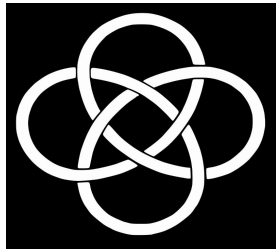


# Spectral & timing analysis of accretion powered millisecond X-ray pulsar MAXI J0911-655

## Advanced AstroSat Data Analysis Workshop 2023



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# Outline

1. Introduction
2. Observation Details
3. Spectral analysis
4. Timing analysis

# Source: MAXI J0911-655

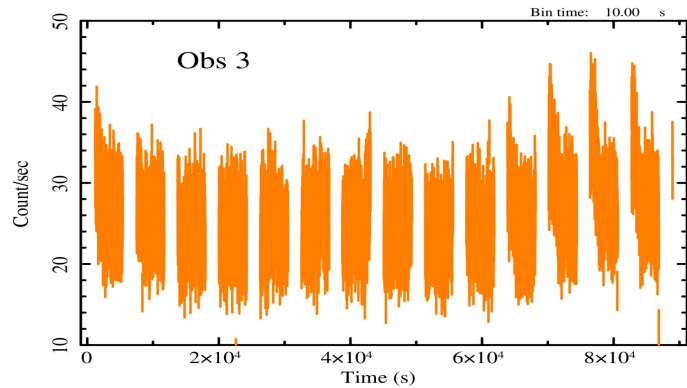
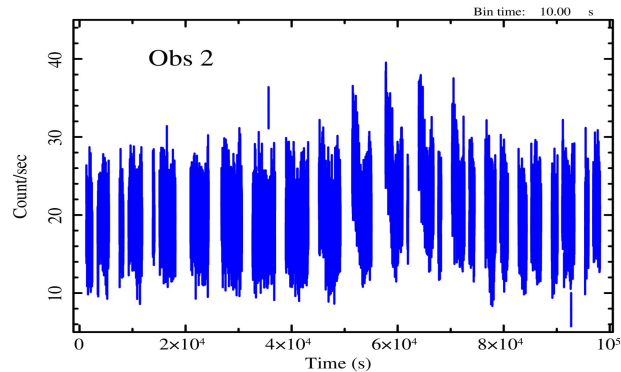
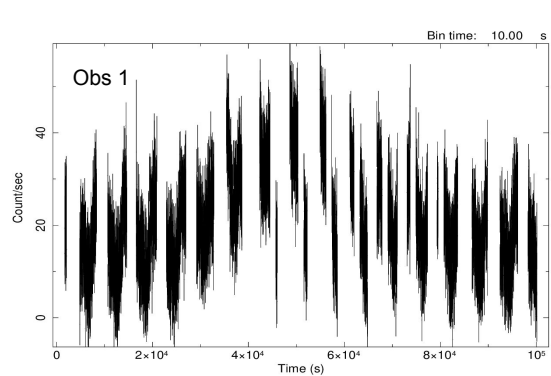
- ❖ It is an accretion powered millisecond X-ray pulsar and discovered on 2016-02-19 with MAXI/GSC. It has been analysed using XMM-Newton & NuSTAR and the characteristics are:
- ❖ Spin period : 2.9 ms
- ❖ Orbital period : 44.3 min
- ❖ Inclination angle  $< 75^\circ$
- ❖ Binary separation: 17.6 lt-ms
- ❖ RA =  $138.010125^\circ$  DEC= $-64.868444^\circ$
- ❖ Distance of the source = 9.6 kpc.

Ref : Discovery of a new accreting millisecond X-ray pulsar in the globular cluster NGC 2808, doi : [10.1051/0004-6361/201629406](https://doi.org/10.1051/0004-6361/201629406)

