FRITS SWEIJEN

Post-doctoral Research Associate

www.strw.leidenuniv.nl/~sweijen
Durham, United Kingdom
0000-0002-6470-7967
frits.sweijen@durham.ac.uk
github.com/tikk3r
/in/frits-sweijen-09a89091

SUMMARY

I am Frits, currently a post-doctoral research associate at Durham University in the group of prof. dr. Leah Morabito. My interests lie in with radio astronomy. I conduct research with the International LOFAR Telescope doing both AGN-related science, and working on the technical aspects of doing VLBI at frequencies below 200 MHz. I also have a strong interest in software development, which I use to develop tools to aid my day to day research, and a side interest in graphic design.

SKILLS

Astronomical:
ILT data reduction, pipeline development

Programming languages:
Python, Rust, Bash

Technologies:
Apptainer/Singularity, CWL, Slurm, HPC

FIRST-AUTHOR PUBLICATIONS

The low-frequency size distribution of radio sources in the Lockman Hole MNRAS, 2025
F Sweijen, J C S Pierce, M J Hardcastle, J H Croston, L K Morabito, M Bondi, J R Callingham, N Jurlin, I Prandoni, H J A Röttgering, R J van Weeren
We measure the projected angular extents of a complete sample of 2,110 radio sources ($z < 2.5$; $S_{144\mathrm{MHz}} > 600\mu$Jy) using $\nu_{\mathrm{obs}} = 144$ MHz images over a $6.6\ \mathrm{deg}^2$ area of the Lockman Hole field from the International LOw Frequency Array (LOFAR) Telescope (ILT) at resolutions of $6''$, $1.8''$ and $0.45''$. Using these measurements, we derive the first sub-arcsecond resolution radio source size distribution at a frequency below $200\ \mathrm{MHz}$ and present a power-linear size diagram for the objects. We then focus on the $1,205$ sources not identified as star-forming galaxies based on spectral energy distribution (SED) classifications from previous work. These have linear sizes in the range $\ell = 0.7\ \mathrm{kpc} - 1\ \mathrm{Mpc}$, radio powers in the range $P_{144\mathrm{MHz}} \approx 10^{21} - 10^{29}\ \mathrm{W\ Hz^{-1}}$, and a linear size distribution in qualitative agreement with that of radio AGNs in the LOFAR Two-metre Sky Survey (LoTSS). At higher redshifts radio AGNs appear to prefer more compact projected lengths $\ell 20\ \mathrm{kpc}$, which could indicate that more short-lived, high accretion activity was present in the Early Universe.

Piercing the Dusty Veil of Hyper-Luminous Infrared Galaxies Astronomy & Astrophysics, 2023
F. Sweijen, Y. Lyu, L. Wang, F. Gao, H. J. A. Röttgering, R. J. van Weeren, L. K. Morabito, P. N. Best, K. Małek, W. Williams, I. Prandoni, M. Bonato, M. Bondi
We study AGN presence in a sample of 154 hyper-luminous infrared galaxies (HLIRGs) in the Lockman Hole field, in a dust-unobscured way using sub-arcsecond resolution $144\ \mathrm{MHz}$ observations with the International LOFAR Telescope (ILT). We identify AGNs through Tb measurements in 20% of sources that were classified as SFGs through SED fitting, raising the overall fraction of AGNs in the total sample from 16% to 32%.

Deep sub-arcsecond wide-field imaging of the Lockman Hole field at 144 MHz Nature Astronomy, 2022
F. Sweijen, R. J. van Weeren, H. J. A. Röttgering, L. K. Morabito, N. Jackson, A. R. Offringa, S. van der Tol, B. Veenboer, J. B. R. Oonk, P. N. Best, M. Bondi, T. W. Shimwell, C. Tasse, A. P. Thomson
We present deep degree-scale sub-arcsecond imaging at low radio frequencies with the International LOFAR Telescope. We demonstrate direction-dependent calibration and imaging of the ILT's full $6.6\ \mathrm{deg}^2$ field of view at an angular resolution of $0.38'' \times 0.30''$ near the phase centre. This serves as a proof of concept for an eventual all-sky sub-arcsecond low-frequency survey.

High-resolution international LOFAR observations of 4C 43.15 - Spectral ages and injection indices in a high-z radio galaxy Astronomy & Astrophysics 2022
F. Sweijen, L. K. Morabito, J. Harwood, R. J. van Weeren, H. J. A. Röttgering, J. R. Callingham, N. Jackson, G. Miley, J. Moldon
We combine sub-arcsecond resolution International LOFAR Telescope observations at 55 and 144 MHz with Very Large Array observations at 4.7 and 8.6 GHz to, for the first time, demonstrate spatially resolved spectral modeling of a high-redshift object using both low and high frequency radio data. Our findings support the idea that increased inverse-Compton losses from interaction with the CMB are one of the drivers behind the observed steep spectral of high-redshift radio galaxies; the $\alpha - z$ correlation.

