INTRODUCTION TO PSRCHIVE

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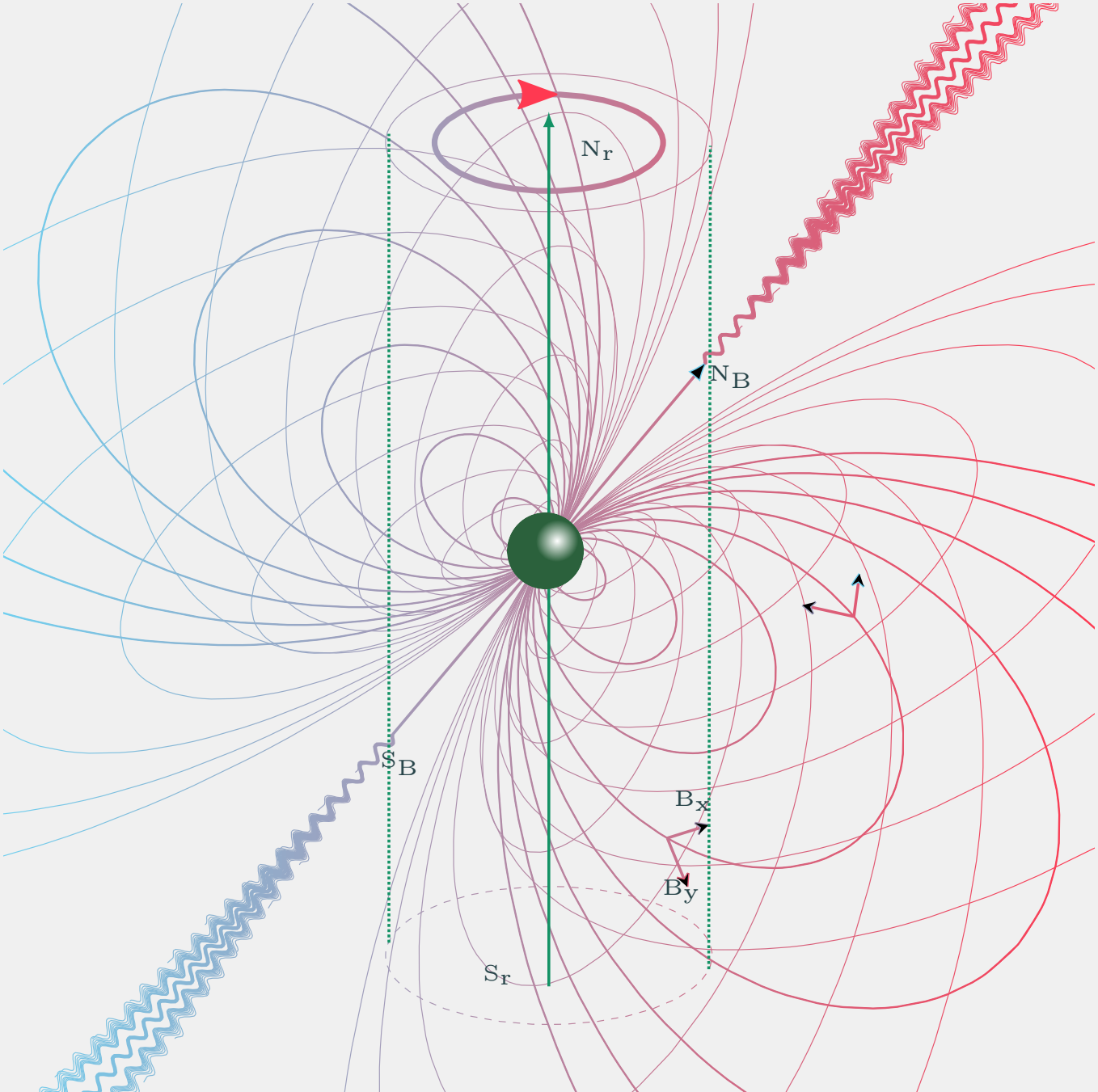
i do not know what it is about you that closes
and opens; only something in me understands
the voice of your eyes is deeper than all roses

– E. E. Cummings

ASTRON
Netherlands Institute for Radio Astronomy

SO YOU WANT TO ANALYSE THIS?



