Phase Prediction: A Comparative Analysis with Observations

Observation Parameters for the Pulsar

Pulsar 1

- ➔ PSR1: B1702-19
- ➔ Observation start time 1: IST Time: 10:42:04.485276160
- ➔ Observation start time 2: IST Time: 11:15:12.249827840
- ➔ Duration of observation : 15 min
- ➔ Frequency of Observation : 550.049

Pulsar 2

- ➔ PSR2: B1929+10
- ➔ Observation start time 1:IST Time: 10:32:31.375577600
- ➔ Observation start time 2:IST Time: 11:05:27.060533760
- ➔ Duration of observation : 5 min
- ➔ Frequency of Observation : 550.049

gptool folding output info

Pulsar: J1705-1906

Start time 1
- Pulsar period: 298.972322035 ms 298.972370317 ms
- Dispersion measure: 22.90719223 pc/cc
- Number of bins in folded profile: 3650
- Phase of pulsar profile will be offset by 0
- Polyco based folding to be performed using tempo2.
- MJD of observation is 60327.216718579576991
- Number of coefficients generated for each span: 12
- Validity of each span: 60 mins
- Maximum Hour Angle: 12

Start time 2
- Pulsar period: 298.972370317 ms
- Dispersion measure: 22.90719223 pc/cc
- Number of bins in folded profile: 3650
- Phase of pulsar profile will be offset by 0
- Polyco based folding to be performed using tempo2.
- MJD of observation is 60327.239725113751774
- Number of coefficients generated for each span: 12
- Validity of each span: 60 mins
- Maximum Hour Angle: 12

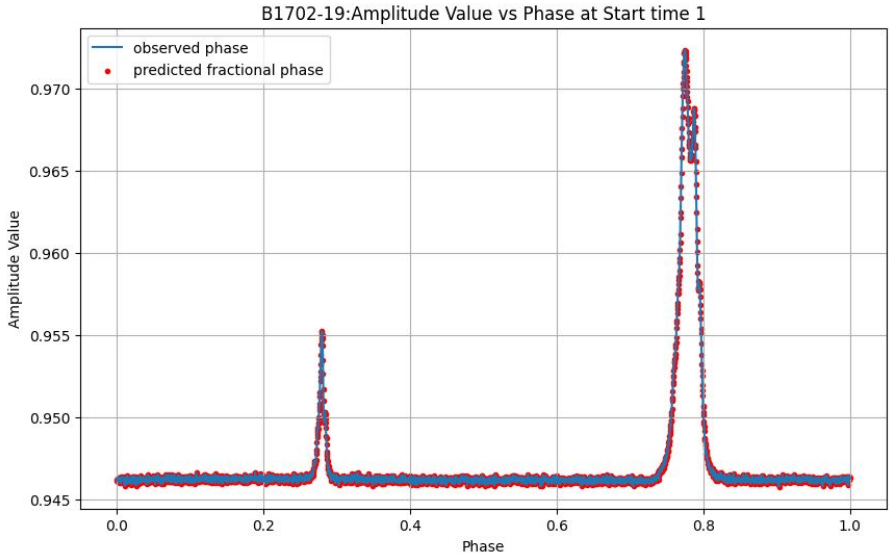
Pulsar: J1932+1059

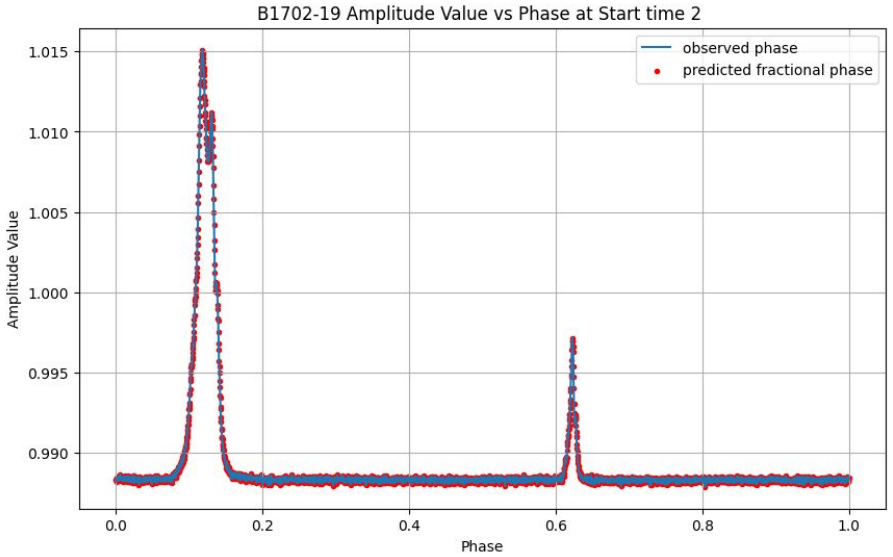
Start time 1
- Pulsar period: 226.518864569 ms
- Dispersion measure: 3.183446884 pc/cc
- Number of bins in folded profile: 2765
- Phase of pulsar profile will be offset by 0
- Polyco based folding to be performed using tempo2.
- MJD of observation is 60327.210085365477426
- Number of coefficients generated for each span: 12
- Validity of each span: 60 mins
- Maximum Hour Angle: 12