CO-AUTHORED PUBLICATIONS

A decade of sub-arcsecond imaging with the International LOFAR Telescope **ASS, 2025**
*Leah K. Morabito, Neal Jackson, Jurjen de Jong, Emmy Escott, Christian Groeneveld, Vijay Mahatma, James Petley, **Frits Sweijen**, Roland Timmerman, Reinout J. van Weeren*

Monster radio jet (>66 kpc) observed in quasar at $z \sim 5$ **ApJL, 2025**
*A. J. Gloudemans, **F. Sweijen**, L. K. Morabito, E. P. Farina, K. J. Duncan, Y. Harikane, H. J. A. Röttgering, A. Saxena, J. Schindler*

Spectral analysis of spatially resolved 3C295 (sub-arcsecond resolution) with the International LOFAR Telescope **Astronomy & Astrophysics, 2022**
*E. Bonnassieux, **F. Sweijen**, M. Brienza, K. Rajpurohit, C. J. Riseley, A. Bonafede, N. Jackson, L. K. Morabito, G. Brunetti, J. Harwood, A. Kappes, H. J. Rottgering, C. Tasse and R. van Weeren*

Identifying Active Galactic Nuclei via Brightness Temperature with Sub- Arcsecond International LOFAR Telescope Observations **MNRAS, 2023**
*Morabito, L. K, **F Sweijen**, J F Radcliffe, P N Best, Rohit Kondapally, Marco Bondi, Matteo Bonato, K J Duncan, Isabella Prandoni, T W Shimwell, W L Williams, R J van Weeren, J E Conway, and G Calistro Rivera*

Nuclear Regions as Seen with LOFAR International Baselines. A High-Resolution Study of the Recurrent Activity **Astronomy & Astrophysics, 2024**
*Jurlin, N., R. Morganti, **F. Sweijen**, L. K. Morabito, M. Brienza, P. Barthel, and G. K. Miley*

Sub-arcsecond imaging with the International LOFAR Telescope. I. Foundational cal- ibration strategy and pipeline **Astronomy & Astrophysics, 2022**
*Morabito, L. K., N. J. Jackson, S. Mooney, **F. Sweijen**, S. Badole, P. Kukreti, D. Venkattu +40 others*

VLBI Imaging of High-Redshift Galaxies and Protoclusters at Low Ra- dio Frequencies with the International LOFAR Telescope **Astronomy & Astrophysics, 2023**
*Cordun, C. M., R. Timmerman, G. K. Miley, R. J. van Weeren, **F. Sweijen**, L. K. Morabito, and H. J. A. Röttgering*

The Resolved Jet of 3C 273 at 150 MHz. Sub-arcsecond Imaging with the LOFAR International Baselines **Astronomy & Astrophysics, 2022**
*Harwood, J. J., S. Mooney, L. K. Morabito, J. Quinn, **F. Sweijen**, C. Groeneveld, E. Bonnassieux, A. Kappes, and J. Moldon*

SOFTWARE EXPERIENCE

Containerisation (Apptainer)
Community software containers https://github.com/tikk3r/flocs
Recipes and utility scripts to build Apptainer containers used by the community that contain all software needed to run common ILT data reduction tools or pipelines.

Rust
LOFAR-H5parm-rs https://github.com/tikk3r/lofar-h5parm-rs
Rust interface to the LOFAR H5parm solution tables.

Python
LOFAR H5plot https://github.com/tikk3r/lofar-h5plot
An interactive potting utility to explore LOFAR calibration solutions in H5parm format and a spiritual successor to parmdbplot. It can be used to quickly explore solutions for single stations as a function of time and/or frequency.

Python
EveryStamp https://github.com/tikk3r/EveryStamp
Over-arching package to easily obtain postage stamps from a variety of surveys.

-
LOFAR einfra group -
A collaboration between Leiden, Astron, SURFsara and other SKSP members to coordinate data processing and software deployment on the DutchGrid. I got involved to help deploy our pipelines on the DutchGrid/Spider and to facilitate our software deployments on those platforms using Singularity containers.

EMPLOYMENT

04/2024 - present **Post-doctoral research associate** **Durham University**
Postdoc position funded by the STFC-DAE collaboration between the UK and India. I will do science with the International LOFAR Telescope as an SKA pathfinder and use this to test out the UK SKA Regional Centre resources in Durham for processing SKA-like data.