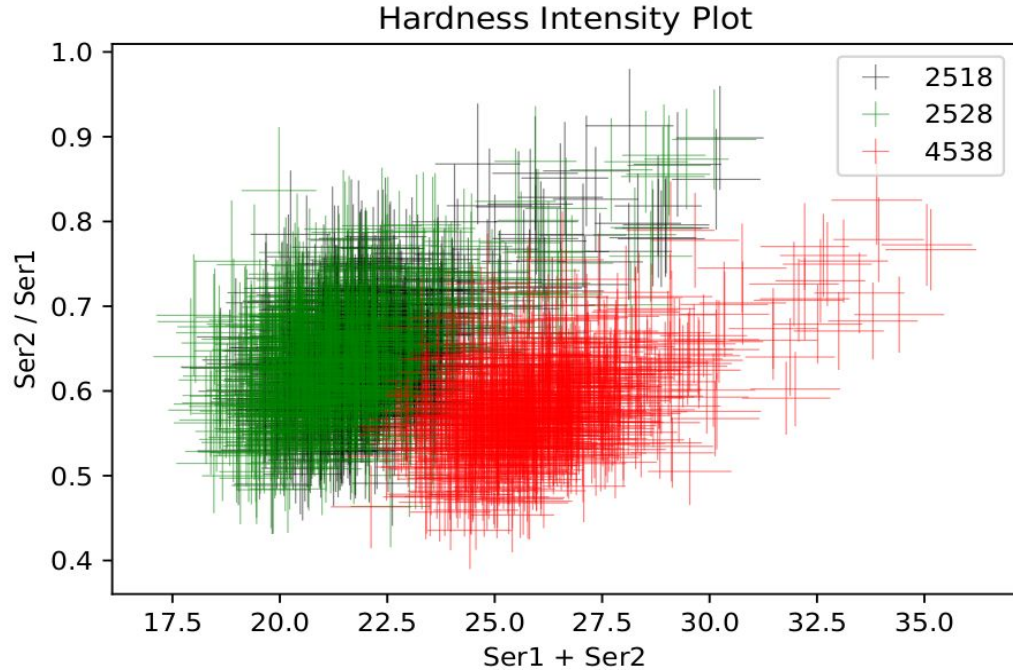
# Observation details of AstroSat:

Observation Id	Observation Date	Exposure time (LAXPC)	Exposure time (SXT)
20181115_A05_206 T01_9000002518 (Obs 1)	2018-11-15	50.93 ks	21.56 ks
20181120_A05_206 T01_9000002528 (Obs 2)	2018-11-20	54.53 ks	23.56 ks
20210714_T04_025 T01_9000004538 (Obs 3)	2021-07-14	57.34 ks	20.07 ks

# Light Curve:



# Hardness-Ratio Diagram:



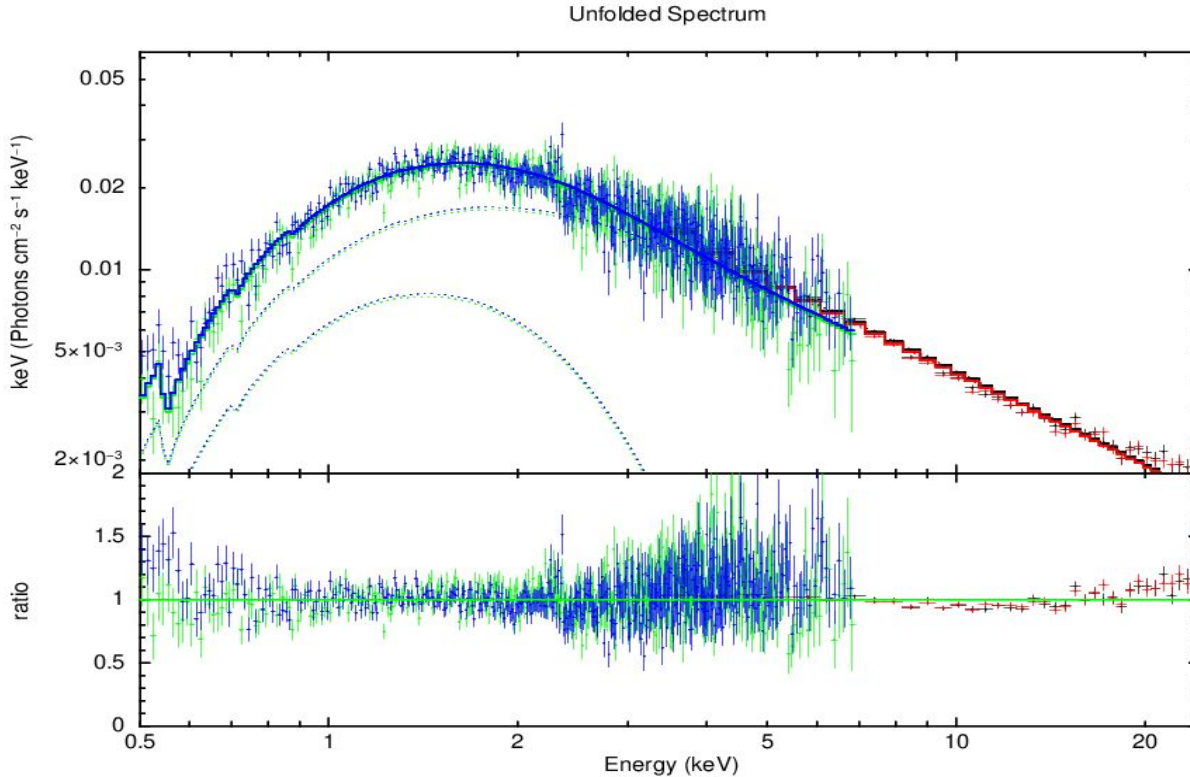
Ser1 : 3-8 keV (Soft Energy Band)

