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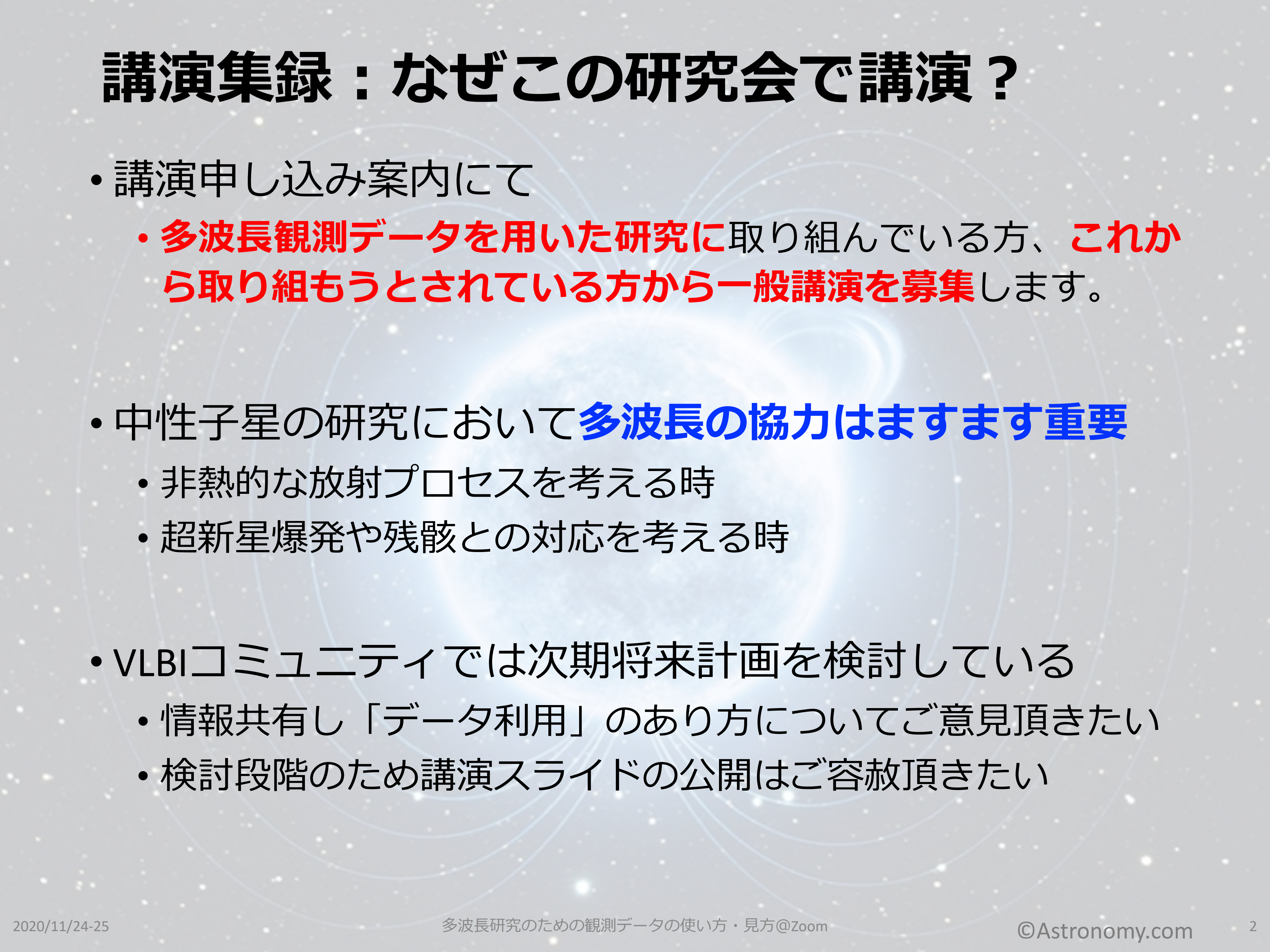
宇宙最強磁場の起源と極限物理法則の探求

MONSTER計画

Monitoring **O**bservations of **N**eutron **S**tars **T**hat **E**volve **R**apidly

VLBI懇談会将来計画検討・極限天体班

赤堀卓也 (国立天文台/SKA機構)



講演集録：なぜこの研究会で講演？

- 講演申し込み案内にて
  - **多波長観測データを用いた研究に**取り組んでいる方、**これから取り組もうとされている方から一般講演を募集**します。

- 中性子星の研究において**多波長の協力はますます重要**
  - 非熱的な放射プロセスを考える時
  - 超新星爆発や残骸との対応を考える時

- VLBIコミュニティでは次期将来計画を検討している
  - 情報共有し「データ利用」のあり方についてご意見頂きたい
  - 検討段階のため講演スライドの公開はご容赦頂きたい