PSRCHIVE

lives here:
`http://psrchive.sourceforge.net`

git:
`https://git.code.sf.net/p/psrchive/code`

maintainers: Willem van Straten, Stefan Osłowski, Aiden Hotan, Paul Demorest and others

Hotan et al. (2004); van Straten et al. (2012, 2011); van Straten (2013, 2006); van Straten et al. (2010)

PSRCHIVE is:

- a full pulsar analysis suite designed to allow you to post-process, inspect and produce publication quality plots
  - integrated with the UNIX environment (psrsh)
- it is also a C++ development library
- has python bindings (python3 too!)
- but!
  - a mature yet constantly evolving set of code

PSRCHIVE CAN:

- read/write many folded data formats:
  - PSRFITS, EPN, PRESTO, ASP, WAPP ...
- perform many common tasks:
  - correct for dispersion and Faraday rotation
  - calibrate instrumental polarization
  - excise corrupted data (e.g. RFI)
  - calculate arrival times
  - produce various publication quality plots

PSRCHIVE CANNOT:

- search for new pulsars:
  - sigproc, presto, etc. do this
  - (used to refine S/N of survey candidates)
- reduce/fold time series data:
  - dspsr, sigproc, presto, etc. do this
  - (dspsr uses psrchive)

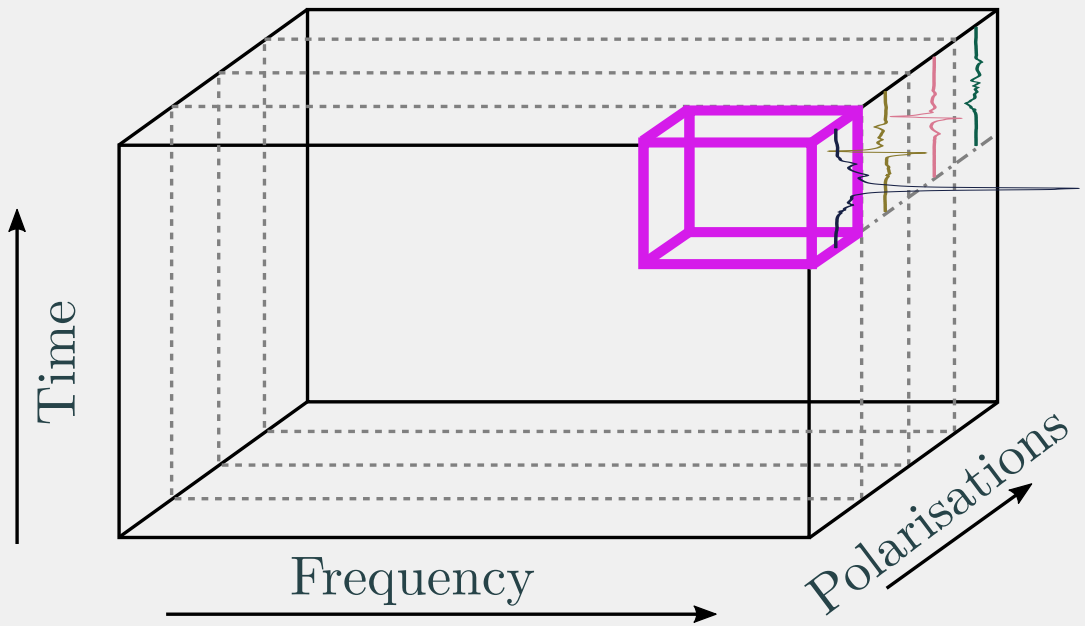
PSRCHIVE Core Applications

- ‘standard’ command line options (i.e., in the modern flavour)
  - remember once, use often
- powerful command language
  - full functionality in every program

USE PSRCHIVE TO:

- understand your data
  - query and edit: psredit
  - evaluate: psrstat
  - plot: psrplot
- modify your data
  - command: psrsh
- combine your data
  - integrate: psradd

PSRCHIVE DATA VOLUME



- each point in slab is a pulse profile

Query your data

print every attribute of file

```
$ psredit filename.ar
```

QUERY YOUR DATA

print selected attributes of files

```
$ psredit -c name,freq,bw,length filename.ar
```

