The German
Long Wavelength
Consortium

GLOW

LOFAR

LOFAR 2.0

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LOFAR: STATUS AND NEW DEVELOPMENTS

Concrete plans for new stations (with LOFAR 2.0 electronics): Medicina, IT; Bulgaria (site search started)

LOFAR: STATUS AND NEW DEVELOPMENTS

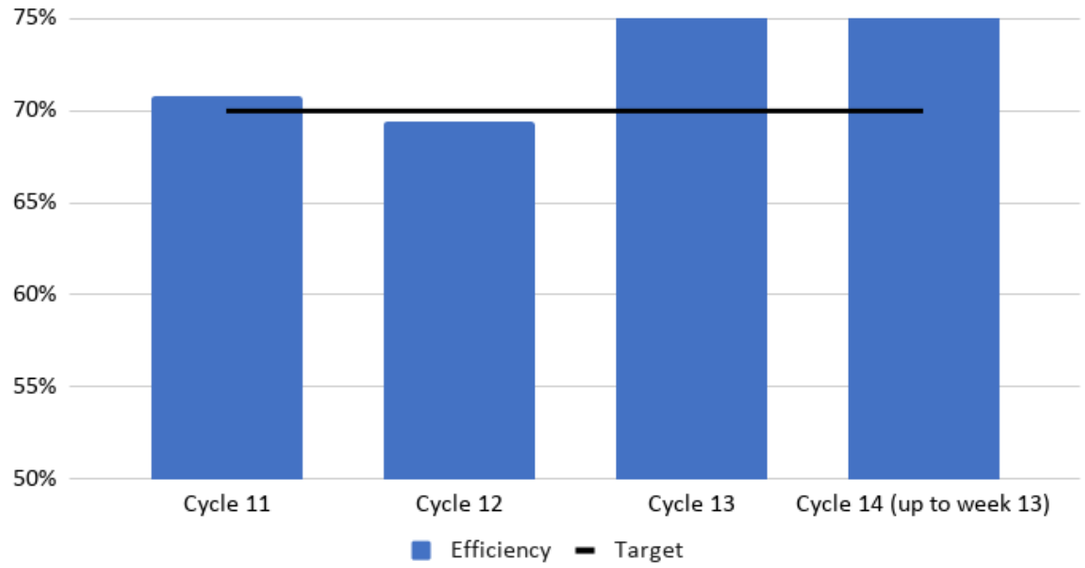

Figure 1: Average Efficiency per LOFAR Cycle.

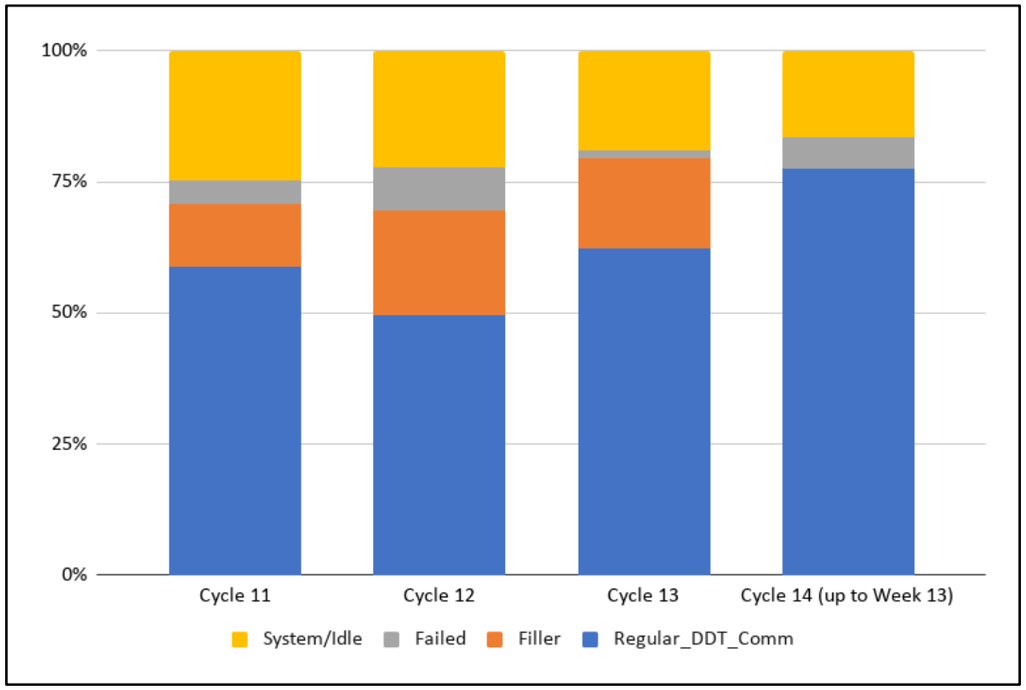

Figure 4: Telescope time distribution.

