आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES
(AN AUTONOMOUS INSTITUTE UNDER DST, GOVT. OF INDIA)

Confirmation of Two Magnetic Cataclysmic Variables as Polars: 1RXS J174320.1-042953 and YY Sex

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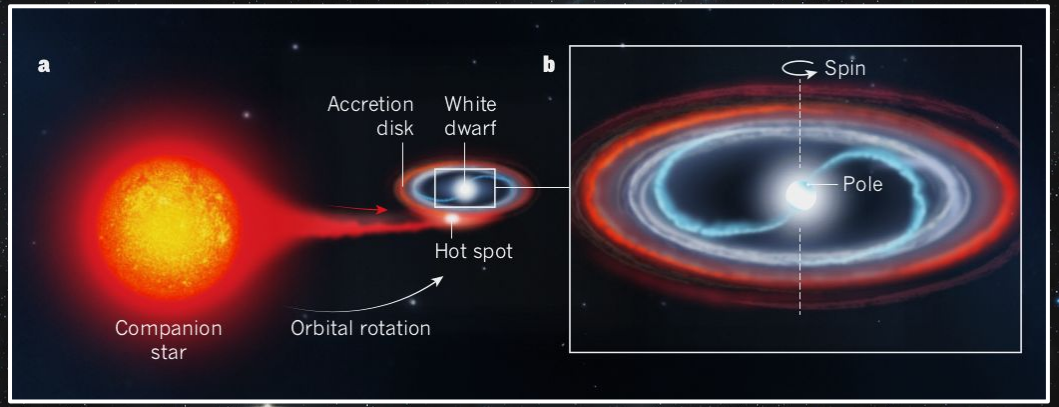
Magnetic Cataclysmic Variables

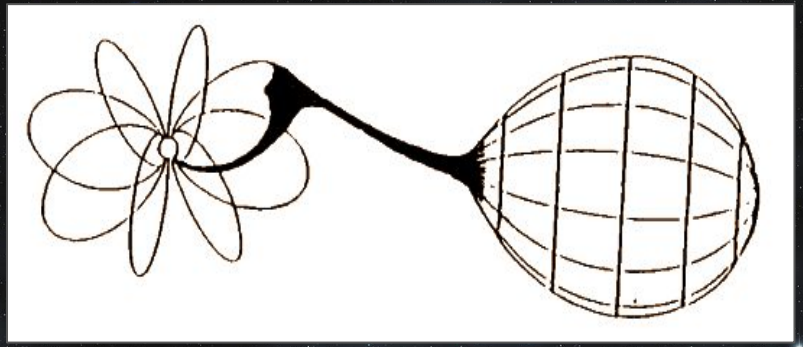
- Semi-detached binary systems.
- B > 1 MG.
- Strong X-ray emission and optical polarization.
- Accretion discs ??



Shore (2017)

Polars

- High magnetic field strength (B>10MG) subclass of magnetic cataclysmic variables (MCVs).
- Accretion discs do not form.
- Synchronous systems (Orbital period, P_{Ω}=spin period of the WD).



Cropper (1990)

Artistic illustration by Mark Garlick

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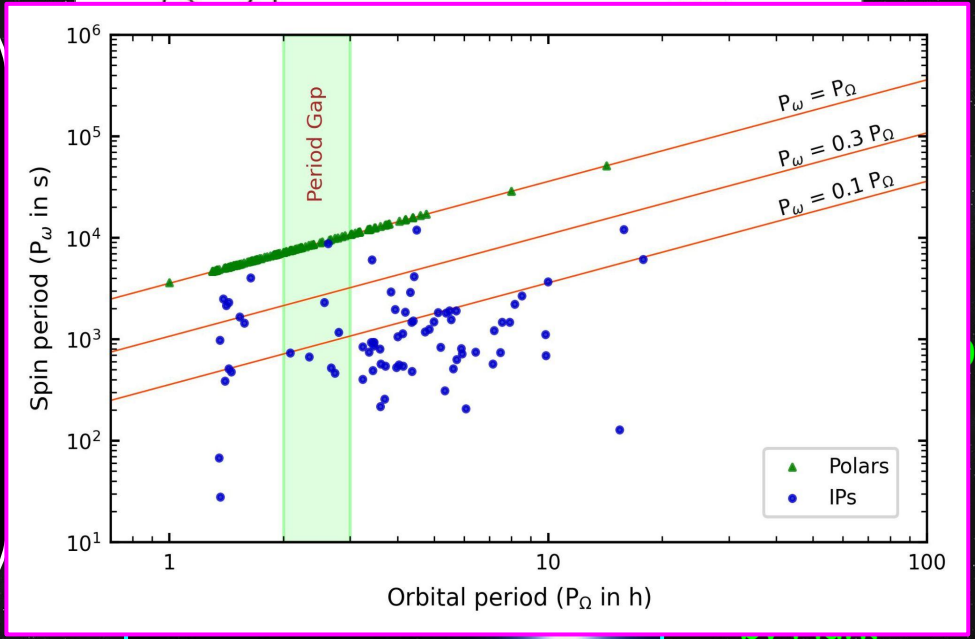


Garlick

Observational characteristics of Polars

- Distinctive brightness states (time scale: days to years).
- Only one periodicity in optical and X-ray bands.
- X-ray spectrum: multi-temperature optically thin plasma with sometimes an optically thick soft component.
- Optical spectrum: hydrogen Balmer emission lines, He I, He II 4686 Å, C III/N III blend at 4650 Å.
- Linear and circular polarization at optical wavelengths.

