

# Pulsar Observation Planning

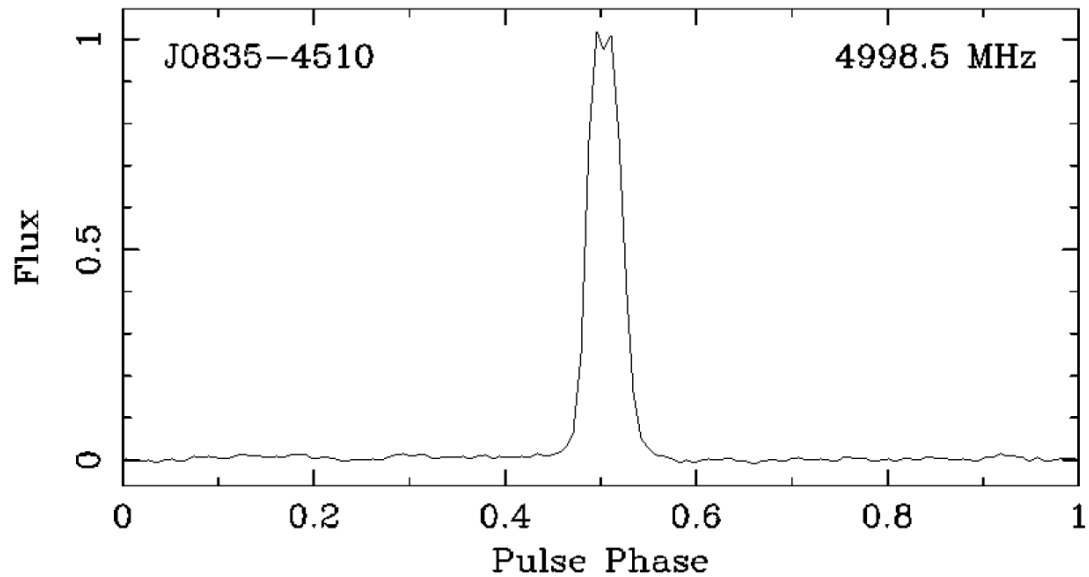
## Exercise

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DARA Unit 2/3 Training

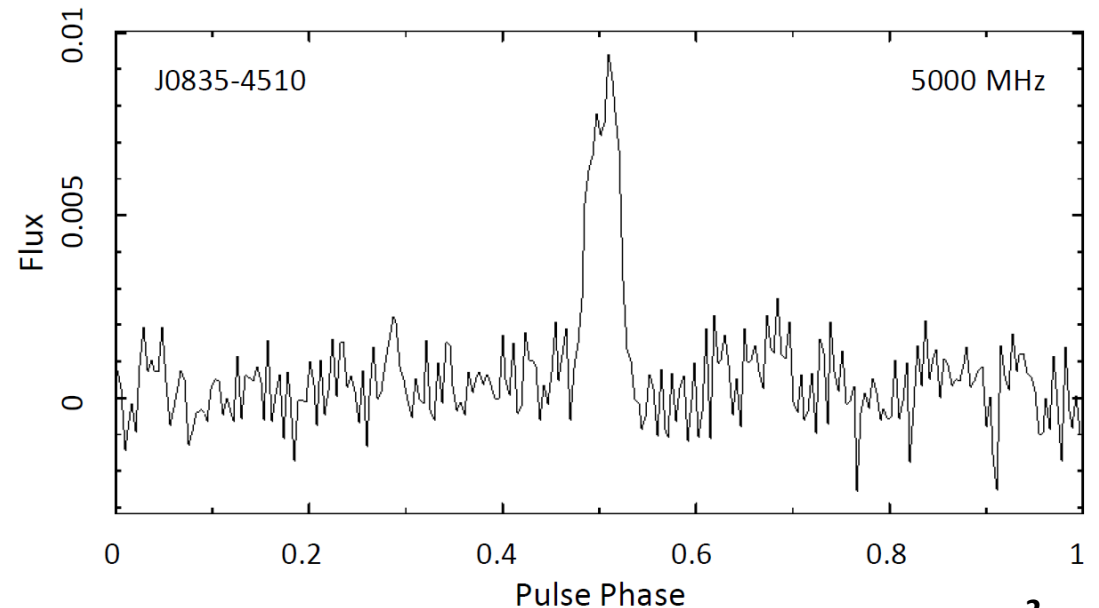
Ghana, 7<sup>th</sup> June 2021

# Pulse Profiles for PSR J0835-4510 (Vela)

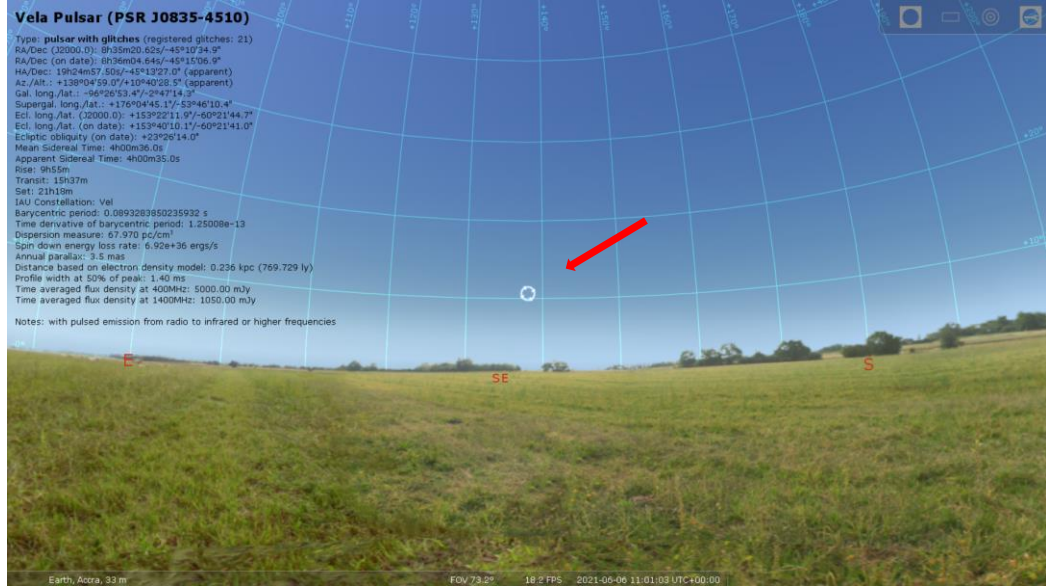


