NenuFAR: status and prospects for 21-cm observations

Rapport sur les contributions

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ID de Contribution: **0** Type: **Non spécifié**

Prospects for EoR and cosmic dawn observations with NenuFAR

lundi 30 mars 2015 14:15 (40 minutes)

The redshifted 21-cm signal of neutral hydrogen, which at every cosmic epoch is strongly correlated to the state of the intergalactic medium and the intensity of radiative backgrounds, is expected to be a unique probe of the Universe at early times. In this talk I will, first, set up the stage, discussing the properties of the signal from the key cosmological epochs, which includes the Dark Ages, Cosmic Dawn and the first half of the Epoch of Reionization. I will then discuss the prospects for observing this signal with NenuFAR, a facility which has the potential to detect the 21-cm signal from the early Universe ($16 < z < 45$) for the very first time.

Auteur principal: FIALKOV, Anastasia (ENS)

Orateur: FIALKOV, Anastasia (ENS)

ID de Contribution: **1** Type: **Non spécifié**

Calibration and imaging issues for the LOFAR surveys

lundi 30 mars 2015 16:25 (40 minutes)

I will present the current state of calibration and imaging techniques for LOFAR, and in particular for the extragalactic surveys Key Science Project. I will focus the discourse on the algorithms relevent to NenuFAR Dark Ages project.

Auteur principal: Dr TASSE, Cyril (Observatoire de Paris)

Orateur: Dr TASSE, Cyril (Observatoire de Paris)

ID de Contribution: **2** Type: **Non spécifié**

Visibility based angular power spectrum estimation in low frequency radio interferometric observations

lundi 30 mars 2015 17:05 (40 minutes)

We present two estimators to quantify the angular power spectrum of the sky signal directly from the visibilities measured in radio interferometric observations. This is relevant for both the foregrounds and the cosmological 21-cm signal buried therein. The discussion here is restricted to the Galactic synchrotron radiation, the most dominant foreground component after point source removal. The Bare Estimator uses pairwise correlations of the measured visibilities, while the Tapered Gridded Estimator uses the visibilities after gridding in the uv plane. The former is very precise, but computationally expensive for large data. The latter has a lower precision, but takes less computation time which is proportional to the data volume. The latter also allows tapering of the sky response leading to sidelobe suppression, an useful ingredient for foreground removal. Both estimators avoid the positive bias that arises due to the system noise. We propose the tapered gridded estimator as an effectively tool to observationaly quantify both foregrounds and cosmological 21-cm signal.

Auteur principal: Dr GHOSH, Abhik (Kapteyn Astronomical Institute)

Orateur: Dr GHOSH, Abhik (Kapteyn Astronomical Institute)

ID de Contribution: **3** Type: **Non spécifié**

Status and characteristics of NenuFAR

lundi 30 mars 2015 10:05 (40 minutes)

While the construcion of NenuFAR is based on the design study carried during an ANR project 2009-2013 and the thesis of J. Girard (2013), it is also characterized by an agile management that allows evolution of the details of the concept at all stages. Recent developments include a few additional mini-arrays of 19 antennas located far from the compact (400m diameter) core, up to ~2 km distance, and a full correlator that will be fed by the data digitized by the dedicated backend. This will considerably reduce the confusion of the images and reinforce the imaging cpabilities of the instrument. The status of the construction of NenuFAR and the prospects for the continuation of the project will be summarized.

Auteur principal: Dr ZARKA, Philippe (Observatoire de Paris, MEUDON)

Orateur: Dr ZARKA, Philippe (Observatoire de Paris, MEUDON)

ID de Contribution: **4** Type: **Non spécifié**

Challenges and Requirements to Observe the Cosmic Dawn with NenuFar

lundi 30 mars 2015 10:45 (40 minutes)

I will discuss the technical and processing requirements necessary for a successful detection of the redshifted 21-cm signal of neutral hydrogen during the Cosmic Dawn with NenuFar, as well as other challenges that need to be overcome such as low-frequency wide-field ionospheric scintillation.

Auteur principal: Prof. KOOPMANS, Leon (Kapteyn Astronomical Institute)

Orateur: Prof. KOOPMANS, Leon (Kapteyn Astronomical Institute)

ID de Contribution: **5** Type: **Non spécifié**

Bayesian semi-blind foreground removal for interferometric 21cm observations

lundi 30 mars 2015 11:45 (40 minutes)

We present a new Bayesian semi-blind approach for foreground removal in observations of the 21-cm signal with interferometers. The technique, which we call HIEMICA (HI Expectation-Maximization Independent Component Analysis), is an extension of the Independent Component Analysis (ICA) technique developed for two-dimensional (2D) CMB maps to three-dimensional (3D)
21-cm cosmological signals measured by interferometers. This technique provides a fully Bayesian inference of power spectra and maps and separates the foregrounds from signal based on the diversity
of their power spectra and frequency dependence. Only relying on the statistical independence of the components, this approach
can jointly estimate the 3D power spectrum of the 21-cm signal, the 2D angular power spectrum and the frequency dependence of each foreground component, with very mild prior assumptions about foregrounds. This approach has been tested extensively by applying it to mock data from interferometric 21-cm intensity mapping observations, demonstrating much better performance for power spectrum recovery
over all scales than the commonly used Principal Component Analysis (PCA).

Auteurs principaux: Prof. WANDELT, Benjamin (IAP, UPMC); Dr ZHANG, Le (University of Wisconsin, Madison)

Co-auteurs: Prof. KOROTKOV, Andrei (Brown); Dr KARAKCI, Ata (APC); Prof. BUNN, Emory (University of Richmond); Prof. TUCKER, Gregory (Brown); Dr SUTTER, Paul (Trieste); Prof. TIMBIE, Peter (U. Wisconsin, Madison)

Orateur: Prof. WANDELT, Benjamin (IAP, UPMC)

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The 21 cm forest

lundi 30 mars 2015 14:55 (40 minutes)

Detecting the 21 cm signal from the EoR not in absorption/emission against the CMB but in absorption against a bright background radio sources (radio-loud QSO) removes many observational difficulties such as foreground removal. It has the potential to probe much smaller scales than 21 cm tomography. Consequently it requires a more detailed modeling.

I will present simulation results that show how the predicted 21cm optical depth is sensitive to a number of processes such as X-ray self-shielding, Ly-alpha self-shielding, and gravitational (shock) heating, that have been ignored or unresolved until now. I will also present
rough evaluations of the detectability of the 21cm forest using SKA, LOFAR and NENUFAR, and conclude that detection with NENUFAR would
require very favorable (unlikely ?) circumstances.

Auteur principal: Dr SEMELIN, benoit (LERMA)

Orateur: Dr SEMELIN, benoit (LERMA)