



Report from the event supported by RadioNet

TITLE *THE BROAD IMPACT OF LOW FREQUENCY OBSERVING*

DATE: *19 – 23 JUNE 2017*

LOCATION: *BOLOGNA ITALY*

MEETING WEBPAGE: *<http://www.astron.nl/lowfrequencyobserving2017/>*

HOST INSTITUTE: *IRA/INAF AND ASTRON*

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BENEFICIARY / NO: *ASTRON / 2*

INAF / 4

Report:

1. SCIENTIFIC SUMMARY

From 19-23 June 2017, the conference 'The Broad Impact of Low Frequency Observing' took place at the Conference Center of the INAF/CNR research campus, in Bologna (Italy). The event was connected with and naturally followed the yearly RadioNet-supported LOFAR Science Meetings where results from the LOFAR science projects are presented and discussed. This year, the event expanded its scope and explored relevant links to some of the main facilities complementary to LOFAR including the MWA, the VLA, and VLBI networks in the radio, as well as some of the world's major observatories at other wavebands. In this respect, the event was cross disciplinary and fed the collaboration between radio astronomers and scientists working in other bands of the electromagnetic spectrum, disseminating the knowledge acquired in our field to the broader astronomical community and at the same time broadening the scientific horizon of radio astronomers.

The programme covered highlights from low frequency observations obtained with a range of observatories around the world. These are significantly impacting science areas including the Epoch of Reionization & Cosmology, Pulsars, The Milky Way and Nearby Galaxies, AGN, Star Formation, Clusters, Sun, Ionosphere, Cosmic rays, and Transients. A few highlights from a few sessions are presented below.

The EoR talks showed that the many telescopes that are trying to detect the EoR signal are facing many technical challenges. Specifically, foreground removal is one key challenge for 21cm EoR experiments. In this respect, it was important to see that the LOFAR-EOR project has made important steps forward and showed (thanks to better foreground analysis) LOFAR EoR upper limits a factor of 4 better with 3 nights data than previously with 13 nights of data (see Fig. 1).

Comparison of current progress

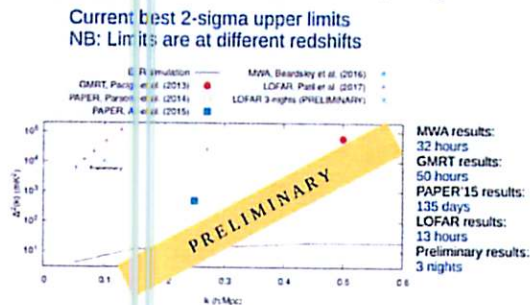


Figure 1: LOFAR EoR upper limits compared to those obtained with other instruments

The Pulsar talks showed the important physics that can be done at low frequency (probe magnetosphere, probe Interstellar medium, find msec pulsars) and how the improvement in computational power is now making all this possible.

The Milky Way session highlighted the very important studies that can be pursued at low frequencies for HII regions, supernova remnants and magnetic fields.

The Solar talks showed the capability of the current arrays to detect and study the powerful processes on the Sun at low radio frequencies, like solar radio bursts (see e.g. Fig. 2 from D. Morosan).

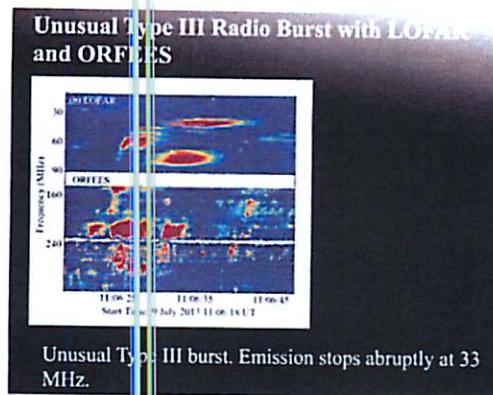


Figure 2: Type III Radio bursts detected with LOFAR and ORFEES

The low frequency regimes are key to detect and study diffuse radio sources in clusters that are not directly associated with radio galaxies. The origin of these sources is not yet well understood. The Galaxy cluster session showed many examples of such Mpc sources now imaged for the first time in great detail and sensitivity at low frequency thanks to the capabilities of the new observatories available. A very important highlight of this session was the image at 150 MHz of the Sausage cluster, by D. Hoang and collaborators. The image is presented here below.



Figure 3: the Sausage cluster as detected by LOFAR at 150 MHz

The science talks as well as the special session on Instrument & algorithms provided a comprehensive overview of the versatility and state-of-the-art technical capabilities available at low frequencies. With LOFAR unmistakably in a world-leading role, it is clear that the breadth of all available observing facilities and data analysis techniques together is contributing to the broad science impact being made.

