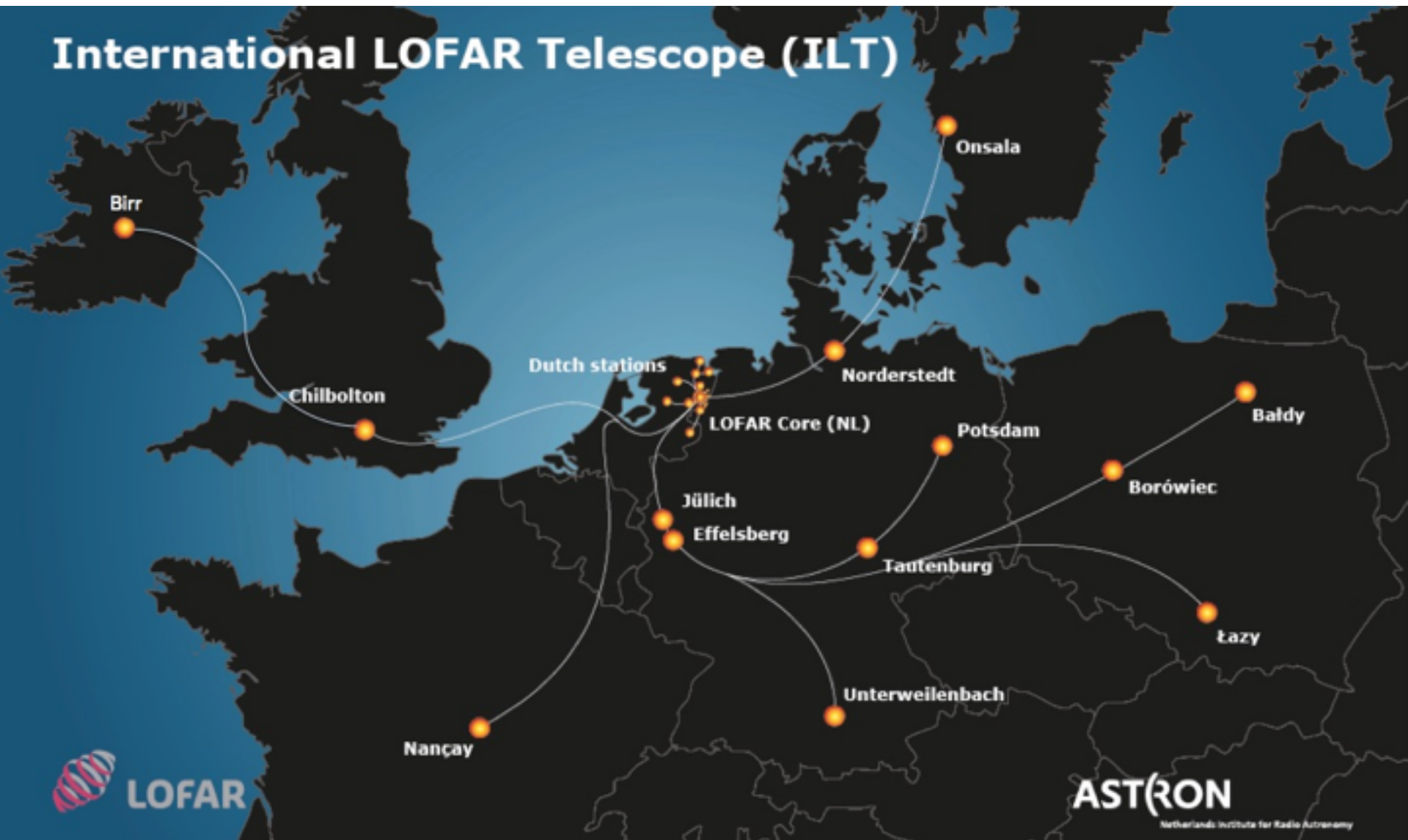




## ASTRON - towards LOFAR 2.0

Prof Carole Jackson  
General & Scientific Director, ASTRON

# International LOFAR Telescope (ILT)



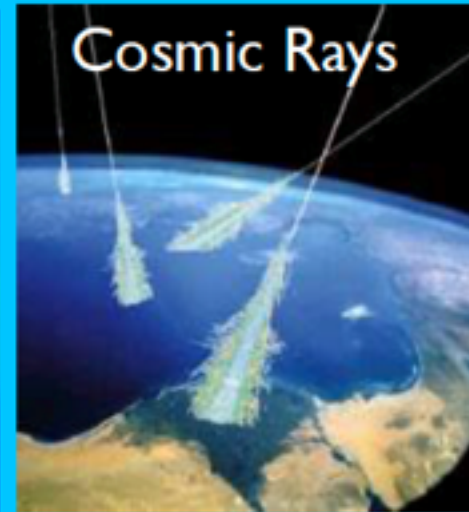