Start time 2
- Pulsar period: 226.518900236 ms
- Dispersion measure: 3.183446884 pc/cc
- Number of bins in folded profile: 2765
- Phase of pulsar profile will be offset by 0
- Polyco based folding to be performed using tempo2.
- MJD of observation is 60327.232952089507307
- Number of coefficients generated for each span: 12
- Validity of each span: 60 mins
- Maximum Hour Angle: 12

Comparison of Observed Pulse Phase and Predicted Phase

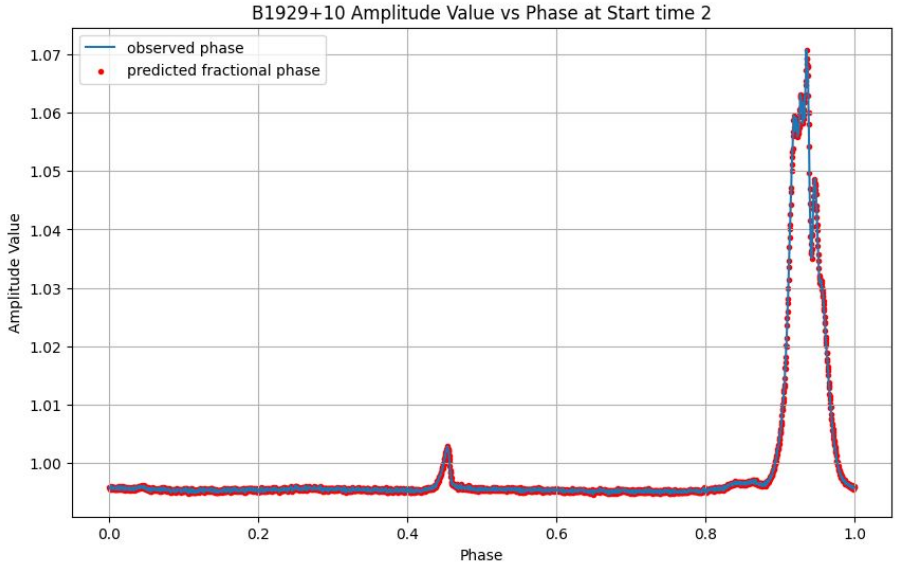
Pulsar 1

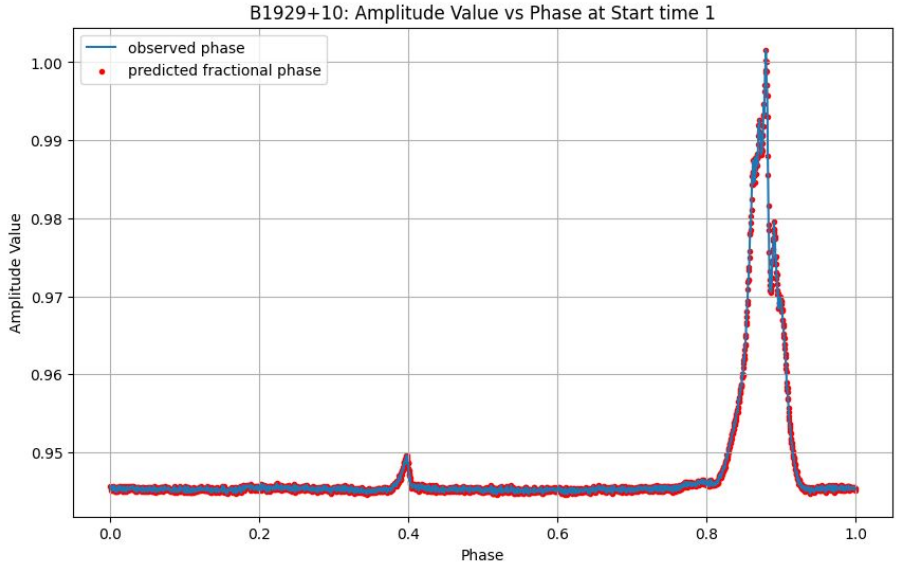




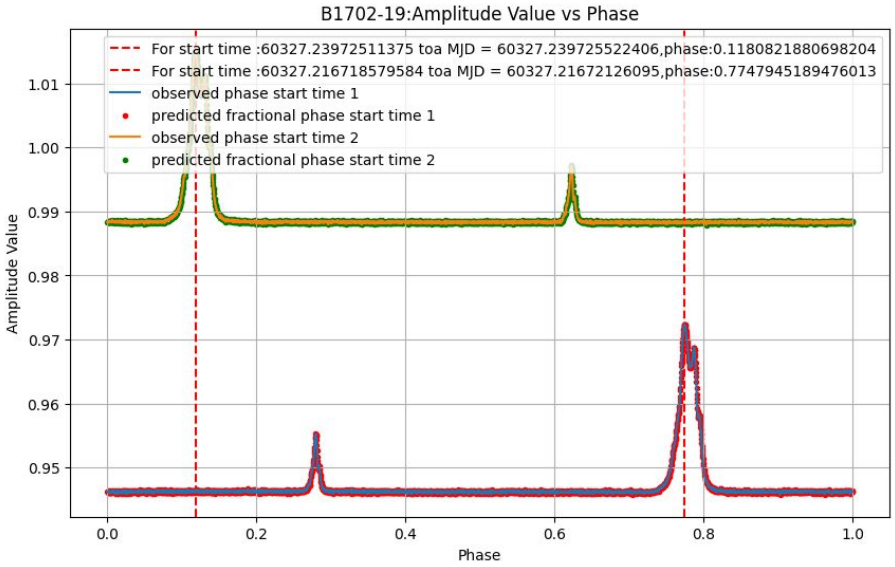
Comparison of Observed Pulse Phase and Predicted Phase

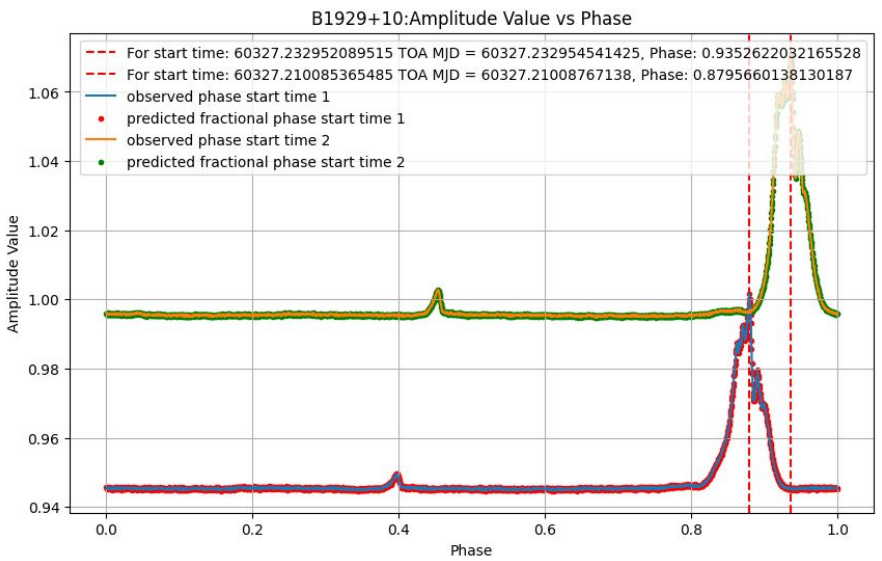
Pulsar 2





Observed TOAs





The observed TOAs for both the pulsars at the respective start times

Predicted Phase at Observed TOAs

Pulsar 1

TOA Observed	Observed Phase at TOA	Predicted Phase at TOA
At Start time1: 60327.21672126095	0.7748985290527344	0.7747945189476013
At Start time2: 60327.239725522406	0.11809873580932617	0.1180821880698204

Pulsar 2

TOA Observed	Observed Phase at TOA	Predicted Phase at TOA
At Start time1: 60327.21008767138	0.8795660138130187	0.8795280456542969
At Start time2: 60327.232954541425	0.9352622032165528	0.9352213144302368

Summary:

The algorithm aims to predict the Time of Arrival (TOA) and its corresponding phase for a pulsar based on a known TOA and phase value at a previous observation time. The TOA is defined as the phase bin in the observed pulse with the maximum amplitude. The objective is to predict the TOA and phase at TOA for the next observation time and compare the predicted values with the observed ones.