This conference fitted well in the RadioNet framework as it had a major focus on the scientific results achieved using also RadioNet facilities, including LOFAR, and had a cross-disciplinary nature, as highlighted above.

Participants advertised the most relevant scientific results presented at the conference through Twitter. The very long list of posts can be found at: <https://twitter.com/hashtag/TBILFO2017>



The event web page is <http://www.astron.nl/lowfrequencyobserving2017/>

2. AGENDA OF THE EVENT

The agenda of the event is reported below. The info on institute/country affiliation of the speakers can be found in the attendance list in Section 3.

Science Programme - Low Frequency Observing 2017

Monday, 19 June 2017

09.00-09.10 Filippo Zerbi
Rene Vermeulen Introduction/welcome

Epoch of Reionisation and Cosmology (Chair: R. Wayth)

09.10-09.40 Jonathan Pritchard Epoch of Reionisation and Cosmology at low frequencies
09.40-10.00 Andre Offringa The EoR with LOFAR
10.00-10.20 Cathryn Trott Progress towards the EoR with the Murchison Widefield Array
10.20-10.35 Emma Chapman Foreground Removal in the Epoch of Reionisation

10.35-11.05 Break

11.05-11.25 Gianni Bernardi The Epoch of Reionization Array (HERA)
11.25-11.45 Benedetta Ciardi EoR Simulations and 21cm Absorption
11.45-12.00 Nichole Barry Sky-Based Calibration and the EoR Power Spectrum: Contamination, Mitigation, and Implications
12.00-12.15 Marta Spinelli Polarised synchrotron simulations for EoR experiments
12.15-12.30 Carolin Hofer Canadian Hydrogen Intensity Mapping Experiment
12.30-12.45 Andrei Mesinger Learning about astrophysics with the cosmic 21-cm signal

12.45-14.15 Lunch

Pulsars

(Chair: H. Falcke)

14.15-14.45 Jason Hessels The low-frequency pulsar renaissance
14.45-15.05 Ramesh Bhat Pulsar Astronomy with the Murchison Widefield Array
15.05-15.25 Catarina Tiburzi Pulsar Timing with LOFAR
15.25-15.40 Cees Bassa Searching for millisecond pulsars towards Fermi gamma-ray sources with LOFAR

15.40-16.10 Break

16.10-16.30 Bhaswati Bhattacharyya Pulsars and Transients with the GMRT
16.30-16.45 Chia Min Tan LOTAAS Periodicity Search for Pulsars
16.45-17.00 Mengyao Xue A Low Frequency Census of Southern Pulsars with the MWA
17.00-17.15 Elliott Polzin LOFAR study of the eclipses of black widow pulsar J1810+1744

Exoplanets

17.15-17.35 Jean-Mathias Grießmeier Observations of extrasolar planets at low radio frequencies
17.35-17.50 Jake Turner The search for radio emission from exoplanets using LOFAR low-frequency beam-formed observations

19:00 - 21:00 Welcoming reception

Hotel I Portici
Via dell'Indipendenza 69
40121 Bologna

Tuesday, 20 June 2017

The Milky Way and Nearby Galaxies (Chair: R. Dettmar)

09.00-09.30	Marijke Haverkorn	The Milky Way at low frequencies
09.30-09.45	Raymond Oonk	Uncovering the diffuse CO-dark gas in cold interstellar clouds
09.45-10.05	George Heald	Low-frequency observations of nearby galaxies
10.05-10.20	David Mulcahy	Exploring the low frequency nature of nearby galaxies with observations and modelling
10.20-10.35	Krzysztof Chyży	Flattening of low-frequency spectra of nearby galaxies
10.35-10.50	Fatemeh Tabatabaei	Cloud-Scale GMRT Survey of M33: Unveiling the Low-Frequency Properties of the ISM

10.50-11.20 Break

Solar Physics

11.20-11.50	Divya Oberoi	The Sun and the Heliosphere at Low Radio Frequencies
11.50-12.10	Diana Morosan	LOFAR Tied array Imaging and Spectroscopy of Solar RadioBursts
12.1-12.25	Eduard Kontar	The First Imaging Spectroscopy of the Solar Radio Burst Fine Structures
12.25-12.40	Gottfried Mann	Tracking of an electron beam through the solar corona with LOFAR
12.40-12.55	Nicoline Chrysaphi	Imaging Spectroscopy of a Type II solar radio burst observed by LOFAR

