Submission: LOFAR2.0 Large Programmes — Full proposal

# (v230515) Template for LOFAR2.0 Large Programme proposals (replace with real title)

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Abstract

In the Abstract, summarise your LOFAR2.0 Large Programme, its scientific goals and required observations.
Please use this LaTeX template to prepare your LOFAR2.0 Large Programme proposal. In the final version, please remove the instructions and other extraneous text included in the template.
PAGE LIMIT: 20 pages total, including 1 page for the title and Abstract, also following the per-section limits. This limit does not include the reference list and you may also place full author lists at the end of the document. Please do not change the font-size, margins, or other aspects of the formatting in the LaTeX template (but do remove the instruction text).
FIRST ANNOUNCEMENT: May, 2023.
WORKSHOP: during the LOFAR Family meeting in Olstyn in June 12-16, 2023.
See http://lfm2023.uwm.edu.pl/program.
DEADLINE: October 12th, 2023.
SUBMISSION: Email a PDF, based on this template, to lofar2-proposals@astron.nl with title "LOFAR2.0 Proposal submission".
QUESTIONS?: Email lofar2-proposals@astron.nl with title "LOFAR2.0 Proposal question".

**Keywords**
Keyword 1, Keyword 2, Keyword 3, Keyword 4

## Announcement (remove this section from final proposal)

LOFAR2.0 is a major upgrade to the Low-Frequency Array, offering simultaneous low- and high-band observing, increased field-of-view, and various other improvements to the sensitivity and operation of the telescope. A set of staged LOFAR2.0 test stations are helping to commission the new hardware and software, with a full system roll-out expected in 2024-2025, followed by early shared-risk observations and full operations thereafter.

Following an earlier call for Expressions of Interest (EoIs), the International LOFAR Telescope (ILT) now solicits full proposals for LOFAR2.0 Large Programmes (L2LPs). Submission of a

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International LOFAR Telescope

L2LP is *not* contingent on having previously submitted an EoI. Please use this LaTeX template to prepare your proposal, and please also consult the additional information in the accompanying LOFAR2.0 White Paper, system overview, description of supported observing modes, and LOFAR2.0 Services & Policies documents (see the call website and links therein).

The L2LP full proposals will be reviewed by experts who will consider the scientific merit and impact; feasibility of observing and processing; strength and inclusiveness of the proposing team; and plans for publication and dissemination of results, including distilled data products with value to a broader community. This review will lead to an advice to the ILT Board, who will establish the Large Programme Portfolio based on scientific excellence, feasibility and timeliness, and other considerations — including the overall breadth, legacy value, and productivity of LOFAR, specific relevance for partner country research communities, and general impact and engagement of the wider community.