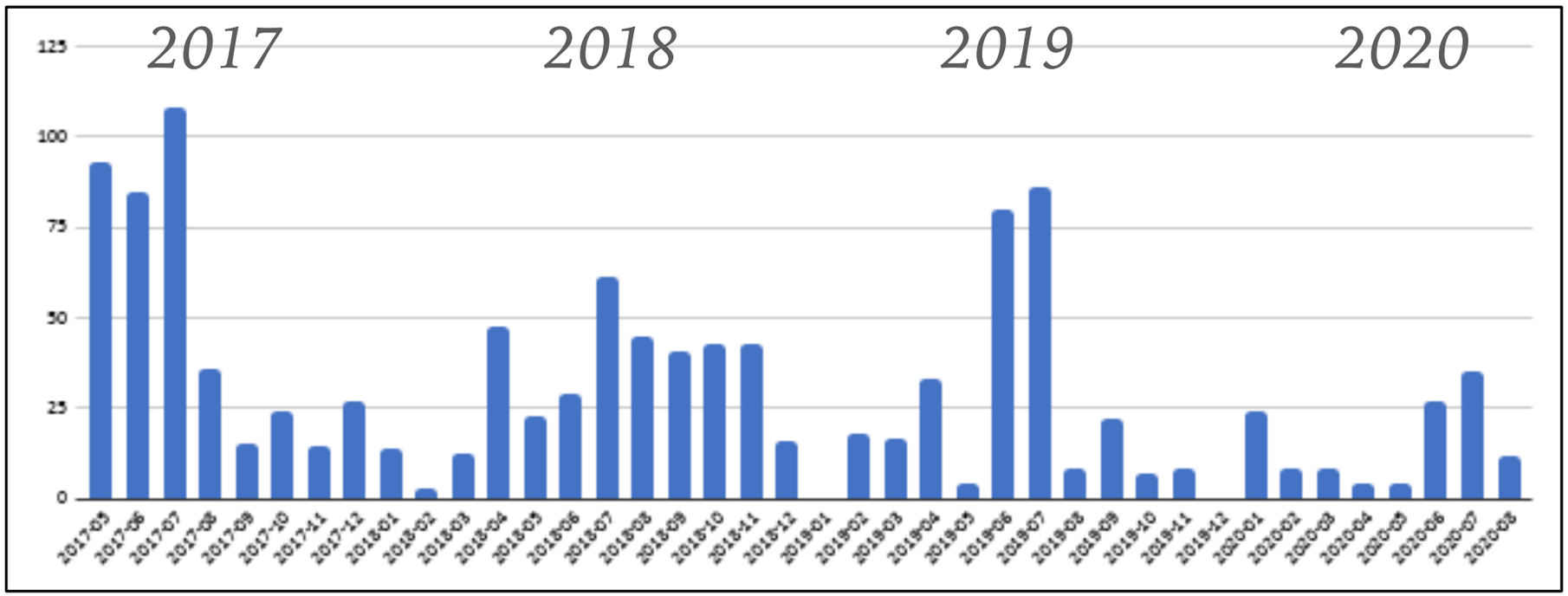

Figure 5: Observing hours lost per month.

