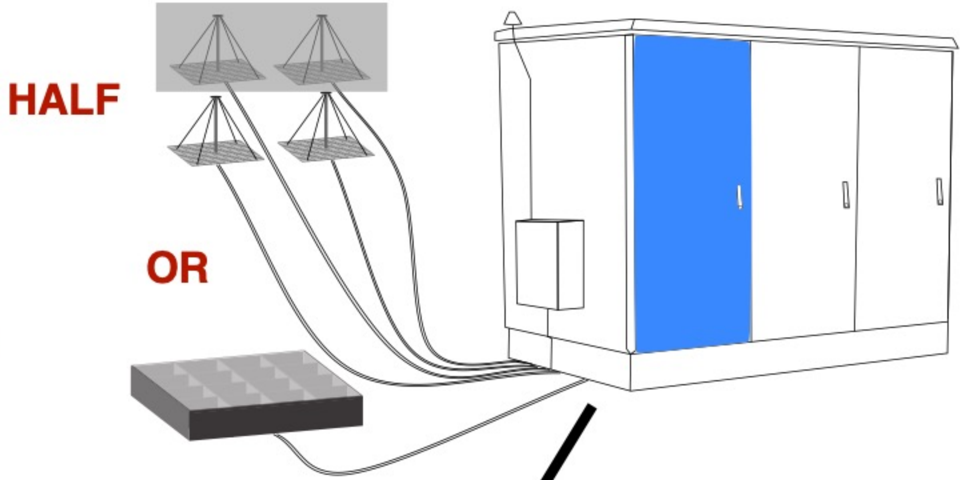
LOFAR2.0 Science

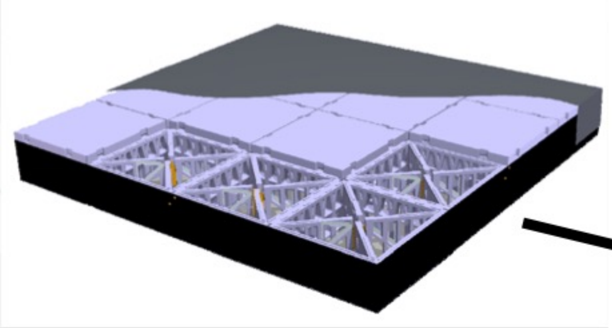
Jason Hessels

LOFAR2.0 Project Scientist

LOFAR Stations



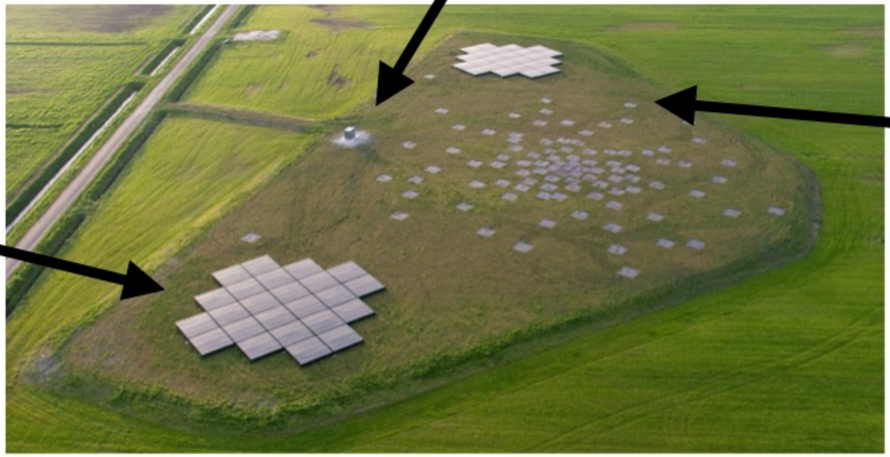
Robust, full-sensitivity imaging



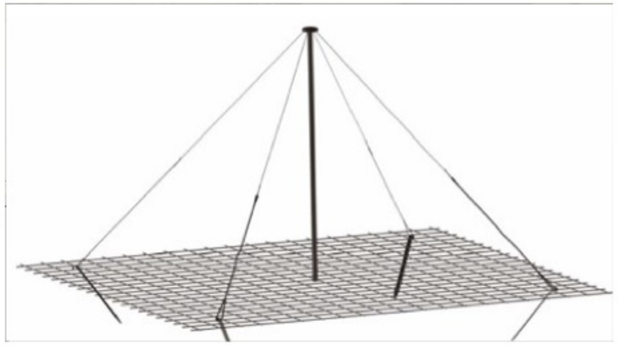
High-Band Antennas

Frequency = 110-240 MHz

Wavelength = 1-3 metres



Sensitivity and accuracy limited by ionosphere

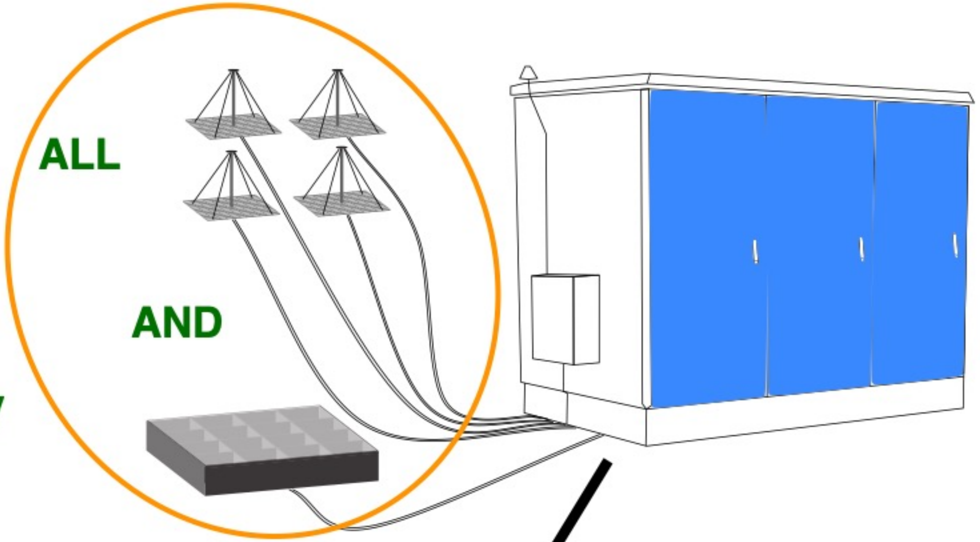


Low-Band Antennas

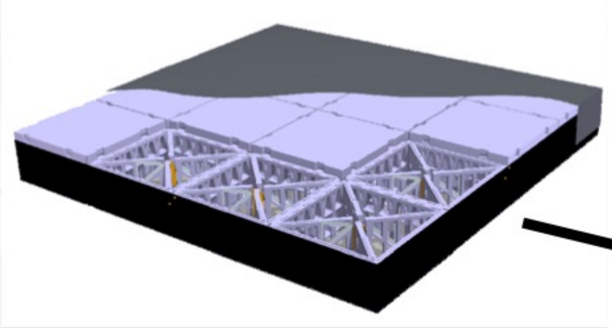
Frequency = 10-90 MHz

Wavelength = 3-30 metres

LOFAR Stations



Robust, full-sensitivity imaging



High-Band Antennas