EDIT YOUR DATA

modify the original files

```
$ psredit -c name=J0437-4715 filename.ar
```

Evaluate your data

don't print label = value

```
$ psredit -Q
```

combine with UNIX sort to find file with highest S/N

```
$ psredit -Q -jFTp -c snr filename.ar | sort -nk2,2
```

PLOT YOUR DATA

PSRPlot

```
$ psrplot -h
```

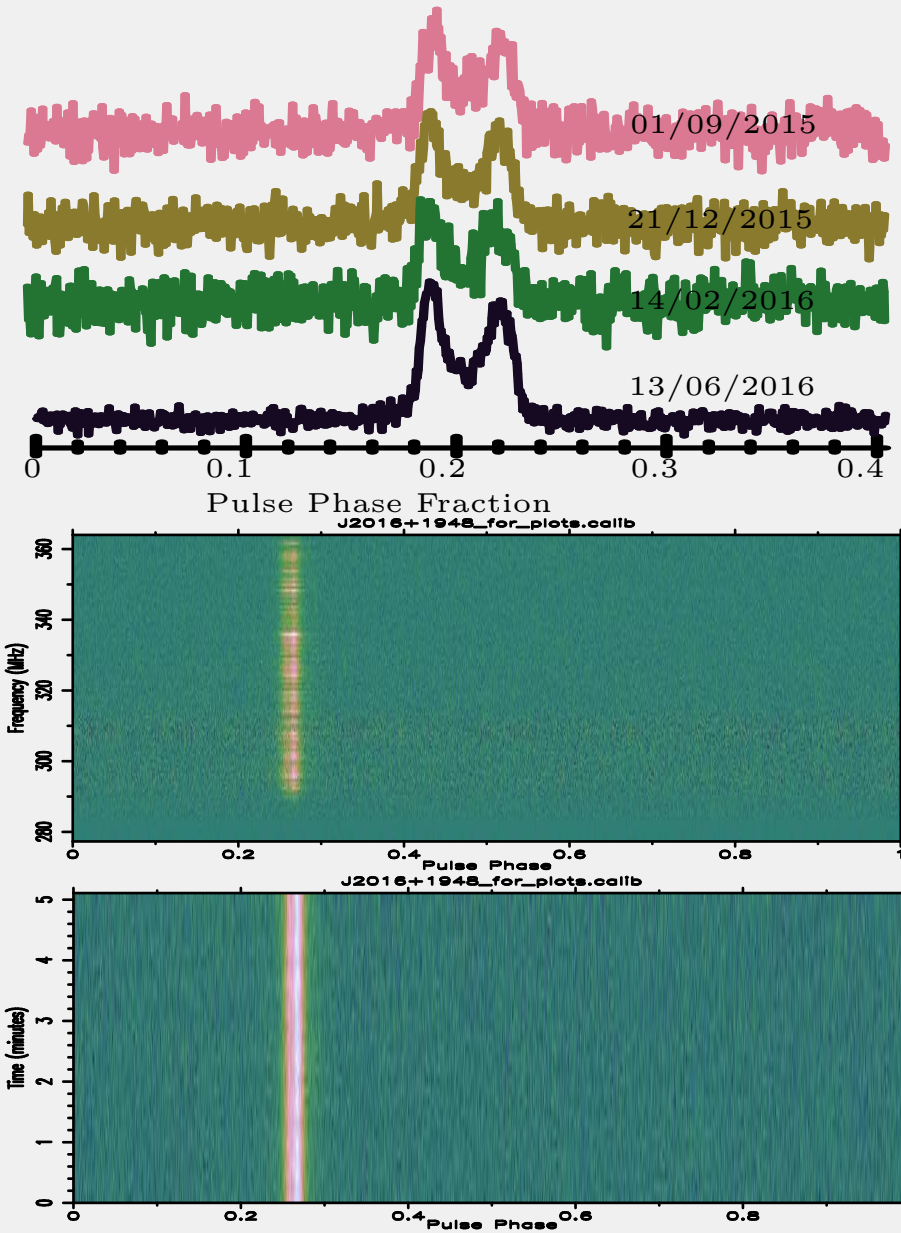
PLOT YOUR DATA

some commonly used plots:

```
$ psrplot -p flux
```

```
$ psrplot -p freq
```

```
$ psrplot -p time
```



