ASTRON

General Big Science Industry afternoon

Wiebe van Breukelen

18 september 2025, Enschede

ASTRON
Netherlands Institute for Radio Astronomy

Exploring the universe

- ASTRON is the Netherlands Institute for Radio Astronomy, and is part of NWO-I.

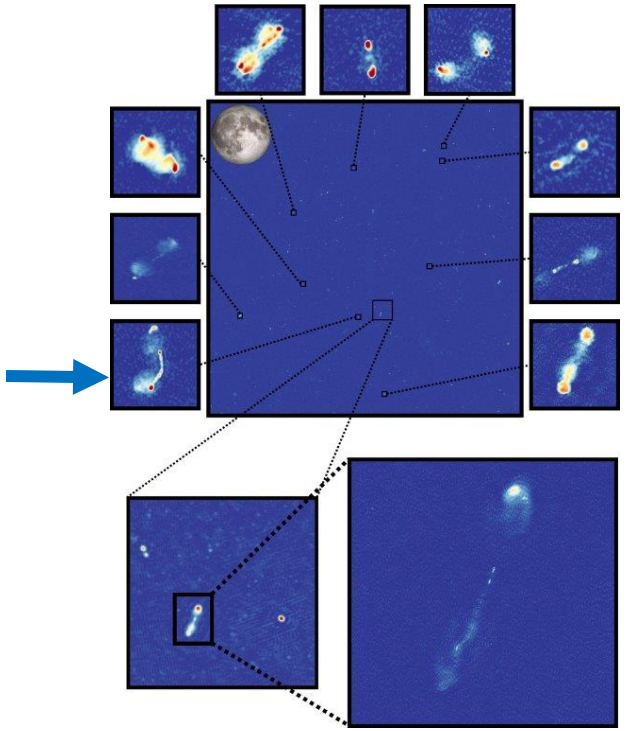
- *Our mission is to make discoveries in radio astronomy happen.*
- *We do this by developing new and innovative technologies, operating world-class radio astronomy facilities, and pursuing fundamental astronomical research.*

Timeline

1956: Dwingeloo Radio Telescope

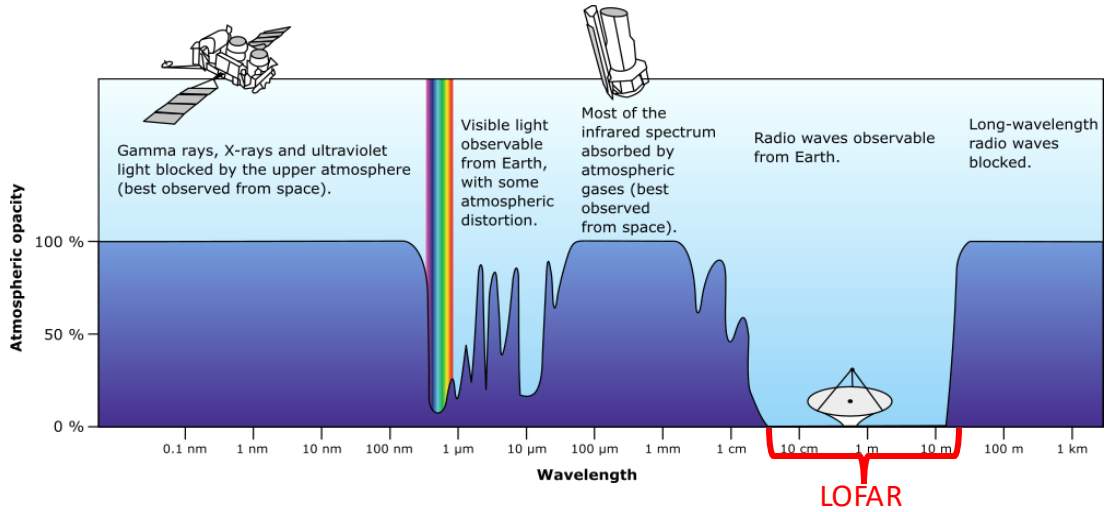
1970: Westerbork Synthese Radio Telescope