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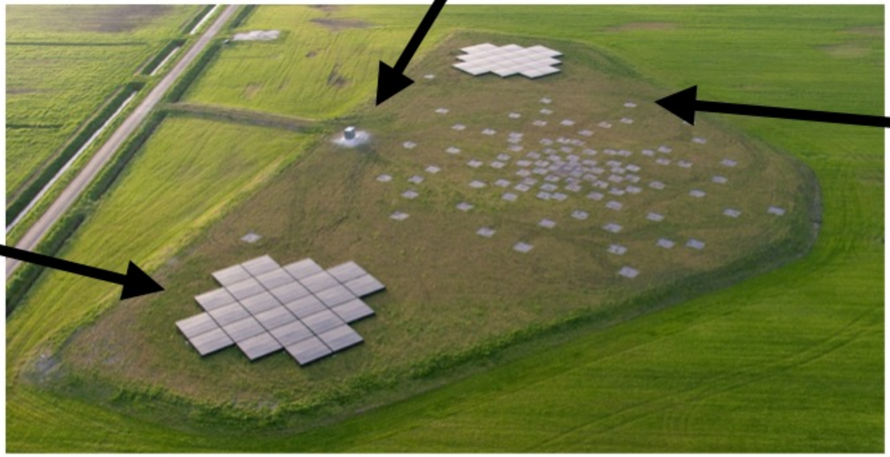
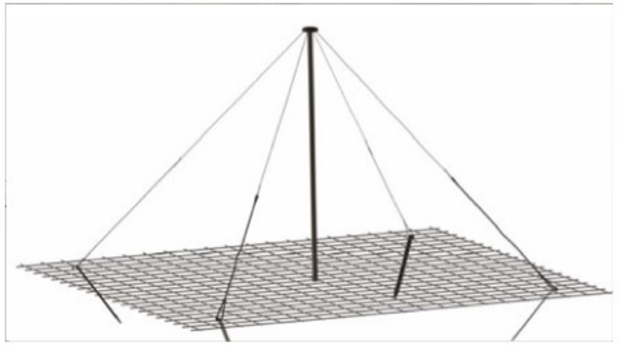


Robust, full-sensitivity imaging

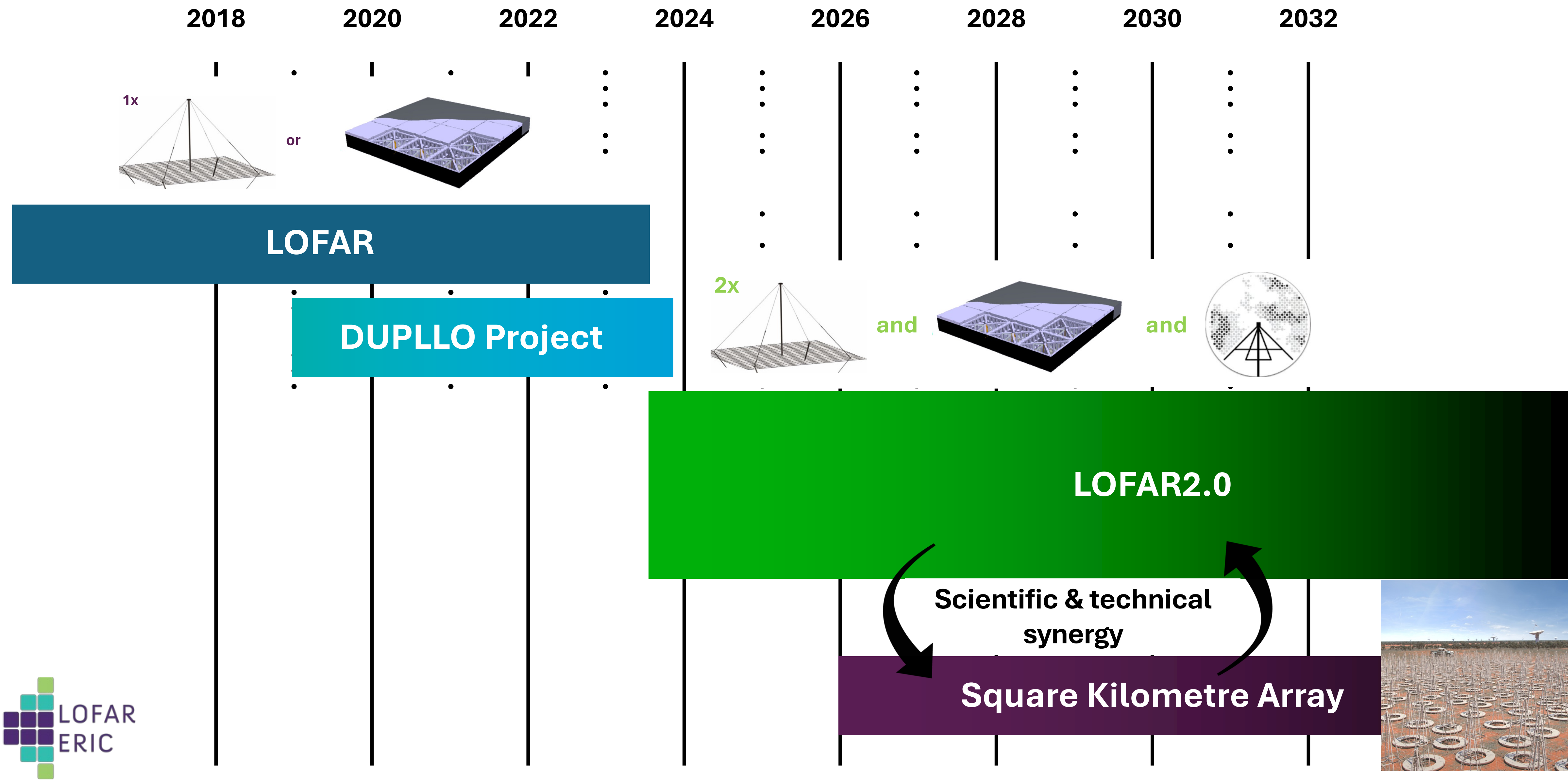


Low-Band Antennas

Frequency = 10-90 MHz

Wavelength = 3-30 metres

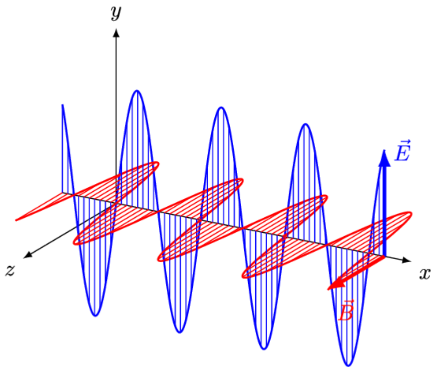
Timeline



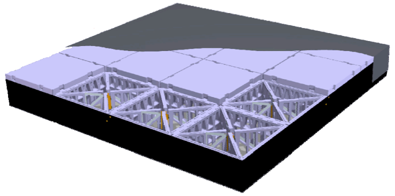
LOFAR ERIC

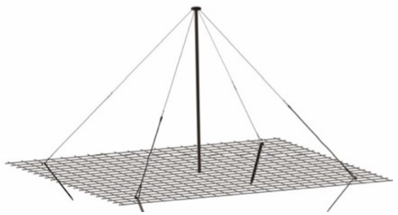
LOFAR2.0 Commissioning

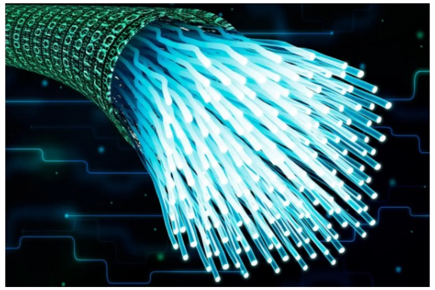
Radio waves



Antennas, stations & network







Correlator & central processing

Pipelines

Published papers


LOFAR Detection of 110–188 MHz Emission and Frequency-dependent Activity from FRB 20180916B

