

The LoFAIR project

Towards FAIR low-
frequency radio data

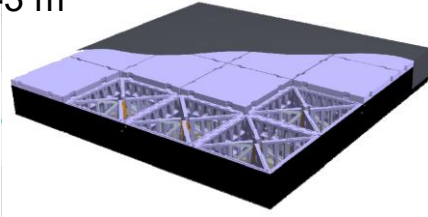
Yan Grange (ASTRON)

LOFAR

LOFAR High-Band Antenna

Frequency = 110-240 MHz

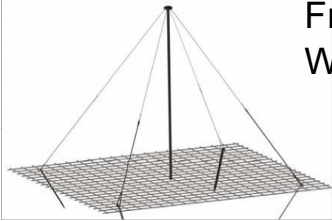
Wavelength = 1-3 m



LOFAR Low-Band Antenna

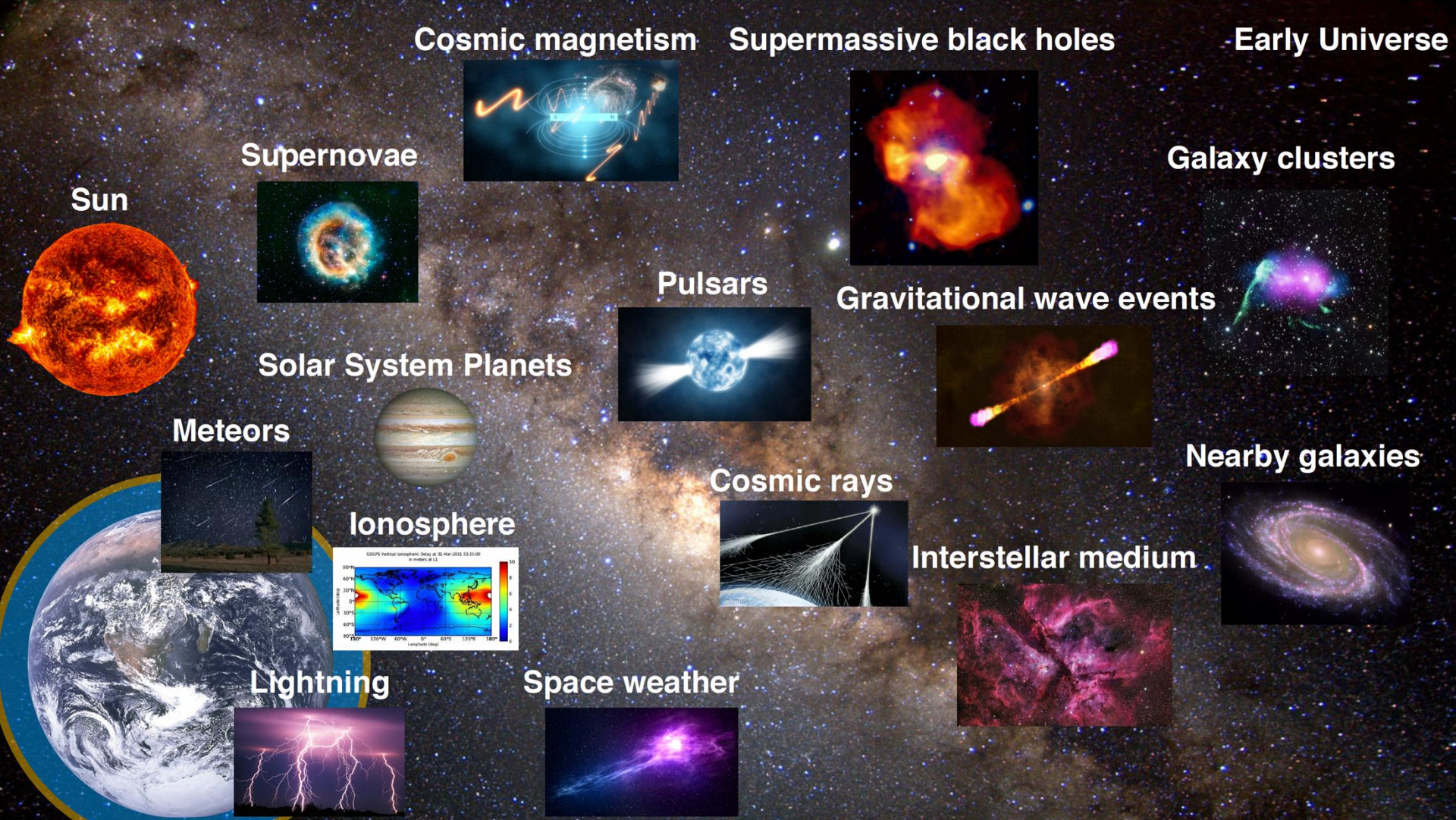
Frequency = 10-90 MHz

Wavelength = 3-30 m



- 38 stations in the Netherlands
- 14 (+2) in the rest of Europe
- ~55 000 antennas in total
- ~2 000 km longest baseline



