



PULSE@Parkes

Engaging students through hands-on radio astronomy

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ASTRONOMY AND SPACE SCIENCE
www.csiro.au

Twitter: @PULSEatParkes



Challenge

- Develop and implement engaging radio astronomy/gravitational wave activities for high school students
- Provide opportunity for students to use a national facility and engage with professional scientists
- Have students doing science that is appropriate for them and useful for professional astronomers



PULSE@Parkes

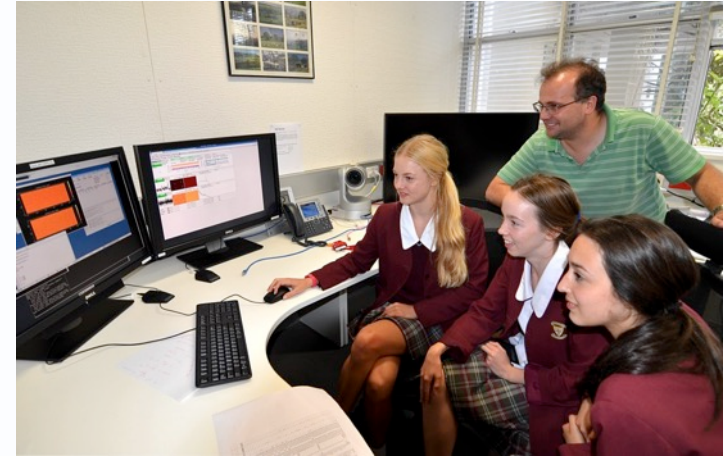
*PUL*sar Student *Exploration* online at Parkes

Our Tool: 64m Parkes radio telescope



Our program

- Free
- Aimed at students Yrs 10-12
- Pre-observing school visit
- ~ Monthly observing session
 - Maximum ~ 24 students
 - 2 hours telescope time, remote observing
 - Online data analysis module
 - Interaction with scientists, PhD students & other schools
- Opportunity for follow-on student investigations



Our progress

- Started, November 2007, launched by then new Science Minister
- 107 sessions to date
- Australian sessions in NSW, Victoria, Western Australia, ACT
- International sessions in at Cardiff, Oxford, ASTRON, Canada + 2 x tours to Japan



Our students

- ~ 1,390 students, ~ 220 teachers
- ~ 111 (134) schools
- Yrs 10-12, some 9s and 7s
- Strong repeat demand from schools
- Strong engagement from girls' schools



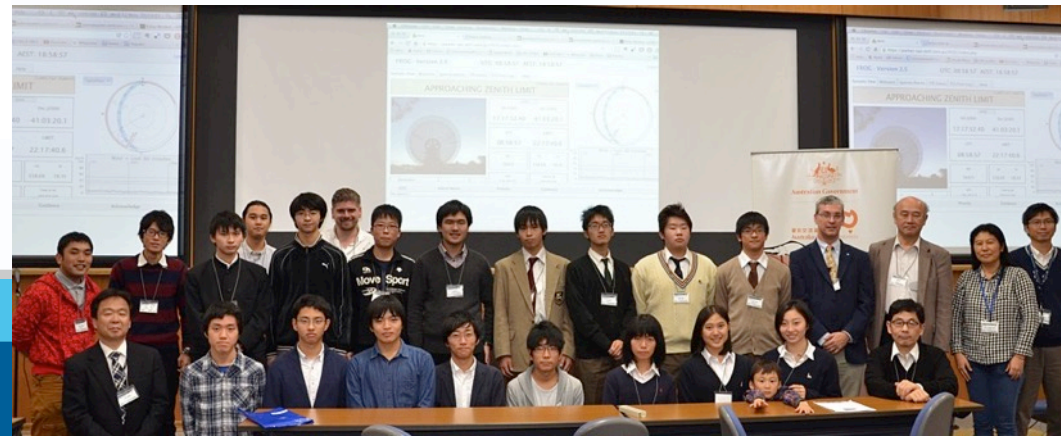
The Japan trips

1. Australia-Japan Foundation grant to take PULSE@Parkes to Fukushima Prefectures in the Tsunami-affected regions in 2013
2. Successful and trip repeated in 2014
3. *Easy to control the telescope remotely (network issues => one session was run through a mobile phone).*
4. Language issues not (much of) a problem!