Ser2 : 8-20 keV (Hard Energy Band)

Bin Time : 16 sec

- 2518 and 2528 are in the same region.
- 4538 has a little higher in the intensity.
- Little difference in the spectral state.

# Spectral Analysis:



- **Joint LAXPC (3.0-25 keV) and SXT (0.5-6.0 keV) spectral fitting of observation 2518 and 2528**
- **Best Model**  
**const\*tbabs\*(bbodyrad+nth comp) model**
- **Blackbody temp ~ 0.43keV**  
**BBnorm ~ 85.48**  
**Electron temp ~ (100 keV)**
- **Reduced chi-square- 1.37**

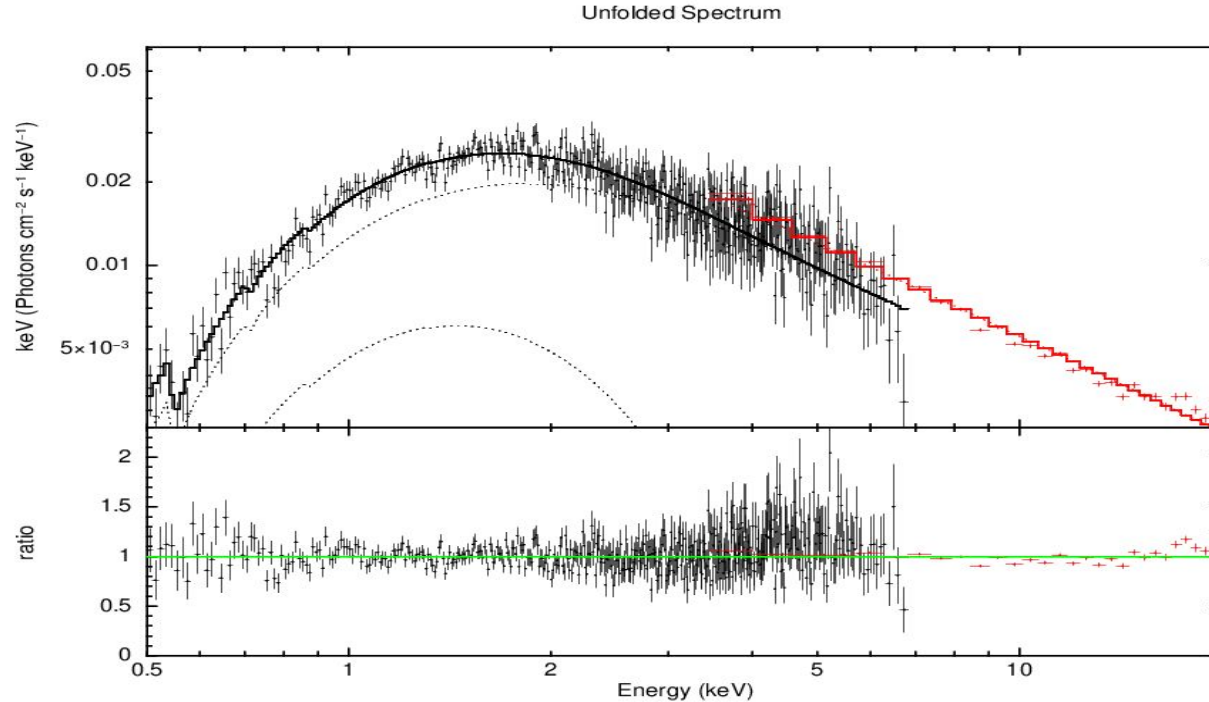
## Model Fit Parameters for joint fitting of Obs 2518 & 2528:

Model parameter	Component	Parameter	Unit	Value
1	TBabs	nH	$10^{22}$	0.21 (-0.02,0.03)
3	bbodyrad	kT	keV	0.43 (-0.01,0.02)
4	bbodyrad	norm		85.48 (-6.83,7.41)
5	nthcomp	Gamma		2.090 (-0.014,0.013)
6	nthcomp	kT_e	keV	(100.000)
7	nthcomp	kT_bb	keV	0.43 (-0.01,0.02)

Model: TBabs\*constant\*(bbodyrad+nthComp)  
Unabsorbed flux:3.09E-10 erg/cm2/s



# Spectral Analysis:



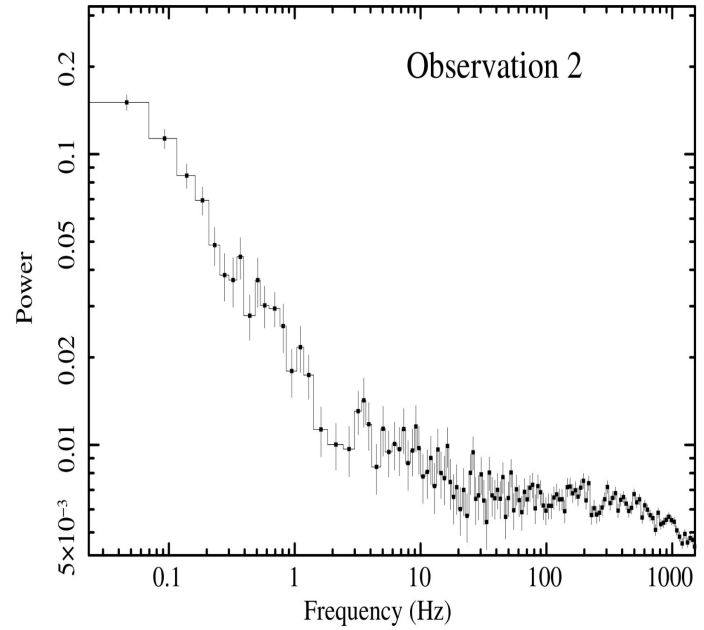
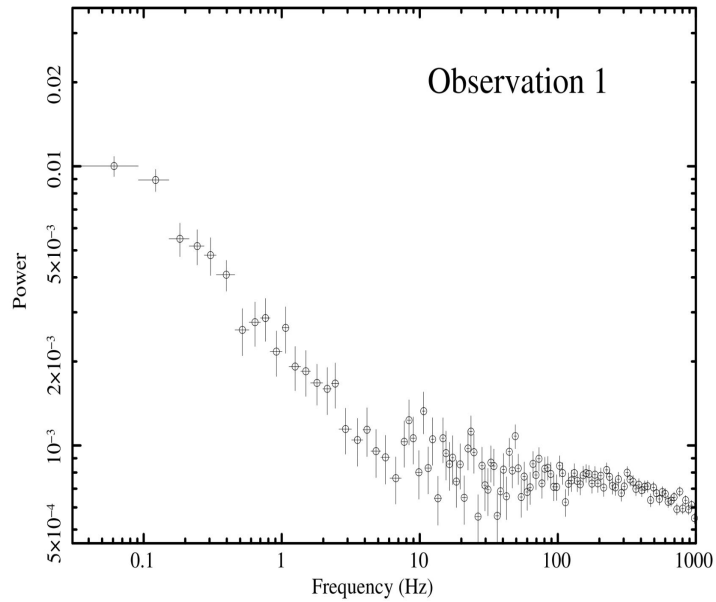
- Joint LAXPC (3.0-25 keV) and SXT (0.5-7.0 keV) spectral fitting of observation 4538.
- Best Model  $\text{const}*\text{tbabs}*(\text{bbodyrad} + \text{nthcomp})$  model
- Blackbody temp  $\sim 0.44\text{keV}$   
BBnorm  $\sim 85$   
Electron temp  $\sim (100\text{ keV})$
- Reduced chi-square- 1.47