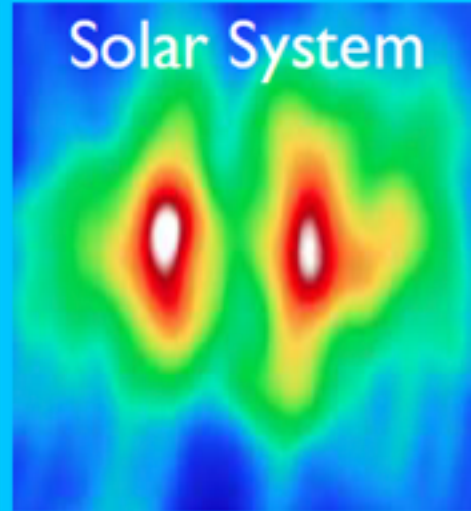
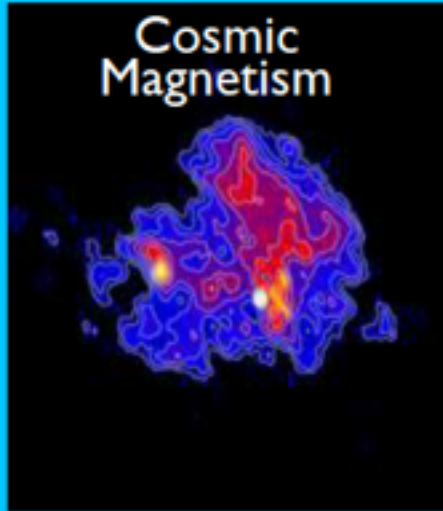
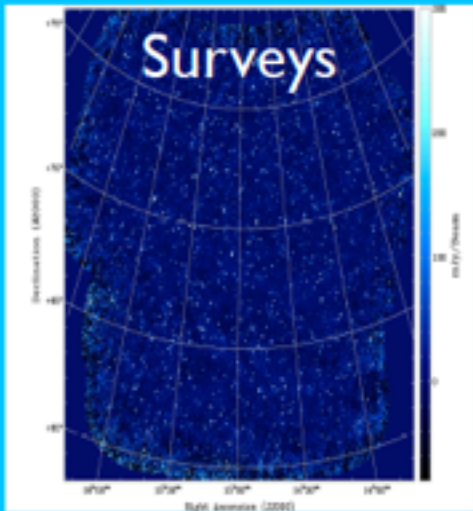
LOFAR - dual-band, LBA (10 - 90 MHz) + HBA (110 - 250 MHz)  
38 NL stations + 13 EU (+Latvia, Italy....) Max baseline 1200 km



