NenuFAR observations and low frequency polarisation

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Introduction: NenuFAR / LOFAR (FR606) Nançay

NenuFAR 10-85 MHz

LOFAR FR606 in Nancay (jun 2015)

NenuFAR (New Extension in Nançay Upgrading loFAR)
« In construction »

- 96 groups of 19 antennas

LOFAR (FR606)

- 96 HBA and 96 LBA antennas

LOFAR HBA 110-240 MHz

LOFAR LBA 10-90 MHz
in practice 30-80 MHz

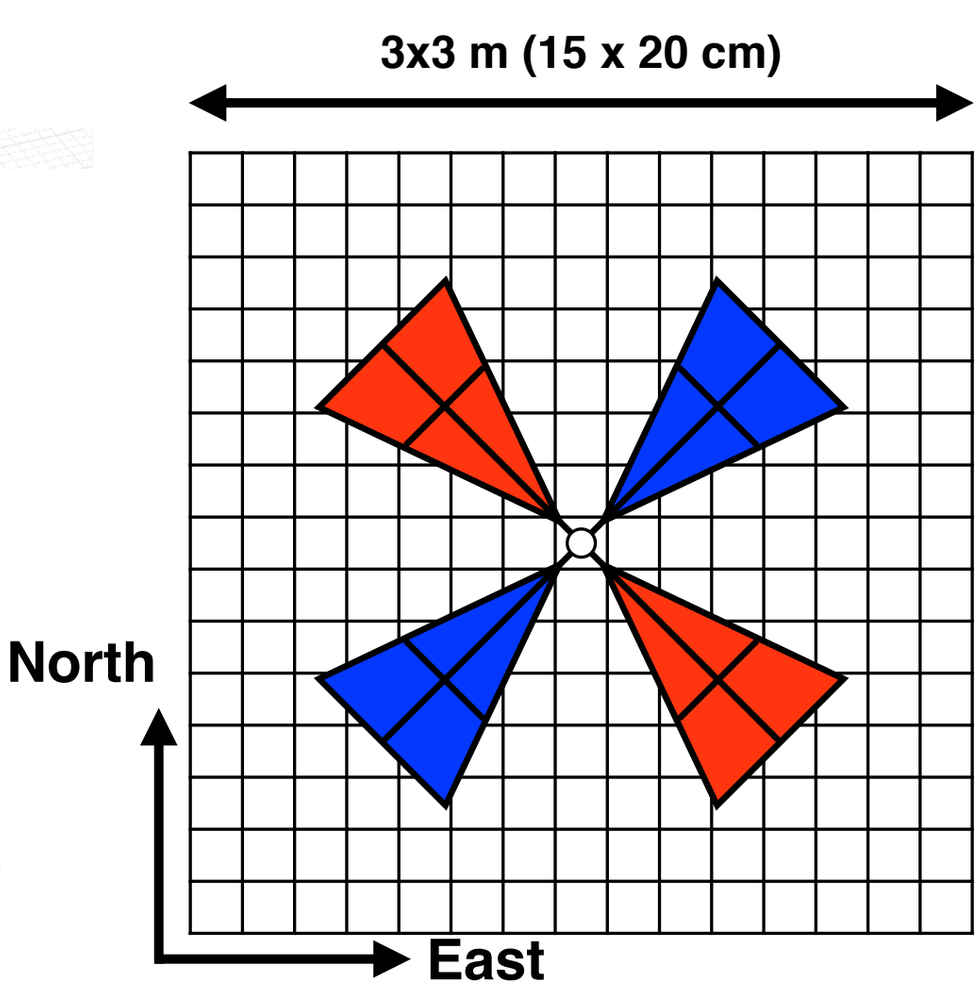
Introduction: NenuFAR

Nançay mini-array status

NenuFAR (New Extension in Nançay Upgrading loFAR)
« In construction »