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講演集録

- **極限天体VLBIの戦略として、自転周期変化率の高い中性子星を長期にモニターするプロジェクトを考えている**
  - 新VERAで年間1000時間・10年間の観測をし包括的なカタログを作成
  - 時間領域観測の環境整備に資する(FRB, etc ,…)
- **プロジェクト化・装置改修の予算獲得はこれから**
  - 研究チームはまだ小さく脆弱→多波長研究に手が回らない状態
  - 既存装置で観測を実施してデータを提供することは可能
    - ToOやDDTのプロポーザル執筆 & データ解析して情報をお渡しできます
    - ただし共同利用に供していたりもしますのでベストエフォートです
- **このカタログデータにアクセスしたいですよ…ね？**
  - 3次元位置速度、スペクトル指数、パルス周期、周期変化率、…
    - たとえばATNF Pulsar Catalog(https://www.atnf.csiro.au/research/pulsar/psrcat/)とVLBA PSR PI(https://safe.nrao.edu/vlba/psrpi/release.html)を合わせたデータベース
  - もしリクエストありましたらお願いします

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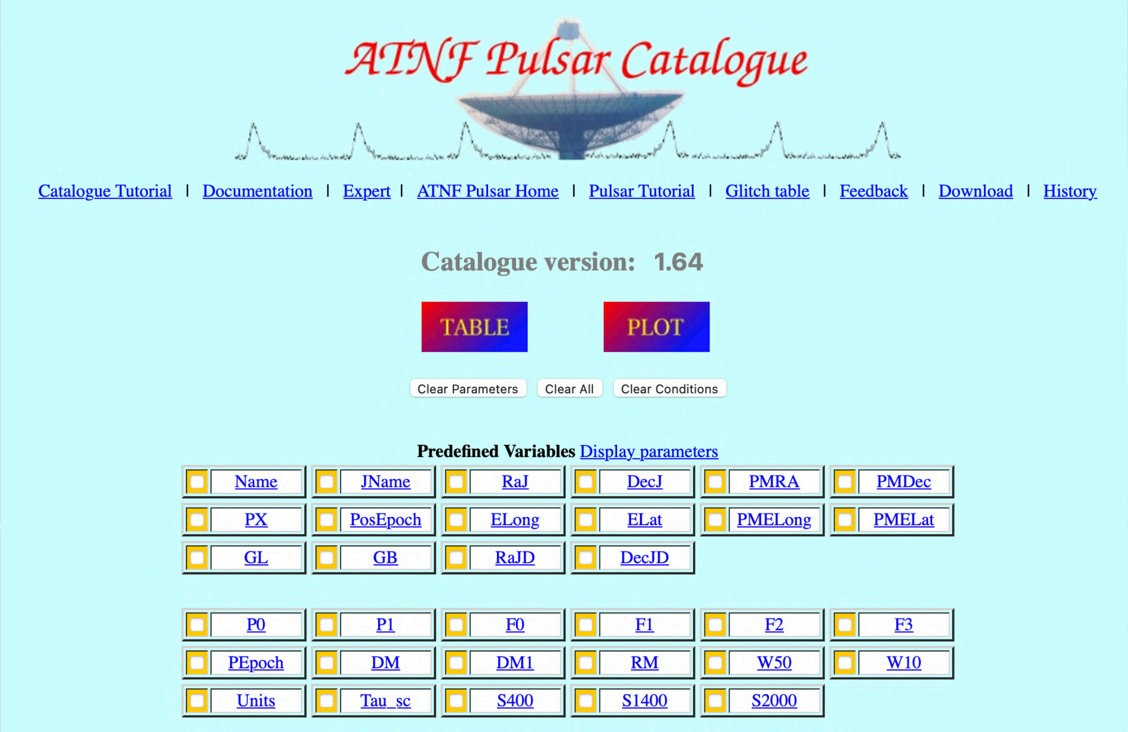
ATNF Pulsar Catalog