Australian Government

豪日交流基金
Australia-Japan FOUNDATION



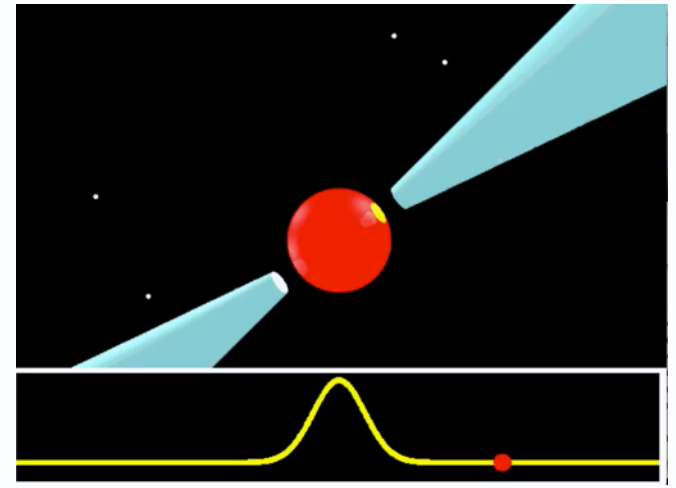
Looking towards China

1. Initial grant to run PULSE@Parkes in Guangzhou, China (December 2015)
2. High school & university students in Guangzhou
3. Likely to develop a multi-year partnership
4. Change in mode of science education
5. Modules and some webpages being translated into Chinese



What do we have? ... Pulsars

1. The highest magnetic fields known
2. Star surface moving close to the speed of light
3. Incredibly dense
4. Incredibly stable
5. A pulsar is “a lighthouse in space”
6. Pulsars are easy **and quick** to observe with a radio telescope
7. Pulsars are being observed to detect ultra-low-frequency gravitational waves



Credit: Michael Kramer

TCS: Telescope Control Software

The screenshot displays the Telescope Control Software (TCS) interface, organized into several functional panels:

- Telescope Information:** Telescope: Parkes 64m, Observer(s): LT RMS, Project id: P456, Project name: P456_MB_DFB3.
- ANTENNA CONTROL:** Source name: J1045-4509, Observation type: TRACK, Coordinate system: RA (J2000), Dec (J2000), Catalogue position: 10h45m50.180s, -45°09'54".10, Source offset type: NONE, Signal offset: +00°00'00", Reference offset: +00°00'00", Longitude offset is: ARLENGTH, Wrap: SHORTEST, Duration: 3840 SECONDS.
- RECEIVER CONTROL:** Receiver: MULTI, Parallax angle tracking: DISABLED, Beams: active 1, reference 1, Feed angle: 0.0 degrees, Focus offset y: 0.0, z: 0.0 mm.
- PULSAR BACKENDS:** Observing mode: PSR, BPSR (OFFLINE), CASPSR (ACTIVE), Accumulation length: 25, Processing file, Bits/sample: 1, Channels to average: 0, Time constant (s): 1, File time max (s): 0, Polarization products: 1, Wind park mode, Frequency scrunch: 1, Time scrunch: 1.
- Control Buttons:** STOP, Start TRACK, Drive, Tsys, Park, Stow, Unstow-ExLim, Check.
- Scheduling:** Sched file: /mnt/psr1/tcs/sched/P456/P456_MB_DFB3.sch, Record mode, Start: 14, End: 15 of 46 Repeat: 1, Start sched, Sched agent: GUI, unit: 15, repeat: 1, Next, Finish.
- SYSTEM STATUS:** antenna, focus, LO chain, attenuator, auxiliary, correlator. RUNNING SCHED FILE: MCP, COMPUTER, Position offset, REFERENCE. Antenna: TRACKING, Position (J2000): 10:45:50.1, -45:09:54, at UTC, 18:10:15, ETA: 0.0, 0.1, Cycles remaining: 326, focus-y: 195.0, focus-z: 2081.0, focus-r: 0.00, Controller: 0, 384.
- Log Window:**

```

UTC: 18:10:23   Freq 1   SKG 1369.000000   Freq 2   -
AEST: 04:10:23
LMST: 11:33:01   Output file   s130112_180025.rf
18:09:05: rcv value: p_trk = DISABLED
18:09:05: rcv value: p_rot = 0.0
18:09:15: rcv value: p_trk = DISABLED
18:09:15: rcv value: p_rot = 0.0
18:09:25: rcv value: p_trk = DISABLED
18:09:25: rcv value: p_rot = 0.0
18:09:35: rcv value: p_trk = DISABLED
18:09:35: rcv value: p_rot = 0.0
18:09:45: rcv value: p_trk = DISABLED
18:09:45: rcv value: p_rot = 0.0
18:09:55: rcv value: p_trk = DISABLED
18:09:55: rcv value: p_rot = 0.0
18:10:05: rcv value: p_trk = DISABLED
18:10:05: rcv value: p_rot = 0.0
18:10:15: rcv value: p_trk = DISABLED
18:10:15: rcv value: p_rot = 0.0