Example profile for Vela from the EPN database of pulsar profiles. The profile was recorded in 1998 at Parkes Observatory by Johnston et al. (1998) at 4998MHz.

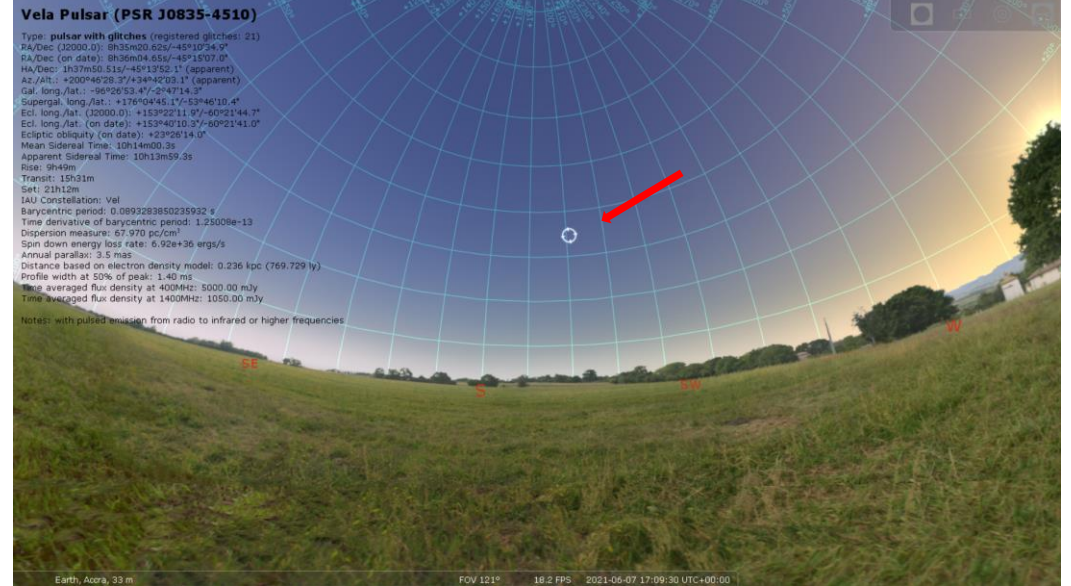
Pulse profile for Vela recorded at Kuntunse in 2018. The profile from a 61 minute observation at 5GHz with a bandwidth of 75 MHz.



