Surname	First name	Email	Title	Abstract Posters
Arias	Maria	maria.arias.de.saavedra@gmail.com	Supernova Remnants at Low Frequencies	The LOw Frequency ARray (LOFAR) offers very interesting possibilities for the study of supernova remnants (SNR), whose steep spectral indexes render them more dominant at low frequencies. Apart from the potential to discover new SNRs thanks to its large field of view, LOFAR's sensitivity and angular resolution allow for more detailed studies of the closer, bigger SNRs than had been previously possible at this relatively unexplored radio window. We are currently studying two kinds of low frequency processes happening at LOFAR frequencies in SNRs: absorption (both internal and external free-free absorption), and intrinsic spectral differences caused by non-homogeneous populations of electrons, and shock physics. In this poster I intend to present our initial results from LOFAR imaging of three SNRs: Cassiopeia A, VRO42.05.01, and HB9. In the LBA, Cas A shows features of low frequency absorption from the unshocked ejecta in front of the synchrotron emitting shell. Part of our work is to disentangle this absorption from that of the interstellar medium along the line of sight. The other two are mixed-morphology SNRs, characterised by displaying thermal X-ray emission inside a radio shell. Some MMSNRs are known to have spectral index segregation, with faint steep spectral regions and bright flat spectral regions. We have HBA images of both VRO.42.05.01 and HB9 which we will compare to higher frequency images and molecular cloud catalogs to explore local variations in the spectral index and their correlation with density. This is part of a larger study of how SNRs expand in higher density environments.
Bezrukovs	Dmitrijs	dmitrijs.bezrukovs@venta.lv	Solar Regions with Low Brightness Temperature in Microwaves and Very Long Waves	The attention to low brightness temperature regions (LTR, coronal-hole like structures, coronal partings) of the solar corona as some expected source of the slow solar wind appeared some years ago. Some authors suggest that LTR are associated with the areas of the depressed emission in soft X-rays and in EUV lines, as well as with the open-field regions. The analysis of microwave spectral polarimetric observations performed with Ventspils International Radio Astronomy Center (VIRAC) RT-32 radio telescope, Metsahovi Radio Observatory (MRO) MRO-14 radio telescope and Nobeyama Radio Heliograph (NoRH) showed the close association of LTR depressed microwave emissions in the chromosphere and lower corona with the open magnetic field on the periphery of two active regions. The analysis of LTR long waves emission observations with LOFAR is necessary to reconstruct the open-field structure, to evaluate the plasma density and to prove the assumption about the coronal plasma flow along open magnetic field lines to outer space crossing all layers of the corona. LOFAR solar observations provide a sufficient spatial resolution and accuracy to complement the microwave solar observations. The presentation discusses possibilities and eventual results of a joint analysis of microwave and LOFAR solar observations in order to clarify LTR general structures.
Bonnassieux	Etienne	etienne.bonnassieux@obspm.fr	On the variation of radio interometic calibration: Quality-based	Authors : Etienne Bonnassieux, Cyril Tasse, Oleg Smirnov, Philippe Zarka. We propose visibility weighting schemes based on calibration quality, as determined by the corresponding residual visibilities.We show the analytical work leading to the proposed weighting schemes, and test their impact on both simulated residuals and real data. Simulation results are consistent with my analytical predictions, and applying the weighting scheme to real data improves dynamic range at negligible computational cost.
Botteon	Andrea	botteon@ira.inaf.it	LOFAR observation of the complex merger in Abell 1758	Diffuse radio emission in the intra-cluster medium (ICM) is observed in a number of merging galaxy clusters. Turbulence and shocks produced in the ICM can lead to the formation of steep synchrotron sources on Mpc scales known as radio halos and radio relics, respectively. In particular a key prediction of turbulent re-acceleration models is the existence of a large population of radio halos with very steep spectrum that should become visible at low radio frequencies. LOFAR for the first time allows to study cluster-scale emission at low frequency with unprecedented resolution and sensitivity. Abell 1758 is a galaxy cluster in a complex merger state. X-ray and SZ observations revealed the presence of two main cluster components, A1758N and A1758S, separated by 8 arcmin while literature radio data revealed the presence of a radio halo in the northern system A1758N. I will present the results from a LOFAR Tier 1 pointing on this cluster. The 150 MHz observation reveals the presence of a radio halo also in the southern A1758S system that is not detected with the GMRT at 330 MHz and with the VLA at 1.4 GHz. I will discuss the implications of the detection of this double radio halo for the models of particle acceleration in the ICM.
Byrne	Ruby	rlbyrne@uw.edu	Precision Foreground Modeling for Southern Hemisphere Epoch of Reionization Measurements	A successful detection of the signal from the Epoch of Reionization (EoR) will require the utmost precision in every step of the measurement process. One critical component of an EoR measurement is the foreground model, which is used for instrument calibration and foreground subtraction. Imprecisions and omissions in the foreground model quickly obscure the faint EoR signal, making a detection impossible. Foreground models for EoR experiments must include both point-like sources and diffuse emission. The Murchison Widefield Array (MWA) in Western Australia is uniquely suited to foreground modeling because of its wide field of view and excellent UV coverage. We present progress toward a fully-polarized precision foreground model of a large swath of the Southern sky based on a data set taken with the MWA in late 2015. This model will include diffuse emission and could benefit upcoming Southern Hemisphere EoR experiments.

Calistro Rivera	Gabriela	calistro@strw.leidenuniv.nl	The LOFAR window on SF galaxies and AGN –curved radio SEDs and IR-radio correlation at 0 < z < 2.5	I will present a study of the low-frequency radio properties of star forming (SF) galaxies and active galactic nuclei (AGN) up to redshift z = 2.5. The new spectral window probed by the Low Frequency Array (LOFAR) allows us to reconstruct the radio continuum emission from 150 MHz to 1.4 GHz to an unprecedented depth for a selected sample of 1542 galaxies in ~ 7 deg2 of the LOFAR Boötes field. Using the extensive multi-wavelength dataset available in Boötes and detailed modelling of the FIR to UV spectral energy distribution (SED), we are able to separate the star- formation and the AGN dominated populations. We study the shape of the radio SEDs of these two populations and their evolution across cosmic time. Our results reveal significant differences in the spectral curvature between the SF galaxy and AGN populations: while the radio spectra of SF galaxies exhibit a weak but statistically significant flattening at lower frequencies, AGN SEDs show a clear trend to become steeper towards lower frequencies. We also investigate the redshift evolution of the infrared-radio correlation (IRC) in SF galaxies and its consequences for the use of low frequency radio luminosity as a star formation rate (SFR) tracer at high redshift. We find a significant decrease in the ratio of total infrared to 1.4 GHz (q1.4) and to 150 MHz radio luminosities as a function of redshift. Calibration of the 150 MHz radio luminosity as a SFR tracer suggests that a single power-law extrapolation from q1.4 GHz is not an accurate approximation at all redshifts.
Brienza	Marisa	brienza@astron.nl	Revealing remnant radio galaxies in the Lockman Hole with LOFAR	In the study of radio galaxies, the phase after the jets have switched off, the remnant phase, is still very poorly understood and very few sources in this stage are known. Using LOFAR observations at 150 MHz, combined with public surveys at higher frequencies, we have performed an extensive search of remnant radio galaxies in the Lockman Hole region and we have identified 24 candidate sources. For the first time we have combined the classical ultra-steep spectrum criterion with morphological criteria for the selection. This helps us to identify remnants that cover the entire evolutionary sequence from when the core switches off to later stages of the evolution. Interestingly, we find that ultra-steep spectrum remnants represent only a fraction of our remnant sample, contrary to what classically suggested. This finding is also supported by the results that we have obtained from mock catalogues of radio galaxies. These were produced using Monte-Carlo simulations based on existing spectral and dynamical evolution models combined with observed source properties. We use these simulations to derive first order predictions of the fraction of remnants in radio flux limited samples, for comparison with our Lockman Hole sample. We find that, using appropriate dynamical models for the radio galaxy evolution, our simulations produce fractions of remnant sources consistent with observations. In this talk I summarize the results of our empirical search and simulations as well as I discuss our plan to expand this study to the entire LoTSS survey to enable a statistical investigation of the remnant properties over bigger samples.