12.55-14.25 Lunch

Instruments and Algorithms

(Chair: I. Prandoni)

14.25-14.55	Robert Braun	Low Frequency Science with the Square Kilometre Array
14.55-15.10	Jason Hessels	LOFAR 2.0: A premier low-frequency facility for the next decade
15.15-15.35	Andre Offringa	Low frequency imaging
15.35-15.50	Jess Broderick	LOFAR MSSS: A low-frequency counterpart to NVSS

15.50-16.20 Break

16.20-16.35	Paul Hancock	The GLEAM survey: Imaging and Calibration challenges
16.35-16.55	Neal Jackson	Long baselines at low frequencies
16.55-17.10	Franz Kirsten	Low Frequency VLBI: fringes between MVA and GMRT
17.10-17.25	Francesco de Gasparis	Imaging at 50 MHz: the LOFAR LBA survey

Wednesday, 21 June 2017

Instruments and Algorithms (cont.) (Chair: R. Vermeulen)

09.00-09.20	Cyril Tasse	Direction dependent imaging and Wirtinger calibration for low frequency radio surveys
09.20-09.40	Huub Rottgering	Deep and sharp imaging at low radio frequencies with LOFAR. Studies of clusters, AGN and starburst galaxies
09.40-09.55	Tim Shimwell	Galaxy Clusters in the LOFAR Two-metre Sky Survey

Clusters

09.55-10.25	Gianfranco Brunetti	Non thermal phenomena in galaxy clusters at low radio frequencies
10.25-10.40	Melanie Johnston-Hollitt	A Catalogue of Relics and Halos from the MWA GLEAM Survey
10.40-11.10	Break	
11.10-11.30	Franco Vazza	The low-frequency view on the complex life of galaxy cluster



- 11.30-11.45 Kamlesh Rajpuranith outskirts
A spectacular view of the Toothbrush: filaments and inhomogeneous magnetic fields
- 11.45-12.00 Gabriella di Genaro Deep in the (un)known: the Sausage Cluster
- 12.00-12.15 Christopher Riseley Magnetic Fields in High-z Clusters: A Full-Polarization Study of MACS J0025.4-1222 with the GMRT
- 12.15-12.30 Annalisa Bonafede New radio emission from the cluster MACSJ0717+3745 – LOFAR observations
- 12.30-12.45 Virginia Cuciti New detections of radio halos in galaxy clusters with low frequency GMRT observations

12:45-14:15 Lunch

Social activities after lunch

20:00 - ~22:30 Conference dinner
Palazzo Isolani
Via Santo Stefano 16
40125 Bologna

Thursday, 22 June 2017

AGN Physics

(Chair: M. Johnston-Hollitt)

- 09.00-09.30 Raffaella Morganti The physics and lifecycle of local radio AGN
- 09.30-09.45 Joseph Callingham Dying young and frustrated? A low radio frequency view of 'young' radio galaxies
- 09.45-10.00 Simona Giacintucci Tracing multiple AGN outbursts at low frequency in cool-core clusters
- 10.00-10.15 Rajan Chhetri Sub-arcsec compact source properties using wide field interplanetary scintillation with the MWA
- 10.15-10.30 Jeremy Harwood The low-frequency perspective of FR II radio galaxies
- 10.30-11.00 Break

AGN and galaxy evolution

- 11.00-11.50 Elaine Sadler Radio AGN populations and their evolution
- 11.30-11.50 Wendy Williams Deep LOFAR imaging and AGN evolution
- 11.50-12.05 Sarah White The MWA GLEAM 4-Jy Sample
- 12.05-12.20 David Nisbet The Determination of the Luminosity Function of Jet-mode AGN out to a Redshift of $z \sim 2$
- 12.20-12.35 Kimberly Emig The first detections of radio recombination lines at cosmological distances

12.35-14.05 Lunch

14.05-14.25 Vernesa Smolcic VLA-COSMOS 3 GHz Large Project: Cosmic evolution of radio AGN and star forming galaxies since $z \sim 5$

14.25-14.45 Tom Muxlow [Star-formation Across Cosmic Time: Initial Results from the e-MERGE Study of the \$\mu\$ Jy Radio Source Population](#)

- 14.45-15.00 Gulay Gurkan LOFAR/H-ATLAS: The low-frequency radio luminosity – star-formation rate relation
- 15.00-15.15 Volker Heesen The low-frequency radio continuum' star formation rate relation in nearby galaxies with LOFAR
- 15.15-15.30 Nick Seymour The Surprising Complexity of the Radio Emission from StarForming Galaxies