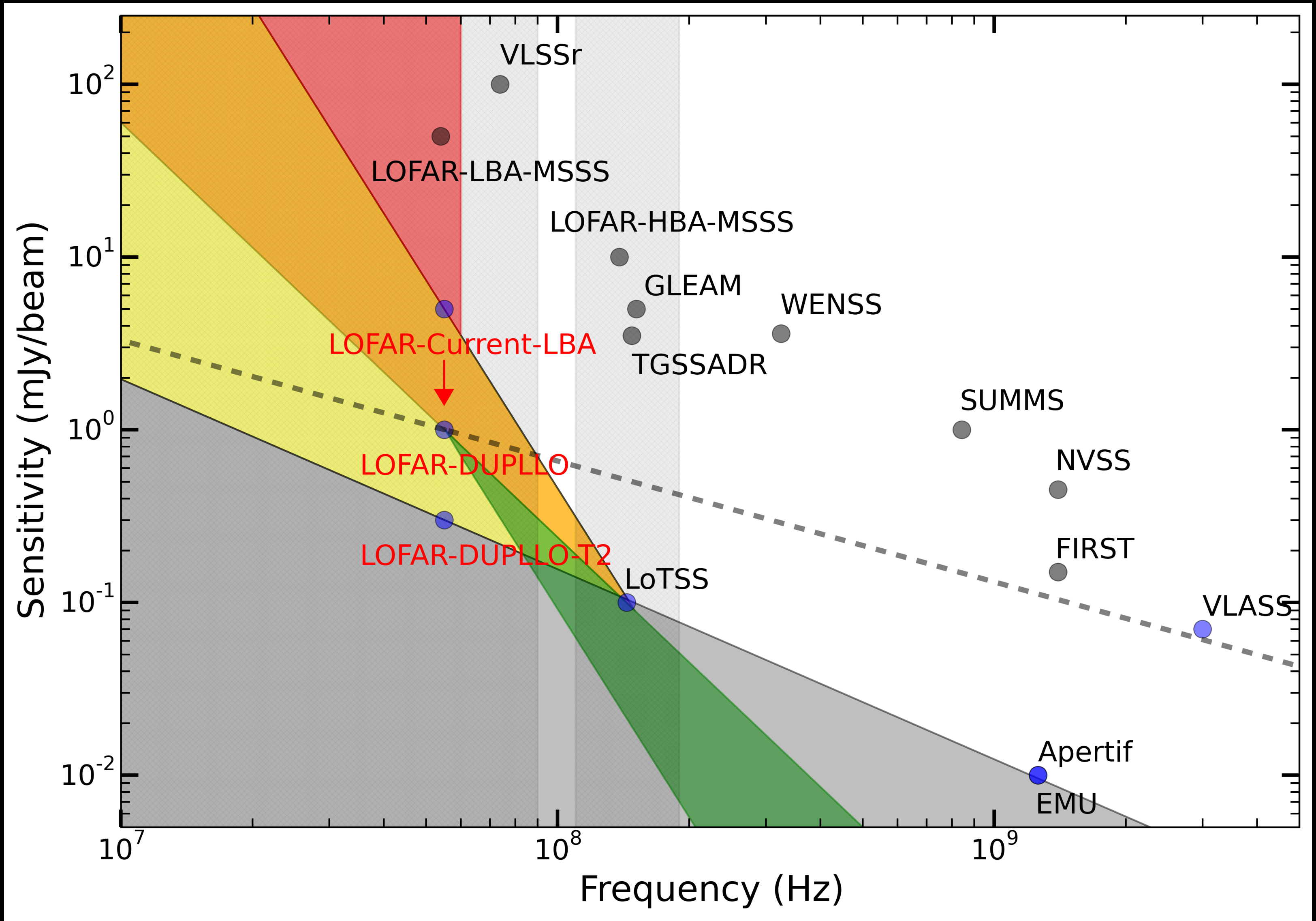
Press releases

New scientific directions

New technical innovations

Netherlands Institute for Radio Astronomy

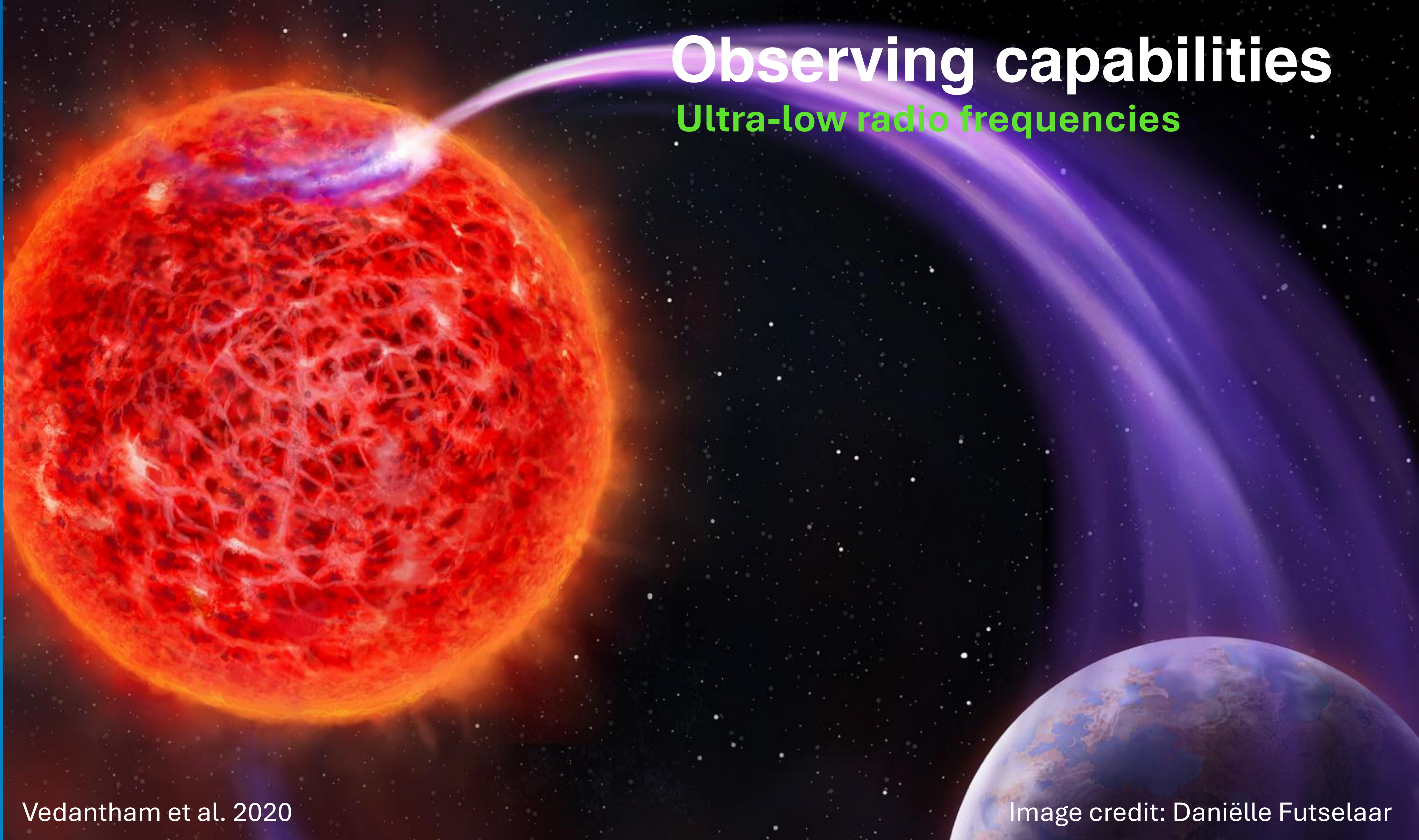
Parameter space



Shimwell

Observing capabilities

Ultra-low radio frequencies

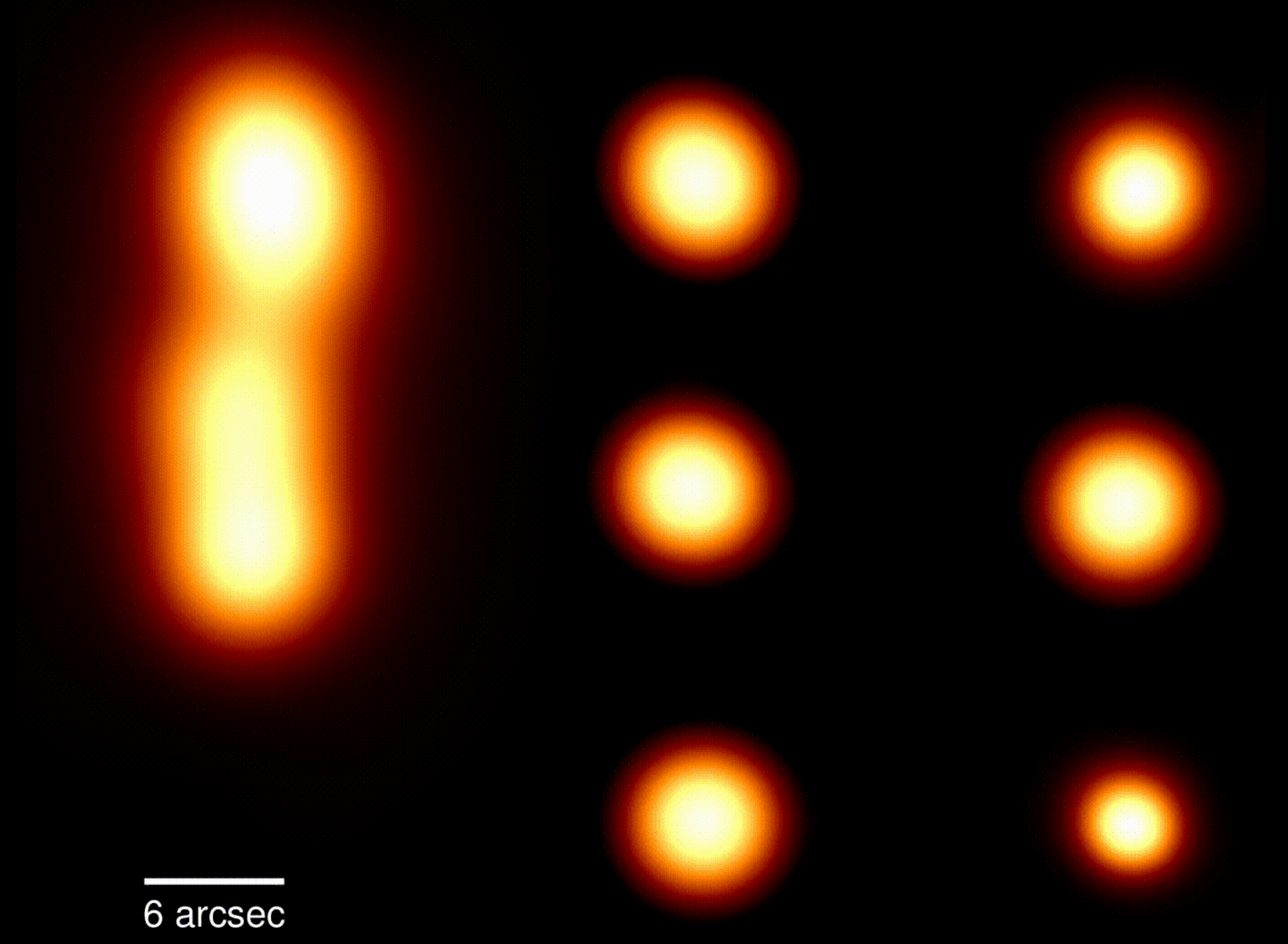


Vedantham et al. 2020

Image credit: Daniëlle Futselaar

Observing capabilities

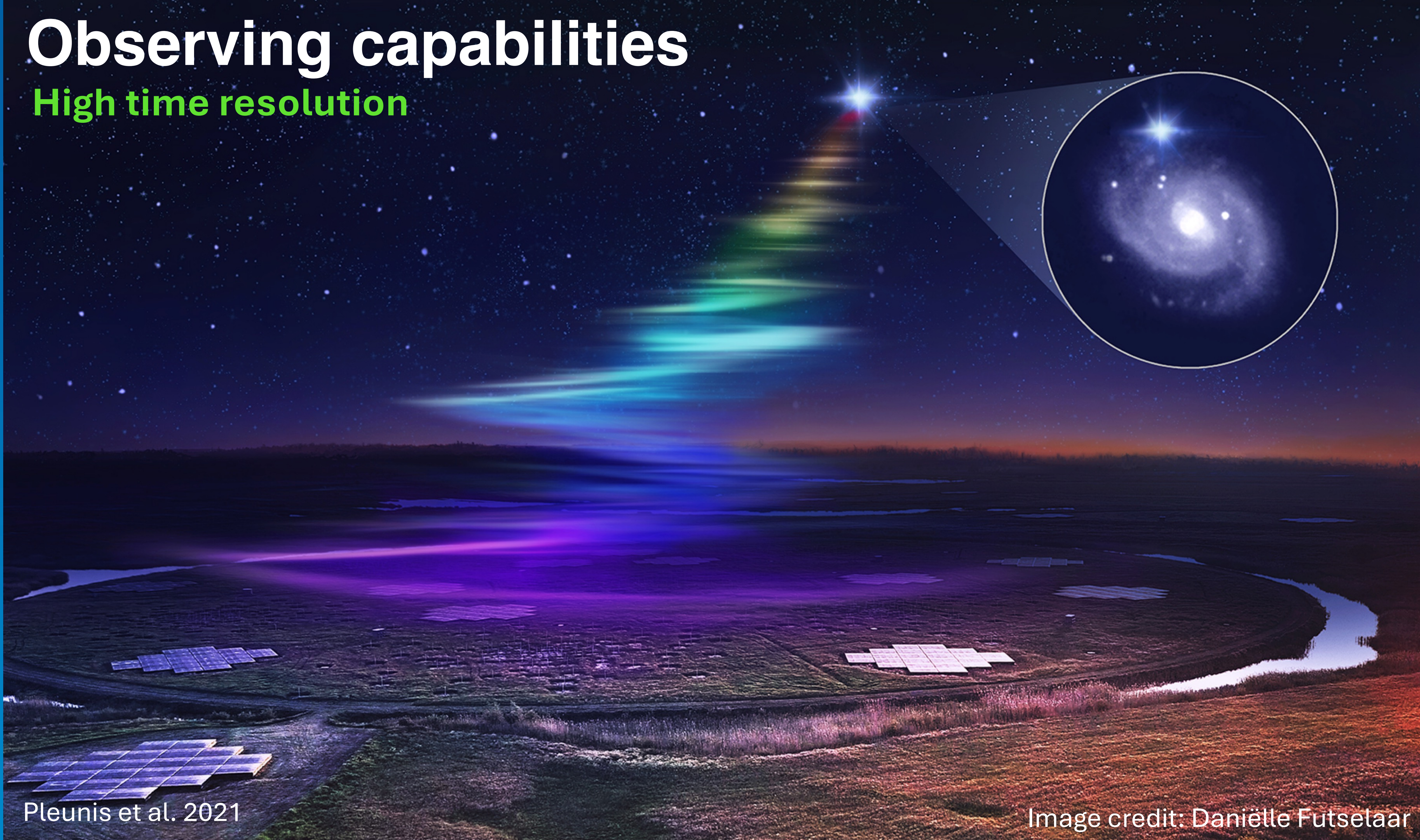
(sub-)arcsecond angular resolution



Morabito + Surveys KSP

Observing capabilities

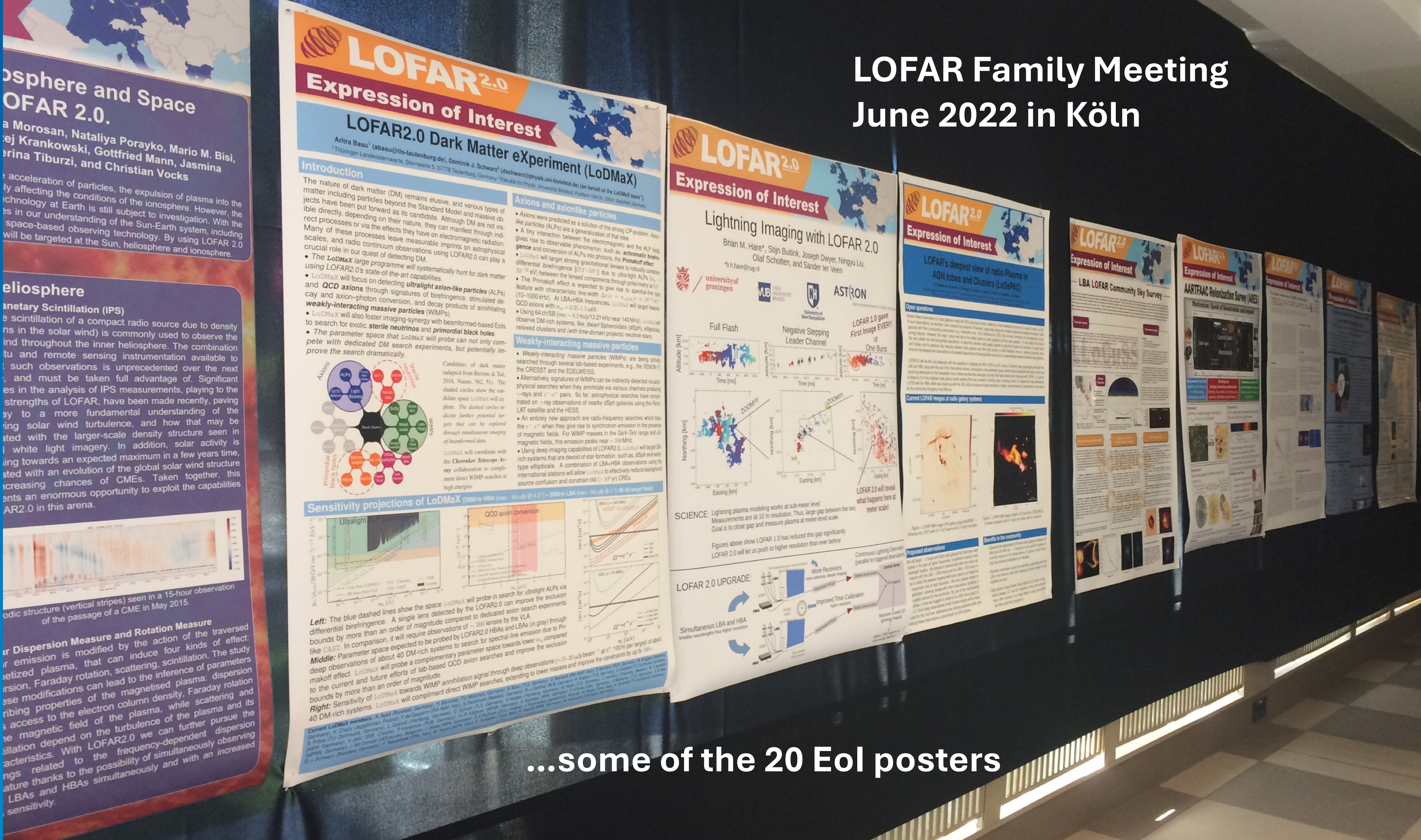
High time resolution



Pleunis et al. 2021