Cau	Massimo	mcau@ira.inaf.it	Offset BCG-Xray Peak vs morphological parameters. JVLA observation of a high z MACS sample.	Morphological parameters are among the most powerful indicators of the dynamical state of galaxy clusters. Another simply but robust tool is represented by the BCG/Xray-Peak offset. Their comparison, lights the question "relaxed/non relaxed clusters" from another point of view. Is under JVLA investigation a wide sample of MACS high redshift galaxy clusters with the aim to improve the knowledge of diffuse radio emission at high z: first results of the imaging analysis.
Clarke	Tracy	tracy.clarke@nrl.navy.mil	Commensal Low Frequency Observing at the VLA: VLITE to LOBO	The VLA Low-band Ionosphere and Transient Experiment (VLITE) is a commensal low-frequency observing system that has been operational for the past two years on the NRAO VLA. The separate optical paths of the prime-focus sub-GHz dipole feeds and the Cassegrain-focus 1-50 GHz feeds allow both systems to operate simultaneously with separate correlators. The initial two years of VLITE operation provided real-time correlation of 10 antennas across the 320-384 MHz band with a total observing time approaching 12000 hours. We present an overview of the VLITE system, including highlights of the complexities of a commensal observing program, sparse-array challenges, and scientific capabilities from our science-ready data pipeline. Looking forward in the near term, we are enhancing the VLITE correlator to allow data recording during the upcoming rapid-scanning VLA Sky Survey (VLASS) that will operate for 5400 hours in the VLA B configurations starting in 2017. In addition, we are expanding VLITE during the summer of 2017 to double the number of baselines to improve the stability and image fidelity. In the longer term, we seek a path to broadband expansion across all VLA antennas to develop a powerful new LOw Band Observatory (LOBO).
Chen	Song	phychensong@gmail.com	Far Beyond Stacking in the Confusion Regime	Measuring radio source counts is critical for characterizing new extragalactic populations, brings a wealth of science within reach and will inform forecasts for SKA and its pathfinders. One way to push the counts to faint levels is via ‘stacking’, using the position information from another catalogue at higher resolution and (often) a different wavelength to extract the faint source flux. For the first time, we adopt the stacking method at the quasi-confusion limit. We cast stacking in a fully Bayesian framework, applying it to the Square Kilometre Array Design Study (SKADS) simulation. The previous studies showed the counts is highly biased when confusion comes into play. With our method, the source counts is recovered correctly after considering the confusion effect in stacking method. This method is extremely useful for the upcoming radio surveys to undertake panchromatic joint analyses.

D'Antonio	Daniele	giroletti@ira.inaf.it	The impact of low frequency observations on the study of blazars and other gamma-ray sources	Low-frequency radio arrays are opening a new window for the study of the sky, both to study new phenomena and to better characterise known source classes. Being flat-spectrum sources, blazars are so far poorly studied at low radio frequencies. We study the spectral properties of the blazar population at low radio frequency and compare the radio and high-energy properties of the gamma-ray blazar population. We first present the results of a cross-correlation of the Murchison Widefield Array Commissioning Survey (MWACS) catalogue with the Roma blazar catalogue and the the third catalogue of active galactic nuclei detected by Fermi-LAT: we find low-frequency counterparts for 186 out of 517 (36%) blazars, 79 out of 174 (45%) gamma-ray blazars, and 8 out of 73 (11%) gamma-ray blazar candidates. The mean low-frequency (120-180 MHz) blazar spectra are flatter than the rest of the population of low-frequency sources, but are steeper than at ~GHz frequencies. Low-frequency radio flux density and gamma-ray energy flux display a mildly significant and broadly scattered correlation. We further show the preliminary results of a similar study performed on the wider and deeper GaLactic and Extragalactic All-Sky MWA (GLEAM) survey and discuss how low frequency surveys can also be useful in the identification and characterisation of unassociated gamma-ray sources.
Dabhade	Pratik	pratikdabhade13@gmail.com	LoTSS of GRGs	Giant Radio Galaxies (GRGs) are the single largest objects known in the Universe. Their sizes extend from 0.5 Mpc to ~5 Mpc. They are born in the active nuclei at the galactic centre. The 'central engine' is a mass accreting supermassive black hole (SMBH) of mass 10^8 to 10^9 msun which is responsible for the ejection of the collimated, bipolar relativistic jets orthogonal to an accretion disc. Since the GRGs are known to extend to such large sizes, they are believed to be the last stop of radio galaxy evolution. Hence their study will help us impose important constraints on the various evolutionary models of radio galaxies. GRGs can serve as outstanding probes of the IGM via the relationship between morphology of a radio galaxy and the properties of surrounding material. GRGs can also transport enriched material from the host galaxy to large distances and pollute the IGM with non-thermal particles and magnetic fields. Low frequency surveys are ideal to search for new GRGs as the radio emission is least suppressed by spectral ageing effects in the extended radio lobes and is prone to detect more diffuse relic plasma from lobes of GRGs. We use the new LOFAR Two-metre Sky Survey (LoTSS) which is a deep 120-168 MHz imaging survey and its early data release provides images with unprecedented sensitivity (0.5 mJy) and resolution(~ 25"). This makes it ideal for GRG (re)search. We have found ~ 150 GRGs from the LoTSS, of which ~50 are above 1 Mpc in linear size and 4 are hosted by quasars with z >1. Work is currently ongoing to make a complete sample of GRGs from this survey area to perform various statistical tests. I shall be presenting methods employed in this work and above mentioned results in detail.
Dabrowski	Bartosz	bartosz.dabrowski@uwm.edu.pl	First solar observations with Polish LOFAR station in Baldy	Bartosz P. Dabrowski, A. Krankowski, Leszek Blaszkiewicz, Kacper Kotulak, Adam Fron, and Tomasz Sidorowicz First solar observations with Polish LOFAR station in Baldy The LOw-Frequency ARray (LOFAR) is a new radio interferometer covering the frequency range 10-240 MHz (corresponding to wavelengths of 30-1.2 m). Its scientific program is very broad. Important issues, between others, are solar and space weather investigations. Three new LOFAR stations were built in Poland in 2015 and have been operating since the beginning of 2016. One of them is located in Baldy village, about 20 km south from Olsztyn. At the end of 2016 we started solar and ionosphere scintillations spectroscopic observations. These topics are one of the main objectives for Baldy station research.
Dijkema	Tammo Jan	dijkema@astron.nl	DPPP: a framework for streaming radio interferometric pipelines	We present the Default Preprocessing Pipeline for LOFAR (DPPP), a pipeline framework that was designed for efficiently handling the large volumes of correlated radio interferometric data that LOFAR produces. It reads and writes standard Measurement Sets, so it also works (and has been used) with data from different radio telescopes. DPPP handles basic tasks like averaging and combining data, and more complicated ones like many variants of calibration. Custom steps can be added to DPPP. An example is the AOFlagger step, which is a wrapper around André Offringa's flagger. Other examples of steps are GainCal and ApplyCal. Also user defined python steps are possible. DPPP was developed at ASTRON by Ger van Diepen and Tammo Jan Dijkema.
Drabent	Alexander	alex@tls-tautenburg.de	The Corona Borealis supercluster seen with LOFAR	Superclusters are structures in the Universe with a high number of interacting galaxy clusters. We investigated the field of the Corona Borealis supercluster which interestingly shows another supercluster in the background, namely the Abell 2069 supercluster. The former consists of seven galaxy clusters at a redshift of 0.07 and the latter is located in the background at a redshift of 0.11. We present the results of the first deep low-frequency observation of this field, performed with the LOFAR HBA and complemented with WSRT and GMRT observations at 350 MHz and 610 MHz, respectively. We observe a radio halo and a radio relic in Abell 2061 as well as a radio halo in Abell 2065. Preliminary claims about the presence of these sources were already published, however our observations unveil them with unprecedented detail and allow us to measure their properties for the first time. The galaxy cluster Abell 2069 consists of two components. We report on the presence of diffuse radio emission in both components of Abell 2069, namely a radio halo in the main cluster component and an ultra-steep spectrum radio mini-halo with a high radio emissivity in the subcluster component. The presence of this radio mini-halo demonstrates that even in such a low X-ray environment a large population of highly relativistic electrons can be generated. However, its very steep spectrum suggests that the acceleration mechanism is poorly efficient.