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

NenuFAR and polarisation

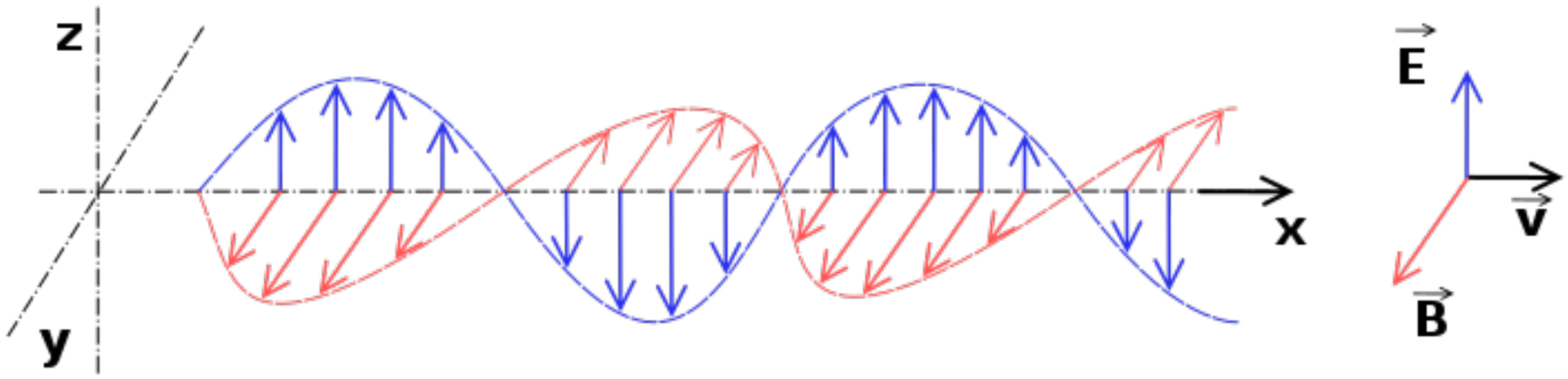


« NW-SE » pol

« NE-SW » pol

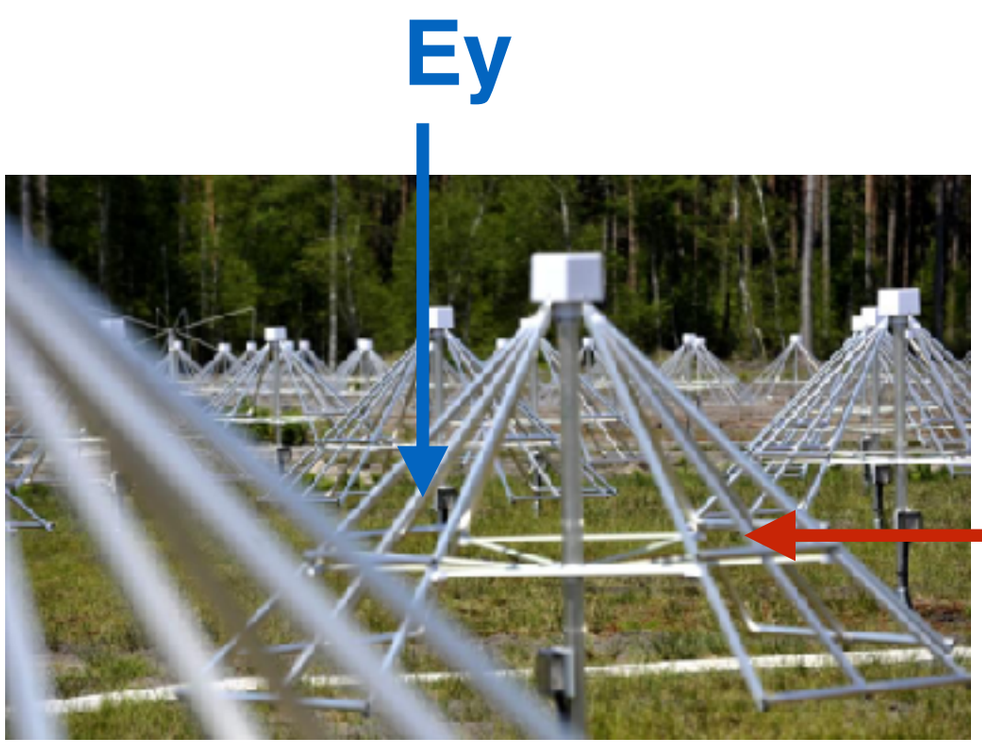
- Two pair of petals per antenna for both polarisations

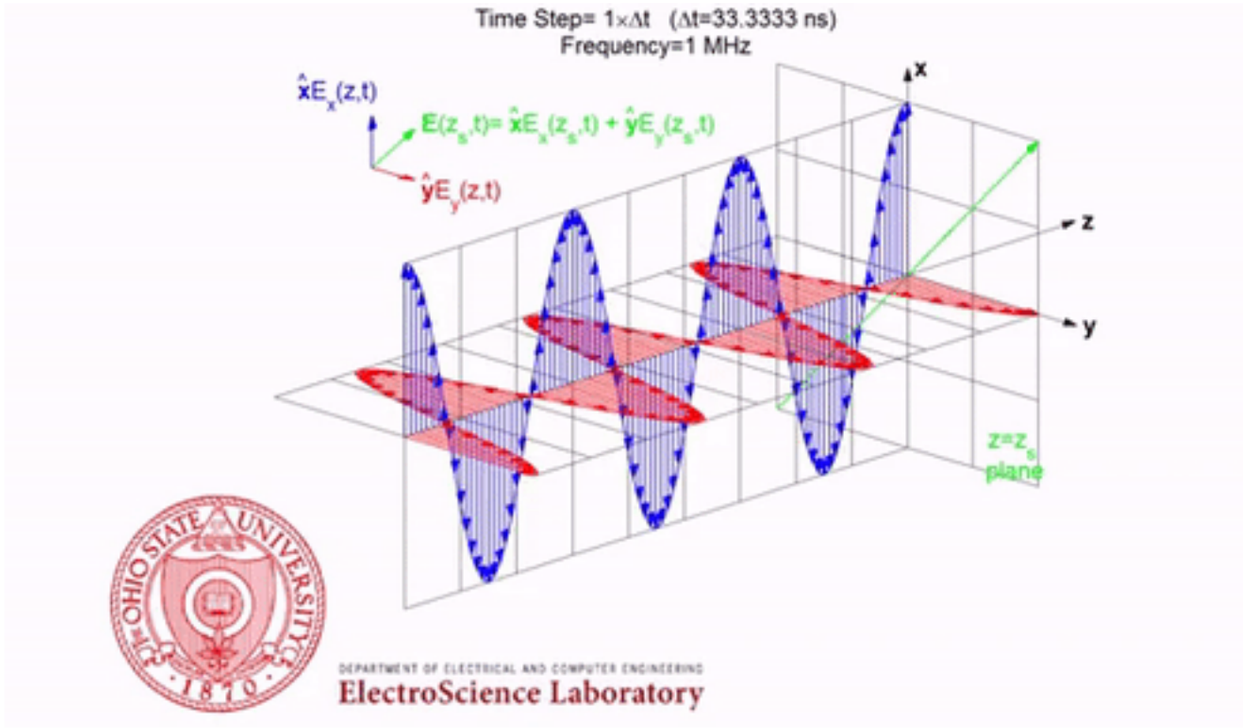
Radio wave



- 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.