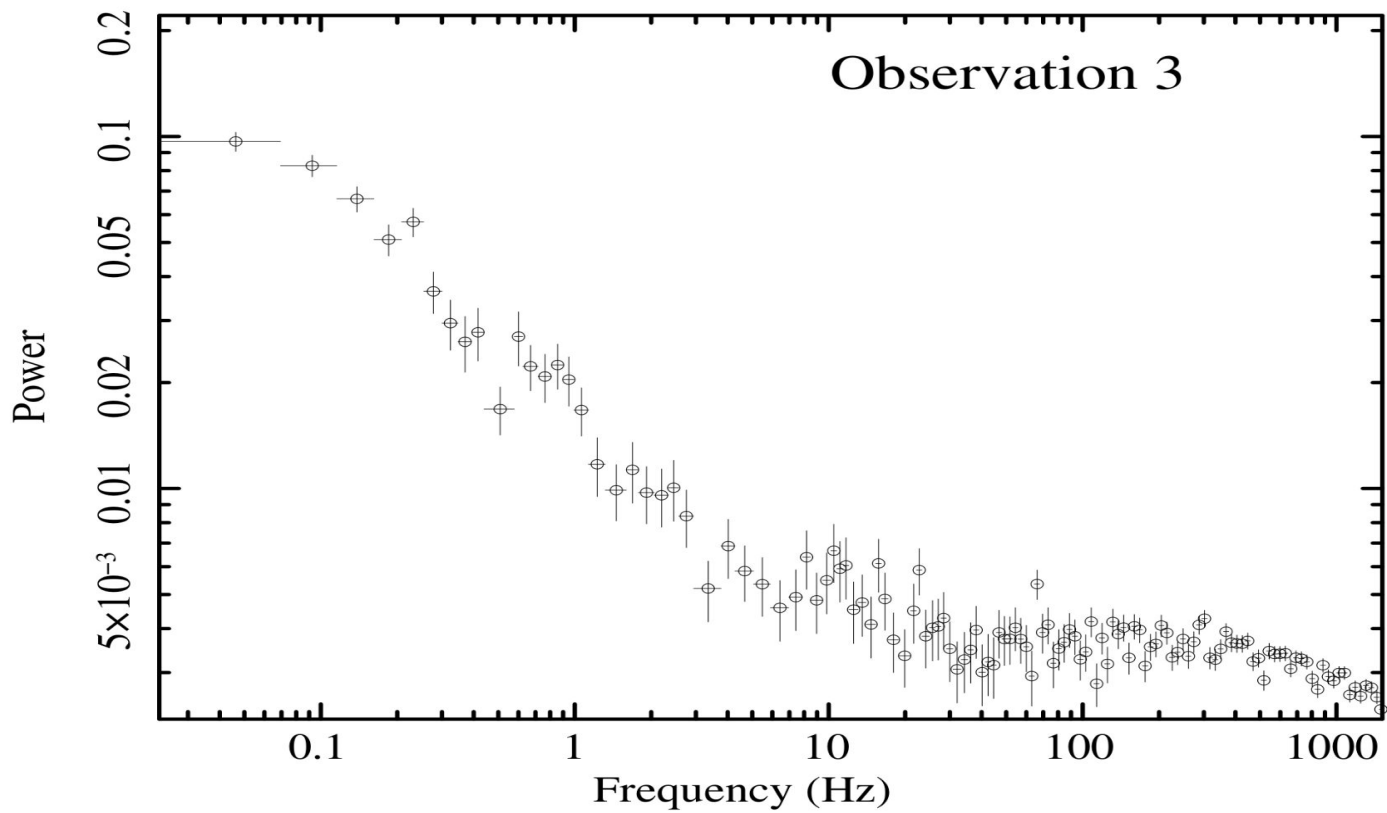
# Model Fit Parameters for Obs:4538

Model parameter	Component	Parameter	Unit	Value
1	Tbabs	nH	$10^{22}$	0.21 (-0.03,0.04)
3	bbodyrad	kT	keV	0.44 (-0.04,0.03)
4	bbodyrad	norm		54.85 (-10.71,7.79)
5	nthcomp	Gamma		2.10 (-0.02,0.01)
6	nthcomp	kT_e	keV	(100)
7	nthcomp	kT_bb	keV	0.44 (-0.04,0.03)