Dumba	Cosmos	cosmos.dumba@yahoo.com	A LOFAR view of the galaxy cluster Abell 115	Abell 115 is a massive merging galaxy cluster. X-Ray studies revealed a double peak in the surface brightness and a cold front associated with northern subcluster. The northern subcluster hosts a very luminous, disturbed radio galaxy, 3C28. Govoni et al. (2001) discovered a moderately bright and extended diffuse radio source with a complex and puzzling morphology. We confirm this peculiar morphology with both the GMRT at 610MHz and the WSRT at 350MHz (Dumba et al. 2015). Unfortunately, the resolution in these observations does not permit to unambiguously disentangle 3C28 from a large part of the relic emission. Here, we present first results of the study of the diverse and fascinating radio sources in Abell 115 with LOFAR HBA. We will discuss, in particular, the morphology and spectral index of 3C28, a narrow angle tail galaxy close to the relic, J0056+26 and several other interesting, extended radio sources in the field. Furthermore, we present initial LOFAR results on the radio relic. The brightness of 3C28 and and its proximity to the relic necessitates a very high dynamic range imaging in order to recover the extended diffuse emission. We therefore discuss our strategies employed in order to achieve the necessary dynamic range.
Dyks	Jaroslaw	jinx@ncac.torun.pl	The origin of radio pulsar polarisation	Polarisation of radio pulsar profiles involves a number of poorly understood, but curious effects, such as the existence of comparable amounts of orthogonal polarisation modes (OPMs), strong distortions of polarisation angle (PA) curves into a form inconsistent with the rotating vector model (RVM), and the strong circular polarisation V which can be maximum (instead of zero) at the OPM jumps. It is shown that the existence of comparable OPMs and of the large V results from a coherent addition of phase-delayed waves in natural propagation modes, which are produced when a linearly polarised emitted signal propagates through the intervening medium on its way to reach the observer. The longitude-dependent flux ratio of observed OPMs can be understood as the result of backliting the intervening polarization basis by the emitted radiation. The coherent mode summation implies opposite polarisation properties to those well known for the incoherent case, in particular, the OPM jumps occur at peaks of V, whereas V changes sign at a maximum of the linear polarisation fraction L/I. These features are indispensable to interpret complex observed polarisation effects, such as the stepwise PA curve of PSR B1913+16 and the strong distortions of the PA curve within core components of pulsars B1933+16 and B1237+25. The inclusion of the coherent mode addition opens the possibility for a number of new polarisation effects, such as a replacement of relative modal strength, twin minima in L/I coincident with peaks in V, 45^\circ PA jumps in weakly polarised emission, and loop-shaped core PA distortions. The empirical treatment of the coherency of mode addition makes it possible to advance the understanding of pulsar polarisation beyond the RVM model.
Filothodoros	Alexandros	alexfilothodoros@gmail.com	Meterwavelength Single-pulse Polarimetric Emission Survey: Component Widths & Profile Classification	A detailed study of the structure of the pulsar profile as well as the individual profile components was conducted for the 123 pulsars observed in the Meterwavelength Single-pulse Polarimetric Emission Survey. Using the schemes developed by Rankin (1990, 1993a) we classified the profile morphology for all the pulsars in our sample. This resulted in 53 new classifications as well as 38 corrections. The different profile classes were associated with different physical parameters like, characteristic age, spin-down energy loss, etc. The availability of high quality single pulse data enabled us to separate the individual components of the profile in a large number of pulsars. We measured the 50% width of the components (W_50) and found the presence of a lower boundary line (LBL) for the distribution of W_50 with the pulsar period (P). We constrained the boundary line performing quantile regression which served as a more robust estimate, independent of any geometrical assumptions. We corroborated a P^(âˆ’0.5) dependence of the LBL for the individual components which was earlier reported for the overall profile width. In addition, we also established that the boundary was similar for both the core and conal components. However, our values for the boundary differed from previous studies, where the expected boundary was 2.45P^(âˆ’0.5) at 1 GHz, while our corresponding value was 2.01P^(âˆ’0.5). We also measured the separation between the adjacent components but these were not as well constrained as the component widths. The individual components are associated with the sparking process in the Inner Acceleration Region (IAR) of the pulsar magnetosphere. Our analysis demonstrates the sparks in the IAR to be more densely packed than previously assumed. Performing the same analysis in LOFAR frequencies will help us to investigate further the LBL because of the frequency to radius mapping.
Gelzinnis	Jacob	jakobg@tls-tautenburg.de	Simulations and surveys of radio relies: A joint analysis	Radio relics are sources of synchrotron emission found in downstream regions of galaxy cluster merger shocks. Diffusive shock accelleration paired with subsequent cooling has been considered as a comprehensive explanation for the origin of radio relics. Recent observational evidence is pointing to a more complex scenario. We present predictions from two large cosmological simulations (MUSIC-2 and Cosmic Web) on the radio relic findings of upcoming radio surveys. A novel approach is used to standardize and automate the extraction of the morphological features of radio relics. We first investigated how well these simulations agree with the NRAO VLA Sky Survey (NVSS). Our model reproduces the power, size, shape and alignment of radio relics with respect to their host clusters. Our analysis suggests a completeness of the NVSS relic sample of about 40% for fluxes above 10 mJy. In the simulations, we find a large number of marginally resolved radio gischt objects at redshifts >~ 0.4 that are not detected by current surveys. We predict that these objects with an extent of less than 1 arcmin can be identified with high resolution surveys like LOFAR-Tier I.

Gendron-Marsolais	Marie-Lou	marie-lou@ASTRO.UMontreal.CA	The low radio frequency view of the Perseus cluster	Accretion onto supermassive black holes creates powerful jets, which strongly perturb their environment, projecting relativistic particles on tens to hundreds of kpcs. When located in the center of a brightest cluster/group galaxy, they are believed to inject energy into the intracluster/group medium and to compensate its radiative losses. In this talk, I will review this mechanism, called mechanical AGN feedback, focusing on its radio signature. More specifically, I will present new results on multi-configuration observations of the Perseus cluster from the Karl G. Jansky Very Large Array (JVLA) at 230-470 MHz, probing the old particles population of the AGN outflows. These observations reveal a multitude of new structures associated with the “mini-halo” extending to hundreds of kpc in size, that seems to be influenced both by the AGN activity and by the sloshing motion of the cluster’ gas. In addition, it has a filamentary structure similar to that seen in radio relics found in merging clusters. These results illustrate the high-quality images that can be obtained with the new JVLA at low radio-frequencies."
Geyer	Marisa	marisa.geyer@gmail.com	Anomalous pulsar scattering at LOFAR frequencies	Scatter broadened pulsar signals carry information of their paths travelled through the ionized interstellar medium (ISM). These imprints are best studied at low frequencies where they are exaggerated. The LOFAR HBA band provides ideal datasets for such studies: offering broad bands at low frequencies. We introduce an improved forward fitting technique to analyse highly scatter broadened profiles. We study the scattering imprints of 13 pulsars with simple profile shapes, and find anomalously low scattering spectral indices (alpha values). Such low indices are likely due to either anisotropic scattering mechanisms or finite scattering screens. We discuss whether our data contains evidence for these. We revisit the empirical scattering time (tau) vs DM relation introduced by Bhat et al. 2004, showing how our results support a frequency dependence of alpha. Lastly we discuss ways of improving detailed ISM analysis at low frequencies.
Giovannini	Gabriele	ggiovann@ira.inaf.it	The mysterious giant radio source 0917+75	The radio source 0917+75 is an elongated diffuse emission located in a region away from rich clusters. It was studied in the past in the radio (VLA) and X-band. Despite of these data its origin and nature is not clear: it was suggested that this source could be a radio halo, a relic or a diffuse emission from a large scale filament. We present here new LOFAR radio data and unpublished VLA data in total intensity and polarization to discuss the origin and properties of this peculiar source.