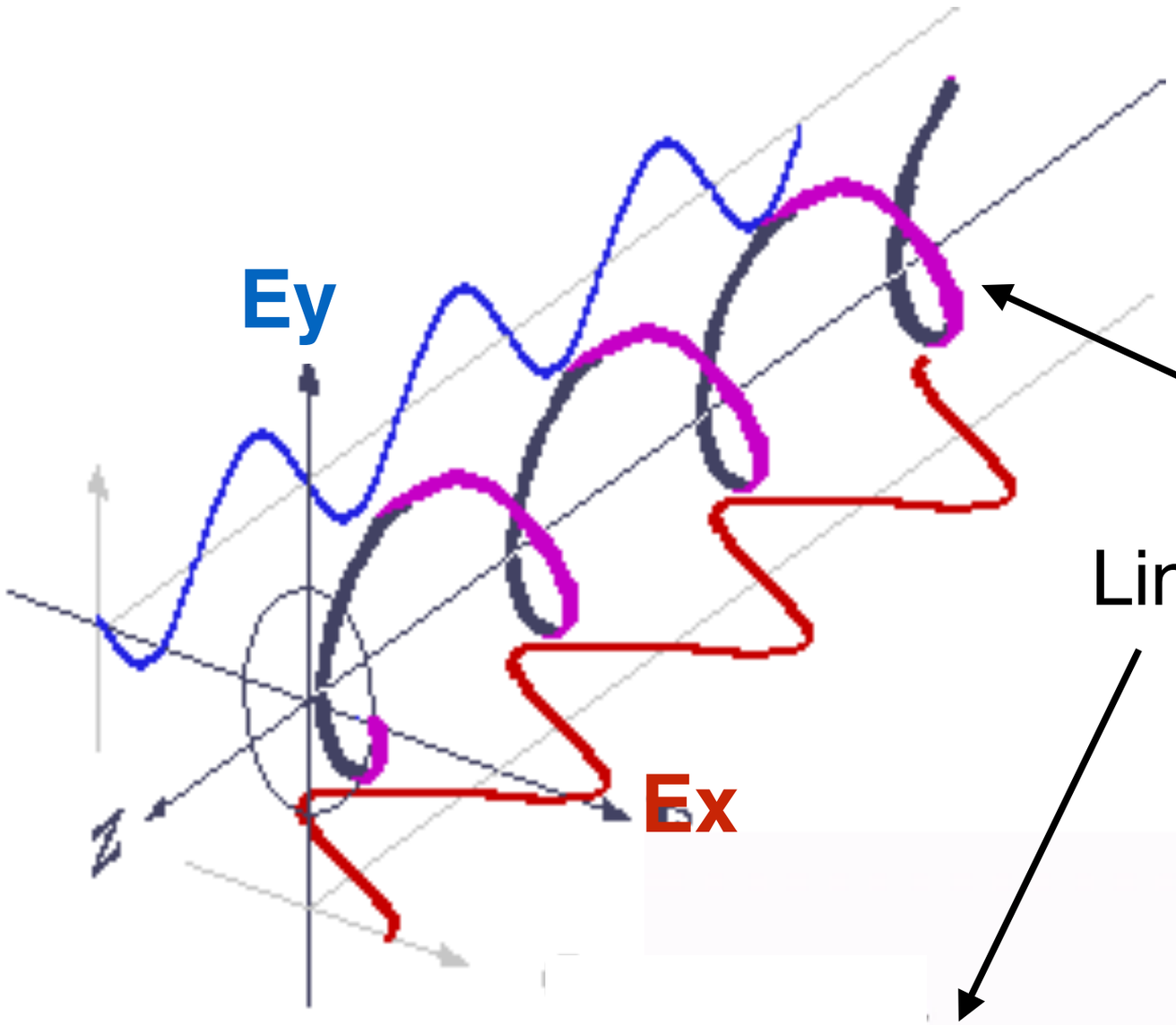
NenuFAR and polarization





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

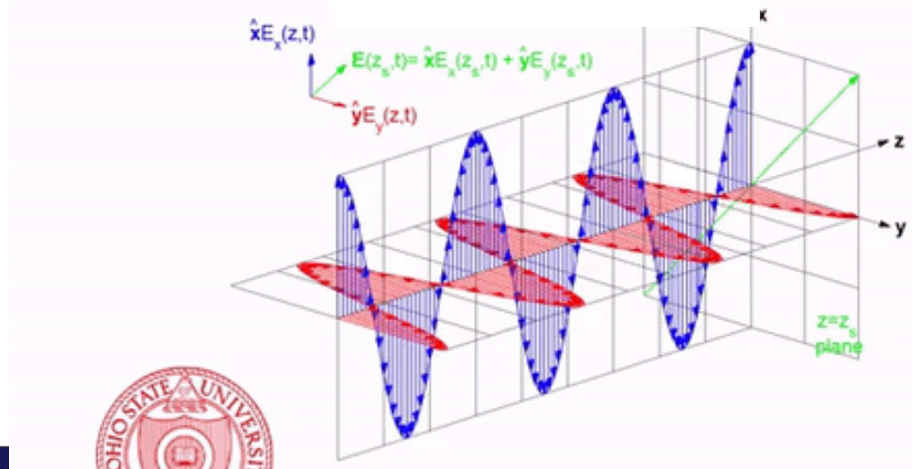
Polarisation

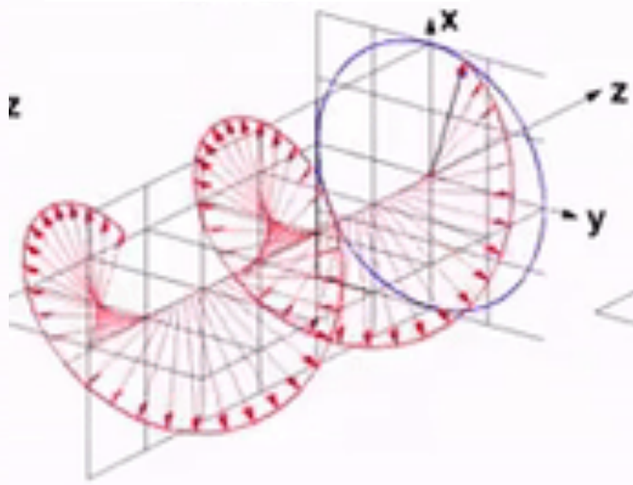


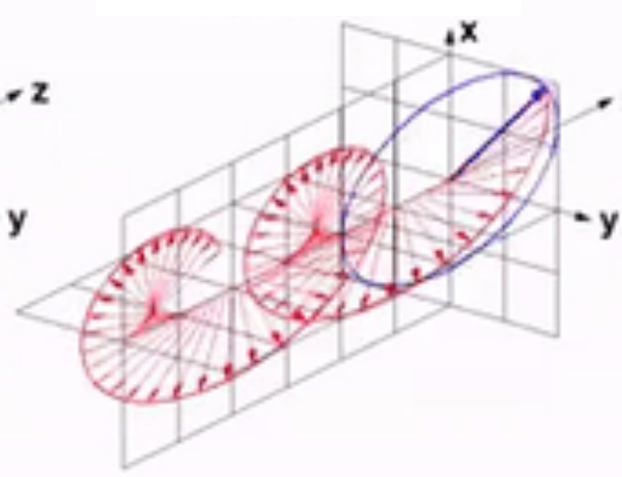
Linear

Circular

Elliptical







The first observation of pulsar

Jocelyn Bell, 1968

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