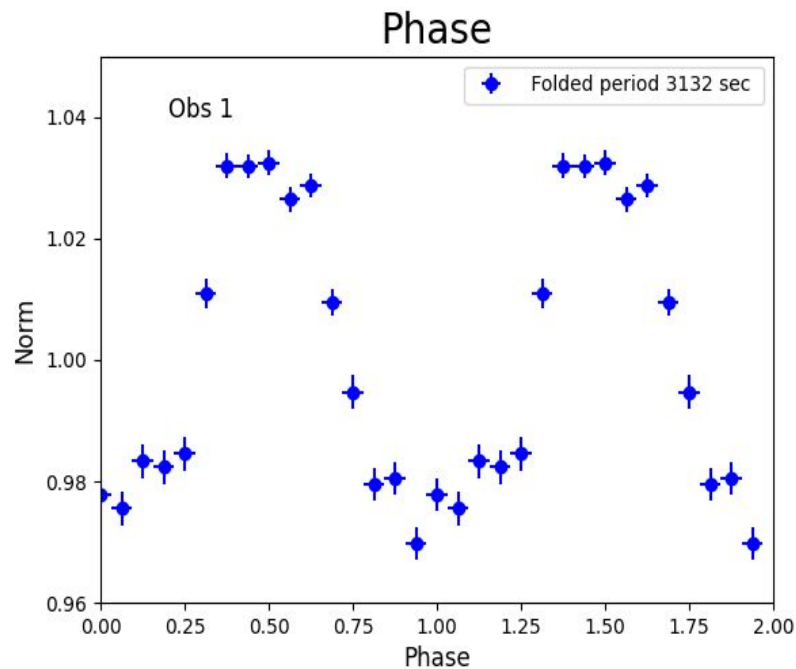
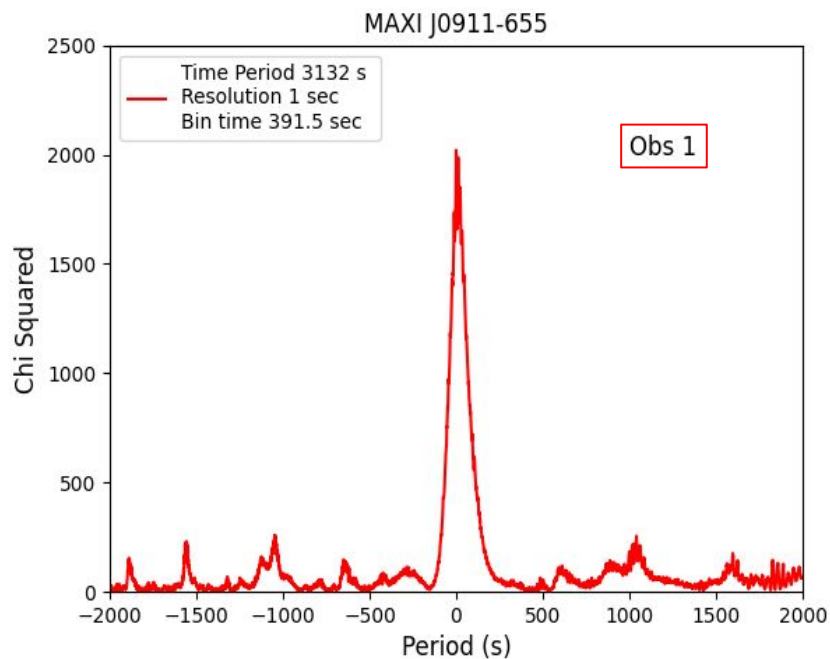
Model:TBabs\*constant\*(bbodyrad+nthComp)  
Unabsorbed flux:2.57E-10 erg/cm2/s

