Observing pulsars with NenuFAR

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Step 1: The cleaning

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Code used: git clone git://github.com/louisbondonneau/NenuPlot.git

The essential options:

-freqappend : addition of several frequency bands
-defaraday : correct the RM in the data
-arout : output psrchive file (.clear)

Practical options:

-t : reduce the number of temporal integration by the requested factor (before RFI mit)
-ta : reduce the number of temporal integration by the requested factor (after RFI mit)
-metadata_out : ascii file with metadata (.metadata)
-fit_DM : fit for a new DM (on 8 thread, at your own risk)

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Example: python /cep/lofar/pulsar/NenuPlot.py -ta 6 -freqappend -defaraday -arout -metadata_out /databf2/nenufar-pulsar/ES03/2020/06/B0950+08_D20200611T1607_59011_*.ar

Loop 1:
- The bandpass is flattened
- A dirty template is made
- A dirty on-pulse is calculated
- The dirty on-pulse is removed in the data set
- CoastGuard is run on the dededispersed data with a threshold of 8 sigma
- A new template is generated

Loop 2:
- The bandpass is flattened
- A beter on-pulse is calculated from the last template
- The new on-pulse is removed from a new copy of the original data set
- CoastGuard is run on the dededispersed data with a threshold of 3.5 sigma
- A new template is generated
- A first mask is generated

Loop 3:
- The bandpass is flattened using a refined bandpass measurement
- A refined on-pulse is calculated from the last template
- The refined on-pulse is removed from a new copy of the original data set on which is installed the new mask beter
- CoastGuard is run on the dededispersed data with a threshold of 3.5 sigma
- A refined template is generated
- A refined mask is generated

recursively up to loop 12 with the option -iterative

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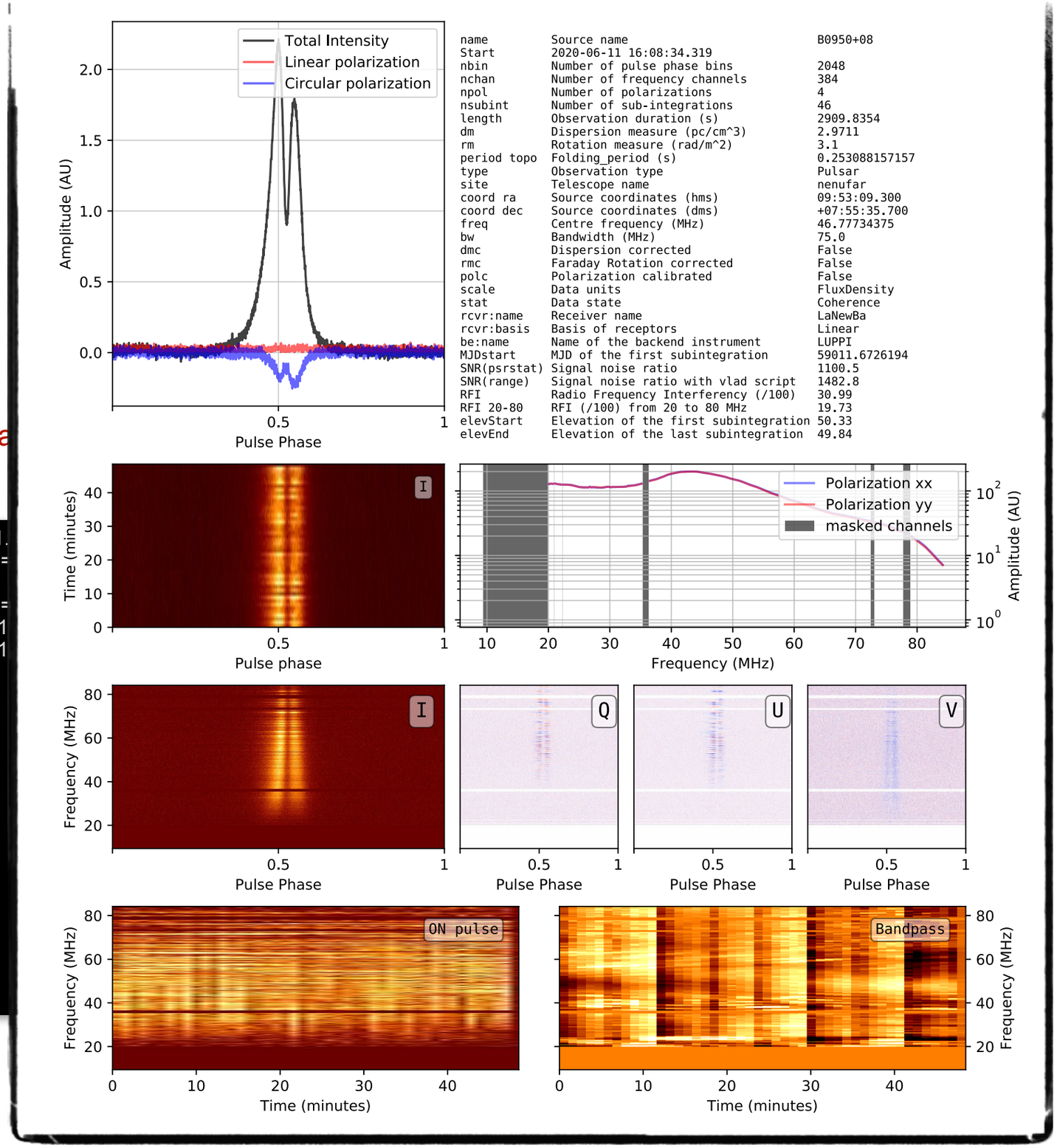
Example:

python NenuPlot.py -ta 6—freqappen -arout -metada
B0950+08_D20200611T1607_59011_*.fits

```
file(s) used: ['B0950+08_D20200611T1607_59011_250606_0028_BEAM1.
============================================================
                    File(s) to be processed:
============================================================
/databf2/nenufar-pulsar/ES03/2020/06/B0950+08_D20200611T1607_5901
/databf2/nenufar-pulsar/ES03/2020/06/B0950+08_D20200611T1607_5901
Loop: 1
ON pulse window is 1949-125
chanthresh = 8.0  subintthresh = 8.0
RFI fraction is 17.51 percent
[…]
Loop: 12
ON pulse window is 1920-127
chanthresh = 3.5  subintthresh = 4.0
RFI fraction is 28.27 percent
Cleaning was interrupted after 12 loops

> ls -tr
B0950+08_D20200611T1607_59011_250606_0028_BEAM1.ar.clear
B0950+08_D20200611T1607_59011_250606_0028_BEAM1.metadata
B0950+08_D20200611T1607_59011_250606_0028_BEAM1.pdf
```

Output files



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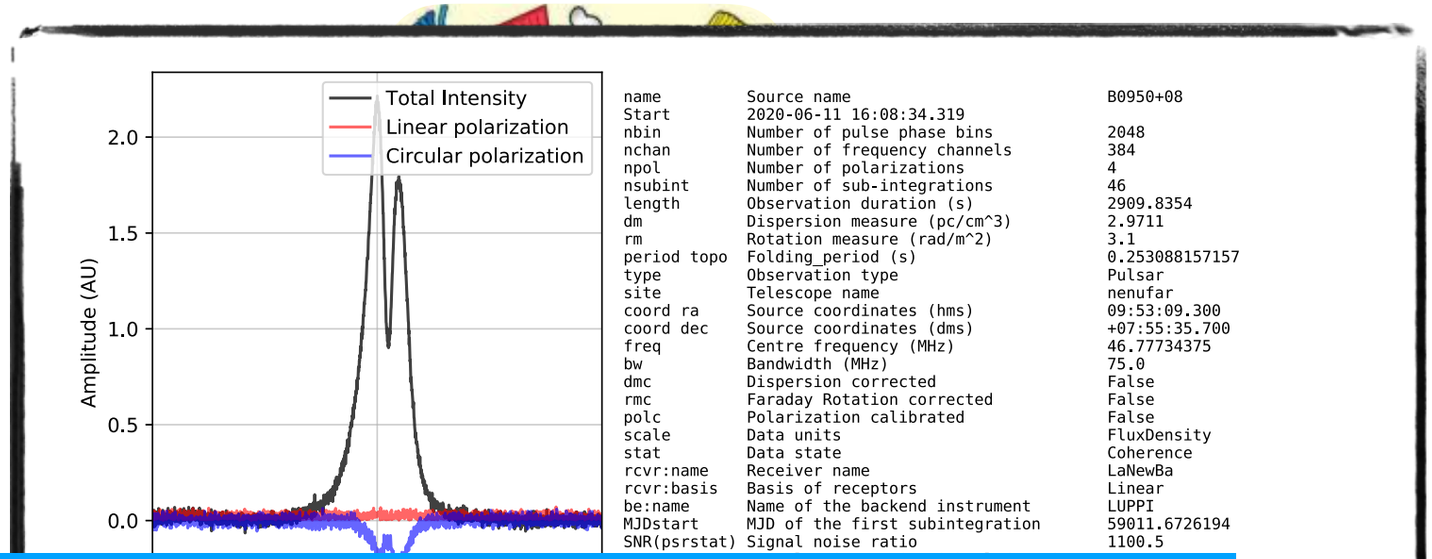

name	Source name	B0950+08
Start	2020-06-11 16:08:34.319	
nbin	Number of pulse phase bins	2048
nchan	Number of frequency channels	384
npol	Number of polarizations	4
nsubint	Number of sub-integrations	46
length	Observation duration (s)	2909.8354
dm	Dispersion measure (pc/cm^3)	2.9711
rm	Rotation measure (rad/m^2)	3.1
period topo	Folding_period (s)	0.253088157157
type	Observation type	Pulsar
site	Telescope name	nenufar
coord ra	Source coordinates (hms)	09:53:09.300
coord dec	Source coordinates (dms)	+07:55:35.700
freq	Centre frequency (MHz)	46.77734375
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	59011.6726194
SNR(psrstat)	Signal noise ratio	1100.5

Example:

python NenuPlo
nenufar-pulsar/B

```
file(s) used: ['B0950+0
==================

==================
/databf2/nenufar-pulsa
/databf2/nenufar-pulsa
Loop: 1
ON pulse window is 1
chanthresh = 8.0  sub
RFI fraction is 17.51 p
[…]
Loop: 12
ON pulse window is 1920-127
chanthresh = 3.5  subintthresh = 4.0
RFI fraction is 28.27 percent
Cleaning was interrupted after 12 loops

> ls -tr
B0950+08_D20200611T1607_59011_250606_0028_BEAM1.ar.clear
B0950+08_D20200611T1607_59011_250606_0028_BEAM1.metadata
B0950+08_D20200611T1607_59011_250606_0028_BEAM1.pdf
```

Output files

Tested on NenuFAR, LOFAR LBA and HBA, NRT, MeerKAT

If it's fail for you please notice me!
I might be able to make it even better.