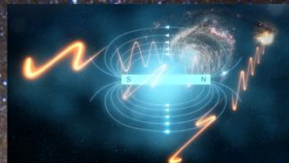


Cosmic magnetism

Supermassive black holes

Early Universe

Supernovae



Galaxy clusters

Sun



Pulsars

Gravitational wave events



Solar System Planets



Meteors

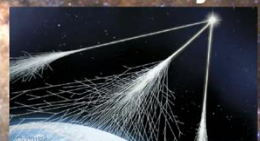


Cosmic rays

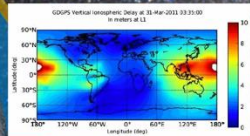
Nearby galaxies



Ionosphere



Interstellar medium



Lightning



Space weather



- LOFAR 1: ~7 PB/yr at full ops
- Peak usage: ~60 PB
- Recent reprocessing (averaging) and early-data retirement saved ~20 PB. Process still ongoing: to remove an extra ~ 10 PB.
- Even after averaging, data from single observations can be up to a few TB, or 10s of GB per file. And still, it's raw averaged voltages



LOFAR data model

Process

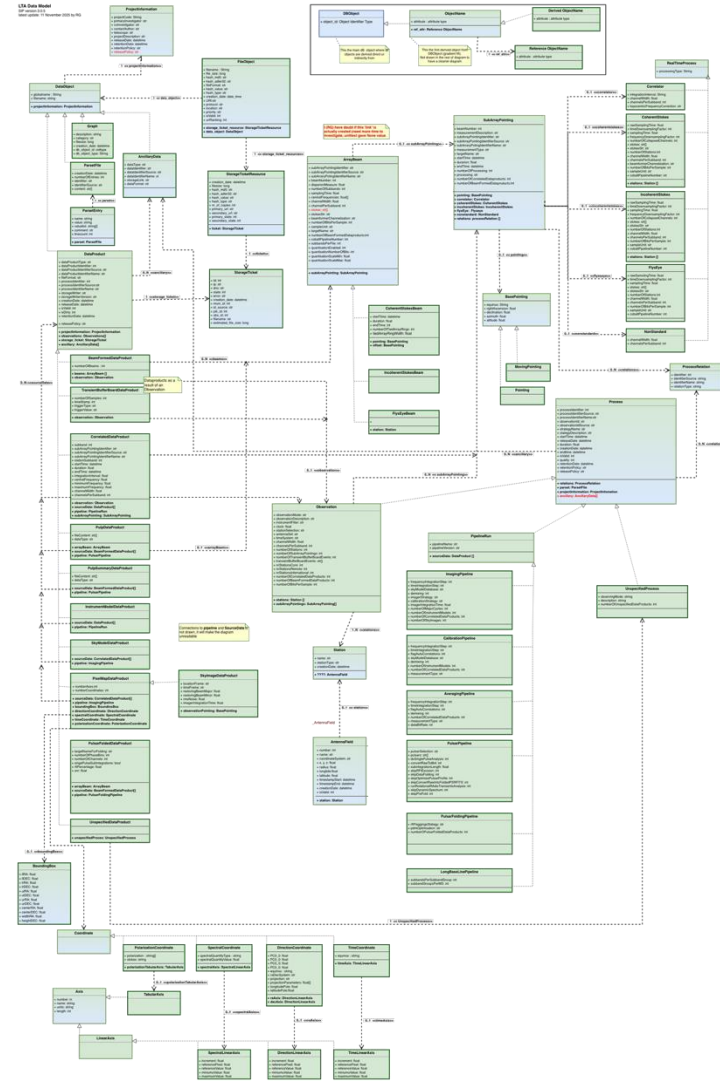
For example:

- Observation
- Calibration Pipeline
- Averaging Pipeline

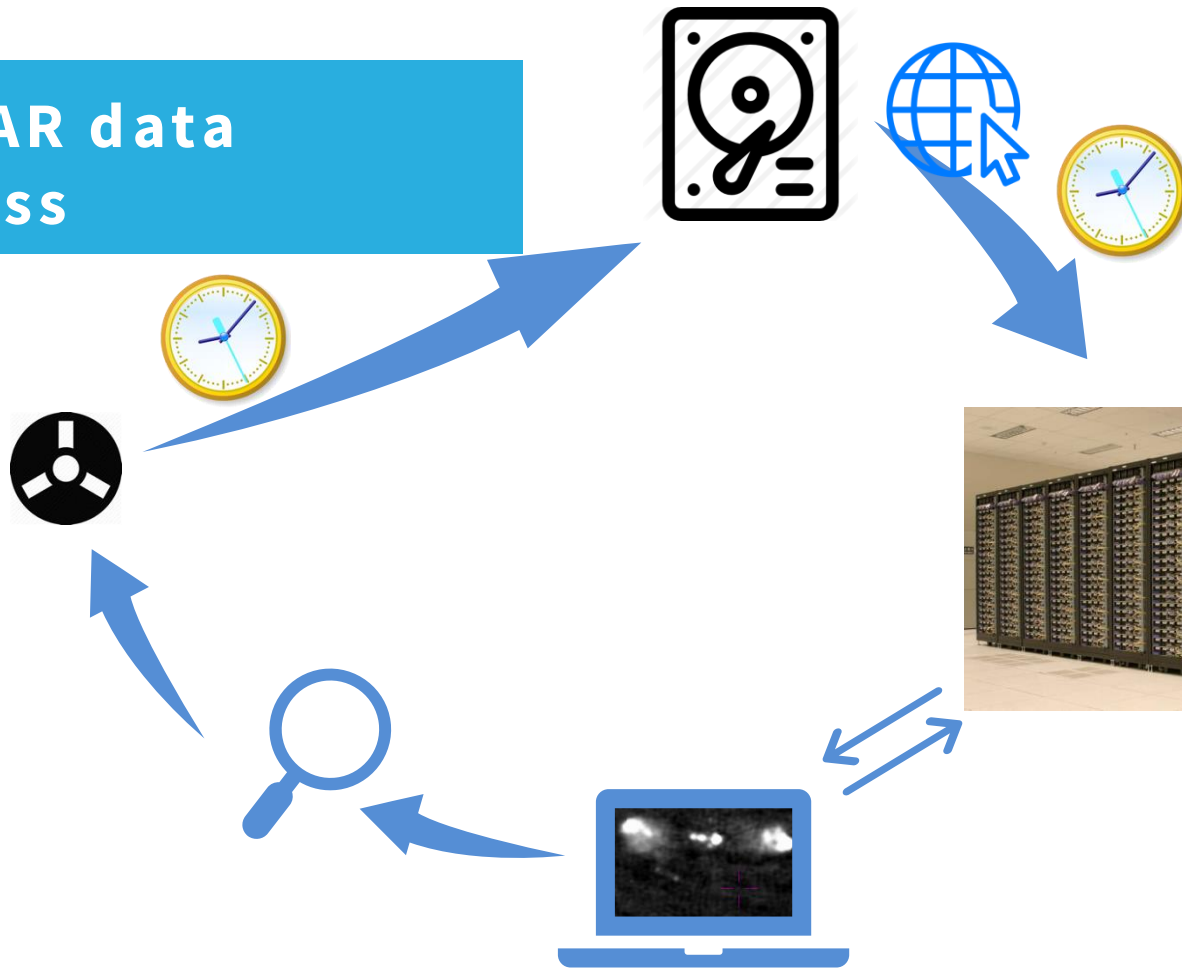
Data product

For example:

- Sky Image data
- Correlated data
- Pulsar folded data



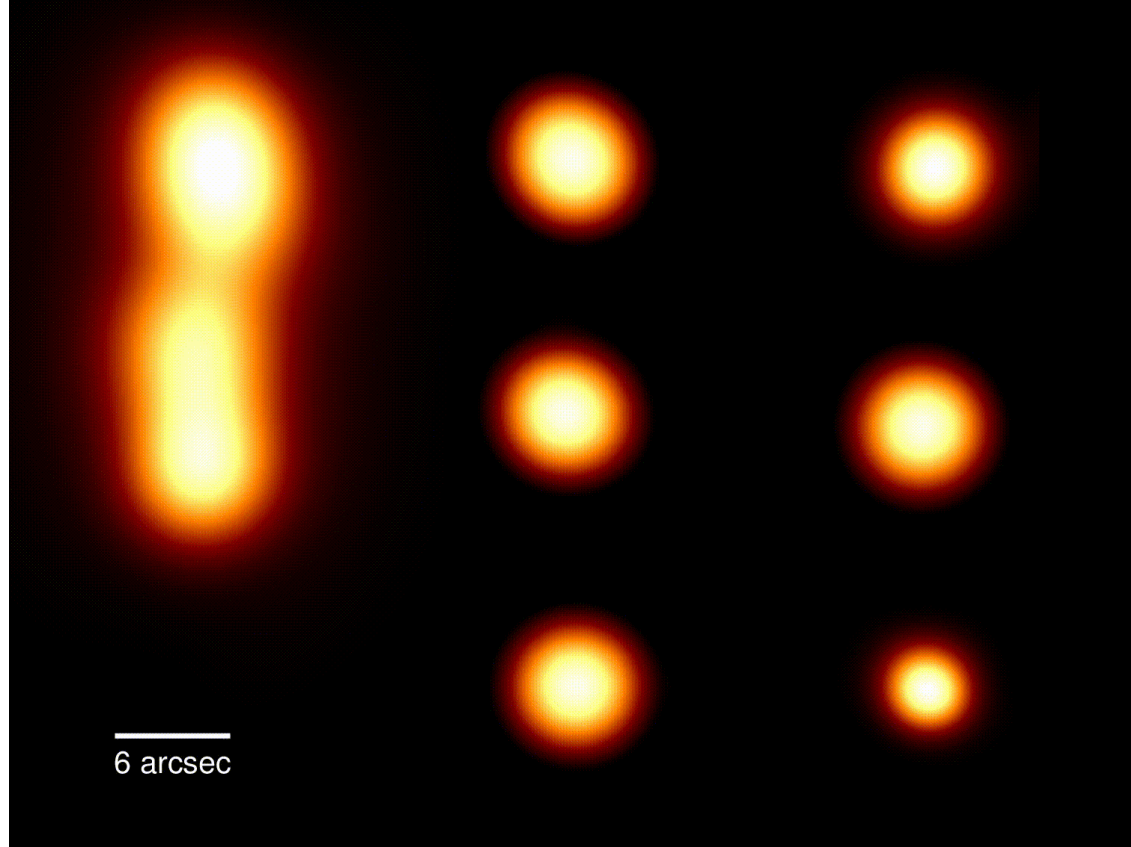
LOFAR data access



LOFAR 2.0

Major upgrade, offering:

- simultaneous LBA and HBA observing, or
- increased field-of-view
- various other improvements to the sensitivity (by a factor of 5 in most fields) and operation of the telescope
- Execution of standard pipelines (for e.g. imaging) to provide advanced data products.



Comparison of the effect of running the standard imaging pipeline, while using international station with the LOFAR 1 LoTSS data release.

LOFAR 2.0 LTA data products

Data product type

Beamforming mode related

Beamformed Data

Pulsar Folded Data

Pulsar Re-digitized Data

Pulsar PSRFITS Data

Other / Multi purpose

Dynamic Spectrum

Data product type

Imaging mode related

Visibility Data

Calibration Solutions

Image/Cube

Sky Model/Catalogue

Transients Database

Transient Buffer mode related

Transient Buffer Data

Cosmic ray Data

Lightning Data


- FITS images/cubes
 - PSRFits files
 - references to visibilities
 - Catalogues
- Already part of current data releases. See talk Aida Ahmadi for more details!

LOFAR 2.0 analysis

- LOFAR 2.0 data production is set to increase in size by ~10 PB per year of long-term stored data (storing intermediate data temporarily in case use case requires reprocessing).
- Future data analysis using more centralised and shared infrastructure (notebooks, but also SSH CLI).
- Current software is mostly built and used by ourselves. In the LOFAR 2.0 and SKA era, software is much more of a community effort.
- So we need a FAIR way to find and run software in our domain.



The LoFAIR project

- A 2-year project, funded by the Open Science NL programme
- Upgrading the LTA to fully support the FAIR principles. The IVOA logo features a stylized planet with a ring system, set against a dark blue background with white stars. The letters "IVOA" are written in white below the planet.
- Providing a centralized location for describing and distributing the software needed to use the data. (using <https://research-software-directory.org>)