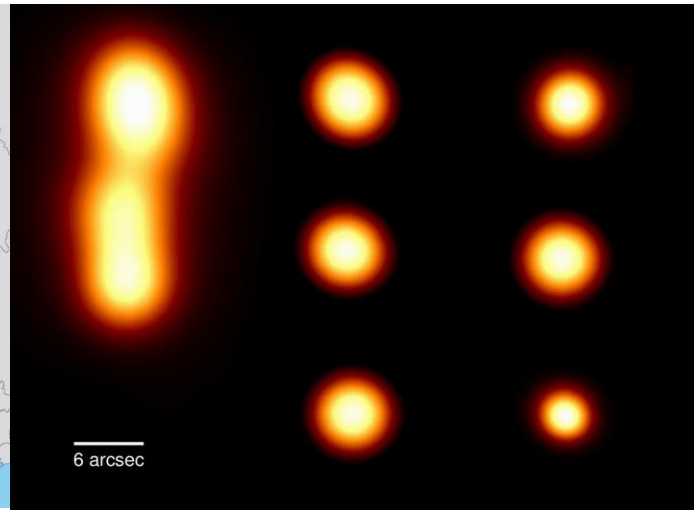
2012: LOFAR (*Low Frequency Array*)



Our largest instrument: LOFAR

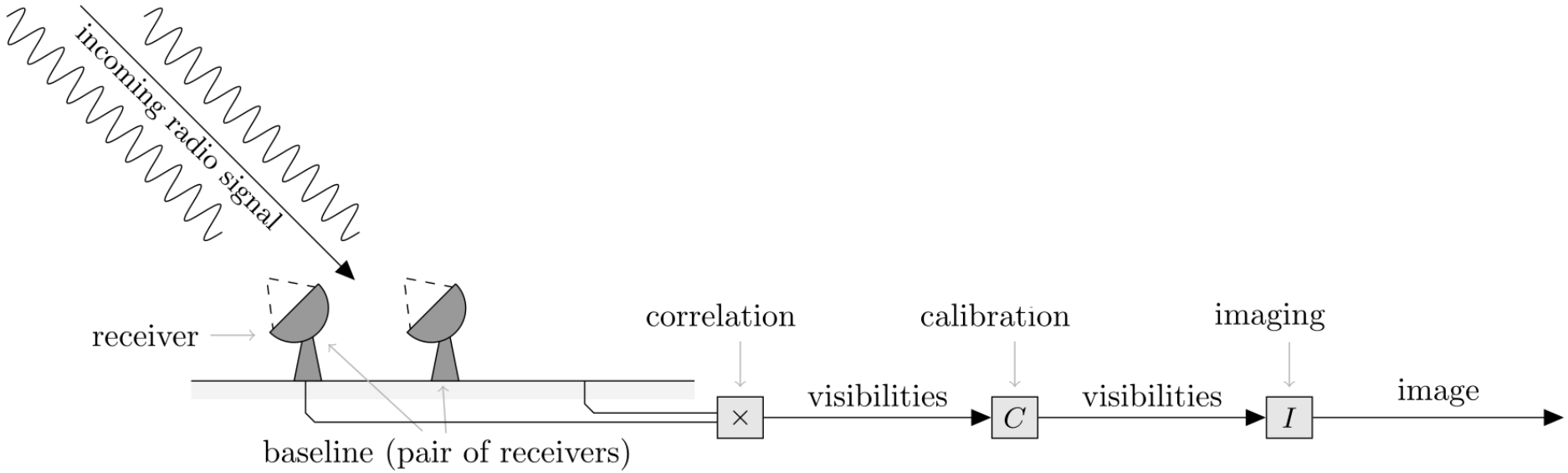
- **LOFAR:** *Low-Frequency Array*
- Observing between 10 MHz – 240 MHz
- Spread across all of Europe, together forming the largest radio telescope in the world





Telescopes as software-defined instruments

- Traditional telescopes: dish, receiver
- Now: **arrays of antennas**, digital backends, and software pipelines
- ASTRON focuses on both **instrumentation** and **data processing**
- Software is central to the telescope: from real-time systems to (offline) processing pipelines



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Current: LOFAR2.0 Upgrade

- LOFAR 2.0, expected release next year
  - **Major upgrade to improve sensitivity**
  - Increases data volume and processing demands
- <u>Upgrades at station (hardware) and software level</u>
  - ASTRON-built **Uniboard 2** processing board spread across 75 antenna fields, totaling over 1200 FPGAs
  - **GPU**-based correlator and processing pipelines (> 400 Gbit/s throughput)

Lots of challenges across the analog and digital domain!