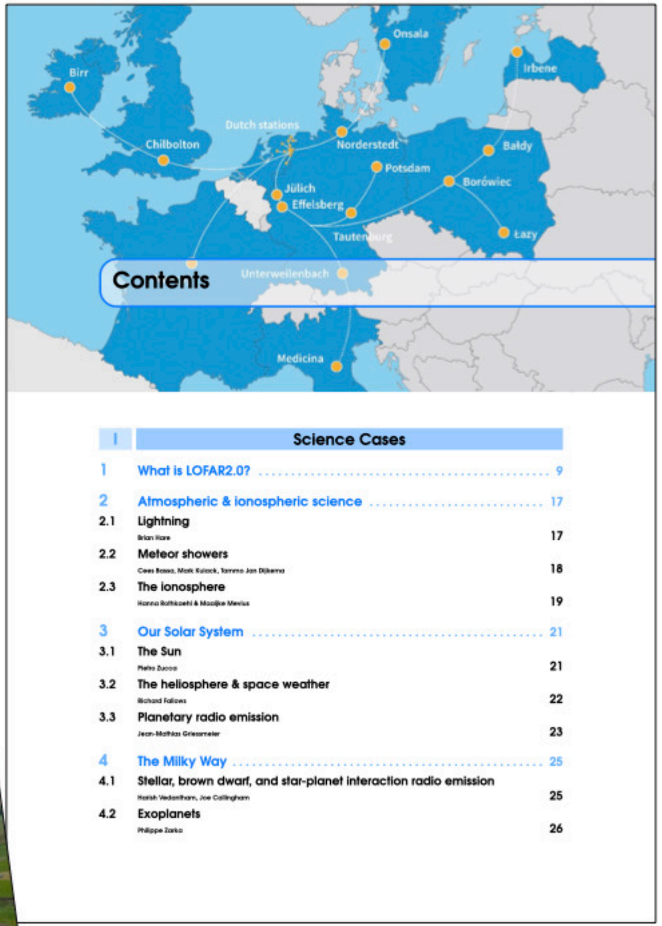
Image credit: Daniëlle Futselaar

LOFAR Family Meeting
June 2022 in Köln

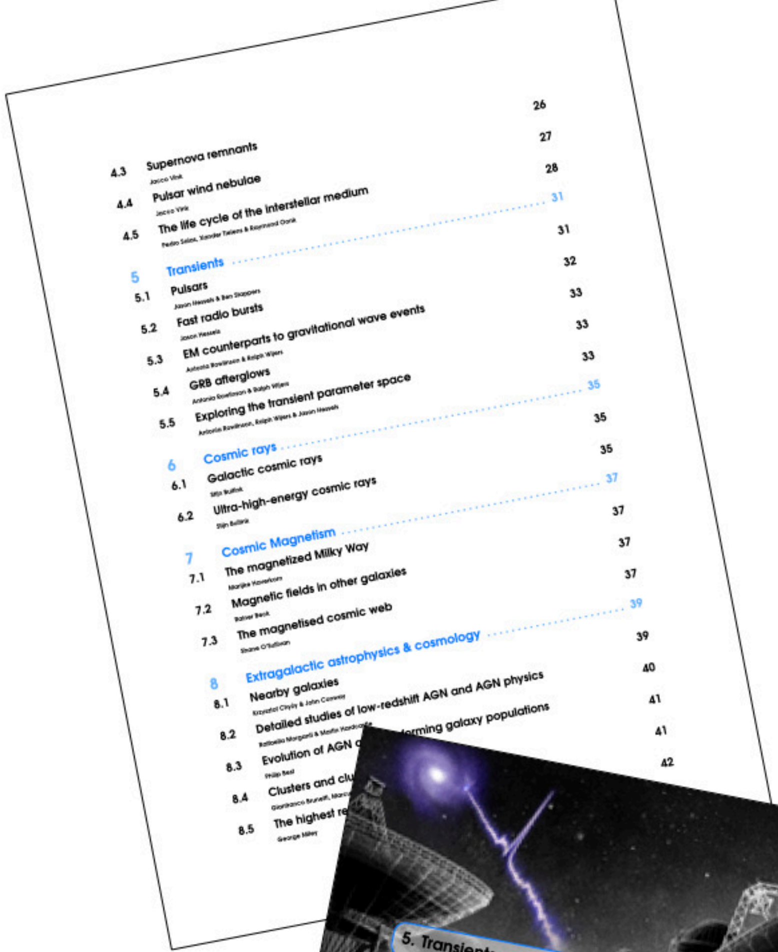


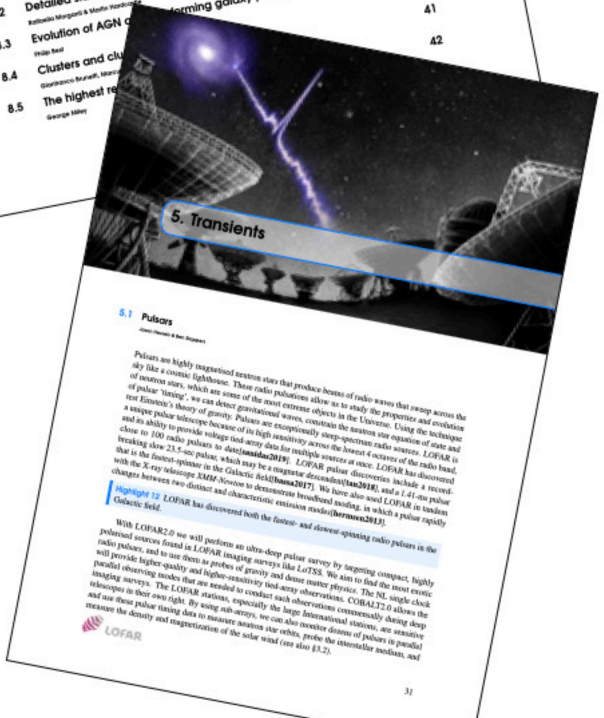
...some of the 20 EoI posters

LOFAR2.0 Science White Paper



Contents





LOFAR2.0 Large Programmes

Deadline: October 12th, 2023 at 12:00 UTC

LOFAR2.0 Large Programmes

- **15 full proposals**
  - From dozens of PIs and hundreds of co-Is, spanning the LOFAR partner countries
- **Diverse topics**
  - Lightning, star-formation, SNRs, transients, cosmic rays, deep surveys, cosmology, galaxy clusters, Sun & heliosphere, exoplanets, pulsars & FRBs, magnetism