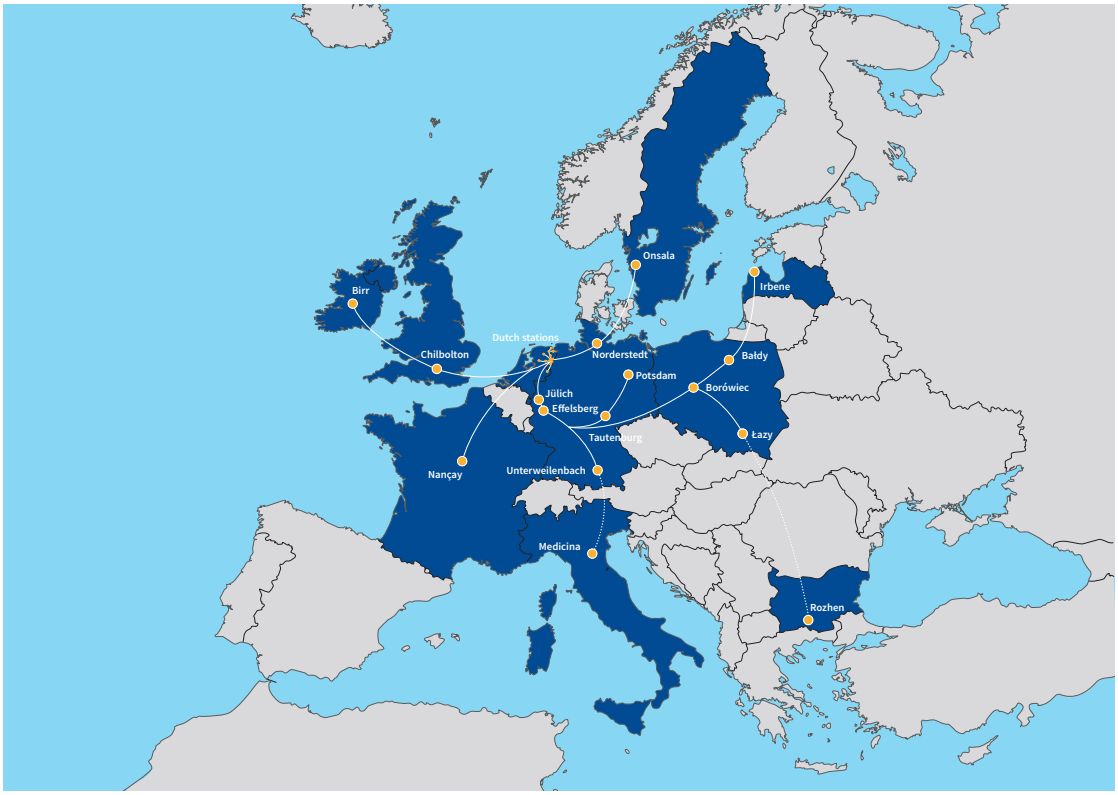


**Figure 1:** International LOFAR Telescope.

## 1. Science goals

Limit 7 pages.

In this section, focus on:

- A summary of the main scientific questions you aim to address.
- What are the most exciting possible outcomes (stretch goals that might be possible, but are not guaranteed)?
- The state-of-the-art in the field, including previous LOFAR observations (if relevant).
- Moving forward, in what ways can LOFAR address these scientific questions; in what ways can it make unique contributions?
- What synergies are there between your envisioned LOFAR data and multi-wavelength / multi-messenger data from other facilities?

Please provide citations in the text. Here are example citations to the LOFAR overview paper[1] and paper presenting LOFAR beam-formed modes[2]. You should also include figures and tables, as needed.

## 2. Observational requirements

Limit 4 pages (**not** including the associated table).

Note:

- If your L2LP is accepted, then a more detailed set of observing and pipeline specifications will be required before the programme can start.

In this section, focus on the following topics. Please also fill-in the table below, as far as is relevant and possible, given your envisioned programme (and providing additional clarifications as necessary):

- The required observing mode(s), including time/frequency resolution, instantaneous FoV, angular resolution, frequency range, sensitivity, etc.
- Describe the observation strategy needed to complete each observation (e.g. 10 min cal1; 10 min cal2; 4 hrs target: multi beam HBA-dual observation with 122 subband on each source; 15 min cal3).
- The observational programme, including what kinds of sources/fields (a full source list is not needed if it is large), integration time, cadence, etc.
- The challenges and strategy for calibrating and processing the data.
- Is a staged approach needed and/or possible (e.g., Pilot survey, Phase 1 depth, Phase 2 depth)? Given the early, shared-risk commissioning stage that is envisioned, it is preferred to divide the observations into stages with associated intermediate goals.
- Are there constraints on how the observing time is spread over the envisioned 5 years of the L2LP observing programme?
- Are you proposing for a deep field type (which LST range?) or a survey type programme (over all LSTs or specific LSTs)?
- The distilled data products that are necessary.

| **Technical Justification Table** (please provide additional clarifications and justifications, as necessary) | |
|---|---|
| Total observing time required | XXX hr |
| Typical time per target | XXX hr |
| Total number of observations per target (including calibrators) | XXX |
| Are there parallel observations planned with other observing facilities? | Yes/No, explain |
| Are there any mandatory stations needed for the observations (e.g. Superterp, International stations, list of customized stations)? | Yes/No, explain |
| Are there date constraints for your observations (e.g., specific dates, LST, cadence)? | Yes/No, explain |
| Are there time constraints for your observations (day, night, no twilight)? | Yes/No, explain |
| Are combined data products requested in the setup (e.g., beam formed + interferometer)? | Yes/No, explain |
| Give the noise-level you wish to achieve for your observations | XXX mJy/beam |
| What is the expected maximum data rate from COBALT to CEP? | XXX GB/s |
| Do you request any processing offered by the ILT? | Yes/No, explain |
| Do you need to store raw data products in the LTA? | Yes/No, explain |
| Do you request your data to be stored at a specific site? | Yes/No, explain |
| Do you have access to external processing facilities? | Yes/No, explain |
| Are you open to co-observing (LBA, HBA) with other programmes? | Yes/No, explain |

## 3. Description of team and programme

Limit 3 pages.