Griessmeier	Jean-Mathias	jean-mathias.griessmeier@cnrs-orleans.fr	Interstellar medium studies below 200 MHz: LOFAR single stations and NenuFAR	International LOFAR stations, equipped with powerful backends, can be used as individual telescopes, and provide data sets complementary to those obtained with the LOFAR Core. Such "local mode" observations are particularly adapted to monitoring observations, where the advantage of having a high observing cadence (one observation per week) outweighs the reduced sensitivity of a single station when compared to the full array. With such observations, it is possible to monitor the temporal evolution of the pulsars' behaviour via its dispersion, scattering, intensity, and profile shape. We will present ongoing studies performed in the LOFAR high band (110-190 MHz), recent observations in the LOFAR low band (10-90 MHz), and plans for the upcoming NenuFAR telescope.
Gitti	Myriam	myriam.gitti@unibo.it	The low-frequency view of radio mini-halos	Diffuse radio emission has been observed in a number of cool-core clusters of galaxies in the form of a so-called `mini-halo' (MH), which surrounds the radio-loud AGN on scales comparable to that of the cooling region. The MH emission is believed to be truly generated from the intra-cluster medium and can be explained in the framework of leptonic models, which envision in situ particle re-acceleration by turbulence in the cool-core region. However, several fundamental questions about the physics of these sources are still unresolved, including the connection between MHs and gas dynamics of the hosting clusters. Obviously, one problem is the limited statistics that prevent us from drawing firm conclusions on the link between thermal and non-thermal phenomena in cool cores. In a recent pilot study (Gitti et al. 2015, AASKA) we showed that future radio surveys with SKA1 at ~1.4 GHz have the potential to detect hundreds of new MHs. In this contribution, we aim at extending the previous explorative study to investigate for the first time the low-frequency case. By considering the minimum flux detectable in radio surveys and exploiting the correlation between radio power and cooling flow power observed for known MH clusters, we estimate the detection limits achievable by future radio observational follow-up of X-ray cluster samples, such as HIFLUGCS, eROSITA and Athena. In particular, we show that future radio surveys with LOFAR and SKA1 at ~140 MHz have the potential to increase the number to >>1000 radio MHs, thus producing a breakthrough in the study of these sources. We further investigate the MH number distribution with redshift as a function of the cluster magnetic field, and discuss the essential role of the synergies of these radio surveys with future X-ray observations and theoretical studies in establishing the radio MH physical nature.
Grobler	Trienko	trienkog@gmail.com	A HERA-19 view of the sky	The HI Epoch of Reionization Array is a 350 dish, low frequency array planned to measure the redshifted 21-cm signal from the cosmic dawn throughout the epoch of reionization. With the first 19 dishes (HERA-19) already built at the Karoo site, I present a look at early data aimed to characterize the instrumental response and the sky seen by HERA-19.

Guidetti	Daria	guidetti@ira.inaf.it	AGN populations in GOODS-N through eMERGE ultra-deep JVLA observations	Multi-wavelength studies of deep radio fields show a composite population of star-forming galaxies, radio-quiet and radio-loud AGNs, with the formers dominating at the lowest flux densities (< 100 microJy). However, the exact mixture between these types of radio sources is still matter of debate. Assessing the faint AGN component in deep radio fields, will provide an important tool to understand the role of nuclear activity in distant galaxies and its possible co-evolution Â with star-formation processes. The most direct way to identify faint AGN-driven radio emission is the detection of embedded radio cores in the host galaxies, through ultra-deep, high resolution extinction free radio observations. This would open the perspective of studying the whole AGN population in the radio band, including the radio-quiet component traditionally selected at other wavelengths (opt/IR/X-ray). In my talk I will report about the e-MERLIN Galaxy Evolution Survey (eMERGE, PI: Muxlow), a legacy project which aims at undertaking a spatially-resolved study of AGN and star formation processes up to high redshift in a 30 arcmin diameter field in GOODS-N, through sub-microJy sms and sub-arcsec (50-500 mas) imaging at 1.4 and 5 GHz, using combined JVLA and eMERLIN observations. I will focus on the 5 GHz JVLA mosaic observations and catalogue of GOODS-N (94 sources), in the framework of the eMERGE project, and on the study of a larger sample of GOODS-N galaxies (300 objects) selected at 1.4 GHz, both to constrain the presence of AGN cores in moderate-to-high redshift (1<z<5) galaxies, via radio spectra-morphological analysis with the additional help of multi-wavelength information. Such kind of studies will be extended to much larger areas and deeper sensitivities with SKA.
Hajduk	Marcin	marcin.hajduk@uwm.edu.pl	Planetary Nebulae in Low Frequency Radio Surveys	We identified 49 planetary nebulae in interferometric radio surveys in the frequency range of 150-330 MHz. Nebular fluxes do not exceed the 1.4 GHz flux in this range in almost all cases. This indicates that observations below 1 GHz trace optically thick emission. Radio emission is dominated by free-free thermal emission of electrons. Radio spectra of selected objects are analysed in the range from 150-330 MHz up to 43 GHz. Spectral fits constrain electron temperature and emission measure in planetary nebulae.
Hale	Catherine	catherine.hale@physics.ox.ac.uk	Early Science with LOFAR Observations of the XMM-LSS field	Radio observations, especially at low frequencies, provide a unique window into the extragalactic universe. The lack of dust attenuation at these frequencies, as well as the ability to trace both Star Forming Galaxies and Active Galactic Nuclei out to high redshifts through their synchrotron emission, means we can use LOFAR observations to trace the evolution of galaxies. This allows greater understanding of the physical processes influencing their evolution. In this talk I shall present the imaging and early science from LOFAR observations of the XMM-LSS field. This field is challenging due to being at low declination (-4.5 degrees), and thus at low elevation to the LOFAR antennae. This has been a difficult field to image, but due to the wealth of multi-wavelength information available, it is an important field to study. I shall present information on the observations and the difficulties faced when reducing these data, before showing the final image of the field. I will then discuss the catalogue extracted from these observations as well as the interesting emission and sources that can be seen in this field at these low frequencies. I will then present early science that can done with this data (e.g. spectral indices, clustering and source properties), emphasising the importance of the complementary data at other wavelengths and the further uses of multi wavelength observations for understanding galaxy evolution.
Iacobelli	Marco	iacobelli@astron.nl	MSSS view of known diffuse emission from Clusters of Galaxies	Extended diffuse radio sources found in an increasing number of merging cluster of galaxies are not associated with any individual cluster galaxy but with the intracluster medium (ICM). The merger processes and the mass of the cluster seem to be relevant for their formation, evolution end energetic. These sources are the evidence of the presence on large scales in clusters, of magnetic fields. These objects, which signature is the low surface brightness, steep spectral index and large angular and linear scales, are ideal targets for LOFAR and low frequency studies in general. A sample of clusters known to host diffuse radio emission has been selected and analysed from re-reprocessed data of the Multifrequency Snapshot Sky Survey (MSSS). In this poster we will present preliminary results of the spectral index characterisation of this sample with respect to their position in the X-ray vs radio power plot.
Indermuehle	Balthasar	balt.indermuehle@csiro.au	RFI prediction and avoidance	Low frequency radio sites are susceptible to radio frequency interference (RFI) from a collection of man made interferers. To minimise their impact, low frequency observatories are often located away from populated areas. Even for these sites however, anomalous propagation of the “ducting” kind can lead to signals from far away population centres impinging on these otherwise radio quiet sites. Using customised instrumentation consisting of bespoke software and receivers, we have characterised the site of the Murchison Radio Observatory (MRO) in remote Western Australia (WA) during times when “ducting” was active. We describe the setup of the RFI system used to track all known emitters providing location information, including terrestrial mobile communications, aviation, rail, marine, and space based transmitters. We cross correlate these data with meteorological models and observational data derived from near real-time observations from the Japanese Himawari 8 satellite and use them to provide short term ducting predictions. We expose these predictions as a RESTful interface to any interested clients. Current telescopes such as the Australian Square Kilometre Array Pathfinder (ASKAP), which has now entered early science operations, as well as future telescopes such as the Square Kilometre Array (SKA), are able to use this information to integrate adaptive scheduling and prioritise observations that are least affected by the predicted conditions.

