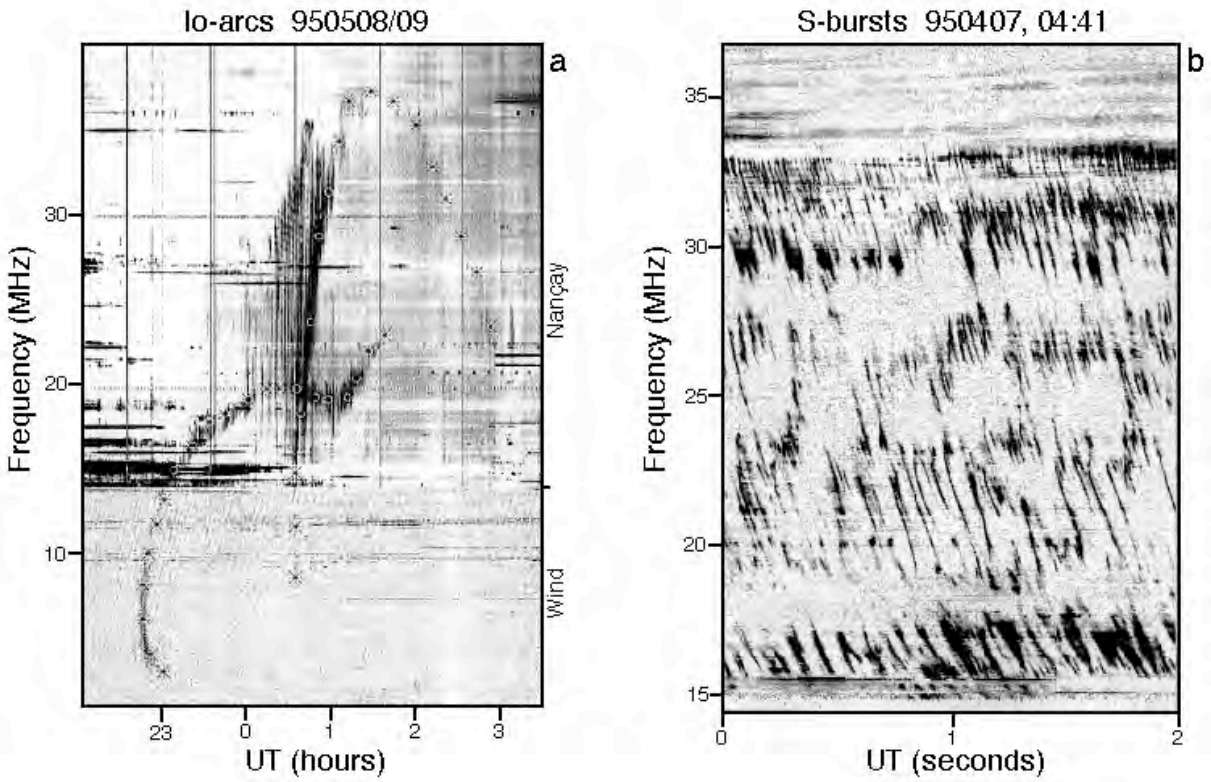
Radio Image of 3C219 (FR-II)