The IPS array (Interplanetary Scintillation Array) near Cambridge

Introduction: Pulsars

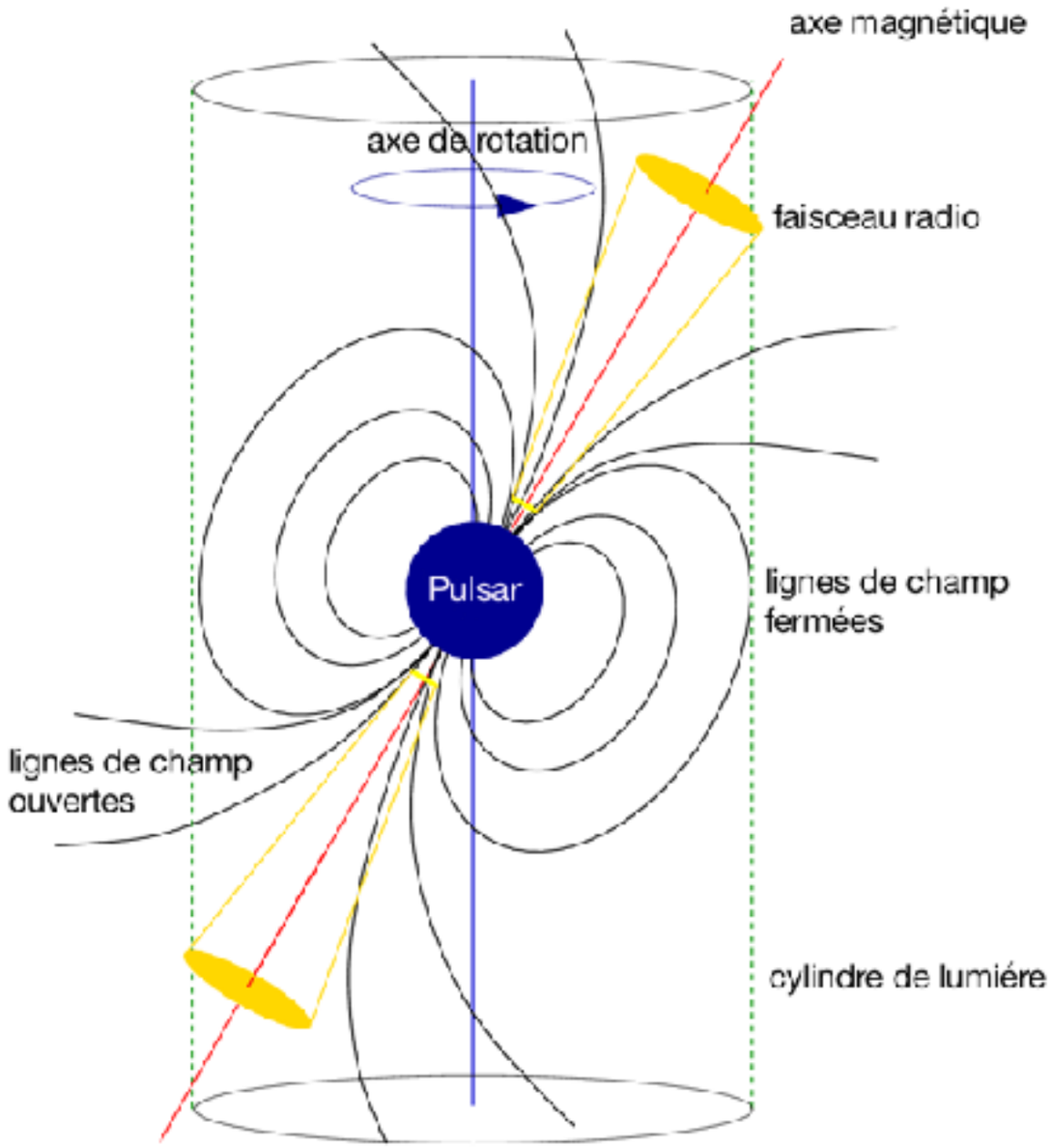
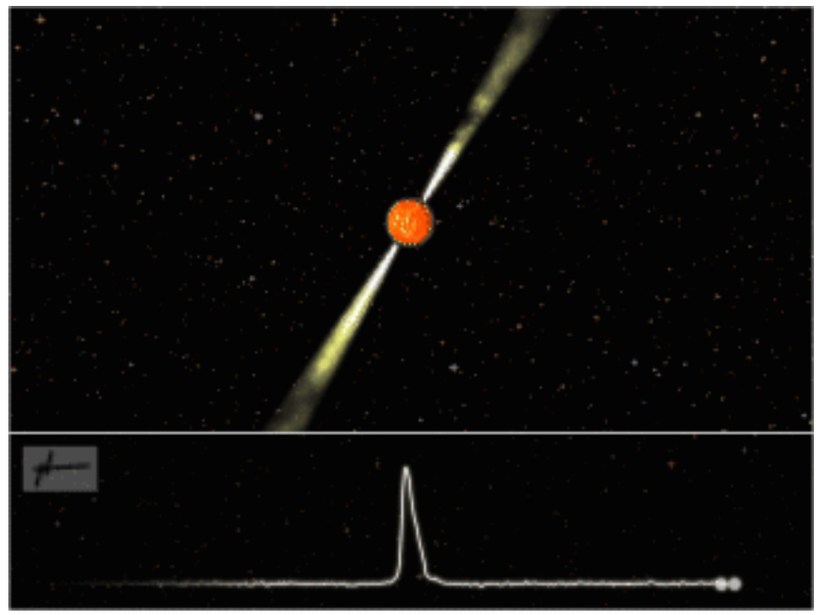


Diagram of a pulsar Handbook of Pulsar Astronomy D.Lorimer & M.Kramer.

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

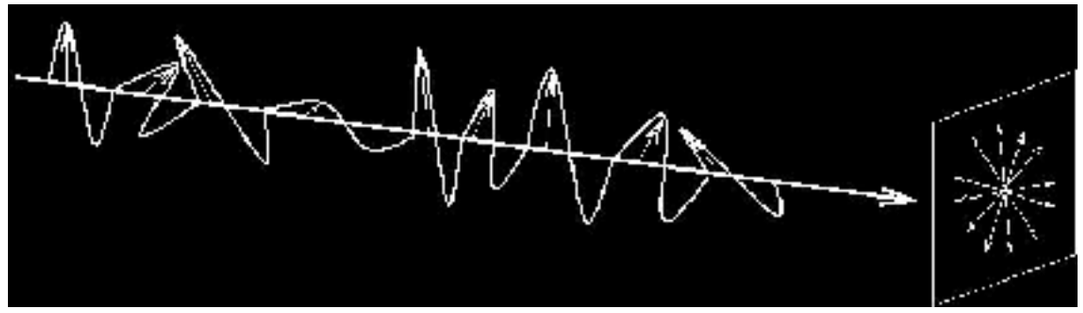


Pulsar and polarisation

Pulsars can be polarised

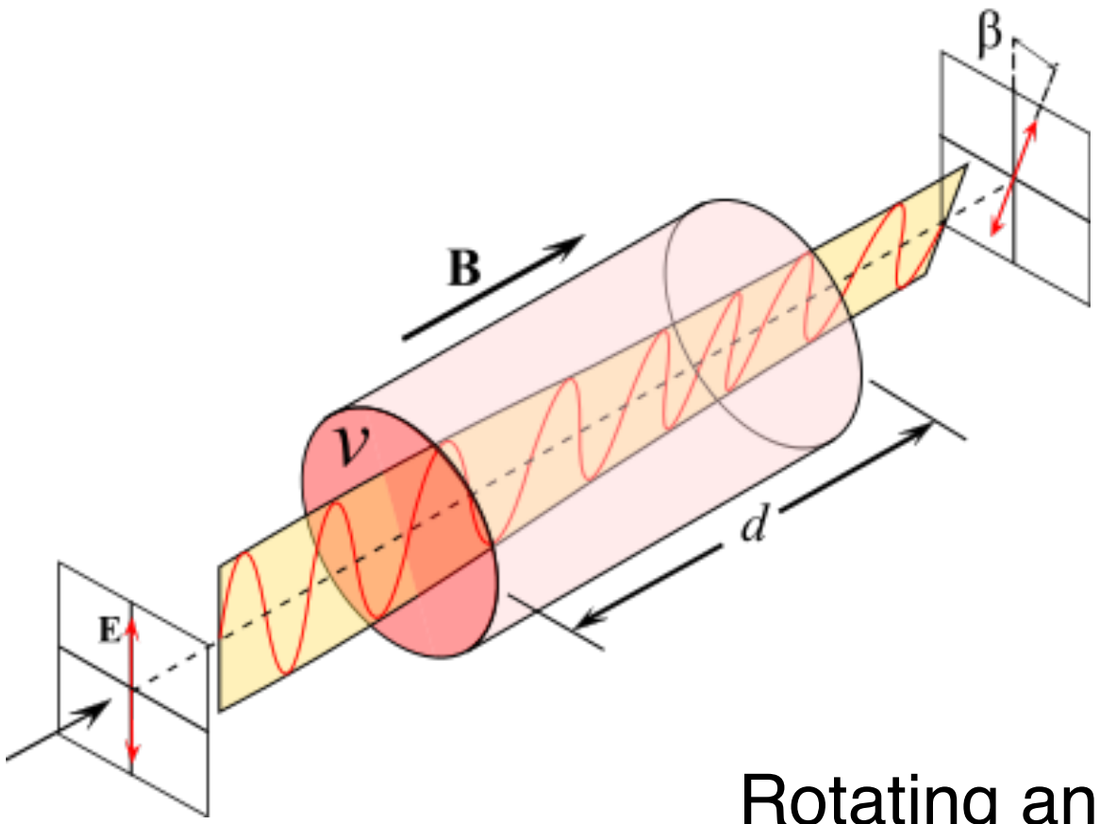
A pulsar can have:

- Linear polarisation
- Circular polarisation
- No polarisation
- usualy it is a melt of all



random polarisation between wave packets

Faraday rotation



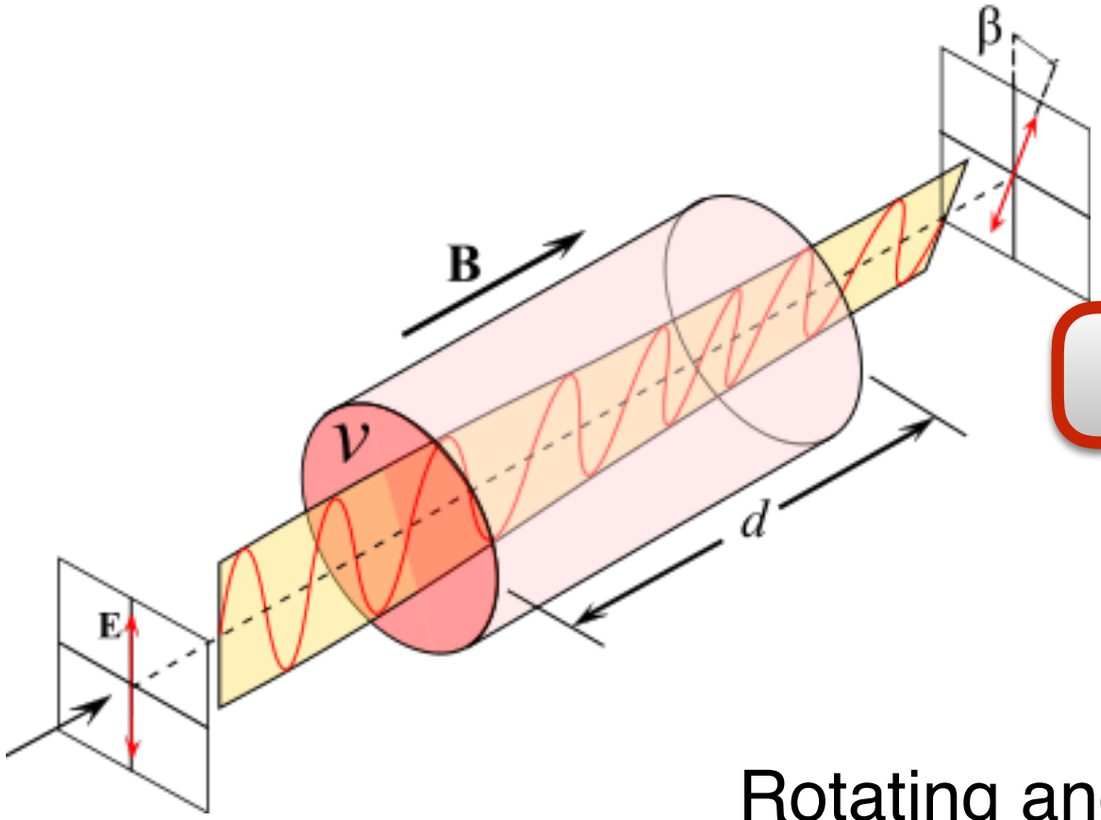
- linear polarisation can be decomposed in a right and left circular polarisation.
- B// introduce a difference on the conductivity seen by both circular polarisation.
- As a result of the differential in speed, the plane of polarisation is rotated.