```
- Log message entry:** Remark: 50, EXIT.

LIVE WEBCAM

Synoptic View **Webcams** Ignored Alarms TPS Status TCS Error Log Help

TRACKING



J2000	
RA J2000	Dec J2000
19:01:55.50	-36:57:37.9

UTC	LMST
06:38:52.88	15:57:40.5

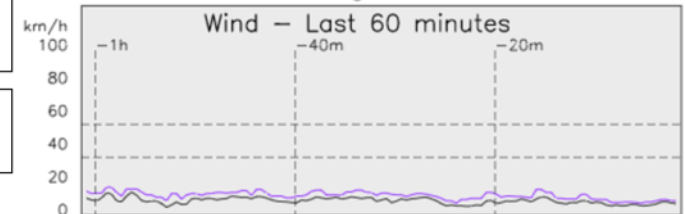
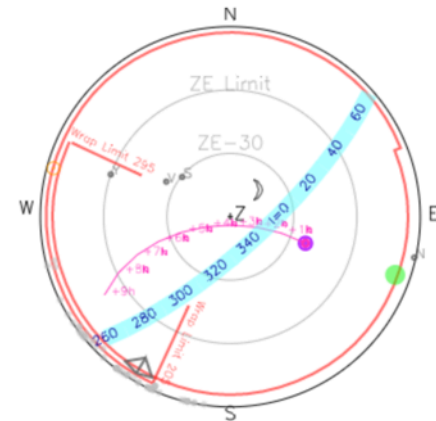
AZ	ZE
109.39	37.76

