NenuFAR observations and low frequency polarisation

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Introduction: NenuFAR / LOFAR (FR606) Nançay

NenuFAR 10-85 MHz

NenuFAR (New Extension in Nançay Upgrading loFAR)
« In construction »
- 96 groups of 19 antennas

LOFAR (FR606)
- 96 HBA and 96 LBA antennas

LOFAR FR606 in Nancay (jun 2015)

LOFAR HBA 110-240 MHz

LOFAR LBA 10-90 MHz
in practice 30-80 MHz
NenuFAR (New Extension in Nançay Upgrading IoFAR) « In construction »

- 96 groups of 19 antennas
  - 72 already funded
  - 56 already operational

Nançay mini-array status
NenuFAR and polarisation

- Two pair of petals per antenna for both polarisations

- « NW-SE » pol
- « NE-SW » pol
Radio wave

- A radio wave is a coupling between: oscillating electric field and an orthogonal magnetic field.

- The polarisation of this electromagnetic wave is the projection of the electric oscillation in the polarisation plan.
NenuFAR and polarization

- **NW-SE** is sensitive to Ex oscillations
- **NE-SW** is sensitive to Ey oscillations
Polarisation

Ey

Ex

Linear  Circular  Elliptical
The first observation of pulsar

First pulsar discovered at 81.5 MHz (Hewish et al. 1968).

Jocelyn Bell, 1968

The IPS array (Interplanetary Scintillation Array) near Cambridge
Introduction: Pulsars

- Rapidly rotating neutron star of \(~1.4\, M\odot\) for a diameter of 20 km.
- Synchrotron Radiation from the magnetic poles.
  - generating a radio beam

Diagram of a pulsar Handbook of Pulsar Astronomy
D.Lorimer & M.Kramer.
Pulsar and polarisation

Pulsars can be polarised

A pulsar can have:

- Linear polarisation
- Circular polarisation
- No polarisation
- Usually it is a mix of all
- Random polarisation between wave packets
Faraday rotation

- Linear polarisation can be decomposed in a right and left circular polarisation.
- B// introduce a difference on the conductivity seen by both circular polarisation.
- As a result of the differential in speed, the plane of polarisation is rotated.

\[ \beta = \text{RM} \lambda^2 \]

Rotating angle

Rotation Measure
Faraday rotation

Faraday rotation

- linear polarisation can be decomposed in a right and left circular polarisation.
- B// introduce a difference on the conductivity seen by both circular polarisation.

As a result of the differential increased, the plane of polarisation is rotated.

β = RM \lambda^2

!! WARNING: low frequency
Faraday rotation and low frequency

Faraday rotation

High frequency observation with RM = 100 rad.m$^{-2}$
Faraday rotation and low frequency

Faraday rotation

High frequency observation with RM = 100 rad.m$^{-2}$

Low frequency observation with RM = 1 rad.m$^{-2}$
NenuFAR and polarisation
NenuFAR / LOFAR (FR606) Rotation Measure

FR606

NenuFAR

Mark Brionne (Ipc2e internship)
NenuFAR: Workshop

- 18-20.3.2019 @ Nançay
- https://nenufar2019.sciencesconf.org/program
- KP proposals
- data analysis tools, ...