# Timing Analysis:

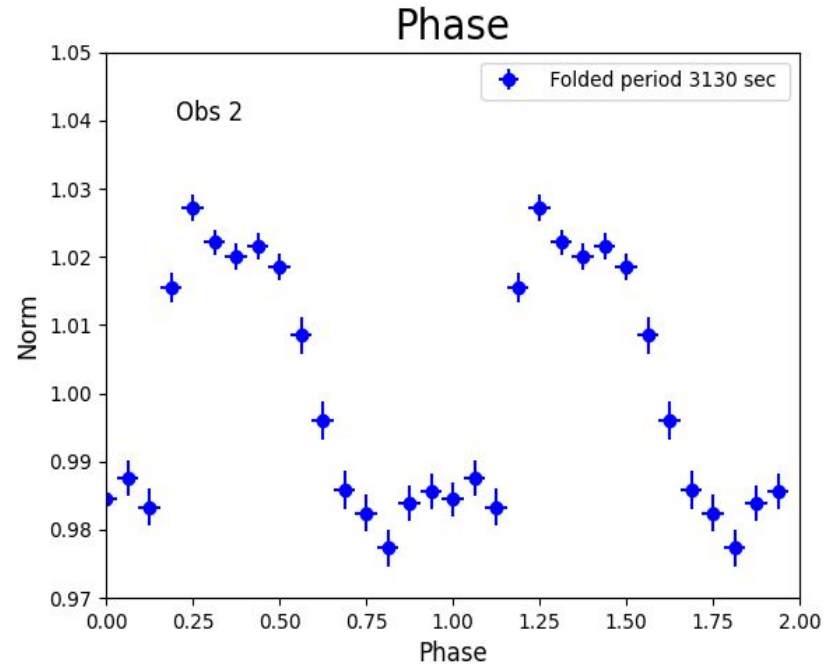
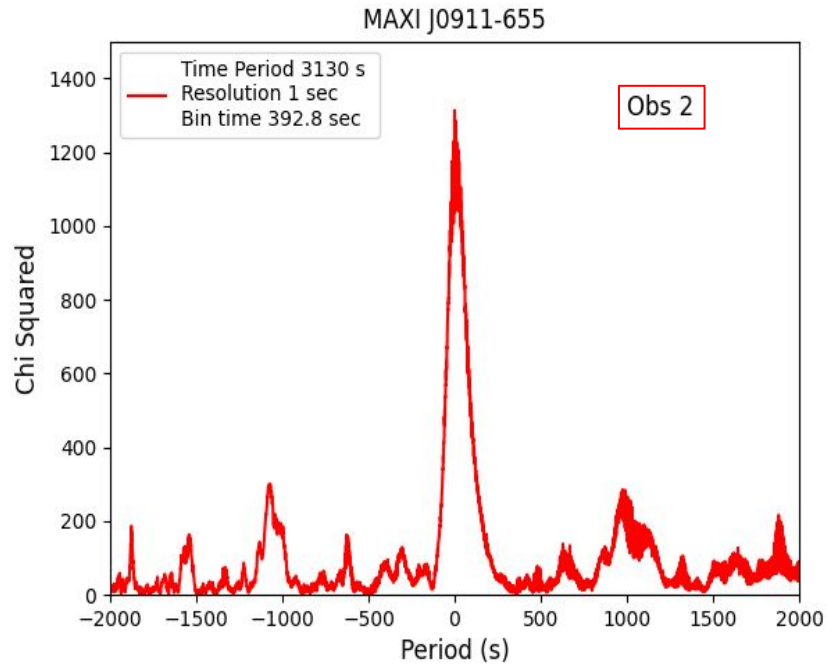




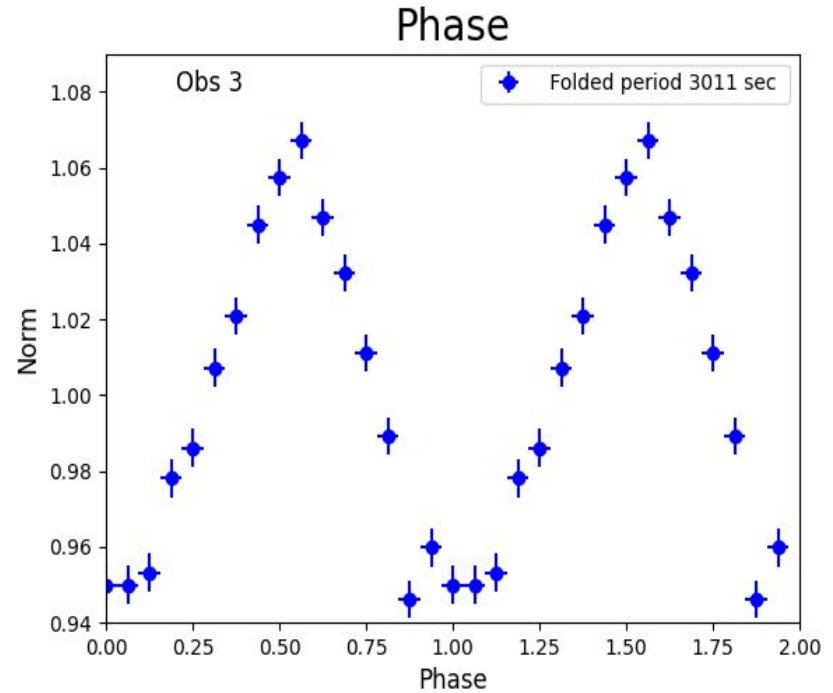
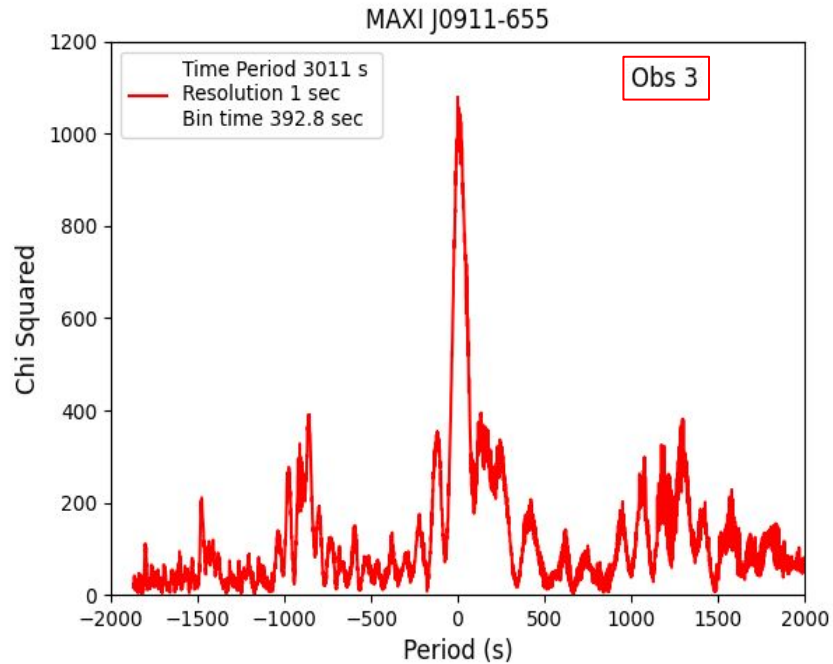
# Folded Light-curve:



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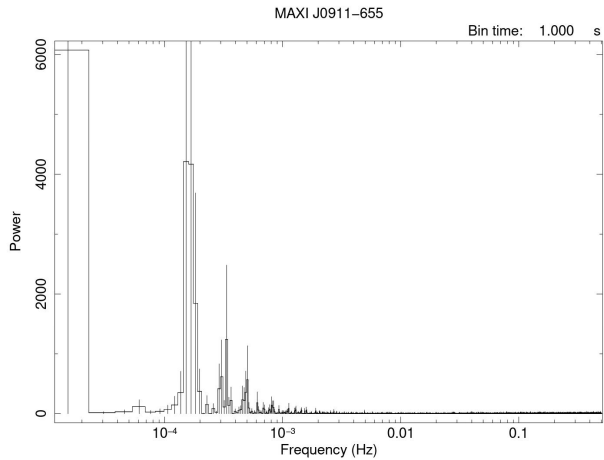


# Folded Light-curve :

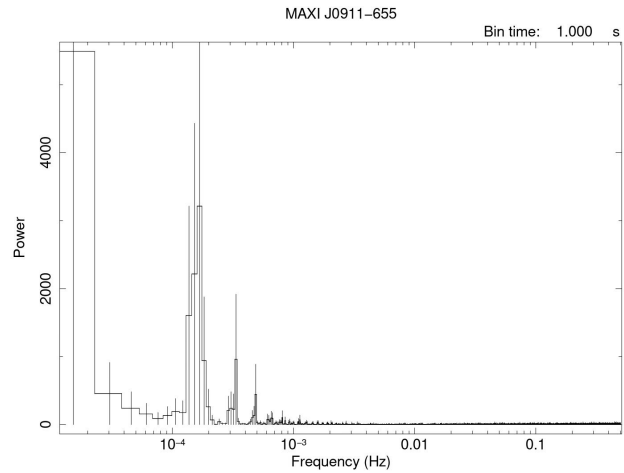


Thank You.

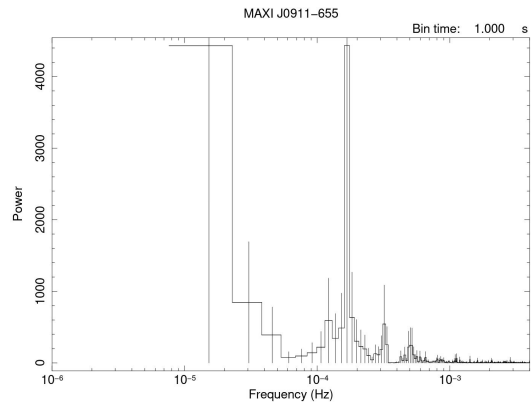




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Start Time 18442 9:20:09.005 Stop Time 18443 3:32:24.000



Start Time 19409 9:31:11.430 Stop Time 19410 3:43:26.424