Control
**COMPUTER:
REMOTE**

Receiver
1050CM

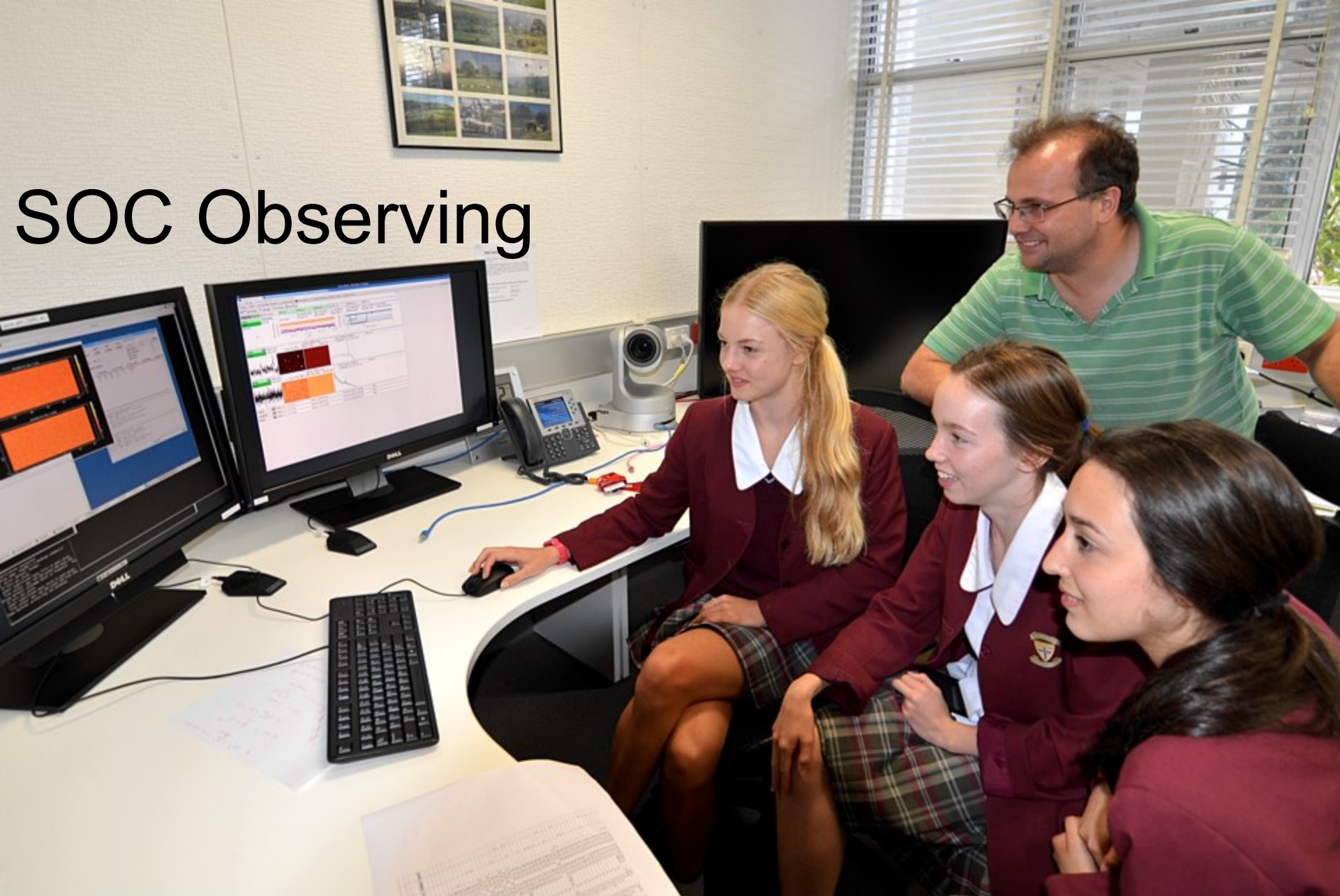
AEST
16:38:57.96

Time to set
08:04:03



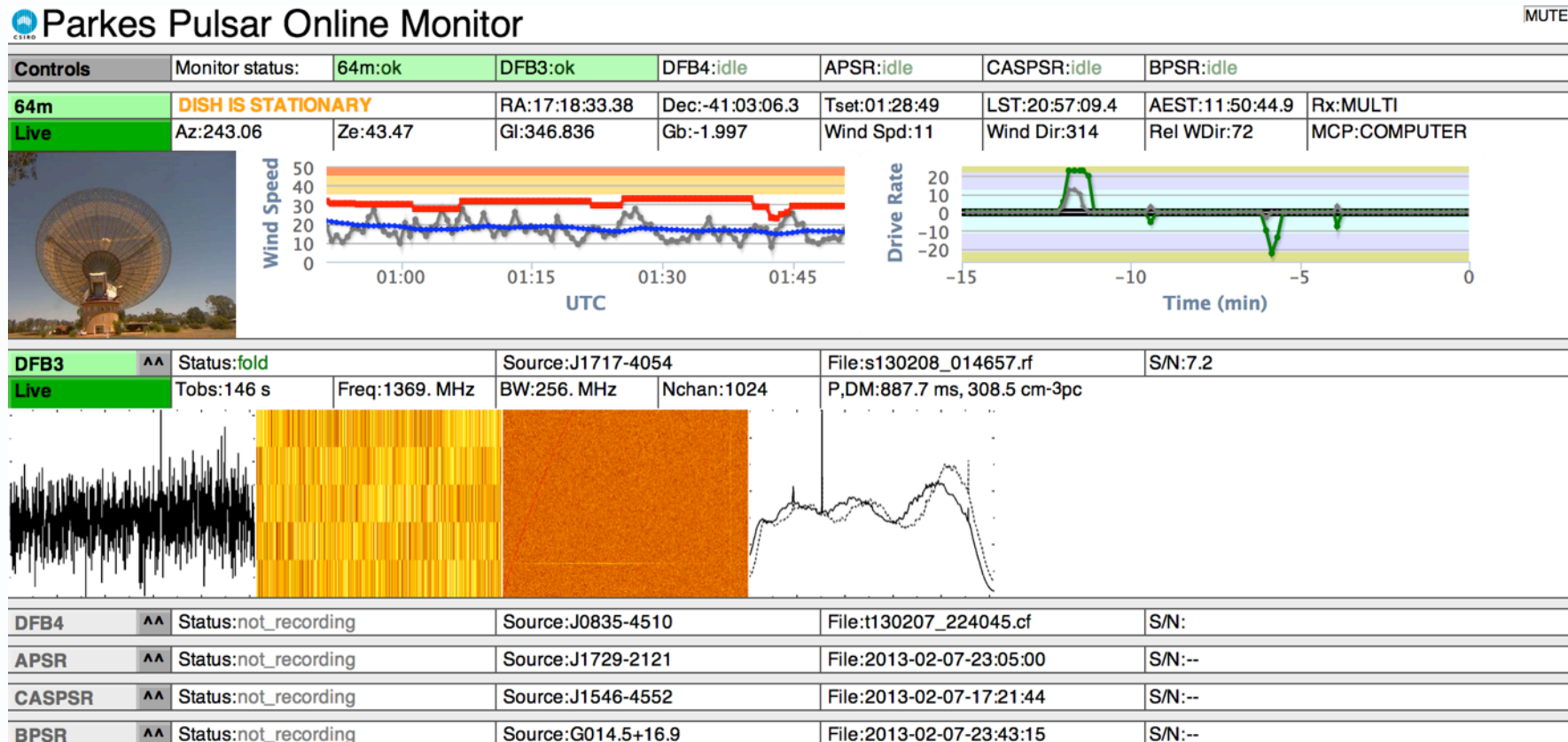
UTC	Alarm Name	Priority	Guidance	Acknowledge	Ignore
No alarms.					