https://www.atnf.csiro.au/research/pulsar/psrcat/

自転周期変化率P* > 1e-13 s/s以上の中性子星の自転周期Pと1.4 GHzでの電波強度S(1400)のプロット。


ATNF Pulsar Catalogue
Catalogue Tutorial | Documentation | Expert | ATNF Pulsar Home | Pulsar Tutorial | Glitch table | Feedback | Download | History
Catalogue version: 1.64
TABLE
PLOT
Clear Parameters
Clear All
Clear Conditions
Predefined Variables Display parameters
Name
JName
RaJ
DecJ
PMRA
PMDec
PX
PosEpoch
ELong
ELat
PMELong
PMELat
GL
GB
RaJD
DecJD
P0
P1
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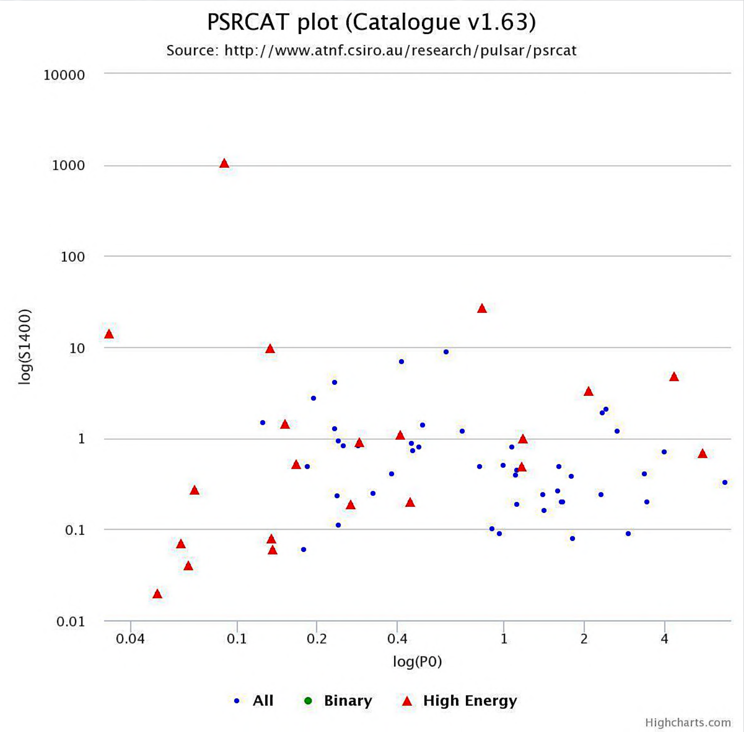
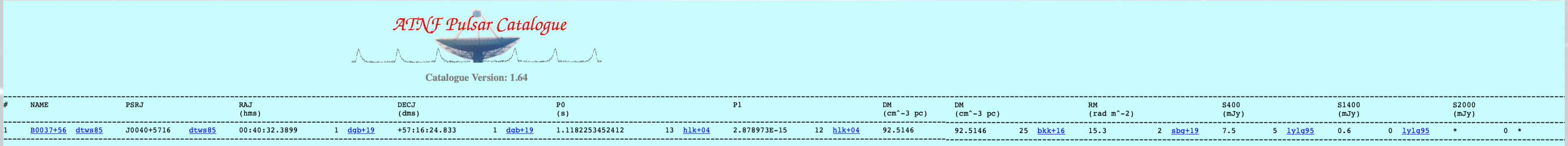
W10
Units
Tau_sc
S400
S1400
S2000