Jamrozy	Marek	marek.jamrozy@uj.edu.pl	Recurrent jet activity in radio galaxies	Maps of a sparse group of extragalactic radio sources show structures which differ significantly in spectral index and age. Various parts of these objects have been formed during different epochs of the central AGN activity, separated by inactive periods. An important feature of the objects with multiple cycles of activity is that the jets coming from the first cycle spread in the pristine dense interstellar and intergalactic medium, while those from the next cycle (or cycles) propagate in an environment significantly modified due to the primary jet interaction with the ambient medium. Accordingly, the evolution of radio structures depends not only on the primordial ambient medium conditions and the strength of the AGN but also on the activity recurrence. The group of known radio sources to show indications of recurrent jet activity phases are still not numerous, however, the phenomenon has rapidly gained interest. Thus, for understanding the evolution of AGNs multifrequency radio data on their extended structures are of crucial importance. The existing and planned modern radio interferometers provide ideal tools to search for and study AGN duty cycles. I am going to present a number of instances of recurrent activity radio galaxies along with a brief description of their physical parameters, comparing them to ordinary one-off radio galaxies.
Kozarev	Kamen	kkozarev@astro.bas.bg	Detailed Radio Imaging of a CME with the Murchison Widefield Array	Solar radio observations allow us to constrain the dynamics of high energy electron beams accelerated in both flares and coronal mass ejections (CME). In particular, the synchrotron emission from erupting flux ropes would give important information about the distributions of energetic electrons trapped in the cores of CMEs. The Murchison Widefield Array is particularly well-suited to imaging the Sun and solar transients at multiple frequency channels between 80 and 300 MHz. This instrument holds great promise for improving the status of direct CME radio imaging. We present high frequency and time resolution imaging observations of a CME, which occurred on November 4, 2015. The observations allow us to obtain detailed frequency spectra of the plasma and synchrotron emission. In addition, such observations provide independent information about the thermal electron density, as well as the evolution of the CME flux rope in its initial stages. The new observations demonstrate the capability of the MWA to contribute to the monitoring and detailed analysis of solar eruptions through its high sensitivity, high dynamic range radio imaging.
Krankowski	Andrzej	kand@uwm.edu.pl	Implementation of ILT dedicated regional ionosphere maps to the low frequency radio observations	The high spatial and temporal resolution ionospheric products dedicated to the International LOFAR Telescope (ILT) purposes are produced in a result of arrangements made during 2016 LOFAR Ionospheric Workshop in Warsaw. The main idea is to introduce product that would replace the currently used global maps with improvement of the accuracy. The proposed product is based on the total electron content map (TEC) adjusted to the operational area of the ILT (34N to 55N in latitude and 11W to 25E in longitude) with the resolution of 0.5 degree. As for temporal resolution, two types of products are introduced: ILTF - five minutes averaged map and ILTQ - fifteen minutes averaged map. Maps are generated using information about the total electron content from the GNSS observations performed by 126 EUREF Permanent Network (EPN) stations. Obtained TEC values are computed into corresponding vertical values and interpolated into target grid using natural neighbour interpolation technique. ILTF and ILTQ products' validity performs well when compared to the other GNSS-based ionospheric products and the radar altimeter JASON measurements and show noticeable accuracy improvement of the Faraday rotation observation with the LOFAR telescope. ILT IONEX files since 2012 are available via the dedicated ftp server.
Kuiack	Mark	m.j.kuiack@uva.nl	Searching for low frequency radio transients with AARTFAAC	The Amsterdam ASTRON Radio Transient Facility And Analysis Centre (AARTFAAC) is an add-on to the central 6 LOFAR stations. Built to create a real-time monitor for low-frequency radio transients, with the aim of triggering other observatories upon reliable detections. It does so by snapshot imaging the entire visible sky every second with a few 10s of arcmin resolution, and detections sensitivities of a few 10s of Jy/beam. AARTFAAC aims to search for the type of bright, low frequency radio transients previously discovered in archived LBA data by Stewart et al. 2016. We estimate that at current capabilities our system should be able to observe on the order of 3 of these events per 24 hours of observing. Furthermore our near real-time analysis capabilities will allow us to generate triggers for follow up observations with the full LOFAR array, and further multi-wavelength observations, with the hope of collecting data with higher spacial and spectral resolution, and sensitivity, to associate a potential progenitor or afterglow. I will report on the recent commissioning progress, which now allows us to generate science quality data for offline processing. Currently ~150 hours of archived data is being processed offline, which will improved the current limits on 1 second timescale low frequency radio transients by an order of magnitude in sky area and sensitivity. I will also report on the preliminary results of this transient survey and lessons learned, which will be applied to design and implement analysis and classification algorithms allowing AARTFAAC to achieve it's full automated real-time detect-and-trigger potential.
Kuznetsov	Alexey	a_kuzn@iszf.irk.ru	Fine spectral structures in a solar type IV radio burst observed with LOFAR	We present the first observations of a moving type IV solar radio burst with the LOw Frequency ARray (LOFAR). The burst was observed for about 2 hours on 20 June 2015 in the frequency range of 30-80 MHz with high spectral, temporal and spatial resolution. The dynamic spectrum consisted of multiple aperiodic short (~5 s) broadband pulses; the pulses had a distinctive “hockey-rod” shape with fast (and frequency-dependent) negative frequency drift. Radio imaging revealed a loop-like structure over the limb, with three dominant emission sources: two footpoints and the loop top. The brightness temperature was typically a few 10^8 K, but sometimes exceeded 10^{10} K; this suggests a plasma emission mechanism. We discuss the formation mechanism of the observed fine spectral structures; the emission characteristics seem to be affected strongly by the propagation effects.

Lal	Dharam	dharam@ncra.tifr.res.in	Dissecting Coma using upgraded GMRT: The importance of low-frequency data	The upgraded GMRT serves as a testbed to demonstrate wide band, wide field-of-view imaging at these low frequencies; an SKA pathfinder instrument is nearing completion and has begun operations. We conducted several test studies using phase II release of the uGMRT, and focus on understanding data quality, fidelity of new GMRT wide-band backend and challenges in uGMRT data reduction and analysis. Among several of these test studies, we would also present the detailed understanding of low radio frequency imaging with the upgraded GMRT of the Coma cluster, an important `laboratory' to study the role of cluster environment on the properties of the radio sources in the cluster that can be determined via their flux densities or their spectra. We discuss the importance of low-frequency, multi-wavelength radio imaging and the improvements that will be possible due to upgraded GMRT and the roles of Lofar and SKA.
Lewandowski	Wojciech	w.lewandowski@ia.uz.zgora.pl	Pulsar observations using the PL612 POLFAR station.	We present the first results of pulsar observations that were performed using the PL612 LOFAR station located in Bałdy, near Olsztyn, Poland. This station, governed by the University of Warmia and Mazury, is one of the three telescopes build in Poland by the POLFAR consortium. For the purpose of pulsar observations we use a software-based system that was modelled after the one developed by the members of GLOW consortium for the use with German LOFAR stations. The PL612 station is observing pulsars regularily since the autumn of 2016. First pulsar observational tests were also made using PL611 station in Łazy near Kraków. Using these telescopes we intend to study the properties of individual pulses from pulsars such as subpulse drifting or nulling and the properties of the average pulse such as moding. Pulsar observations will be also used to investigate the properties of interstellar medium, by studying the effects of interstellar scintillation and scattering. In this presentation we will show preliminary results concerning almost all of the above mentioned research aspects.