SOC Observing



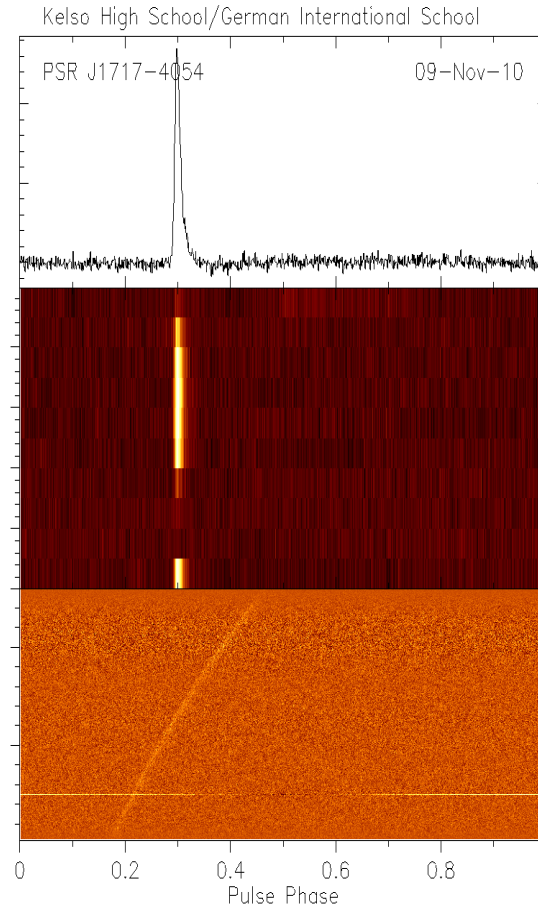
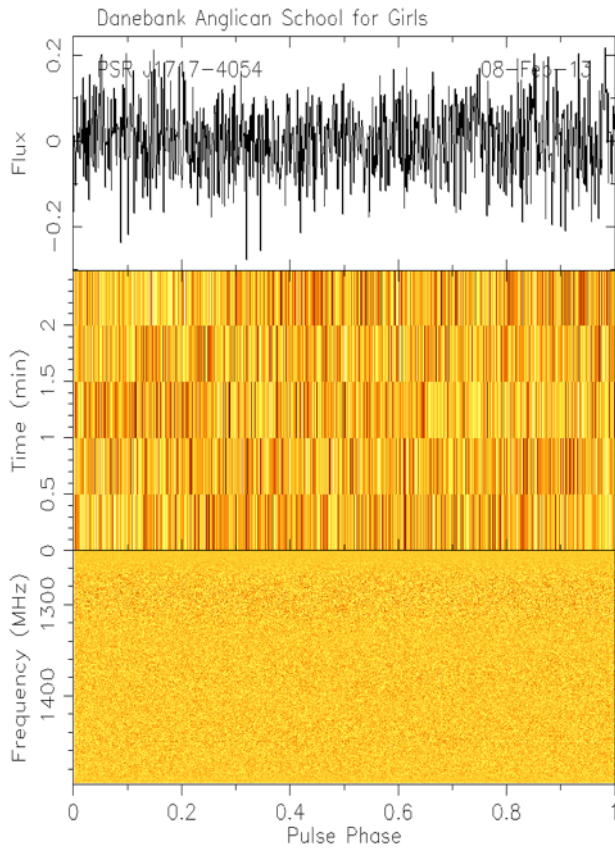
Live Web-based Data Monitor