15.30-16.00 Break



Ionosphere & Upper Atmosphere

(Chair: H. Rothkaehl)

16.00-16.20 Maaijke Mevius
16.20-16.40 Huib Intema
16.40-16.55 Christopher Jordan

Probing ionospheric structures using LOFAR
SPAM - 10 years of ionospheric calibration
Ionospheric characterisation above the Murchison Radio
Observatory with EoR datasets

16.55-17.10 Maria Rioja

Ionospheric studies and calibration using MWA and LOFAR
observations

17.10-17.30 Richard Fallows
17.30-17.45 Brian Hare

From the Sun to the Earth: Observing Space Weather with LOFAR
LOFAR for Lightning Interferometry and Mapping

19:00-20:00 Public lecture (in Italian) by Daria Guidetti (INAF-IRA)
Auditorium Biagi
In the main Bologna Public Library Sala Borsa
Piazza del Nettuno, 3, 40124 Bologna

Friday, 23 June 2017

Cosmic Rays

(Chair: A. Rowlinson)

09.00-09.30 Heino Falcke
09.30-09.50 Tim Huege
09.50-10.10 Stijn Buitink
10.10-10.25 Olaf Scholten

Cosmic Ray studies at low frequencies
Precision measurements of cosmic-ray air showers with SKA-low
Radio detection of neutrinos with LOFAR and ARIANNA
Status and perspectives of the radio detection technique of cosmic
ray air showers

10.25-10.40 Arthur Corstanje

Improving the accuracy of cosmic-ray composition measurements
with LOFAR

10.40-11.10 Break

Transients

11.10-11.40 Tara Murphy
11.40-12.00 Emily Petroff
12.00-12.20 Ralph Wijers
12.20-12.35 Steve Croft
12.35-12.50 David Kaplan

Exploring the dynamic radio sky with SKA pathfinders
Fast Radio Bursts: Recent Discoveries and Future Prospects
Finding transients in the image plane at low radio frequencies
Breakthrough Listen
Faint, Highly-Polarized Flares from UV Ceti with the MWA

12.50-13.00 Concluding remarks

3. PARTICIPANTS

200 participants attended the conference. Gender balance played an important role in the event. 32% of the participants, 30% of the SOC and 50% of the LOC were women. 48 participants were phd, and 48 were post-doc. 34 experts in various astrophysical areas, 38.5% of which are women, have been invited to give review and invited talks. The country affiliation of the participants is shown in the chart below.

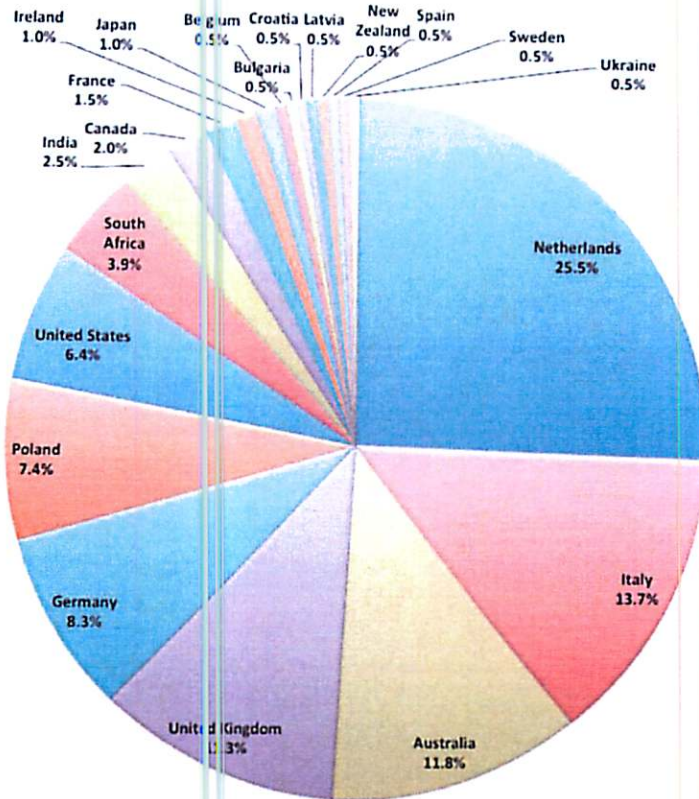


Figure 4: country affiliation of the participants

The conference picture taken at the conference venue is shown below.



Figure 5: Conference picture taken on Tuesday 20 June at the conference venue.