Operations are only minimally affected by SARS-COV-2

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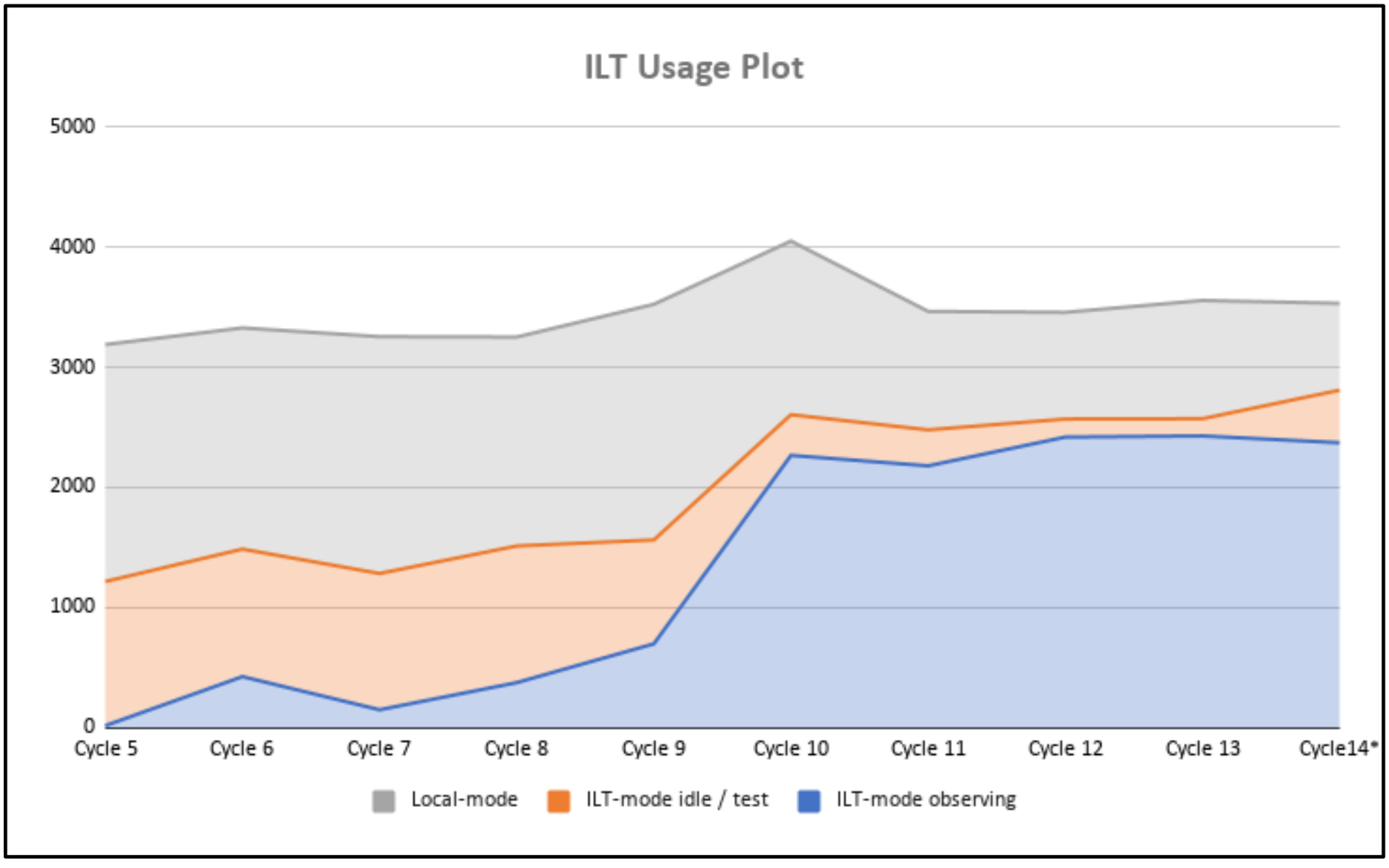


Figure 6: Usage of international stations.

LOFAR VISION

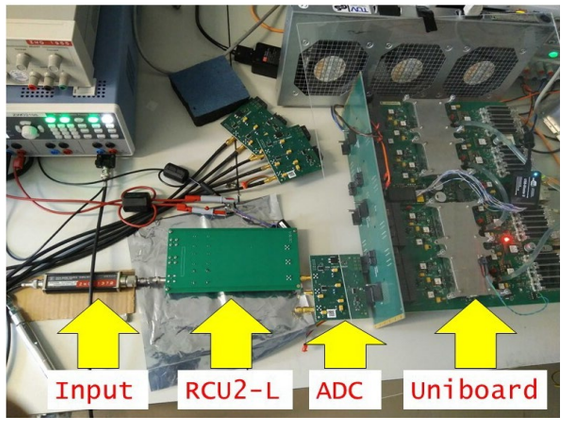
- **LOFAR 2.0: be the world leading very low frequency instrument until 2030+**
  - spectacular science at very low frequencies (simultaneous LBA and HBA observation: 10 - 240 MHz, higher dynamic range, multiple-beams on sky)
    - international stations provide outstanding resolution (0.2'' over all Northern hemisphere, matches resolution of Euclid and Hubble)
- Develop LOFAR LTAs into Science Data Centers
- Improve LOFAR governance: transform to LOFAR ERIC