- **All together a (very) ambitious programme**
  - Can only come to fruition by working together

Submission: LOFAR2.0 Large Programmes — Full proposal

LOFAR2.0 Pulsar & Fast Transient Surveys

Jason Hessels[1,2], Cees Bassa[1], Maura Pilia[3], Charlotte Sobey[4], Ben Stappers[5], Shivani Bhandari[2,6], Leszek Blaszkiewicz[7], Marta Burgay[3], Manisha Caleb[8], Jesus Alberto Cázares[9], Pragya Chawla[2], Alessandro Corongiu[3], Marcin Gawronski[10], Aaron Golden[11], J.-M. Griessmeier[12,13], Akshatha Gopinath[2], Gemma Janssen[1,14], Aris Karastergiou[15], Evan Keane[16], Mark Kennedy[17], Franz Kirsten[18], Vladislav Kondratiev[1], Kamen Kozarev[19], Michael Kramer[20,5], David McKenna[21,16], Daniele Michilli[22,23], Leah Morabito[24,25], Rouhin Nag[3], Cherry Ng[26], Kenzie Nimmo[22], Aditya Parthasarathy[1], Ziggy Pleunis[26], Andrea Possenti[3], Harry Qiu[27], Kaustubh Rajwade[1,5], Alesssandro Ridolfi[3], Antonia Rowlinson[1,2], Maciej Serylak[27,28], Xiaoxi Song[1], Laura Spitler[22], Chia Min Tan[29], Caterina Tiburzi[3], Sander ter Veen[1], Dany Vohl[2,1], Jun Wang[30], Emma van der Wateren[1,14], Patrick Weltevrede[5] and Ziwei Wu[31]