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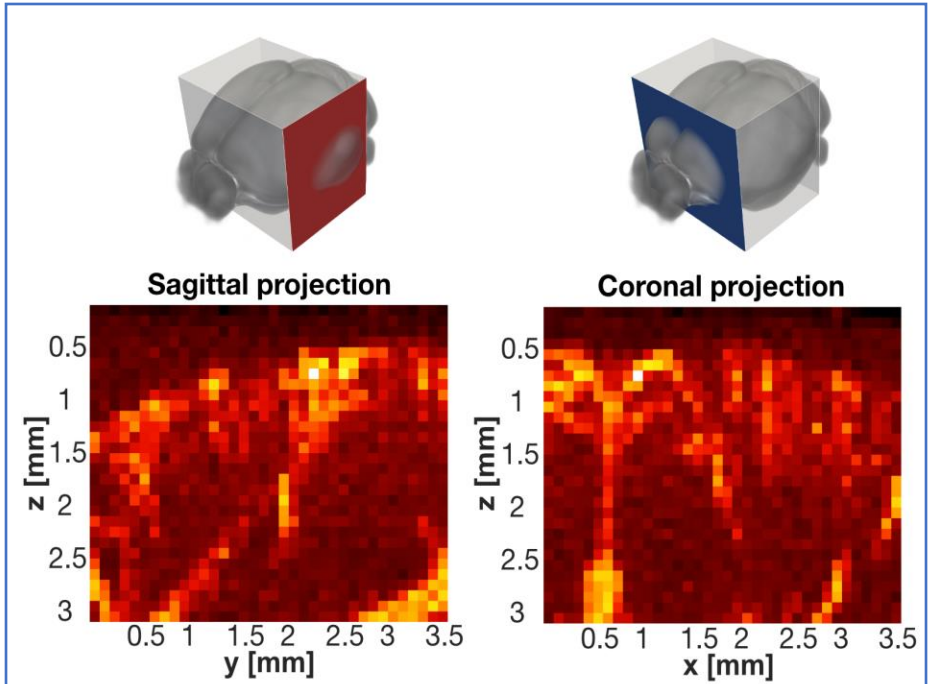
Collaboration with industry
Medical imaging

- Application of our technologies in other domains
- By leveraging GPU tensor cores, blood vessels can be mapped accurately and rapidly.



Blood flow in the brain of a mouse.
Credits: P. Kruizinga/Erasmus MC

SIOUX TECHNOLOGIES

Erasmus MC
Universitair Medisch Centrum Rotterdam

netherlands eScience center

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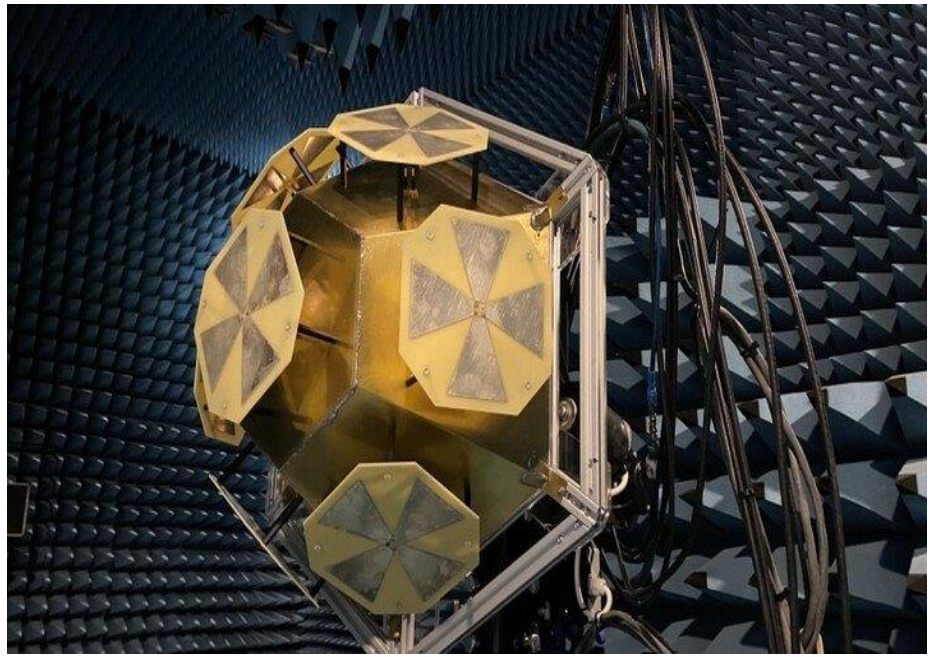
Collaboration with industry
GNSS

