

The NenuFAR pulsar blind survey: observations, expectations, and data processing

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Pulsars are rapidly rotating neutron stars with a very high surface magnetic field. This magnetic field produces a coherent emission which is, due to the angle between the rotation and magnetic axes, emitted towards Earth as a periodic pulsation. This emission is continuous in radio, with an increasing flux towards low frequencies. However, it appears that at least an important part of the pulsars show a spectral turnover at around 100 MHz.

NenuFAR is a phased array radio telescope located in Nançay which can, with a bandwidth from 10 to 85 MHz, observe this turnover. The NenuFAR pulsar blind survey is a program whose objective is to observe the entire sky above 39° of declination in the bandwidth 39 – 77 MHz. The aim is to find new pulsars, especially close to the Earth with a dispersion measure less than 70 pc/cm^3 . We expect to find pulsars with relatively long periods (between about 100 ms and 30 s), and/or steep spectra.

We have performed simulations based on a modified version of the software PsrPopPy, taking into account of the turnover. These simulations give an estimation of 70 ± 8 detections with a handful of discoveries (new pulsars). However, according to the LOTAAS results, the population of slow pulsar geometrically visible probably is currently underestimated. We try to estimate this effect and improve the predictions.

Observations have begun in August 2020, and 84% of the 7 692 pointings have already been observed. The processing of data has started (14% done), using a custom processing pipeline based on the pulsar search software PRESTO. The observation setup was validated in two steps. The first step consisted in detecting pulsars already seen by the NenuFAR pulsar census using a targeted search. For the second step, we use the blind detections of known pulsars in blind survey pointings, which allows to validate the sensitivity of the dispersion measure and period search in the detection pipeline.