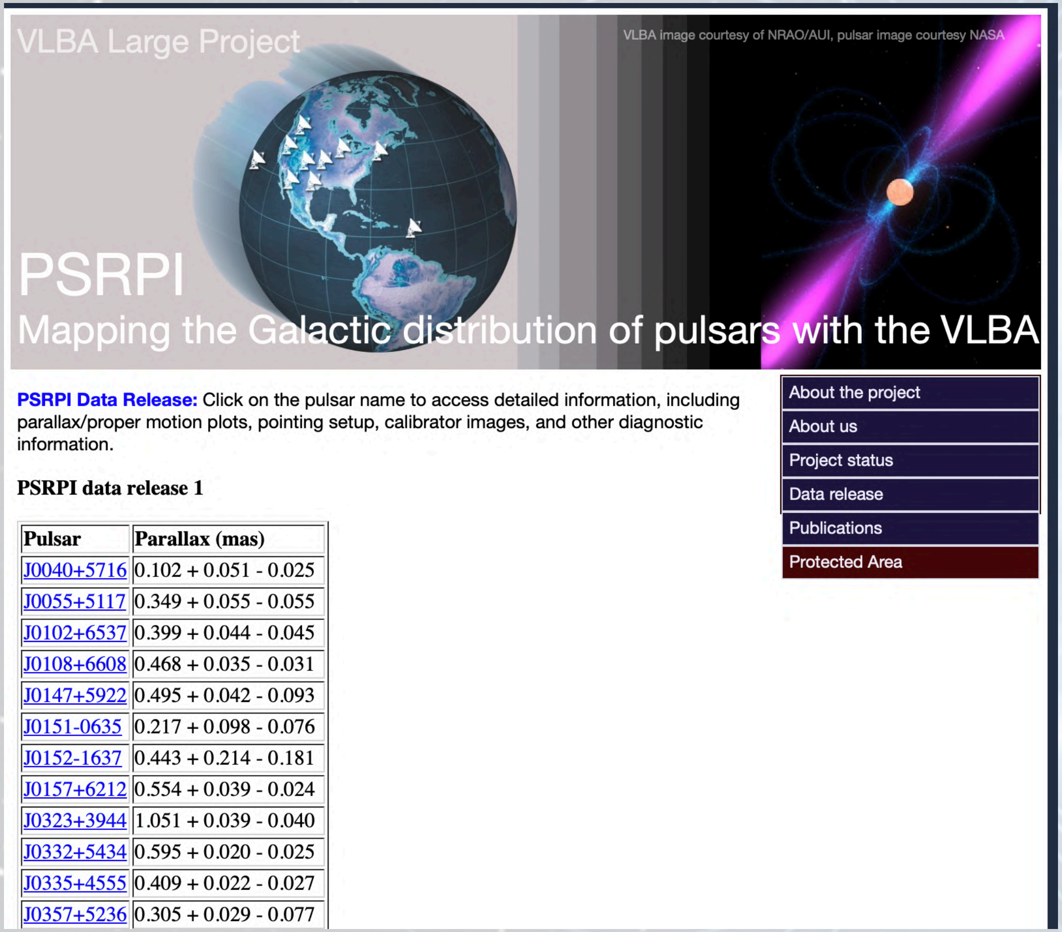



ATNF Pulsar Catalogue
Catalogue Version: 1.64

```
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
#    NAME               PSRJ                RAJ                         DECJ                        P0                              P1                            DM            DM                     RM                         S400                S1400               S2000
                                            (hms)                       (dms)                       (s)                                                           (cm^-3 pc)    (cm^-3 pc)             (rad m^-2)                 (mJy)               (mJy)               (mJy)
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
1    B0037+56  dtws85   J0040+5716  dtws85  00:40:32.3899      1  dgb+19  +57:16:24.833      1  dgb+19  1.1182253452412     13  hlk+04  2.878973E-15    12  hlk+04  92.5146       92.5146      25  bkk+16  15.3              2  sbg+19  7.5        5  lylg95  0.6        0  lylg95  *          0  *
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
```

VLBA PSR PI

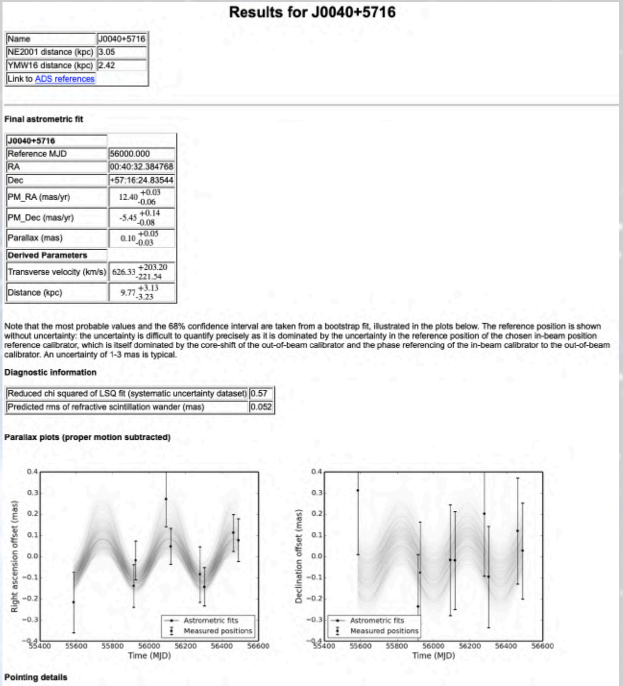
https://safe.nrao.edu/vlba/psrpi/release.html


VLBA Large Project
VLBA image courtesy of NRAO/AUI, pulsar image courtesy NASA
PSRPI
Mapping the Galactic distribution of pulsars with the VLBA
About the project
About us
Project status
Data release
Publications
Protected Area

PSRPI Data Release: Click on the pulsar name to access detailed information, including parallax/proper motion plots, pointing setup, calibrator images, and other diagnostic information.