- Developing a *Global Navigation Satellite System (GNSS)* antenna for ESA with enhanced anti-jamming and anti-spoofing techniques
- Used for calibrating Galileo



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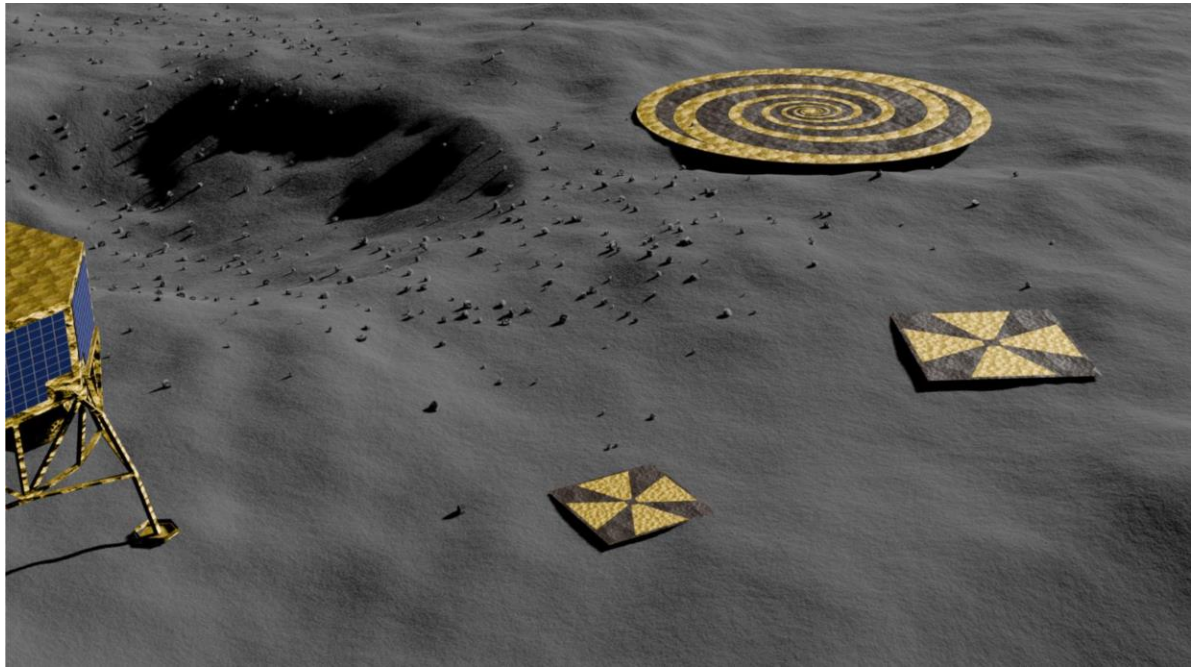
2025-

Collaboration with industry
Radio telescope on the Moon

- **Goal**: Observing hydrogen deep in the universe (Dark Ages / Cosmic Dawn)
- Earth has too much radio noise; the far side of the Moon may offer the right conditions
- Feasibility study in collaboration with ESA and various universities



esa

Radboud Universiteit

TU/e

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Interested in collaboration?

If you are interested in collaborating or just want to explore ideas, please get in contact with me, Wiebe (breukelen@astron.nl) or Lukasz (nowak@astron.nl)

Thank you for your attention!

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