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[15] *Department of Astrophysics, University of Oxford, Denys Wilkinson Building, Keble Road, Oxford OX1 3RH, UK*
[16] *School of Physics, Trinity College Dublin, College Green, Dublin 2, D02 PN40, Ireland*
[17] *Department of Physics, University College Cork, College Road, Cork, T12 K84F, Ireland.*
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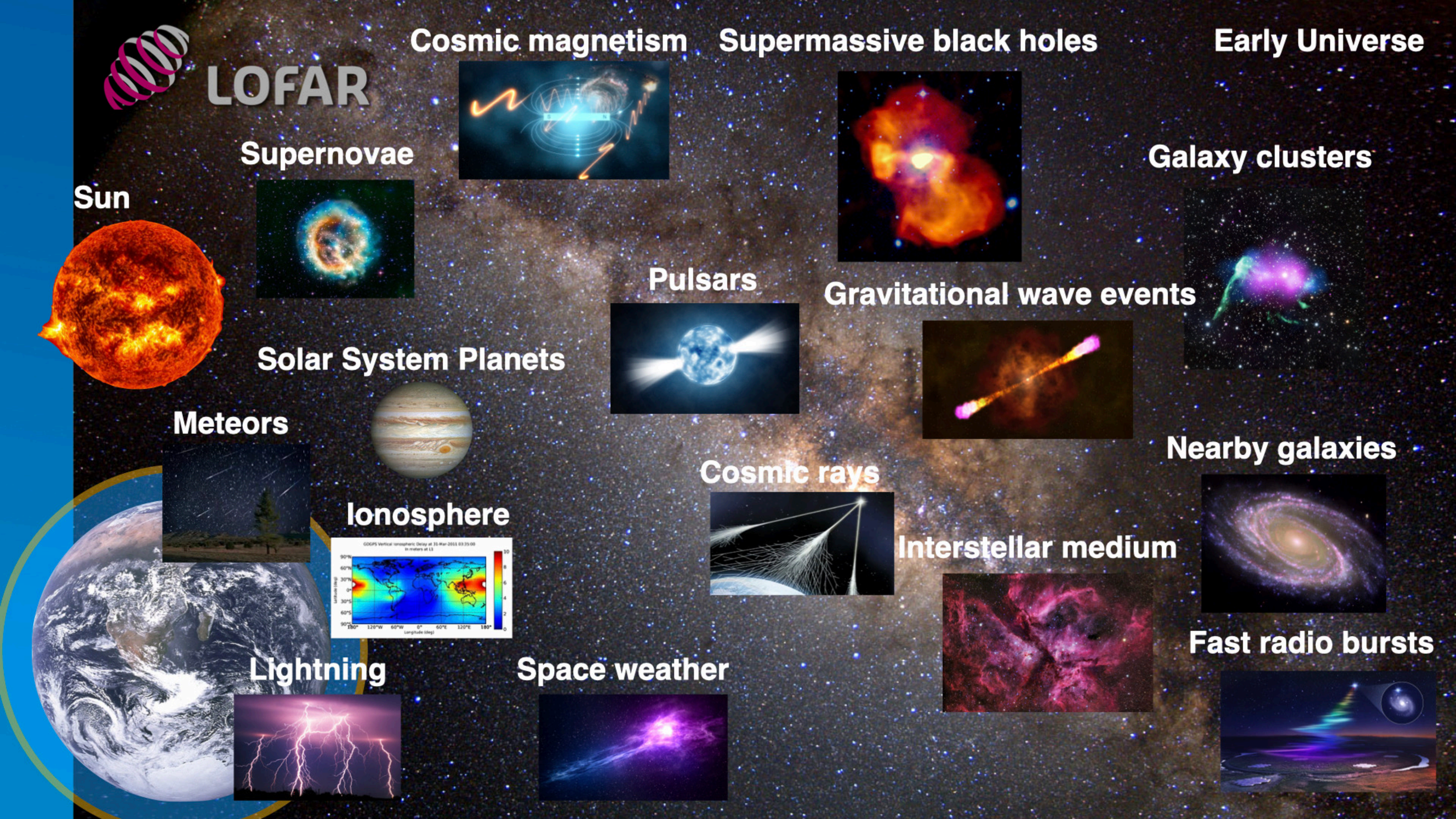
[19] *Institute of Astronomy and National Astronomical Observatory, Bulgarian Academy of Sciences, Sofia 1784, Bulgaria*
[20] *Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany*
[21] *School of Cosmic Physics, Dublin Institute for Advanced Studies, 31 Fitzwilliam Place, Dublin 2, Ireland.*
[22] *MIT Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139, USA*

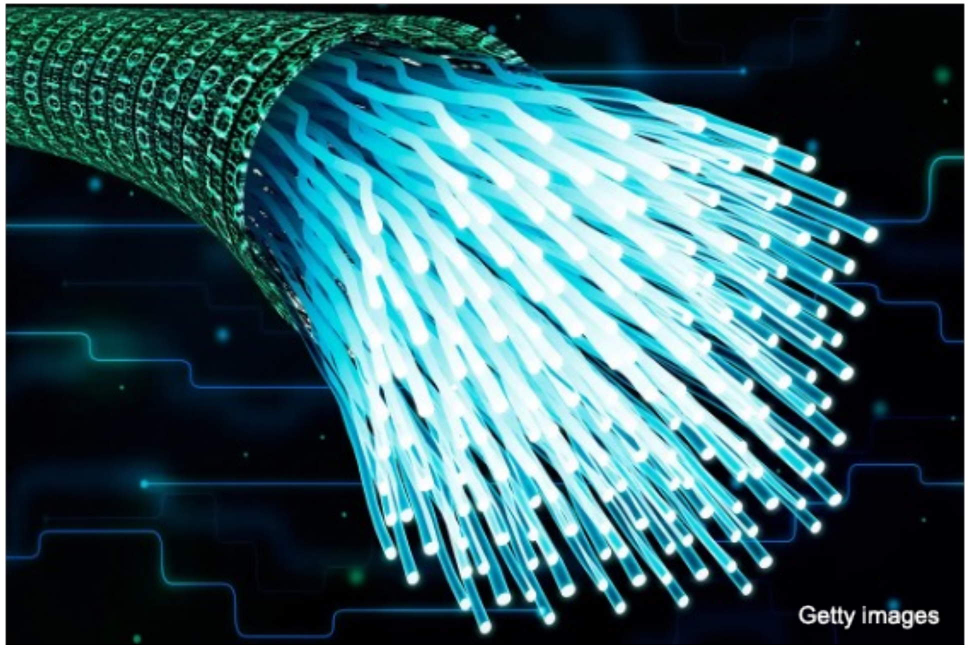

LOFAR
Cosmic magnetism
Supermassive black holes
Early Universe
Supernovae
Galaxy clusters
Sun
Pulsars
Gravitational wave events
Solar System Planets
Meteors
Nearby galaxies
Cosmic rays
Ionosphere
Interstellar medium
Fast radio bursts
Lightning
Space weather

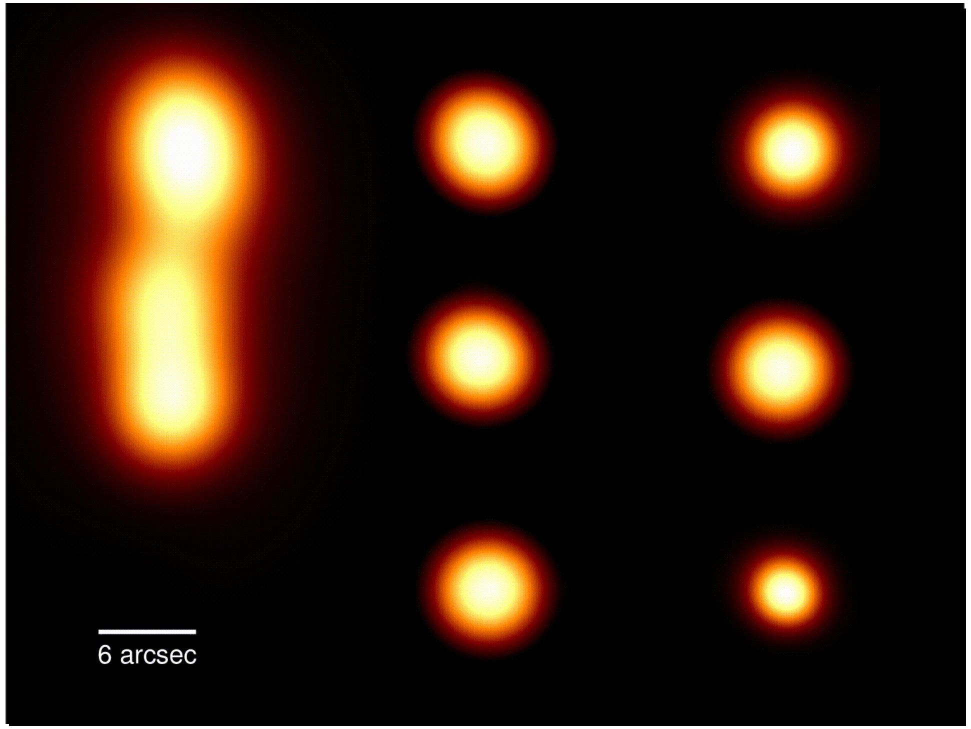
Firehose rodeo with LOFAR2.0

Inspired by Daniela Huppenkothen

LENSS - LOFAR Enhanced Network for Sharp Surveys

- Community consultations in NL and with LOFAR partners
- Where can we have a large and unique impact in the coming decade?
- 2024: NWO-RI for upgraded network (10→100Gb/s) and full-FoV, full-res imaging
- 2026: NWO-Roadmap focusing on ultra-low frequencies?