10/2022 - 04/2024 **Software developer** **ASTRON**
Software developer at the Netherlands Institute for Radio Astronomy (ASTRON). I worked in the Innovation & Systems group where I helped develop and maintain open-source, in-house data reduction pipelines for LOFAR. I also picked up experience of working in a Scrum team, becoming familiar with e.g. project and sprint planning, daily stand-ups and project management in Jira.

10/2017 - 04/2024 **PhD – Prying eyes on radio skies: pushing the high-resolution low-frequency frontier with LOFAR** **Leiden Observatory**
In this thesis we push the boundaries of high-resolution imaging at radio frequencies between 100 and 200 MHz. Using the International LOFAR Telescope that spans across Europe we achieve sub-arcsecond angular resolution. We demonstrate mapping of the full field of view of the telescope at its native resolution and use the resulting images to study active galactic nuclei in the Lockman Hole field. The full thesis can be found in the thesis repository of Leiden University.

EDUCATION

2015 - 2017 **MSc Astronomy (cum laude)** **Rijksuniversiteit Groningen**
Masters's degree in Astronomy at the University of Groningen, obtained with distinction. For my final-year MSc research project I studied the strongly gravitationally lensed dusty star-forming galaxy (DSFG) MM18423+5938. We used data from the HST at 1.1 μm, the VLA at 5 (radio continuum), 21 (CO(1-0)) and 45 GHz (CO(2-1)) and Herschel at 250 μm, 350 μm and 500 μm to study the SED of this source and its lens morphology.

2012 - 2015 **BSc Astronomy** **Rijksuniversiteit Groningen**
Bachelor's degree in Astronomy at the University of Groningen. For my final-year BSc project I worked with three other students, building a horn antenna radio telescope in order to measure the temperature of the Cosmic Microwave Background radiation. My role focussed on controlling the telescope and its measuring equipment through a Raspberry Pi using Python. With observations of the Sun and a satellite we verify the beam size. This was found to be 12.07°±0.13° using the Sun and 12.61°±0.19° using a satellite,in agreement with expectations.

COLLABORATIONS

LOFAR2.0 **LOFAR Ultra Deep Observations** https://sites.google.com/view/lofarultradeep/home
Part of the team that will lead the data reduction of an ultra-deep $\sim 3,000$ observation of a single field to be started when the LOFAR2.0 upgrade finishes.

ORGANISATIONAL EXPERIENCE

04/2025 **Building Indo-UK collaborations towards the Square Kilometre Array** **Oxford**
Part of the scientific organising committee of a collaboration meeting; organising the science program, communication with participants, chairing.

11/2023 - present **LOFAR core software telecon**
Regular telecon with software/group leads at ASTRON and within the LOFAR imaging working groups to coordinate software development between components and pipelines.

2021, 2022 **Klankbordgroep SURF research week 2021 and 2022**
Input to the organising committee of the SURF research week as a scientist making use of SURF's distributed compute services.

2021 **Netherlands Astronomy Conference 2021**
Part of the local organising committee of the 2021 NAC and EASAM. Duties involved technical support and communication to participants.

2020 **Netherlands Astronomy Conference + European Astronomy Society Annual Meeting 2020**
Part of the local organising committee and assisting the SOC for both the 2020 NAC and EASAM. Duties involved chairing, communication to NAC participants and maintaining the NAC website.

2018 **LOFAR SKSP Meeting 2018**
Part of the local organising committee of the LOFAR Surveys Key Science Project meeting.

SUPERVISION

2025-2026 **Pombili Christian** **MSc project, Durham**
Co-supervision of an African MSc Student doing her Masters by research here in the UK.

10/2024-04/2025 **Srimoyee Mitra** **MSc project, Durham**
Co-supervision of an Indian MSc student on a 6-month work visit. The work focussed on studying star-planet interaction at low frequencies with LOFAR. It led to the discovery of a novel result and work towards a paper is in progress.

CONFERENCES / WORKSHOPS / SCHOOLS

06-08/05/2025 **LOFAR VLBI Hackathon** **Leiden**
Hackathon with a group of core LOFAR VLBI pipeline people to work on the pipeline.

22-25/04/2025 **Building Indo-UK collaborations towards the Square Kilometre Array** **Oxford**
Collaboration meeting for the Indo-UK collaboration to present updates on science and knowledge exchange between India and UK regarding SKA(-like) data processing.

18/02/2025 **LOFAR2.0 Imaging Forum (Virtual)**
20-minute talk updating the LOFAR community on the Deep Fields and current status of sub-arcsecond processing of the Boötes, Lockman Hole, ELAIS-N1 and EDF-N fields.

03-07/02/2025 **LOFAR long baseline busyweek (Virtual)**
Gathering of the long baseline working group to develop and test the pipeline.

09-10/01/2025 **DEX XXI**
Decades of EXtragalactic workshop in Newcastle. I gave a short contributed talk on an on-going ILT study into the sizes of red and blue quasars.