# LOFAR 1.0, core @ Exloo

ASTRON



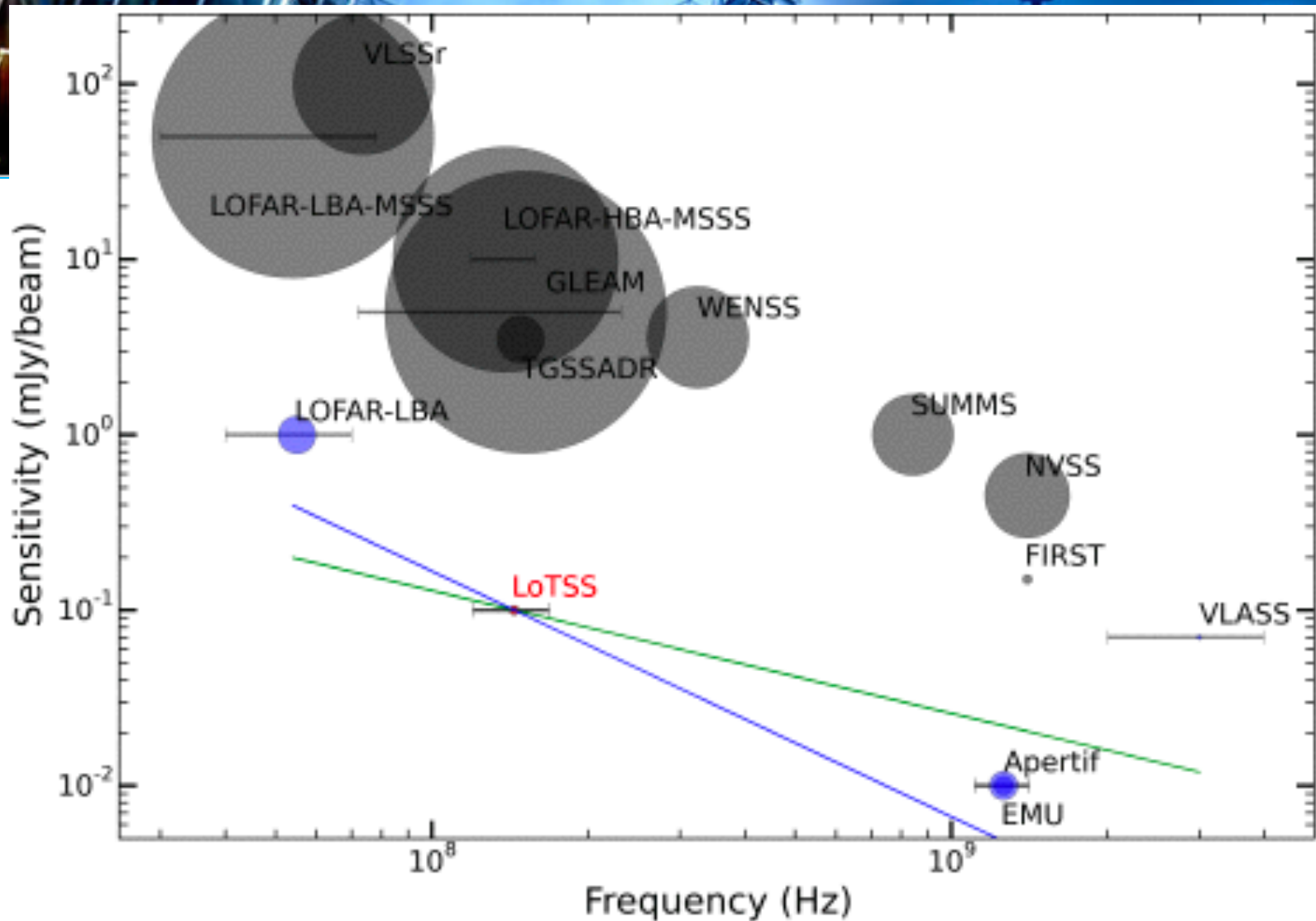




**LOFAR - the Two-metre sky survey (LoTSS) PI: Röttgering  
150 MHz ~6" resolution 0.1mJy sensitivity**

- Northern sky: 3170, 8hr pointings >13% of complete survey observed
- Preliminary data release (Shimwell et al, A&A 2017)
- Lockman hole 150 MHz study (Mandal in prep)
  - 25 $\mu$ Jy/beam noise: 37,000 sources in 20 sq deg