$$\beta = RM\,\lambda^2$$

Rotating angle

Rotation Measure

Faraday rotation



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

!! WARNING: low frequency

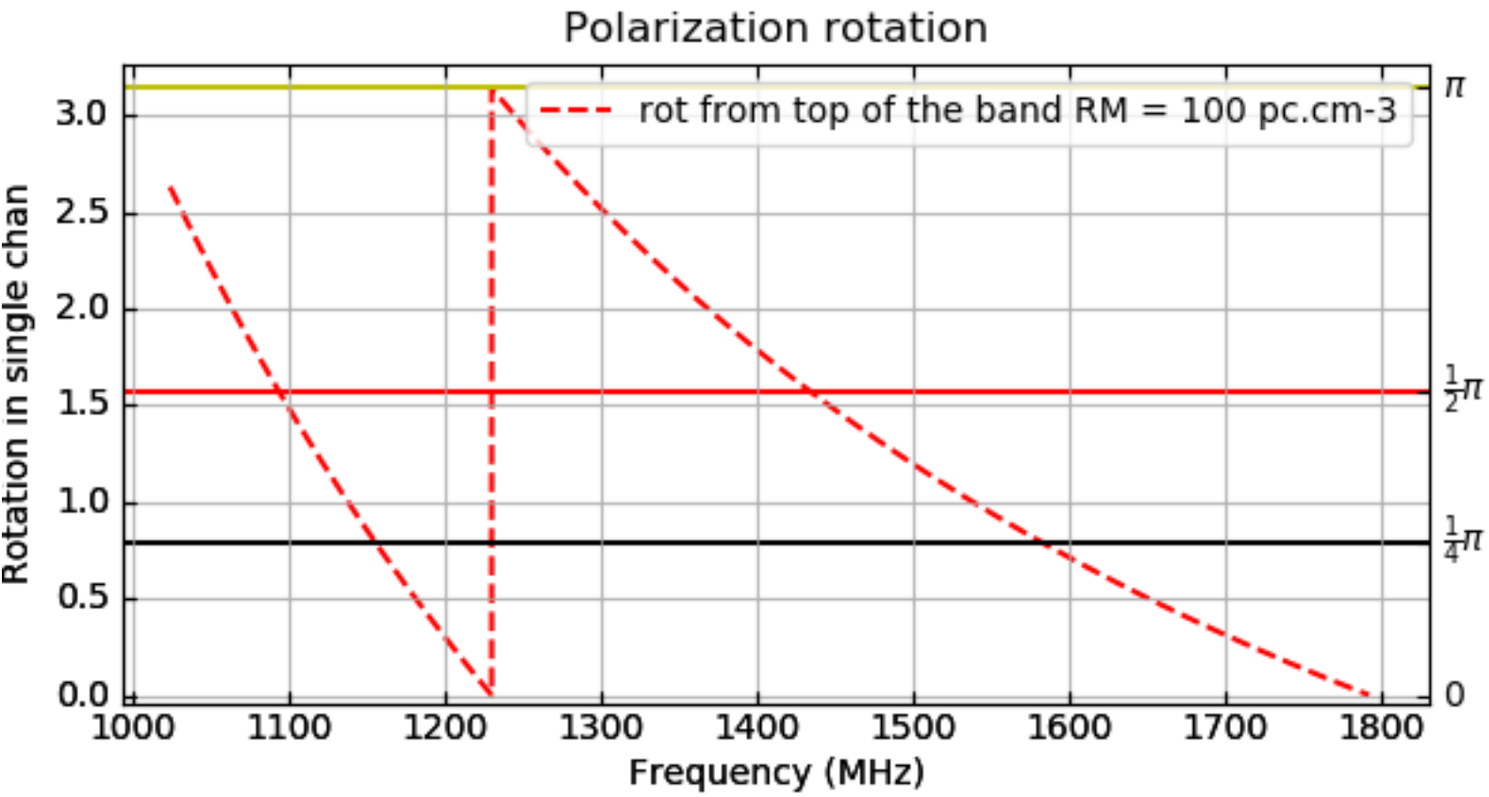
$$\beta = RM\,\lambda^2$$

Rotating angle

Rotation Measure

Faraday rotation and low frequency