Combine your data

```
$ psradd -h
```

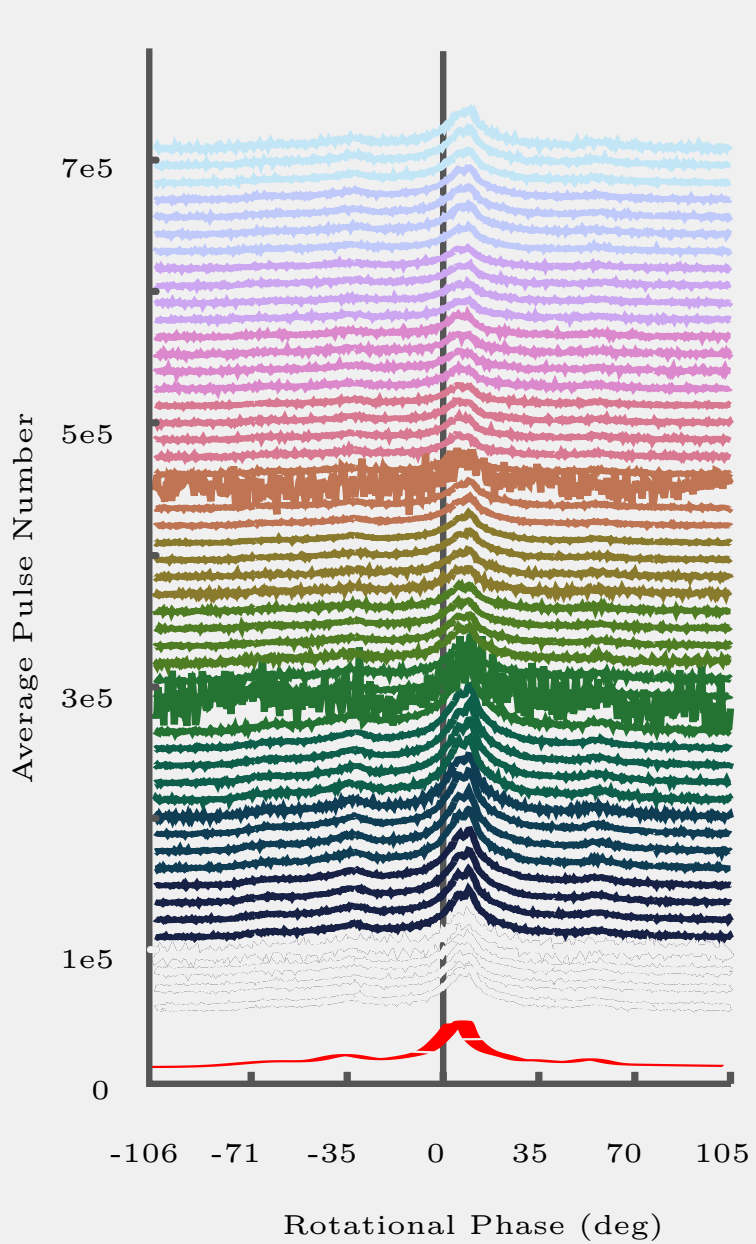
- Take 5-minute integrations and create 1-hour integrations, join into one file and integrate all frequency channels together