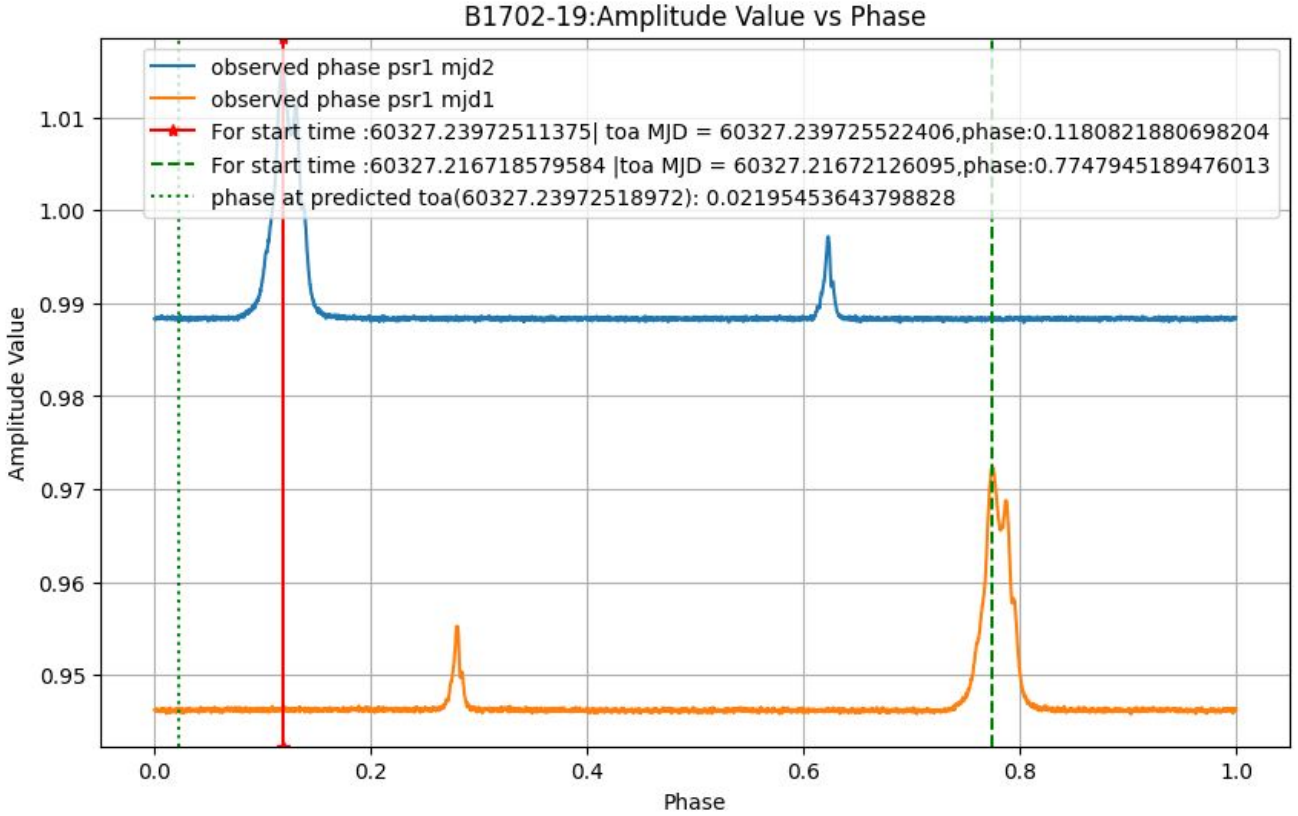
Problem Statement:

Given an initial TOA and its corresponding phase, along with various parameters such as the pulsar's rotation frequency (f0), polyco coefficients (coeff1, coeff2, coeff3), and the time span between observations, the code predicts the TOA and phase for the next observation time

Methodology:

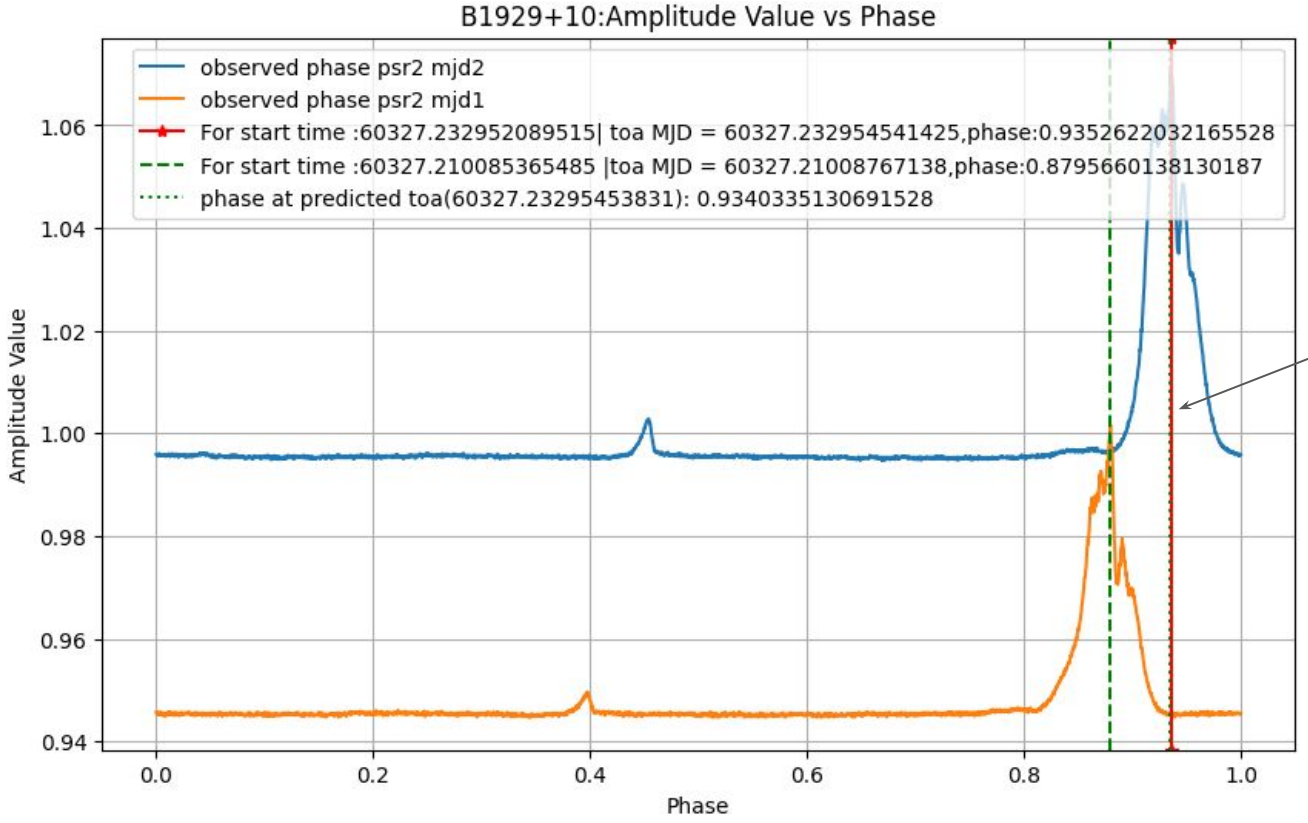
1. Initialize the starting observed TOA
2. Define initial phase : phase at start time 2
3. Estimate the number of rotations the pulsar undergoes during the time span between observations.
4. Iterate through the estimated rotations, predict the phase and frequency of the pulsar using polyco definition.
5. Update the TOA, absolute phase, fractional phase, and time elapsed for each iteration.
6. Find the closest match to the start time 2 by comparing the calculated time elapsed with the actual time span between observations.(Assuming TOA is to be found in a time within the pulse period of the start time 2)
7. Print the predicted TOA and its corresponding absolute and fractional phases for the closest match.
8. Verify with observation.

Predicted TOA and it's phase at start time 2 for Pulsar 1



The dotted green line shows the **predicted TOA**

Predicted TOA and it's phase at start time 2 for Pulsar 2



Predicted and Observed TOA: Strong Agreement

The dotted green line shows the **predicted TOA**

All the files used for the present analysis have been uploaded to the github :

https://github.com/viren1408/Gated_imaging-/tree/main/Observation_Analysis