Linford	Justin	jlinford@gwu.edu	Searching for Radio Transients with VLITE	The VLA Low Band Ionosphere and Transient Experiment (VLITE) is a commensal low frequency system on the Karl G. Jansky Very Large Array (VLA). Because the VLA repeatedly observes certain areas for either calibration purposes (e.g., 3C286 & 3C48) or as part of deep imaging campaigns (e.g., CHILES), there are many opportunities to search for transient sources. Thanks to the tagging along with VLA observations, VLITE has access to a large swath of parameter space previously unavailable to transient searches, from minute to year timescales. We are utilizing the LOFAR Transient Pipeline to search for transient sources on multiple timescales with VLITE. We present early results from VLITE image plane transient searches.
Lonsdale	Colin	cjl@haystack.mit.edu	Astronomy experiments enabled by the RAPID array	The Radio Array of Portable Interferometric Detectors (RAPID) is a new imaging interferometer system developed at MIT Haystack Observatory in collaboration with the University of Cambridge in the UK, and JPL. It is unique in that each array element is fully self-contained, highly portable, solar powered, and requires no cabling. Essentially, each element is a miniaturized low-frequency VLBI station with an independent clock and recording system, that can be shipped to any desired location, then picked up and moved by hand; correlation is performed offline, allowing processing parameters to be fine-tuned in response to the observed behavior of target sources. The unparalleled flexibility of a RAPID array facilitates a wide variety of radio studies including a number of strong-signal astronomical applications. In this presentation, we focus on three such applications, specifically high time, spectral and angular resolution imaging of the quiet and active Sun, astrometric measurements of Jovian decametric radiation, and wideband high-precision mapping of the galactic background synchrotron radiation. The extraordinary scientific potential of the RAPID system for these experiments, driven by customized, detailed sampling of the relevant radiation field, is highlighted.
Mandal	Soumyajit	mandal@strw.leidenuniv.nl	LOFAR observations of the Lockman Hole field and the merging galaxy cluster ABELL 1914	The Low Frequency Array (LOFAR) is a powerful survey instrument and particularly sensitive to steep spectrum diffuse objects. LOFAR data processing is challenging due to the data volume and the ionosphere, which, at low frequencies, needs to be calibrated as a function of time and location. In this talk, I will present our ongoing work on the ~48 hours of LOFAR observation of the “Lockman hole” which is a well studied extra-galactic field with extensive multi-band ancillary data covering a wide range in frequency, essential for characterizing the physical and evolutionary properties of the various source populations detected in deep radio fields (mainly star-forming galaxies and AGNs). I will also present our work on the merging galaxy cluster Abell 1914 where we have analyzed LOFAR (150MHz), GMRT (325MHz and 610MHz), VLA (1.4GHz), CFHT and Chandra observations allowing us to: 1) Discover an ultra steep spectrum source (4C38.39; spectral index<-2) that is probably not part of the previously claimed radio halo, 2) Discover a new candidate radio relic, 3) Study the structure of the previously claimed radio halo, which appears unique as it does not trace the disturbed X-ray map. Using the deep, multi-frequency data available in the Lockman Hole, we will also be able detect ultra steep spectrum sources related with galaxy cluster mergers. One of our aims is to study the detailed astrophysical mechanisms that are responsible for creating extended ultra steep spectrum sources in galaxy clusters. We also aim to study the properties of the cluster’s non-thermal particles and magnetic fields.
Mechev	Alexandar	apmechev@strw.leidenuniv.nl	Distributed Processing of LOFAR Data	One of the goals of the LOFAR telescope is to conduct deep wide-field surveys. The LoTSS survey will observe 3100 fields, each of which needs to undergo several processing steps. In the span of five years, the total data produced will be close to 50 PB. These data rates require processing at locations with high-speed access to the archived data. To complete the LoTSS project, the processing software needs to be made portable and moved to high throughput clusters with a high bandwidth connection to the LTA. This work presents a framework that makes the LOFAR software portable, used to scale out LoTSS data reduction. Discussed are the high level details, implementation, data flow and results.

Michilli	Daniele	danielemichilli@gmail.com	LOTAAS searches for dispersed single pulses	LOTAAS (LOFAR Tied-Array All-sky Survey) is an ongoing survey for pulsars and fast radio transients. It represents the first SKA-Low-like pulsar survey, taking advantage of the flexibility of a phased-array telescope like LOFAR to observe 222 fields-of-view in the sky simultaneously, covering a total field of view of ~10 square degrees per pointing. In this talk, I will give an overview of LOTAAS operations, focusing on the search for bright single radio pulses. The large instantaneous sky coverage together with the 1-hr duration of each pointing allows for an unprecedentedly long dwell time, increasing our sensitivity to radio transients. A major challenge is the huge amount of false candidates generated, with several millions of detections per pointing. I will present the characteristics and early results of a machine learning classifier specifically developed to deal with these numbers. During its early operations, it discovered 5 new sources and it will be used extensively to process all the data from the survey in the near future. In the following talk, Chia Min Tan will present a parallel search for periodic signals, which led to the discovery of 50 new pulsars, already making LOTAAS one of the most successful low-frequency surveys ever performed.
Miyashita	Yoshimitsu	randallmiya@gmail.com	Performance test of QU-fitting in cosmic magnetism study	Cosmic magnetic field is ubiquitous in the universe and plays an important role in the understanding of the evolution and structure formation of astronomical objects. Also cosmic magnetism is one of the key sciences of the Square Kilometre Array and its precursors. In order to understand about the origin and evolution of the cosmic magnetic field, it is necessary to accurately draw the information of the cosmic magnetic field from the polarimetry such as the observation of synchrotron radio waves, and we use a method called Faraday tomography. Faraday tomography is a promising technique that constructs a Faraday spectrum representing a distribution of the polarized intensity and the cosmic magnetic field along the line of sight from the observed polarized intensity. According to this method, we can get the information about three-dimensional structure of not only the magnetic field strength but also thermal electrons and cosmic rays. Since all of the information is stored in the Faraday spectrum, we are studying to estimate the Faraday spectrum accurately from observed polarized intensity. One method for estimating the Faraday spectrum is called QU-fitting which is model fitting method. QU-fitting is performed in three steps as follows, the assumption of a model of the Faraday spectrum, comparing the model with the observation and the estimation of the best fit model parameters using Markov Chain Monte Carlo(MCMC) method, and an objective evaluation of the results using the information criterion called Akaike's Information Criterion(AIC) or Bayesian Information Criterion(BIC). In this study, we test a performance of the QU-fitting in the simple simulations and research how these criteria work as indicators of evaluation of QU-fitting.
Nikiel-Wroczyński,	Błażej	iwan@oa.uj.edu.pl	Combined low&high frequency observations of the Stephan's Quintet	In this poster the results from a multi-frequency observing campaign of the best known compact group, the Stephan's Quintet, are presented. Radio studies reveal presence of several radio-emitting entities, including a large-scale radio halo, signifying strong magnetic fields; a smaller part of the envelope contains intergalactic, regular magnetic fields. Most of these entities are visible at each of the studied frequencies in the range of 120 MHz to 8.35 GHz, allowing us to study their spectral energy distributions, yielding information about their spectral age.
Ocran	Emmanuel	ocran62@gmail.com	The nature of the faint low-frequency radio source population	We present a multiwavelength study into the nature of faint radio sources in a deep radio image with the Giant Meterwave Radio Telescope at 612 MHz covering 1.2 deg2 of the ELAIS N1 region. We detect 2800 sources above 50 μJy beam−1. By matching to multiwavelength data, we obtain a redshift estimate for 63 per cent, with 29 per cent based on spectroscopy. For 1526 of the sources with redshifts, we use radio and X-ray luminosity, optical spectroscopy, mid-infrared colours and 24 μm and IR to radio flux ratios to search for the presence of an active galactic nucleus (AGN). The analysis reveals a rapid change in the population as flux density decreases from∼500 μJy to ∼100 μJy. We find that 80.3 per cent of the objects show no evidence of AGN and have multiwavelength properties consistent with radio emission from star-forming galaxies (SFG). We classify 11.4 per cent as radio-quiet (RQ) AGN and the remaining 8.3 per cent as radio-loud (RL) AGN. The redshift of all populations extends to $z > 3$ with a median of ∼1. The median radio and far-IR luminosity increases systematically from SFG, to RQ AGN and RL AGN. The median 24μm for SFG, 0.89 ± 0.01, is slightly below that for RQ AGN, 1.05 ± 0.03, and both differ substantially from the value for RL AGN of -0.06 ± 0.07. However, SFG and RQ AGN show no significant difference in far-IR/radio ratios and have statistically indistinguishable star formation rates inferred from radio and far- IR luminosities. We conclude that radio emission from host galaxies of RQ AGN in this flux density regime results primarily from star formation activity.