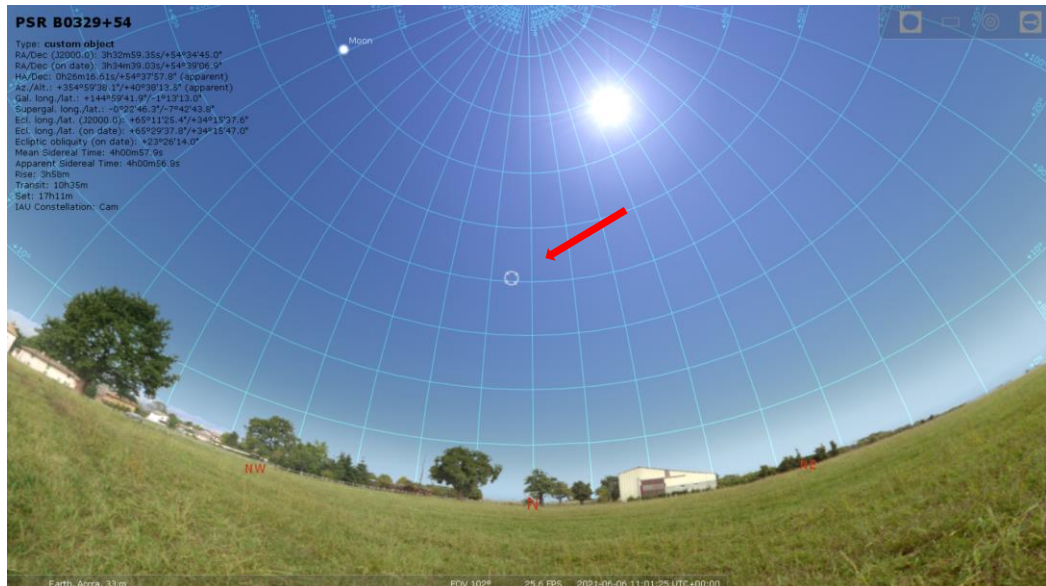
# Where is the object to be observed?



PSR  
 J0322+5434  
 at 11:00 and  
 17:00 GMT  
 Kuntunse 7<sup>th</sup>  
 June 2021



PSR  
 J0322+5434  
 at 11:00 and  
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 June 2021



# Parameters

## What are the key parameters for a Pulsar Observation?

### Pulsar Target:

- $S_{psr}$ : Strength of the radio signal from the pulsar in Janskys (Watts per square meter per Hz)
- $P$ : Pulse Period in seconds
- $W$ : Pulse width in seconds

### Telescope:

- $T_{sys}$ : System temperature, a measure of the background noise level of the telescope in degrees Kelvin (K)
- Gain: proportional to the size (collecting area) of the telescope dish and the performance of the amplifier (K per Jansky)
- $n_{pol}$ : Number of polarisations observed (generally 2)
- $B_w$ : Bandwidth of the receiver in MHz

### Variable parameters:

- $T_{int}$ : Integration time or duration of the observation in seconds
- $S/N$ : Signal to Noise ratio, how much of a signal do we need for a detection?

# Integration Time Calculation

The observing time required to achieve a specific Signal to Noise ratio can be calculated using the radiometer equation (Dicke 1946).

- As we do not receive radio emissions for the whole of the pulsar period a duty cycle correction,  $\sqrt{W/(P-W)}$ , is used to adapt the basic radiometer equation for pulsar observations
- Ignoring the effects of Radio Frequency Interference (RFI) on the noise floor ( $T_{sys}$ ).

$$T_{int} = \left( \frac{T_{sys}(S/N)}{GS_{psr}\sqrt{n_{pol}B_w} \sqrt{\frac{W}{P-W}}} \right)^2$$

# Exercise

**Table 1**

Pulsar Name	Flux Density @ 5GHz (mJy)	Period (seconds)	Pulse width (milliseconds)	
A) J0835-4510	201	0.089328	1.4	Vela - Brightest Pulsar
B) J0332+5434	26.5	0.714520	6.6	Brightest in Northern hemisphere

**Table 2**

$T_{\text{sys}}$	$n_{\text{pol}}$	Gain	Bandwidth	S/N
125	2	0.17	100	10

Fill in (or plot) Table three and repeat with different values for  $T_{\text{sys}}$  and Bandwidth

**Table 3**

Pulsar	S/N 10	S/N 30	S/N 50	S/N 100	S/N 300
A) J0835-4510					
B) J0332+5434					