PSRPI data release 1

Pulsar	Parallax (mas)
J0040+5716	0.102 + 0.051 - 0.025
J0055+5117	0.349 + 0.055 - 0.055
J0102+6537	0.399 + 0.044 - 0.045
J0108+6608	0.468 + 0.035 - 0.031
J0147+5922	0.495 + 0.042 - 0.093
J0151-0635	0.217 + 0.098 - 0.076
J0152-1637	0.443 + 0.214 - 0.181
J0157+6212	0.554 + 0.039 - 0.024
J0323+3944	1.051 + 0.039 - 0.040
J0332+5434	0.595 + 0.020 - 0.025
J0335+4555	0.409 + 0.022 - 0.027
J0357+5236	0.305 + 0.029 - 0.077



Results for J0040+5716

Name	J0040+5716
NE2001 distance (kpc)	3.05
YMW16 distance (kpc)	2.42
Link to ADS references	

Final astrometric fit

J0040+5716	
Reference MJD	56000.000
RA	00:40:32.384768
Dec	+57:16:24.83544
PM_RA (mas/yr)	$12.40^{+0.03}_{-0.06}$
PM_Dec (mas/yr)	$-5.45^{+0.14}_{-0.08}$
Parallax (mas)	$0.10^{+0.05}_{-0.03}$
Derived Parameters	
Transverse velocity (km/s)	$626.33^{+203.20}_{-221.54}$
Distance (kpc)	$9.77^{+3.13}_{-3.23}$

Note that the most probable values and the 68% confidence interval are taken from a bootstrap fit, illustrated in the plots below. The reference position is shown without uncertainty: the uncertainty is difficult to quantify precisely as it is dominated by the uncertainty in the reference position of the chosen in-beam position reference calibrator, which is itself dominated by the core-shift of the out-of-beam calibrator and the phase referencing of the in-beam calibrator to the out-of-beam calibrator. An uncertainty of 1-3 mas is typical.

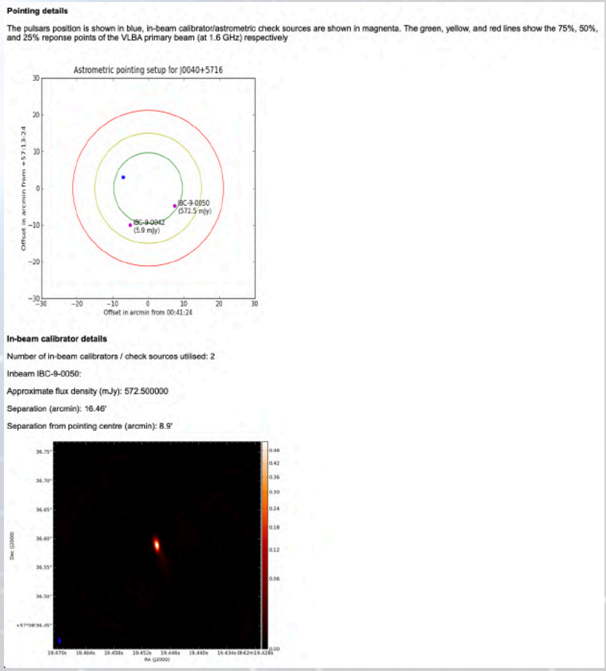
Diagnostic information

Reduced chi squared of LSQ fit (systematic uncertainty dataset)	0.57
Predicted rms of refractive scintillation wander (mas)	0.052

Parallax plots (proper motion subtracted)

Right ascension offset (mas)
Declination offset (mas)
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
55400
55600
55800
56000
56200
56400
56600
Time (MJD)
Astrometric fits
Measured positions

Pointing details



Pointing details

The pulsars position is shown in blue, in-beam calibrator/astrometric check sources are shown in magnenta. The green, yellow, and red lines show the 75%, 50%, and 25% reponse points of the VLBA primary beam (at 1.6 GHz) respectively

Astrometric pointing setup for J0040+5716
Offset in arcmin from +57:13:24
Offset in arcmin from 00:41:24
30
20
10
0
−10
−20
−30
IBC-9-0050
(572.5 mJy)
IBC-9-0042
(5.9 mJy)

In-beam calibrator details

Number of in-beam calibrators / check sources utilised: 2

Inbeam IBC-9-0050:

Approximate flux density (mJy): 572.500000

Separation (arcmin): 16.46'

Separation from pointing centre (arcmin): 8.9'

36.75°
36.70°
36.65°
36.60°
36.55°
36.50°
0.48
0.42
0.36
0.30
0.24
0.18
0.12
0.06
0.00

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