<http://www.parkes.atnf.csiro.au/online/psrmon/>



Also includes live webcam

Seeing pulsars in “real time”



Interacting with PhD students





Process their own data

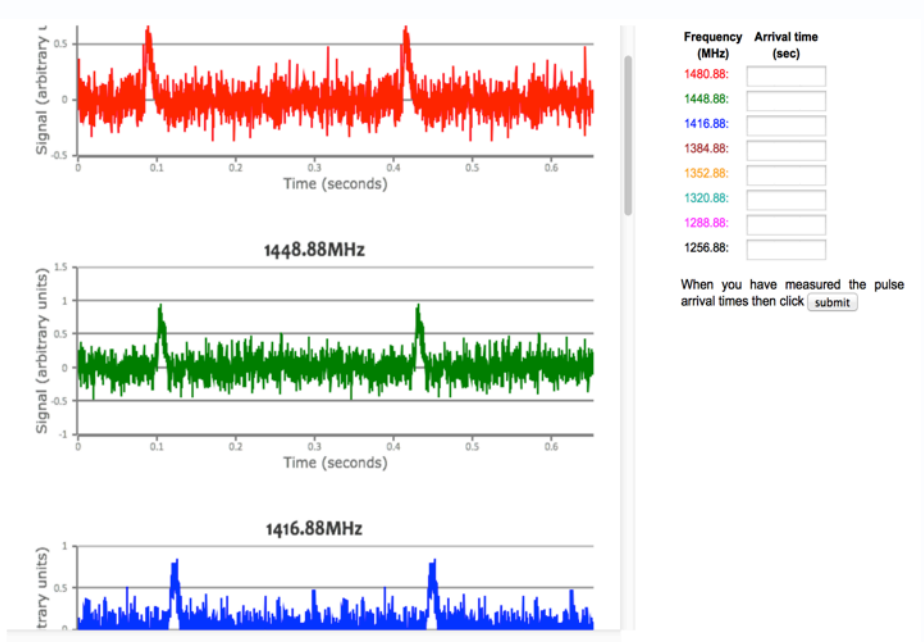
1. Student data available on web within a few minutes of the observation
2. Use their data to determine the distance to their pulsar
3. Have a go ...
<http://pulseatparkes.atnf.csiro.au>
 “measure a distance to your pulsar”

85	23-May-14	Kirrawee High School
84	20-May-14	Tara Anglican School for Girls
83	8-Apr-14	MNBCS Balgowlah Boys' Campus

Pulsar observations

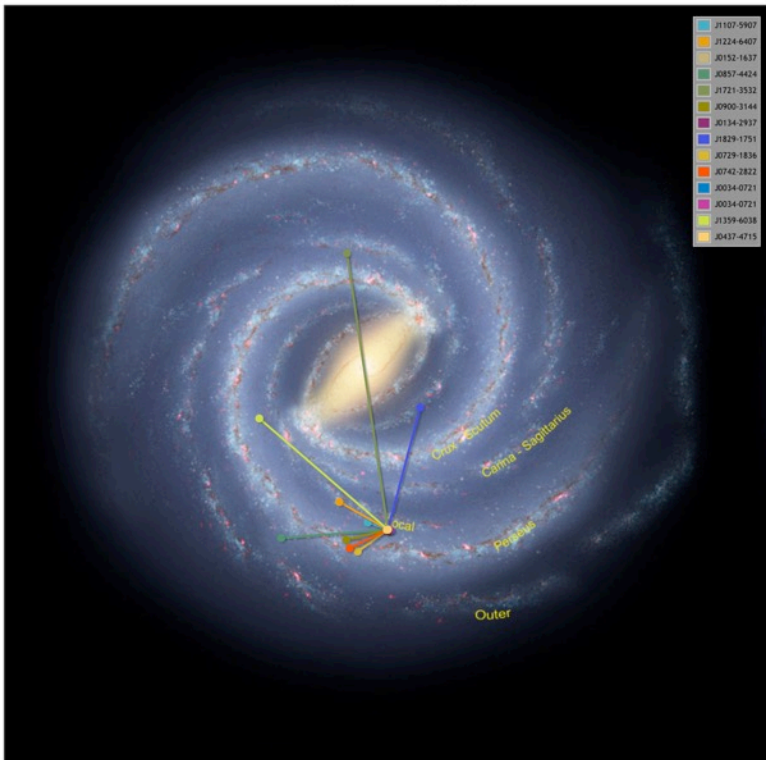
Use the mouse to scroll left and right in this table. Click on a pulsar name to see all observations of that pulsar. Click on a number to see the observations made of a pulsar by a specific school group.