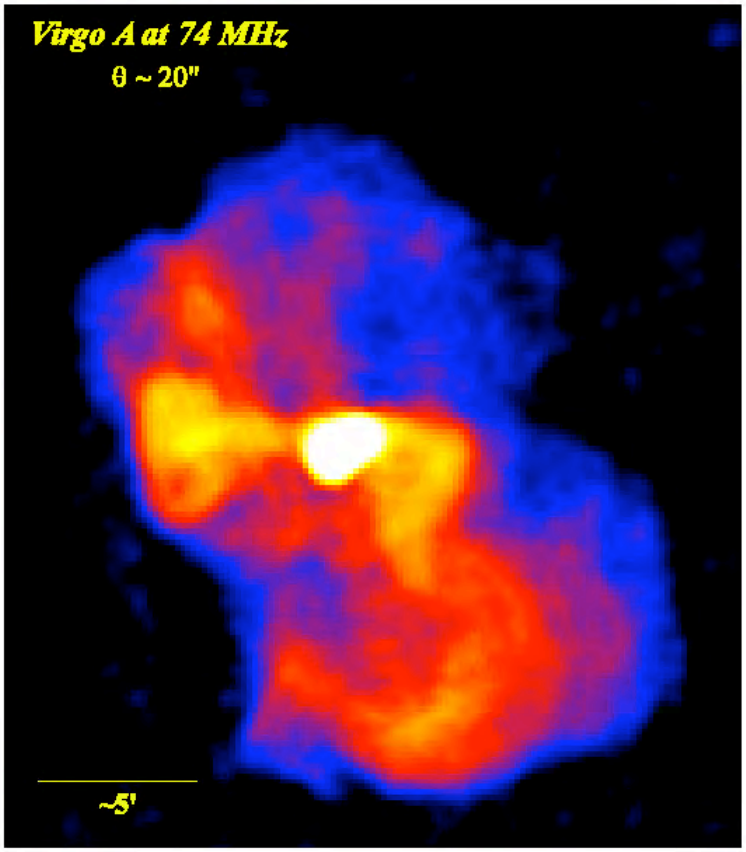
1.4+1.6 GHz combined image at 1.4 arcsec resolution

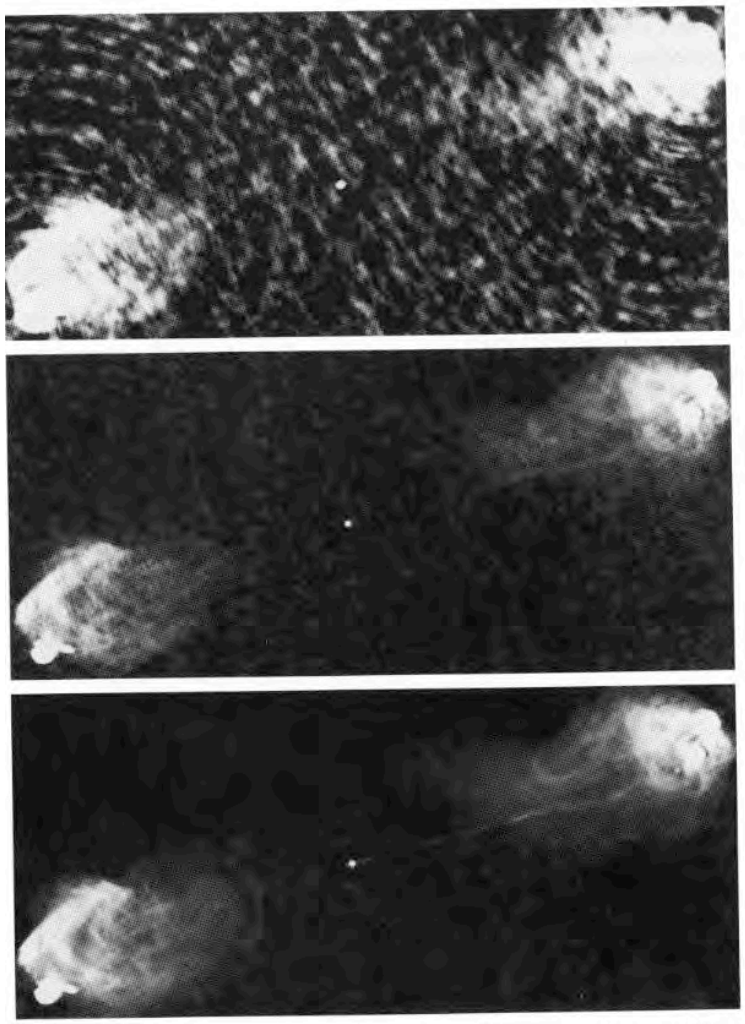
8 GHz image of jets at 0.1 arcsec resolution

$\Rightarrow$ LF spectroscopy, broadband, high t-f resolutions, large dynamic range : Sun, Jupiter … (dedicated instruments with generally A $\leq 10^4$ m^2)