Pajdosz	Urszula	urszula.pajdosz@gmail.com	Low-frequency observations of a hybrid blazar	Blazars constitute intriguing subclass of the active galactic nuclei. Their family includes BL Lacertae objects as well as flat-spectrum radio-loud quasars. These sources are characterized by rapid variation of the continuum and polarized flux, superluminar motions in their radio core and high energetic GeV and even TeV gamma-ray emission. High dynamic range radio imaging of BL Lac objects sometimes reveals the presence of a diffuse, extended radio emission with the integrated luminosity exceeding, in several cases, the FRI/FRII division. Among them, there is quite unique source - "mini blazar" which merges the properties of BL Lac and FSRQ. With the help of the NRAO VLA Sky Server and dedicated Giant Meterwave Radio Telescope observations, we have disclosed and investigated an extended structure of this hybrid object, which could be caused by a multiple jet activity of the central AGN.

Polderman	Irene	i.polderman@astro.ru.nl	Galactic Cosmic Ray Tomography with LOFAR LBA	In the low frequency radio regime, the Milky way emission is dominated by synchrotron radiation from low energy cosmic rays. By mapping this emission we will gain further knowledge of these cosmic rays. In this same low frequency regime, HII regions can be seen as absorption regions against the Galactic background radiation. By observing these regions with an interferometer we will be able to quantify the synchrotron emission being emitted behind the HII regions. Effectively, these HII regions divide the line of sight into multiple parts helping us gain dimensional information. Using dedicated LOFAR LBA observations we plan to significantly expand on the list of existing of lines of sight from literature and get better coverage of our galaxy. Combining all lines of sight gives us a map with the synchrotron emissivity in a large part of the Milky Way. From this map we can draw conclusions about the cosmic ray density by comparing it to different cosmic ray models.
Pommier	Mamta	mamtapan@gmail.com	Bright Cluster Galaxy and feedback in cool core clusters	Brightest Cluster Galaxies (BCGs) are the most luminous population of massive galaxies known within the cluster environment. Nearly all BCGs tend to show radio emission with radio jets varying in size from a few kpc to Mpc scale with various morphological and spectral details. At optical wavelengths many BCGs show ionised emission line (H-alpha) nebula with a range of different morphological structures and inner disc region with rotational velocities ranging from ~100 to several hundred km/s. In this paper we present a correlation between the disc and jet properties (alignment, radio power, rotational velocity, etc.) using the MSSS, GMRT, VLA and optical data on BCGs and discuss the impact of feedback and mergers in the cluster environment, in order understand the duty cycle (birth, evolution and death) of AGNs in cool core clusters.
Pupillo	Giuseppe	g.pupillo@ira.inaf.it	Experimental characterization and modelling of the antenna patterns of LOFAR	In April 2016, a joined Italian-Dutch team performed an experimental campaign at Exloo (The Netherlands) to characterize the electromagnetic responses of the Low Band Antennas (LBAs) and High Band Antennas (HBAs) of a LOFAR station. The main aim of the measurement campaign was to validate/improve the beam models for the LOFAR stations including mutual coupling, i.e. without assuming that all element beams are equal. The measurement was carried out by using a radio-frequency transmitter installed on an Unmanned Aerial Vehicle (UAV) flying over the LOFAR station. Specifically, for the LBAs and HBAs, several crosscuts and more advanced flight strategies have been made through multiple element beam patterns at different frequencies. Data analysis is still in progress, however these measurements already demonstrated that we can reliably measure individual elements and tiles in a station, for which the far field condition is satisfied, despite the fact that this condition is not satisfied for the full station. By means of properly verified and "tuned" simulations, we can infer an improved description of the station beam pattern. Finally, we will point out the very interesting behaviour in the LBA response at the dipole resonance frequency, around 57 MHz.
Roskowinski	Carole	carosko@gmail.com	Radio galaxies with LOFAR: relic emission from opposites scales	Divers in their age, scale and distance, the radio galaxies (RGs) are one of the imprints of the AGNs. One of the open questions regarding these objects is the phase of their activity. Because of their characteristic synchrotron emission, it is necessary to go to low frequencies in order to detect possible diffuse and extended emission. Indeed this emission would be the remaining of a previous activity, and, hence, show a steeper spectrum. New generation of radio telescopes such as LOFAR are thus extraordinary tools, which enable us to achieve our main goal and analyse different steps of RGs' evolution. Here we present our current work, which is focusing on the study of individual objects belonging to the two extremes of the RGs, with the principal use of this European radio interferometer. On one end, 4C33.33 is a member of the family of the oldest and biggest objects, the Giant RGs. Because of this expected very extended and faint emission, its mapping is still a challenge not only for the science case but also for the automated processing and imaging of the data. It is also demonstrating the possibility for users to contribute in the development of the reduction tools, as simultaneously learning to master them. On the other end, the most compact and youngest of RGs (CSS/GPS - such as 1159+4645 shown here) require the use of LOFAR European baselines to resolve them and to observe the older emission. Thus this work is a part of the current exhilarating difficulty to solve within the frame of an international collaboration; the extension of the LOFAR pipelines to all its stations
Savini	Federica	federica.savini@hs.uni-hamburg.de	Discovery of AGN radio remnants in galaxy groups with LOFAR	Radio remnant sources present steep spectra that make them ideal targets for low-frequency observations. Our aim is to search for radio remnant sources with the Low Frequency Array (LOFAR). We carried out an observation within the Tier-1 deep imaging LOFAR survey of the northern sky and used the facet calibration scheme to obtain an image with a sensitivity of 135 microJy/beam at 10.6"x6" resolution in the frequency range (120 - 168 MHz). We discovered an extended radio source located at center of the poor galaxy cluster MaxBCG J199.31832+51.72503. We reveal the presence of a central radio galaxy embedded in radio diffuse emission with a projected linear size of 630 kpc at z = 0.18095. We studied the spectral properties of different regions of the source deriving a low-frequency spectral index map Between LOFAR and GMRT images. GMRT images reach a sensitivity of 55 μJy/beam at 6"x4.8" resolution. The morphology of the central AGN in MaxBCG J199.31832+51.72503 and the derived spectral index map allow us to classify the source as a Fanaroff-Riley type II (FR-II) radio remnant, fading away after the ceasing of its activity phase.

Schwarz	Dominik	dschwarz@physik.uni-bielefeld.de	Do we understand the cosmic dipole?	The dipole of the cosmic microwave background defines a reference frame for cosmology. Is is assumed since its discovery that the CMB dipole is caused by the proper motion of the Solar system. This hypothesis leads to the prediction that the corresponding Doppler shifts and abberation effects are universal to all frequencies. Thus the CMB frame is assumed to be the comoving frame of freely falling Friedmann observers, which is essential in the analysis of many cosmological observables such as the Hubble diagram. As any fundamental hypothesis, also the proper motion hypothesis must be tested. We present results from a suite of cosmic radio dipole measurements based on public continuum catalogues across frequencies. We find that the cosmic radio dipole agrees with the direction of the CMB dipole within errors but has an excess in amplitude which increases with wavelength (at between 2 and 3 sigma). The limitations and consequences of our finding are discussed. [T. Siewert submitted a poster which will cover the more technical aspects of parameter estimation, cleaning and masking of catalogues etc.]
Sebastian	Biny	biny@ncra.tifr.res.in	GMRT study of candidate X-shaped radio galaxies	The nature of X-shaped radio galaxies is a matter of considerable debate in the literature: Lal & Rao 2005 showed that the low-surface-brightness wings have flatter radio spectral index than the active lobes in 3C223.1, an X-shaped source, which is not compatible with any of the currently accepted models for their formation. The statistical understanding of nature of these sources is a must in order to investigate in detail the mechanism of the formation of X-shaped sources and hence we undertook a study of a large sample of (candidate) X-shaped sources gleaned from the VLA FIRST survey images using GMRT. Here, we present our preliminary results including GMRT images, spectral structure, etc.
