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WIBAR: a wide band spectrometer for the Nançay Radio Telescope

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1 Extended Abstract

We have designed a new versatile spectrometer for the french decimetric Nançay Radio Telescope (NRT) and its cryogenic receivers to carry out observations with much improved efficiency. Indeed, the science programs carried out at the NRT over the past years have shown the need for one or several of the following specifications :

- broad band acquisition, to explore the full range of frequencies between 1.0 and 3.4 GHz.
- large number of spectral channels and high spectral resolution.
- high dynamic range to allow sensitive radio observations amidst strong narrow band transmitters
- high time resolution down to sub-millisecond.
- implementation of RFI mitigation techniques.
- real-time Stokes parameters.

The WIBAR receiver is connected to the intermediate frequency output of the NRT hederodyne receiver, which covers the frequency band 0–550 MHz. After direct analog to digital conversion of the whole input band (without using numerous contiguous narrower sub-bands), the digital 8-bits data are sent to 4 PCs equipped with GPU devices which perform on-the-fly Fast Fourier Transforms (2^{16} to 2^{26} channels), and several additional calculations like:

- calculation of the spectral correlation of the two input channels (with orthogonal linearly polarized feeds), for subsequent full Stokes parameters determination.
- selectable time/frequency integration.
- integration of subsequent power spectra.
- mitigation of radio interferences.

The data are transferred on-the-fly to two backend computers which can perform off-line automated post-processing procedures and algorithms The WIBAR data processing is performed in 2 or 3 steps, depending on the selected observation mode, and using one of the dedicated real-time executable programs chosen by the user. Dedicated real-time and automatic off-line algorithms will be made available to NRT users, but the WIBAR software architecture can accept other specific or experimental real-time and off-line post-processing programs.

In particular, RFI mitigation techniques can be implemented in real time (at the GPU level), while more complex ones can be performed off-line using either waveforms or spectral data at high time resolution. Sigma-clipped filtering algorithms are already implemented in the post-processing software and a dedicated software package which makes use of robust statistics methods.

We will present the status of the project, and some recent results to illustrate the capabilities of the WIBAR spectrometer in various fields of research in radio astronomy.