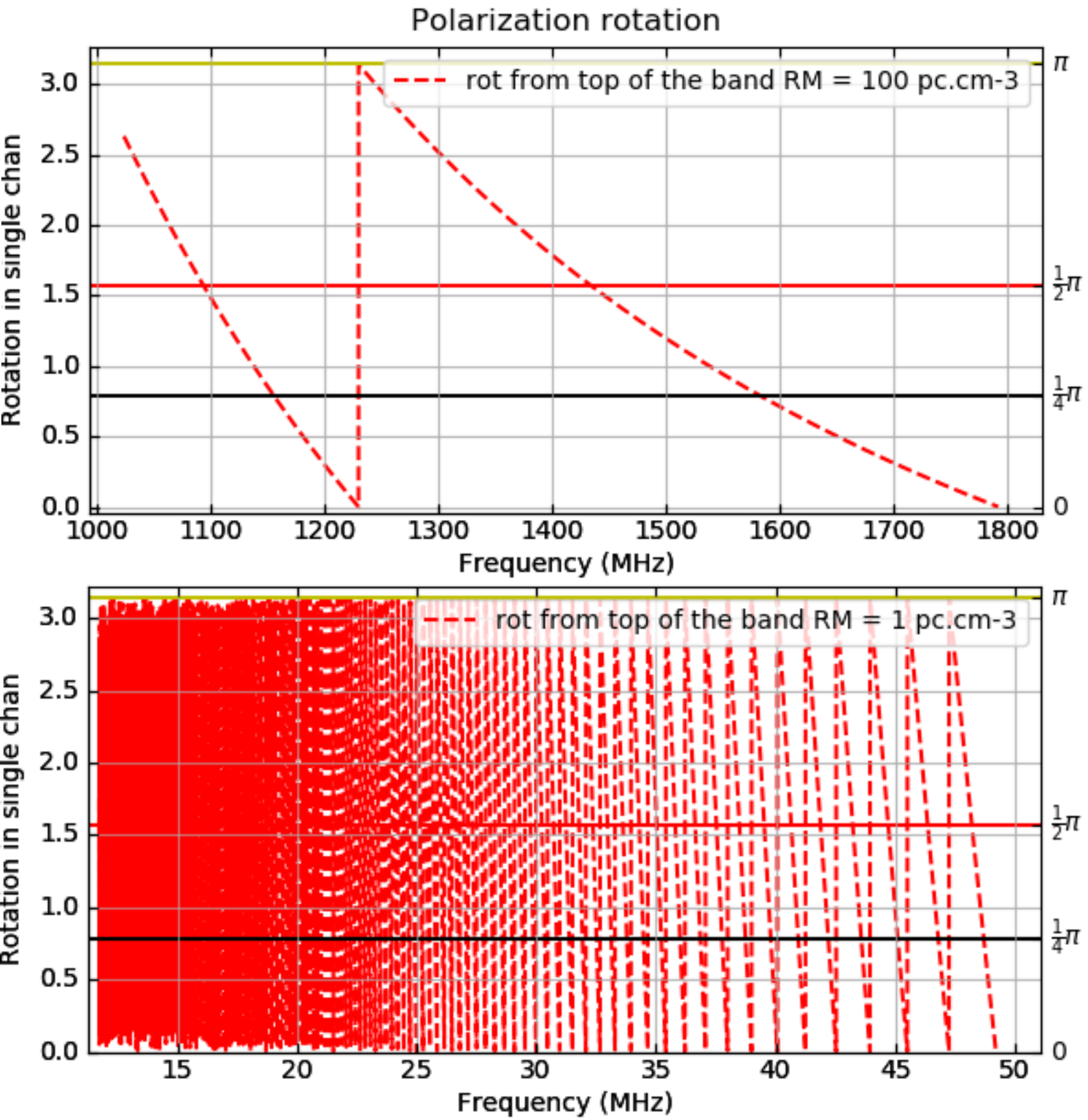
Faraday rotation



High frequency observation with RM = 100 rad.m-2

Faraday rotation and low frequency

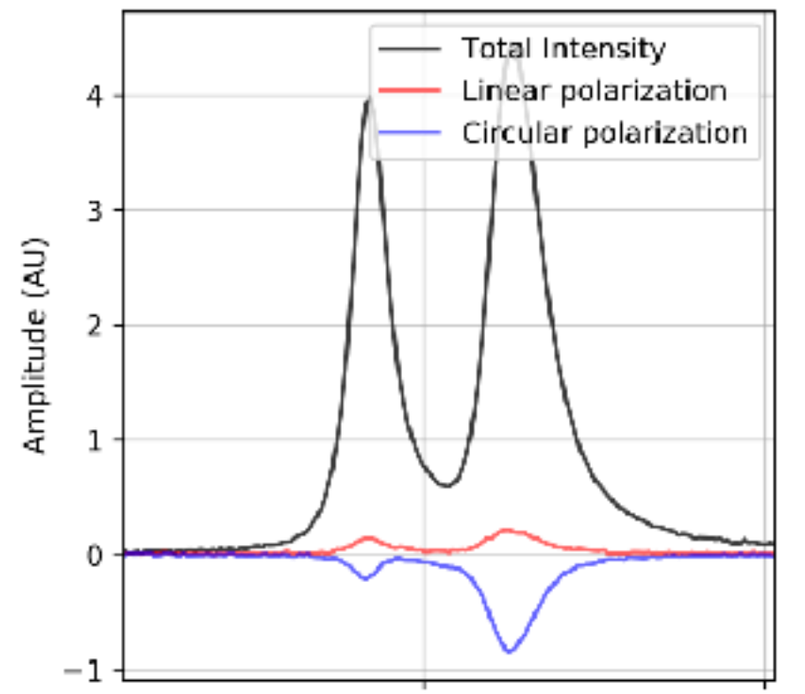
Faraday rotation



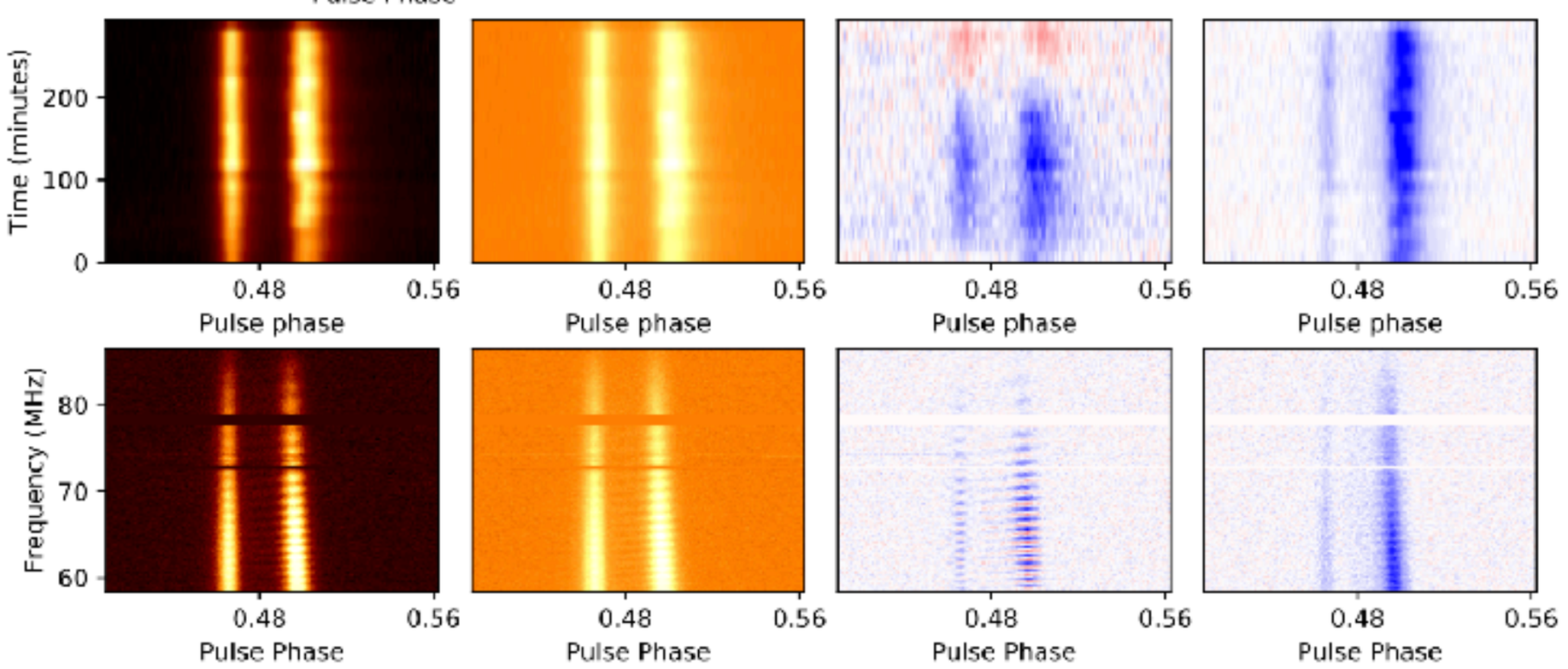
High frequency observation with RM = 100 rad.m-2