≥1993 : VLA imagery at 74 MHz with ionospheric correction (CLEAN, MEM, phase-closure, self-cal)

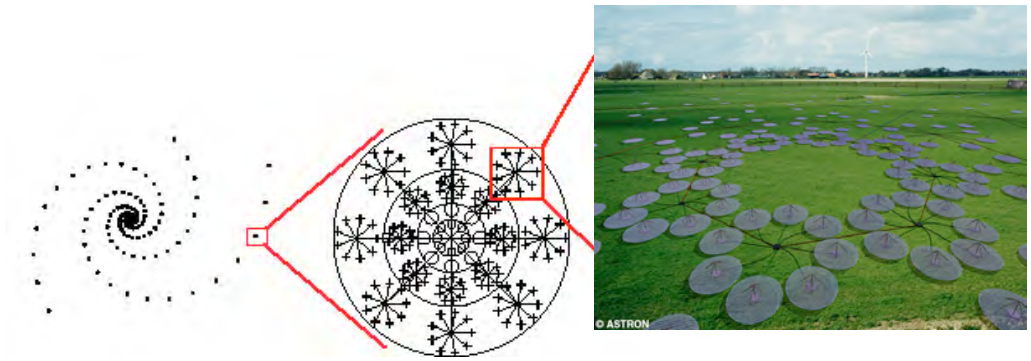


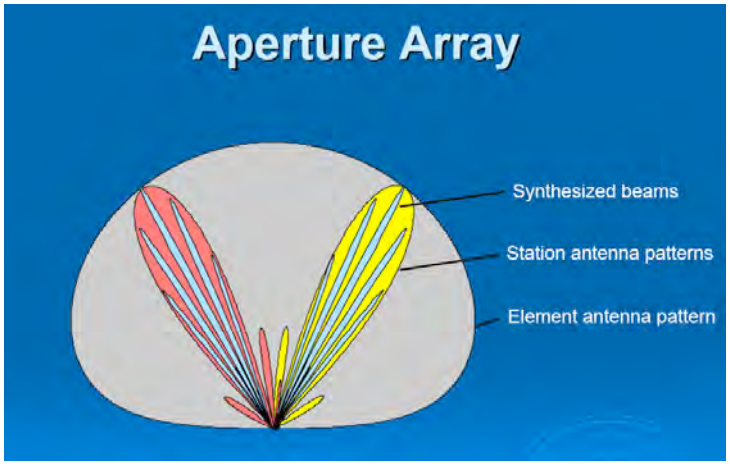


1990’s : several projects for large LF instruments
(LWA, LOFAR…)

2000-1 : LOFAR project
ASTRON (NL), NRL + MIT/Haystack (USA)

- Interferometer / Phased array : core + stations, 10^6 m^2, $\varnothing > 400$ km
- Wide-field (several °) high-resolution (1-10") imagery / multi-beam (8)
- Multi-frequency (32 MHz $\subset$ 10-240 MHz),
  resolutions down to (1 kHz × 1 msec)
- High sensitivity (0.1-10 mJy), dynamic range, full polarization
  (4 Stokes)
- Built in RFI mitigation + ionospheric corrections