In this section, focus on:

- The composition and structure of the team. If the team is very large, you can provide a web-link.
- The various expertises of the team members. Lack of prior experience with LOFAR is not a disqualifier; will (part of) your team require additional support?
- How do you plan to give leadership roles to early and mid-career researchers such that they can leverage this to acquire funding for themselves and their team?
- What are the additional avenues for rewards (beyond publication) for software development, observing, etc.?
- Describe how you will let other interested scientists to join the collaboration.
- How do you intend to develop a broader, more diverse and more capable user community?
- Give an overview of the representation of the collaboration (regional, institutional, career stage, gender).

- How the team will organise the observing programme and processing (including computing resources), in collaboration with the ILT and telescope operators.
- Describe how you will maintain and evaluate internal engagement (collaboration meetings; collaboration rules; publication policy).

## 4. Observing, data processing and management plan

Limit 3 pages.

Note:
The ILT will provide data archiving and curation, as well as a range of pipelines and other software, as described in the accompanying documentation. In addition, we will be available to work with proposal teams to undertake advanced processing campaigns.

After proposal acceptance, observation planning will be done through the dynamic scheduler. Under the coordination of the Science Data Centre group, contact points from each proposing team will be involved in the generation of the observing and processing templates, in data quality assessment, and in handling the data workflow.

Based on available resources, on the availability of processing pipelines in the operational environment, and on the observing mode, distinct levels of processing will be performed for the users.

- For the supported observing modes, the ILT will generate instrumental and intermediate data products. Advanced data products may be generated based on available resources and in collaboration between ILT and the users, who may be assigned specific responsibilities for the data handling, as mentioned above;
- For expert observing modes, i.e., for those modes that are not supported in the operational environment, the ILT will make the raw data available to users;
- The data will be made available to the users through the SDC. The ILT anticipates that (final) science data products, generated through standard pipelines (such as image cubes) can be kept available indefinitely (under open access policies), but that raw/intermediate products may only be retained for further processing within a restricted dwell time. As an indicative example: processing of visibility data to image cubes may have to be carried out within an average timespan of one to two years, thus significantly restricting achievable combinations of final image cube field size, spanned bandwidth, spatial and spectral resolution, given available compute clusters to handle a sustained observing rate. Allocation of data storage dwell times and other parameters may be tailored to specific science projects. Additional resources contributed by an L2LP team will be of significant benefit, especially where these can be incorporated into the production data flow for the L2LP project. Composition of the Large Programme Portfolio will take into account, among other factors, the potential to realize (afford) the resources necessary to achieve overall science excellence and high impact for the community;
- Expert users who may wish to do so can generate advanced data products by executing their own processing routines, either within the ILT infrastructure (when and if the User Pipeline Execution (UPE) becomes available) or by exporting the data to external clusters.

In this section, please focus on:

- Which members of your team will be available to support the observing process and carry out quality checks on the data? What experience do they have in handling LOFAR products?

- What software, services and computing resources will be required to generate advanced data products? Do you plan to build on the documented ILT offering, or will you provide your own?
- What data products need to be archived for the long term?
- What data releases do you plan, and how will you contribute to making science-ready data products more accessible?
- Will your project produce legacy data products and/or data products for other future uses? If so, describe the value to the broader community.
- How will you contribute to achieving lower barriers of accessibility to science usable products? What data releases do you plan?
- What software/pipelines and computing resources will you be using?
- Do you have any co-development plans for software with ILT and/or other partners? How will these tools be made Open Access?

## 5. Publication and dissemination plan

Limit 2 pages.

Note:

- There will be a LOFAR2.0 Builders List for publications stemming from early shared-risk observations.

In this section, focus on:

- The proprietary period for data is 1 year; do you require an exception to this? If so, why?
- What publications are envisioned, and what it the timeline for these?
- How are publications being fairly distributed amongst the team (e.g., early and mid-career scientists)?
- In what way will software and data releases be published?
- How will you disseminate the project results? What key conference series and other venues? How will you approach press releases?

## References


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