PSR J (# obs)	28-Sep-14	16-Sep-14	29-Jul-14	24-Jul-14	23-May-14	20-May-14	8-Apr-14	25-Mar-14	13-Mar-14	20-Feb-14	05-Dec-13	07-Nov-13	05-Nov-13	24-Oct-13	13-Sep-13	29-Aug-13	09-Aug-13	24-Jul-13	25-Jun-13	26-May-13	25-May-13	19-May-13	18-May-13	17-May-13	22-Mar-13	01-Mar-13	
J0006+1834 (7)							2	1																			
J0034-0721 (37)					7	7	2	2																		1	
J0108-1431 (24)	2			1	3	2		1																			
J0134-2937 (30)	2			1	3	4	2															1			2		
J0152-1637 (25)	4			1	2	2	2	1														1			1		



Get a sense of the scale of our galaxy

Pulsar positions in our galaxy



Pulsar	Your distance (light years)	Actual distance (light years)	How close are you? (light years)	Error in determination (percent)
J0857-4424	20000	20041	-41	0.20 percent
J0452-1759	4300	4336	-36	0.83 percent
J1359-6038	32000	31916	84	0.26 percent
J1543-0620	2000	1999	1	0.05 percent
J1721-3532	54000	53898	102	0.19 percent



Being part of “real” science

1. Observations carried out with world-leading instruments.
2. Data can be used for research science by professionals
3. All data public (data.csiro.au)
4. Currently 1 refereed, research paper (on pulsar intermittency) using PULSE@Parkes data. More to come.
Kerr, M *et al* MNRAS vol 445, pp320-329, 2014
5. Data also used (and published) as part of the PPTA project and observations of gamma-ray pulsars.

What we have learned from the project

1. Real data and interfaces are strong motivators
2. Astronomers & educators need to collaborate
3. Pulsars provide quick results, ideal radio astronomy example
4. Student interactions with scientists and university students are a vital and integral component of program
5. Students like to know that there are unsolved problems
6. Very effective as capability demonstrator and ambassadorial role

What next for PULSE@Parkes?

1. Continue & expand observing sessions – new telescopes?
2. Refine remote sessions to increase accessibility
3. More online modules
4. Sandbox & resources for open-ended student investigations
5. More detailed teacher training/collaboration
6. Develop collaboration with PSC and other groups
7. Explore, develop and expand undergraduate training resources
8. Better evaluation



ASKAP



SKA



Keeping in touch

1. <http://pulseatparkes.atnf.csiro.au>
2. Project lead: robert.hollow@csiro.au
3. Science lead: george.hobbs@csiro.au
4. Twitter: [@PULSEatParkes](https://twitter.com/PULSEatParkes)



follow us on
twitter



Our products

- Website: <http://pulseatparkes.atnf.csiro.au/>
(upgrade coming soon!)
- Data archive:
<http://pulseatparkes.atnf.csiro.au/database>
- Distance analysis module:
<http://pulseatparkes.atnf.csiro.au/pulsardistance/>
- Pulsar online monitor – real time data:
<http://www.parkes.atnf.csiro.au/online/psrmon/>

Invitation to Try it Out

Hands-on session Tuesday 11 Aug,
10am-12pm on Australian Astronomy
booth.

COME ALONG!

Thank you

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