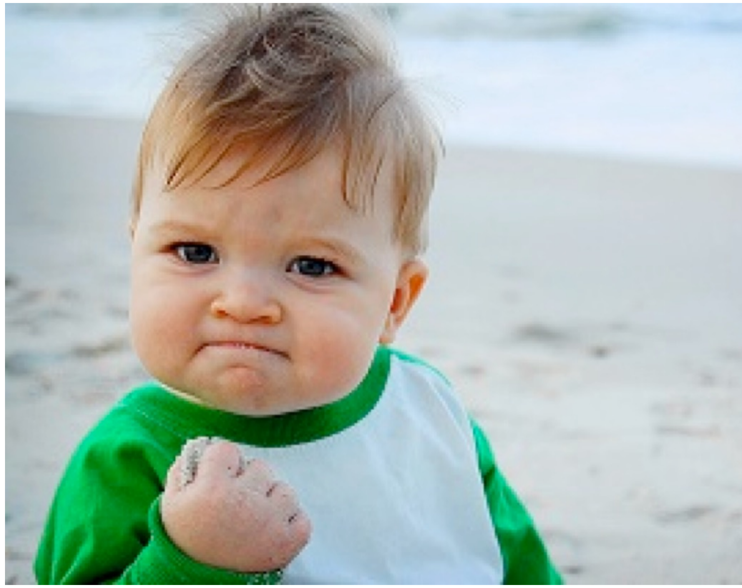




LOFAR2.0 Large Programmes

Success Criteria

- **Scientific impact**
  - Publications, citations, theses, prizes, grants
- **Technical impact**
  - Techniques, software
- **Community impact**
  - Partner countries & institutes, support ECRs, develop SKA leadership roles
- **Accessibility & legacy**
  - Data reuse, distilled data products
- **Visibility**
  - Make LOFAR better known to other astronomers, policy makers, the public



LOFAR2.0 Commissioning

Seeds

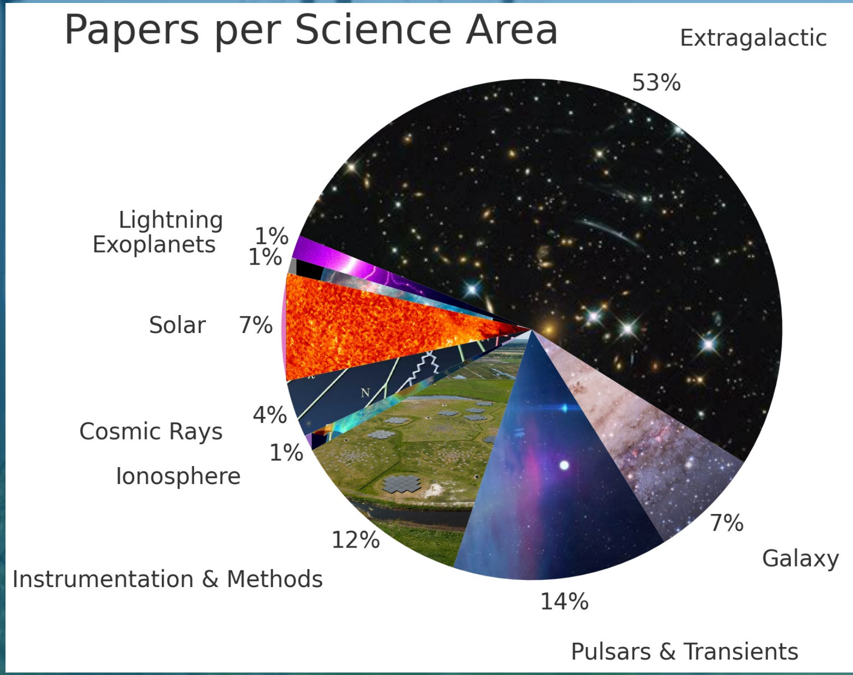
Hardware Science ideas Computing
Software Algorithms Expertise

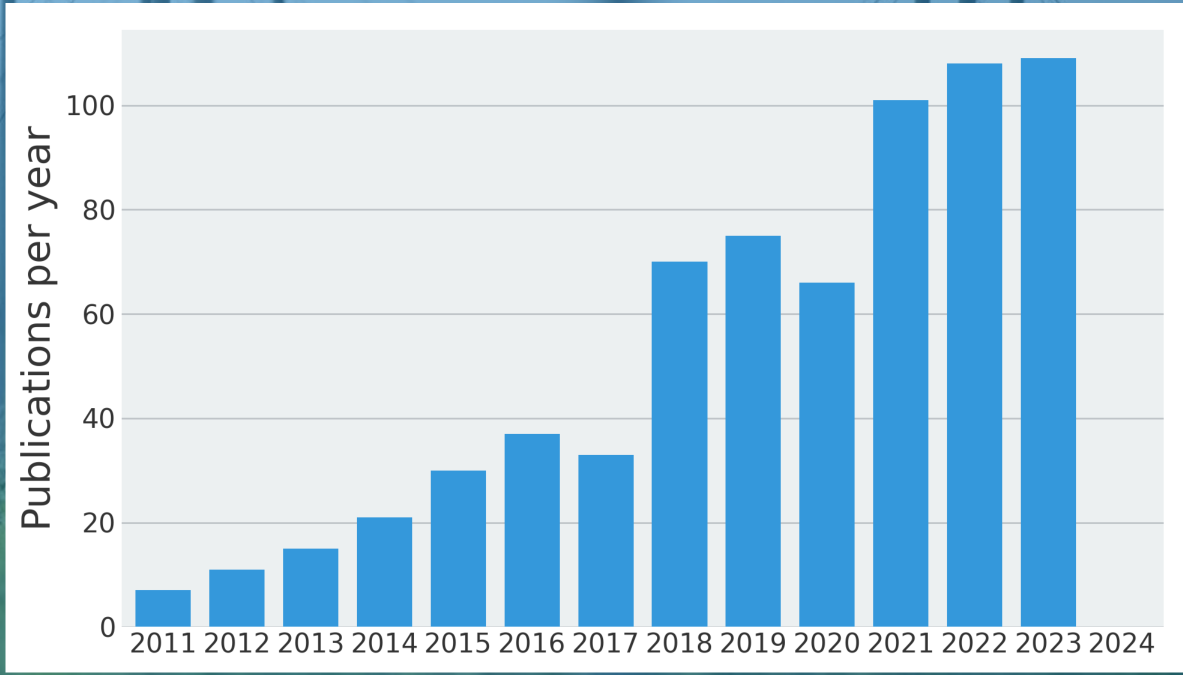
Harvest

Published papers New scientific directions
Press releases New technical innovations

ASTRON
Netherlands Institute for Radio Astronomy

Impact of LOFAR2.0





Major new suite of science at a fraction of the original investment in LOFAR