Low frequency observation with RM = 1 rad.m-2

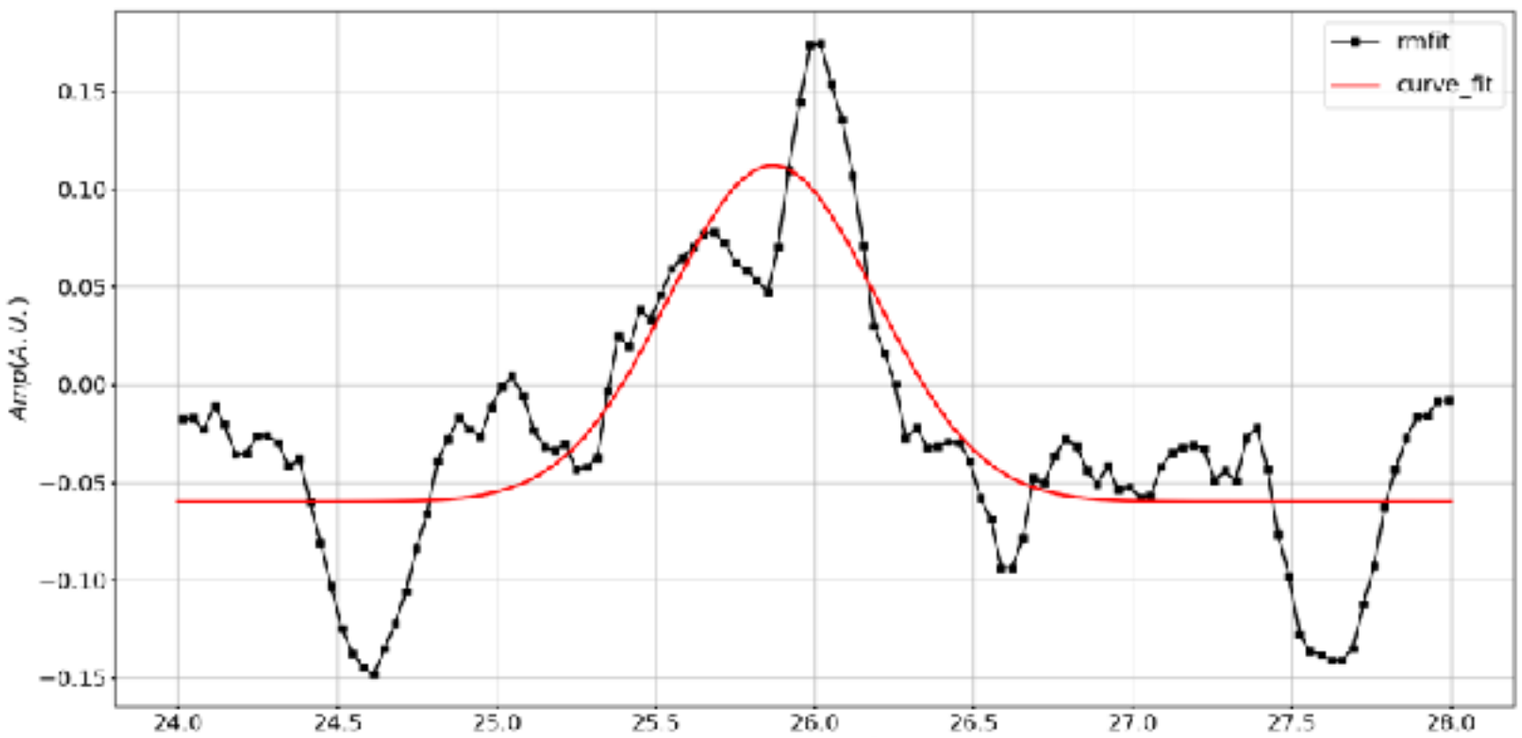
NenuFAR and polarisation



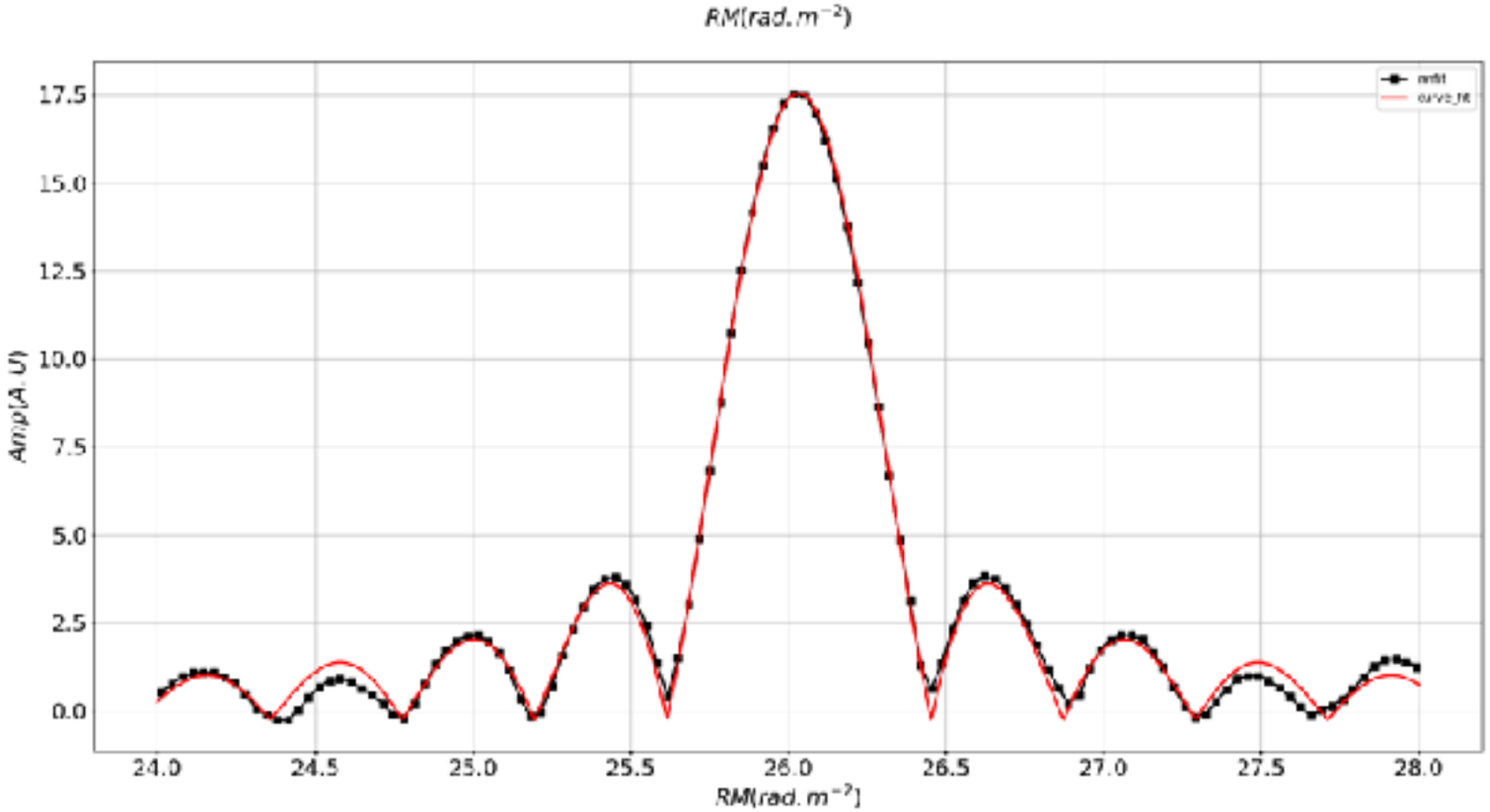
name	Source name	B1133+16
nbin	Number of pulse phase bins	1024
nchan	Number of frequency channels	384
npol	Number of polarizations	4
nsubint	Number of sub-integrations	21
length	Observation duration (s)	17630.7287
dm	Dispersion measure (pc/cm^3)	4.84066022517
rm	Rotation measure (rad/m^2)	0.0
period topo	Folding period (s)	1.18782751628
type	Observation type	Pulsar
site	Telescope name	nenufar
coord ra	Source coordinates (hms)	11:36:03.247
coord dec	Source coordinates (dms)	+15:51:04.478
freq	Centre frequency (MHz)	49.12109375
bw	Bandwidth (MHz)	75.0
dmc	Dispersion corrected	False
rmc	Faraday Rotation corrected	False
polc	Polarization calibrated	False
scale	Data units	FluxDensity
stat	Data state	Coherence
rcvr:name	Receiver name	LaNewBa
rcvr:basis	Basis of receptors	Linear
be:name	Name of the backend instrument	LUPPI
MJDstart	MJD of the first subintegration	58502.0803075
SNR	Signal noise ratio	2016.97119141
RFI	Radio Frequency Interferency (/100)	12.47
elevStart	Elevation of the first subintegration	52.2303959542
elevEnd	Elevation of the last subintegration	40.7653753902



NenuFAR / LOFAR (FR606) Rotation Measure



FR606



NenuFAR

Mark Brionne (lpc2e intership)

NenuFAR: Workshop

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