LOFAR 2.0

- LOFAR2.0 will capture and deliver standard data products to a Science Data Centre facility.
- **LOFAR2.0 Stage 1 will include:**
  Station2.0 (STAT): Simultaneous LBA/HBA Observing, Control Software,
  RFI mitigation measures
  Central Processing (CEP): LOFAR2.0 Megamode,
  Modifications to adopt LOFAR2.0 data
  Timing Distributor (TD): Central clock for all Dutch stations
  Network (NW): Upgrade of network capacities
  Telescope Manager (TM): Interface to new station control, Stand-alone mode
  Station1.0 (STAT1): Software wrapper to control LOFAR1.0 stations by LOFAR2.0 TM
- **Out of scope of stage 1:**
  AARTFAAC continuation, Antenna redesign (HBA redesign in LOFAR4SW),
  Implementation of LOFAR — SDC split, Integration of NenuFAR,
  TMSS (is part of current LOFAR1.0 budget), Replacement of CEP4,
  DUPLLO Survey pipeline (is part of SDC programme),
  LOFAR-IT delivery (will partly use LOFAR2.0 components), new stations

LOFAR 2.0 & LOFAR4SW HIGHLIGHTS

- Prototype of new receiver units by ASTRON and INAF



- Prototype for clock distribution by ASTRON
- Test station at Chilbolton (4 HBA tiles), beam former development in ongoing

LOFAR 2.0 — BUDGET AND TIMELINE

- LOFAR 2.0 development budget and timeline is under pressure:
  Delays/underestimated effort in firmware development and station control software
- ILT Board approved a downscoping process:

Step	Body	Action	Scope
1	Project Scientists	Prioritise initial list	Scientific
2	LOFAR2.0 Science Advisory Committee (L2SAC)	Review Advise program board and ILT Board	Scientific
3	Program Board	Review Re-order list	Time/budget/risk/operations
4	ILT Board	Review Re-order list Approve	Non-scientific

- Timeline: downscoping (Dec 2020), deadline for upgrade commitment (originally Sept 2021) will be shifted;
  original plan: Italian and Dutch stations starts 2/2022; roll-out of INT stations in 2023,
  LOFAR2.0 operations start 2024

LOFAR ERIC

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  very low frequency instrument until 2030+
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          (0.2'' over all Northern hemisphere, matches resolution
          of Euclid and Hubble)
- Develop LOFAR LTAs into Science Data Centers
- **Improve LOFAR governance: transform to LOFAR ERIC**

LOFAR GOVERNANCE

- **Dutch Stichting** “International LOFAR Telescope”
- ILT Board and ILT Director
- National Consortia: NL, D, PL, F, IR, IT, S, UK, LAT
- 38 Dutch stations owned by ASTRON
- 13 international stations owned by various parties (8 in D)
- 3 Long Term Archives (Amsterdam, Jülich, Poznan)
- ILT has contracts with station owners and consortia (including LTAs)
- Central operations by ASTRON, NL
- **ILT governance** was great to pull this off the ground, but **does not scale with the number of new partners, growing complexity** in management and funding, not ideal for **common effort** in hardware procurement, operation of **infrastructure on European scale**

CASE FOR AN ERIC

- ERIC = **European Research Infrastructure Consortium**
- Legal entity recognised by the European Commission and EU law
- **Members are states and IGOs** (with a majority of EU member states)
- **Advantages of an ERIC:** Visibility at European level, involvement of national science ministries via Representing Entities, ERIC can own, operate, coordinate infrastructure across Europe — even in states that are no ERIC members, common procurement, VAT reduction, etc.
- First preparatory meeting under lead of Dutch ministry (including BMBF) took place in Feb 2020; 2nd meeting Oct 15, 2020
- **Timeline:** 2 step process:
  1st step April 2021 (statutes, financial annex, technical description);
  2nd step September 2021 (members, representing entities, rules of procedure, etc.);
  EC decides; Publication of statutes in Journal of EU
- Start of LOFAR ERIC envisioned for April 2022
- Roll-out of LOFAR2.0 hardware starts 2022, LOFAR2.0 science starts in 2024

ISSUES TO CONSIDER FOR GERMANY

- Current GLOW-LOFAR Infrastructure Owners are:
  AIP Potsdam, FZ Jülich, MPA, MPIfR, RU Bochum, U Bielefeld, U Hamburg, TLS Tautenburg
- Community will be represented by a Representing Entity (TBD)
- We operate under the assumption that the total budget of the LOFAR ERIC is the same as the ILT budget (mix of cash and in-kind)
- LOFAR2.0 investments on top
- New partners are welcome, involvement can reach from small to contributing an extra LOFAR station (not before 2024)