09-13/12/2024 **SALF X** **Shanghai, China**
Contributed talk to the Science at Low Frequencies conference.

08/2024 **LOFAR long baseline busyweek (Olsztyn)**
Gathering of the long baseline working group to develop and test the pipeline.

14/07-19/07/2024 **National Astronomy Meeting (Hull)**
National astronomy meeting of the UK. Contributed talk to the *"Era of SKAO Pathfinders – Pushing the Boundaries of the Radio Sky"* session.

08/07-12/07/2024 **AGN Populations Across Continents & Cosmic Time (Durham)**

02/2024 **LOFAR long baseline busyweek (virtual)**
Gathering of the long baseline working group to develop and test the pipeline.

07/2023 **LOFAR long baseline busyweek (Paris)**
Gathering of the long baseline working group to develop and test the pipeline.

14/11-18/11/2022 **LOFAR long baseline busyweek (Durham)**
Gathering of the long baseline working group to develop and test the pipeline.

06/12-09/12/2021 **SALF 2021**
Contributed talk on sub-arcsecond widefield imaging of the Lockman Hole region.

29/06-03/07/2020 **EASAM 2021 + NAC 2021**
Lightning talk showing preliminary results of widefield sub-arcsecond imaging with LOFAR.

01/12-04/12/2020 **SALF 2020**
Lightning talk showing preliminary results of widefield sub-arcsecond imaging with LOFAR.

29/06-03/07/2020 **EASAM 2020 + NAC 2020**
European Astronomical Society Annual Meeting combined with the Dutch astronomers conference.

22/06/2020 **LOFAR long baseline mini symposium (virtual)**
Symposium focussing on various ILT results. Contributed talk about resolved spectral modeling.

22/05/2020 **LOFAR Deep Fields mini symposium (virtual)**
Symposium focussing on various LOFAR Deep Fields results. Contributed talk about widefield sub-arcsecond imaging of the Lockman Hole deep field.

OUTREACH & COMMUNICATION EXPERIENCE

link to visualisation **LoTSS DR2 3D locations of galaxies**
The LOFAR Two-metre Sky Survey (LoTSS) has released its second data release (DR2), containing over 4 million radio sources. Many of these are galaxies harbouring an active super-massive black hole in their core. Positions of approximately 1.6 million radio sources in LoTSS DR2, for which distances are available, are shown here. Read more in the official press release.

2023 **PR image LOFAR-Euclid**
PR composition of LOFAR imaging of the Perseus cluster of galaxies and the Euclid image.
https://www.astron.nl/dailyimage/main.php?date=20231114

2023 **Article for Universum**
Article about radio astronomy and LOFAR for a quarterly magazine of a Dutch youth astronomy club.

2023 **PR image ILT Perseus**
PR composition of high-resolution LOFAR imaging of NGC 1275, the BCG in the Perseus cluster of galaxies.
https://www.astronomie.nl/nieuws/en/clusters-of-galaxies-better-in-view-with-radio-x-ray-combination

02/2022 **Article for NTvN**
Article for the Dutch physics magazine "Nederlands Tijdschrift voor Natuurkunde" about LOFAR and high-resolution, low-frequency radio astronomy.

12/2021 **Article for Zenit**
Article for the Dutch amateur astronomy magazine Zenit about LOFAR's high-resolution capabilities.

19/03/2021 **Online lecture Euroster Rotterdam**
Invited talk for an amateur astronomy club. I discussed the history of radio astronomy, the concept of black holes and AGN and their importance for our understanding of galaxy formation and evolution.

01/2021 **Article for Zenit**
Article for the Dutch amateur astronomy magazine Zenit about hyperluminous infrared galaxies.

21/12/2020 **Online lecture Leidse Weer en Sterrekundige Kring**
Invited talk for a local amateur astronomy club. I discussed the history of quasars and radio galaxies and the importance of black holes and AGN for our understanding of galaxy formation and evolution.

21/09/2019 **Nacht van Ontdekkingen**
A talk at the yearly "Nacht van Ontdekkingen" about the LOFAR telescope and how it advances our understanding of black hole and galaxy formation in the Universe.

2019 **Inspiring stars 3D prints**
Provided 3D prints of tactile planets and other objects for an Inspiring Stars exhibition.

2018-2020 **ICLON guest lecturer**
Guest lectures about LOFAR / radio astronomy at high schools or other interested parties.

2014-2017 **Planetarium operator**
Operator at the Kapteyn Mobile Planetarium (2014-2017) traveling to schools to educate children about astronomy as well as at the former Infoversum planetarium (2015) in Groningen.

LANGUAGES

English - certified B2, **Dutch** - native