Shulevski	Aleksandar	shulevski@astron.nl	AGN radio relics hosted by multi-core galaxies	Low frequency images of the radio sky are an ideal data set to search for remnants of AGN activity. I will describe the initial results of a search performed in the vicinity of massive multi core cluster galaxies using the LoTSS survey and discuss why these systems provide an ideal case for timing AGN duty cycles.
Siewert	Thilo	t.siewert@physik.uni-bielefeld.de	Estimation of the cosmic radio dipole	Continuum surveys can provide suitable data for the analysis of the cosmic radio dipole. We compare different linear and quadratic estimators, as well as estimators in real and spherical harmonic space. Furthermore we present a optimized routine of masking surface density maps, which is needed to handle foreground contaminations and observational artefacts. We present results of a multi-frequency analysis, based on NVSS, WENSS and TGSS. We find evidence for an unexpectedly increasing dipole at larger wavelengths and discuss the consequences of our results for cosmological models.
Skrzypczak	Anna	hera_ania@o2.pl	Meterwavelength Single-pulse Polarimetric Emission Survey: Component Widths & Profile Classification	A detailed study of the structure of the pulsar profile as well as the individual profile components was conducted for the 123 pulsars observed in the Meterwavelength Single-pulse Polarimetric Emission Survey. Using the schemes developed by Rankin (1990, 1993a) we classified the profile morphology for all the pulsars in our sample. This resulted in 53 new classifications as well as 38 corrections. The different profile classes were associated with different physical parameters like, characteristic age, spin-down energy loss, etc. The availability of high quality single pulse data enabled us to separate the individual components of the profile in a large number of pulsars. We measured the 50% width of the components (W_50) and found the presence of a lower boundary line (LBL) for the distribution of W_50 with the pulsar period (P). We constrained the boundary line performing quantile regression which served as a more robust estimate, independent of any geometrical assumptions. We corroborated a P^(−0.5) dependence of the LBL for the individual components which was earlier reported for the overall profile width. In addition, we also established that the boundary was similar for both the core and conal components. However, our values for the boundary differed from previous studies, where the expected boundary was 2.45P^(−0.5) at 1 GHz, while our corresponding value was 2.01P^(−0.5). We also measured the separation between the adjacent components but these were not as well constrained as the component widths. The individual components are associated with the sparking process in the Inner Acceleration Region (IAR) of the pulsar magnetosphere. Our analysis demonstrates the sparks in the IAR to be more densely packed than previously assumed. Performing the same analysis in LOFAR frequencies will help us to investigate further the LBL because of the frequency to radius mapping.
Ter Veen	Sander	veen@astron.nl	Localising Fast Radio Bursts with LOFAR	Fast Radio Bursts (FRBs) are highly dispersed pulses, and therefore likely of extra-galactic origin, that have been discovered in recent years. For only one source an accurate position and redshift has been determined, proving this extra-galactic origin. This redshift is required for good energy estimates and to use the FRB as a probe to study intergalactic matter. Typically, FRBs are discovered by a single dish telescope offering poor resolution and thus not enabling us to find an association with a host galaxy. In this contribution I will explain how the Low Frequency Array (LOFAR) can be used to localise sources, even for one-off events, by immediate follow-up of self-triggered events or by events found by Effelsberg and APERTIF. I will also present results from a real-time Fast Radio Transient Search (FRATS) with LOFAR and discuss the expectations for low frequency detectability of FRBs.
Toribio	MCarmen	toribio@strw.leidenuniv.nl	Radio Recombination Lines from M82 with LOFAR	Radio Recombination Lines (RRLs) have been detected in LOFAR observations of M82. The first detection in the LBA frequency range (Morabito et al. 2014) complemented with our results using the High Band Antennae provide us with constraints on the physical properties of the cold gas component of the interstellar medium of this nearby galaxy.

Varenius	Eskil	eskil.varenius@chalmers.se	Subsecond international LOFAR observations of nearby starburst galaxies at 150 MHz	We present new subarcsecond images of the galaxies Arp 299 and NGC4194 made with the International LOFAR telescope at 150MHz. The main aim is to study in detail the structure of the low frequency radio emission from both AGN and star forming regions in these galaxies. The high spatial resolution allows us to separate compact emission from e.g AGN core and SNe from extended halos and outflows, and to study the structure of free-free absorption in the galaxy nuclei. We compare these new preliminary images with previously published subarcsecond LOFAR images of the nearby star forming galaxies M82 and Arp 220.
Vocks	Christian	cvocks@aip.de	Interpretation of low-frequency images of the solar corona	The solar corona is the hot, tenuous outer atmosphere of the Sun. It is highly structured due to coronal magnetic fields, but generally shows a barometric density profile along magnetic fields, for altitudes well below the sonic critical point that marks the transition towards the supersonic solar wind. If the Sun is observed at a given radio frequency, then the corona becomes opaque below the density level where that frequency corresponds to the local plasma frequency, that is a function of electron density only. LOFAR's frequency range corresponds to the middle (high band) and upper (low band) corona. Since the refractive index of a plasma approaches zero for radio waves near the local plasma frequency, refraction effects become important. A ray path through the solar corona shows total reflectance and cannot connect a source that is located near the solar limb and at such a coronal height, where the wave frequency equals the local plasma frequency, with an observer on Earth. This has important consequences on the appearance of the low-frequency radio Sun under quiet conditions. The diameter of the radio Sun increases with decreasing frequency, as expected from the relationship between electron density and plasma frequency. But it does not appear as a disk with constant brightness temperature, even for an isothermal corona. So deriving the radius of the radio Sun requires fitting of observed intensity profiles to ray-tracing simulations, based on free-free radio wave emission and absorption, as well as refraction. These simulations also depend on the plasma conditions above that radius. LOFAR's capability of simultaneously observing a broad frequency range enables the derivation of a consistent coronal density model. We'll present results for polar coronal density and temperature profiles based on LOFAR low band images.
West	Jennifer	jennifer.west@dunlap.utoronto.ca	Cygnus loop: probing the two remnant scenario	The Cygnus Loop is a well-studied supernova remnant (SNR) that has been observed across the electromagnetic spectrum, however existing low frequency observations are very low resolution. Although widely believed to be an SNR shell with a blow-out region in the south, we are considering the possibility that this object is two distinct but interacting SNRs. This interpretation is motivated by large differences in observed polarization properties across the SNR. We believe that these differences imply differences in age and/or explosion environment. LOFAR data will provide a critical information that can help disentangle the thermal and synchrotron radiation components. In addition the possibility of detecting LOFAR polarization is very exciting.
Zucca	Pietro	pietrozucca83@gmail.com	Kinematics and shock locations of a spatial resolved solar type II radio burst with LOFAR.	Type II radio bursts are evidence of shocks in the solar atmosphere emitting radio waves ranging from metric to kilometric lengths. These shocks may be associated with coronal mass ejections (CMEs) reaching super-Alfv enic speeds. Radio imaging of the decameter wavelengths is now possible with the Low Frequency Array (LOFAR), opening a new radio window to study coronal radio shocks leaving the inner solar corona and entering the interplanetary medium and understand their association with CMEs. Here, we study a coronal shock associated with a CME and type II radio burst to determine the location where the shock is triggered in relation to the propagating CME, the ambient medium Alfv en speed and the orientation of the coronal magnetic field. The type II shock imaging and spectra were obtained using 91 simultaneous tied-array beams of LOFAR while the CME was observed by the Large Angle and Spectrometric Coronagraph (LASCO) on board the Solar and Heliospheric Observatory (SOHO). Using the tied array beam observing mode of LOFAR we were able to locate the type II radio shock position between 45 and 75 MHz and relate it to the expanding flank of a CME leaving the inner corona. The radio emission associated with the type II shock was found to be located at the flank of the CME in a region where the mach number is between 1.5 to 2.0 and the shock geometry is quasi-perpendicular.