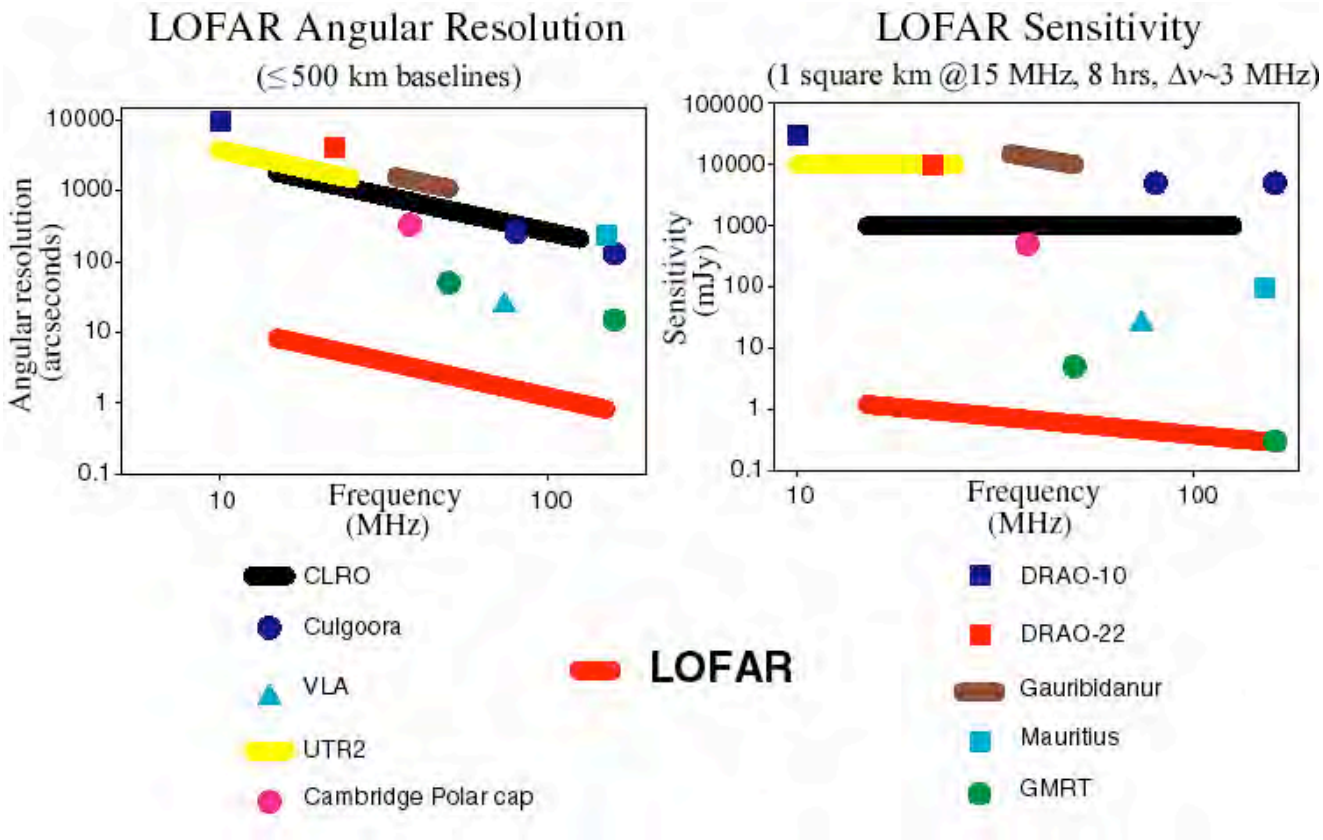




• Targets :

>1-2 orders of magnitude improvement / existing telescopes

1st all-purpose LF telescope and 1st spectro-imager at f ≤ 100 MHz



• Science → cf. H. Falcke

2002-3 : CNRS/INSU « Prospective »

- LOFAR proposal ~30 scientists from 14 labs.

- Support with limited funding

→ Involvement in

(1) scientific case
(2) enabling observations (ITS/NDA)
(3) software (RFI) developments
(4) hardware participation