Complements EMU/APERTIF surveys at 10 $\mu$ Jy/beam, 1.1-1.4 GHz  
(future) LOFAR-LBA survey ~1mJy/beam at 50 MHz  
good match to WEAVE-LOFAR - spectros follow up 0.5m LOFAR  
sources (2018+)



Shimwell:  $\alpha = -0.7$  (aging synchr),  $\alpha = -1.4$  (cluster emission)



### **LOFAR - ongoing upgrades (*not LOFAR 2.0*)**

- General system monitor and control
- Observing efficiency and effectiveness (data throughput)
- Long-term archive: data access to 27 PB
- System responsiveness/agility (HBA or LBA; one beam)
- Calibration and algorithms, accessibility to all observing projects

### **e.g. LoTSS - key system & science explorations**

- Going deeper with >50 hrs data on 5 fields
- Adding longest baselines - LW VLBI (Neal Jackson et al)
- Derive polarisation properties



# Square Kilometre Array

*'s werelds grootste  
radiotelescoop*







## What is LOFAR 2.0?

*A staged expansion of the scientific and technical capabilities of LOFAR*

- Maintain LOFAR at leading edge into 2020's out to 2030
- Scientifically complementary to SKA1\_Low
- Pathfinding to SKA2\_Low
- Driven by science drivers: LBA survey; space weather....

*...and we have to upgrade for worsening NL EM environment, end of LOFAR spares for NL + demand for new stations from new partners (EU +)*

**Capped at €25m total (major grant funds, LOFAR4SW, Windfarm, NWO, ASTRON +)**



## **LOFAR 2.0 - 3 phase**

- 1: Double/triple station electronics capabilities (DAB-robust front end)**
  - use all 96 LBAs
  - simultaneous LBA+HBA observing (& x-ionospheric calibration)
  - correlator & data transport upgrade (space weather demonstration)
- 2: Replace LBA dipoles with better design (10 - 50 MHz)**
- 3: Build ~6 new NL stations**
  - 10 - 100 km baseline gaps
  - fill in superterp
- 4: Add new international stations at strategic baselines (200 - 1000 km)**



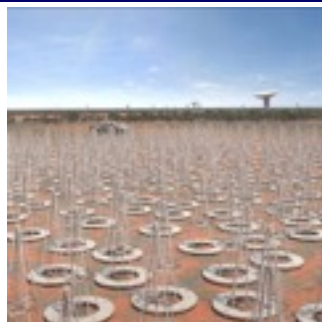


## **LOFAR4SW space weather design & feasibility study (H2020 €3m)**

2017 - 2021: Deliver LOFAR design for parallel radio astronomy -and- space weather monitoring

- Facilitates dual HBA-beam capacity (viz LOFAR 2.0 route)
- LOFAR4SW includes engaging with Space Weather Service Centres, Met Offices, ESA, funding agencies and policy makers.
- May allow LOFAR to be an operational Space Weather monitoring data provider

LOFAR 2.0 (core - increase)



SKA1 Low &  
SKA1 Mid



SKA1 Science  
Operations

2024 onwards: Intern Gov Org

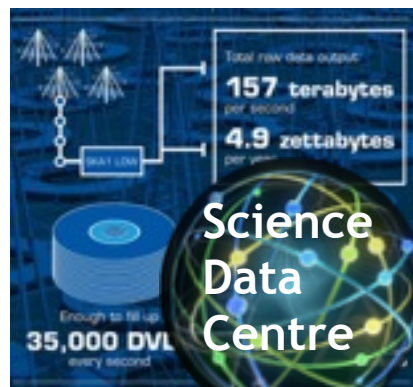


International LOFAR Telescope (ILT)



NL Science Data Centre

A centre of excellence  
EU focus  
Outward reach  
Possible PPP



International LOFAR  
+ additional partners  
(ASTRON share ~75%)