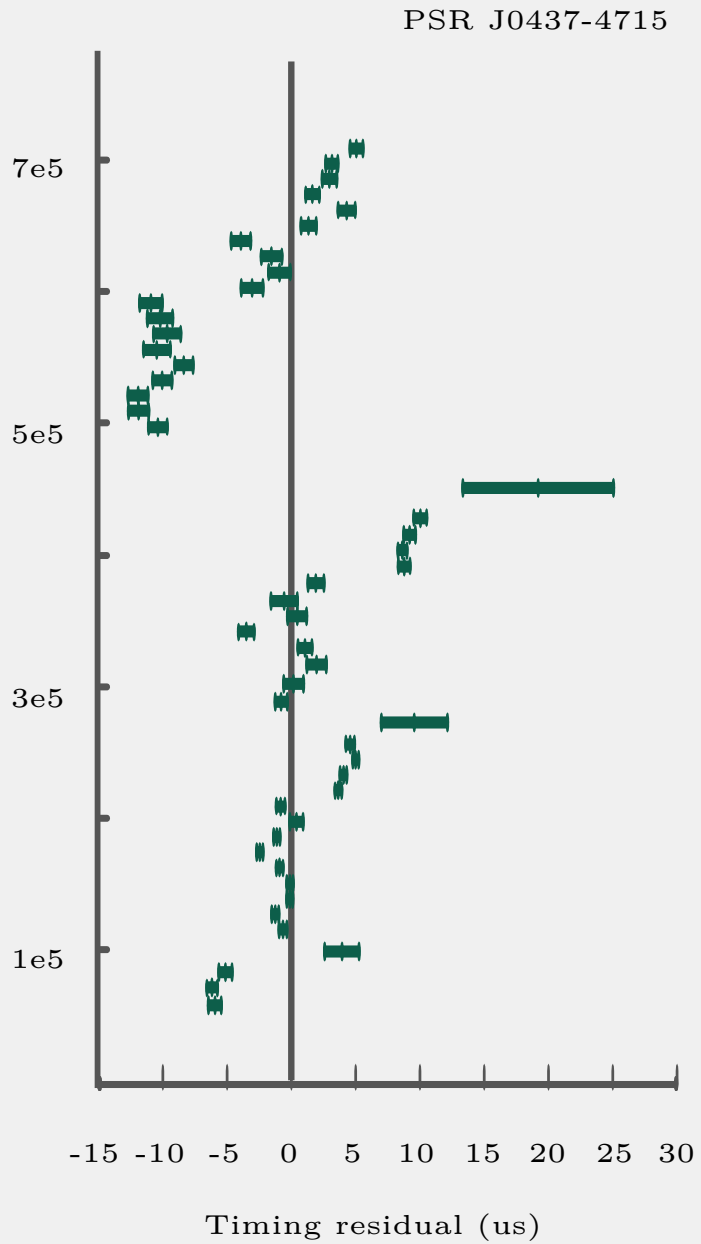
Combine your data

```
$ psradd -Fp -I 3600 -e Fp *.ar
```

- double-check results

PSRCHIVE Data Volume





Template matching (and a secret..)

- Three kinds of templates:
  - The data derived template
  - The smoothed template
  - The analytical template

△ All of these are '1D' templates!

- Aside:
  - (Ultra-)Wideband data inlcudes frequency evolution of the pulse profile, scintillation, etc.
  - PSRchive based 2D templates - Liu et al. (2014); not public yet.
  - Python based 2D templates - PulsePortraiture, Pennucci et al. (2014)

Create a standard template

scrunch in time

```
$ pam -T -eFTp
```

alternatively:

```
$ psradd -jFTp -o all_standard.FTp *.ar
```

```
$ paas -i -D/xs all_standard.FTp
```

GENERATE TOAS

time aginst a standard template using the PGS algorithm

```
$ pat -F -s standardtemplate.ar *.ar
```

better estimates of the errors!

```
$ pat -AFDM -s standardtemplate.ar *.ar
```

Now produce IPTA style TOAs

```
$ pat -AFDM -f IPTA -s standardtemplate.ar *.ar
```

Conclusion

- PSRCHIVE Core Applications:
  - general data analysis tools
  - tightly integrated interfaces
- PSRCHIVE Advanced Applications:
  - pac and pcm: polarization calibration
  - pat: arrival time estimation
  - pdmp: survey candidate refinement
- etc.

Thank You!

References & Literature

Hotan A. W., van Straten W., Manchester R. N., 2004, PASA, 21, 302

Liu K., et al., 2014, MNRAS, 443, 3752

Pennucci T. T., Demorest P. B., Ransom S. M., 2014, ApJ, 790, 93

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van Straten W., Manchester R. N., Johnston S., Reynolds J. E., 2010, PASA, 27, 104

van Straten W., Demorest P., Khoo J., Keith M., Hotan A., et al. 2011, PSRCHIVE: Development Library for the Analysis of Pulsar Astronomical Data (ascl:1105.014)

van Straten W., Demorest P., Oslowski S., 2012, Astron. Res. & Tech., 9, 237