2004-5: LOFAR funded in NL, with NL site

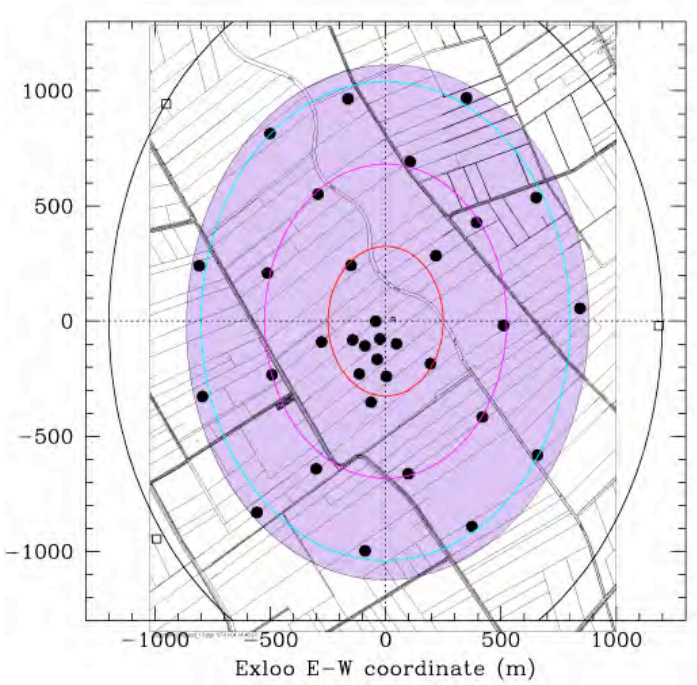
→ reorganization of LOFAR consortium,
descope (A~0.2×10^6 m^2, ∅ ~100 km)
broadening of project contours (WAN)
ITS

→ cf. M. van Haarlem

→ (1) & (2) done/in progress
(3) generic LOFAR/SKA/FASR…
(4) cancelled/reoriented SKA, FASR

2005-6

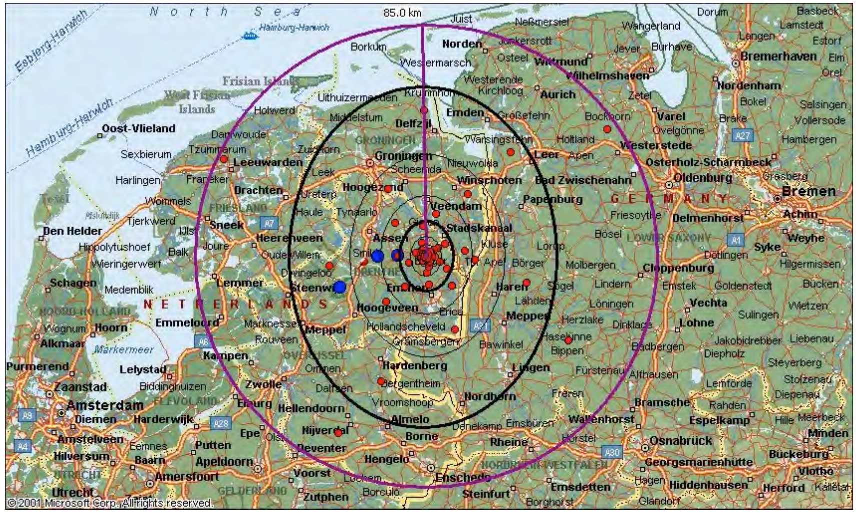
- CDR → core + stations architecture defined
- Formation of Key Projects SWG
- Core Station-1 (may-june)



2006+

→ Operation start 2007 ?
→ Full operation 2008 ?

European expansion :
- remote stations
- science centers
- funding (FP7…)
- enhanced scientific collaboration…



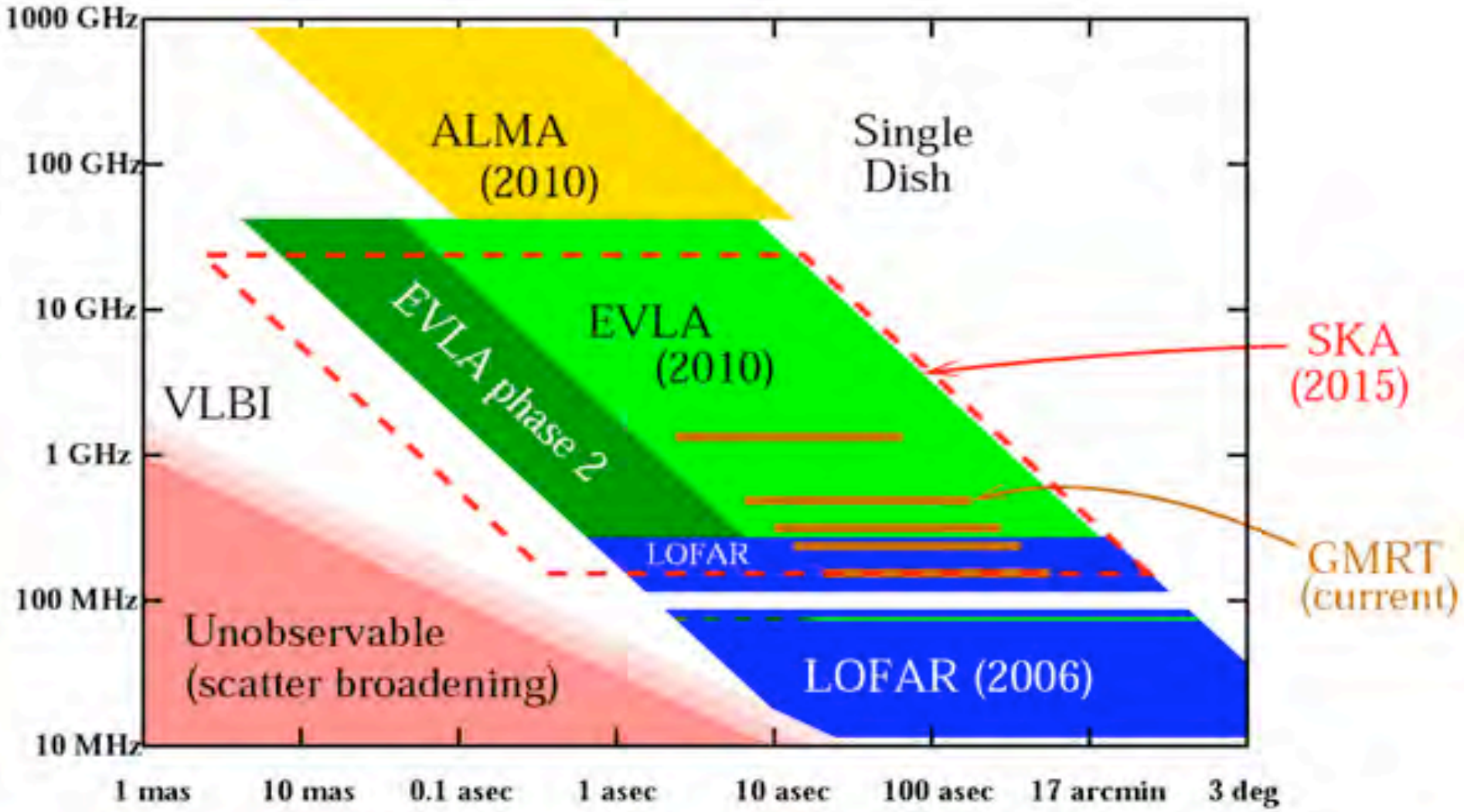
Associate members of LOFAR consortium : Sweden (LOIS), Germany (GLOW) … UK ? France ? Italy ? Poland ?

Questions to be addressed (not limitative) :

- National participation ?
- Who is interested by what ?
- How ? (remote stations, science centers,
  funding, integration / european programmes)
- Funding sources ?
- Organization / animation in France ?
- Coordination with consortium (MOU…) ?

Format of the workshop :

- Introductory talks : Falcke, van Haarlem, Dubouloz
- Science talks : Tuesday & Wednesday morning
- Parallel discussions :
  - Radiodetection of cosmic showers
  - Reionization, galaxies & cosmology
  - High angular resolution (arcsec)
  - Data processing
- Synthesis / Conclusions


1000 GHz
100 GHz
10 GHz
1 GHz
100 MHz
10 MHz
1 mas
10 mas
0.1 asec
1 asec
10 asec
100 asec
17 arcmin
3 deg
ALMA
(2010)
Single
Dish
EVLA phase 2
EVLA
(2010)
SKA
(2015)
VLBI
LOFAR
GMRT
(current)
Unobservable
(scatter broadening)
LOFAR (2006)