Why magnetic cataclysmic variables?

- 130 polars and 71 IPs (Ritter & Kolb, 2003; Ferrario et al., 2015)
- To understand the physics of magnetically controlled accretion.
- The characterization helps to understand these systems more deeply in terms of their evolution and accretion geometry.
- Improved number of statistics — evolution of MCVs, especially the relationship between IPs and polars.

Answers to these questions could emerge from enlarged samples of these scarce objects.

Targets under present study

1RXS J174320.1-042953 (hereafter J1743)

- P_{Ω}: 2.078(7) h (Denisenko & Sokolovsky (2011)
- IP candidate based on light curve features.
- Intense He II 4686 Å, H□, Hα lines in the optical spectrum (Oliveria et al. 2017).
- No previous X-ray study.

YY Sex

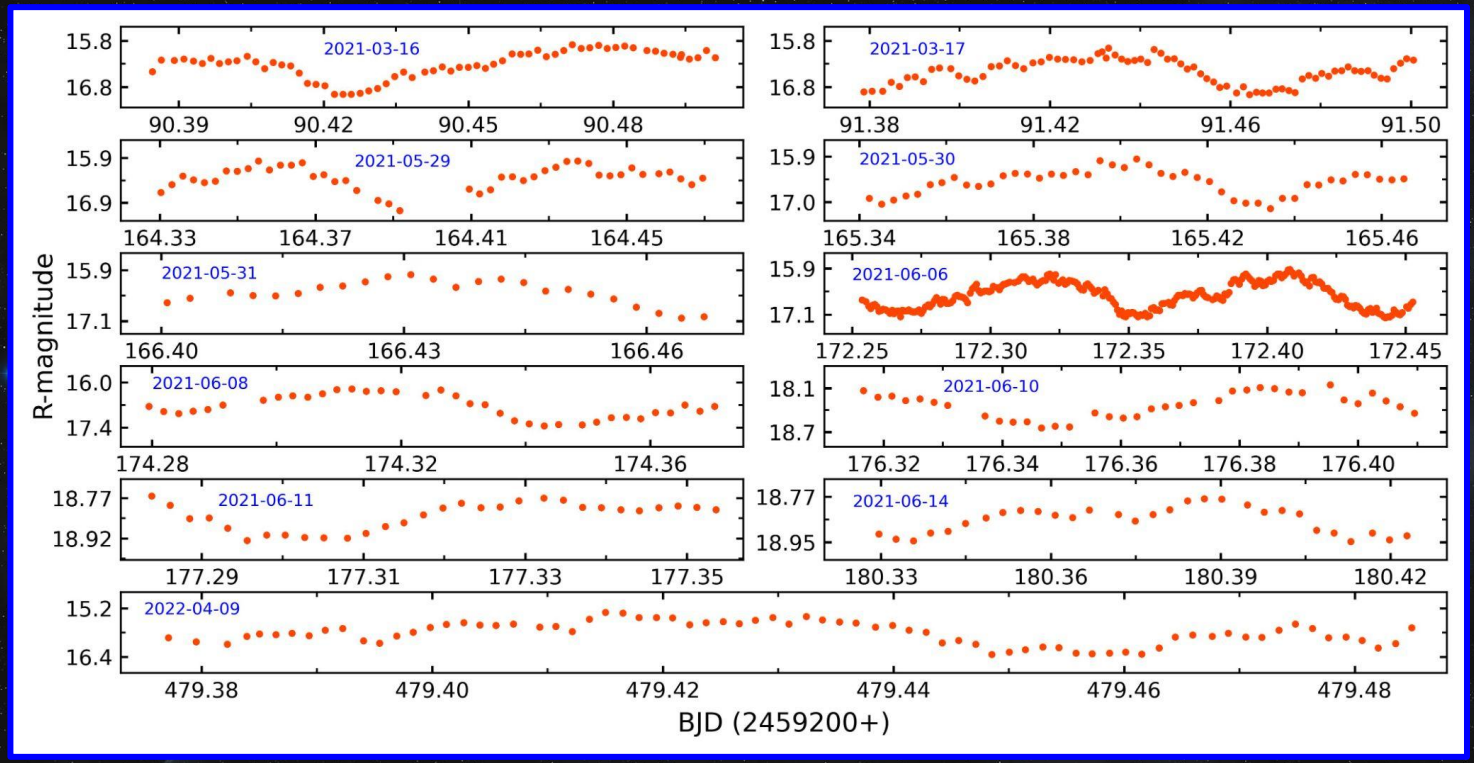
- P_{Ω}: 1.574 h and other periods: 1444 s and 1932 s (Woudt and Warner 2003)
- He II 4686 Å, Hydrogen Balmer lines in the optical spectrum (Gabdeev et al. 2017).
- No previous X-ray and polarimetric study.

Facilities used

- Photometry: 1.04m ST, 1.3m DFOT, 0.6m Zeiss-600NT, 1.5m AZT-22, and TESS
- Spectroscopy: 2m HCT
- Polarimetry: 1.9m SAAO
- X-ray: XMM-Newton

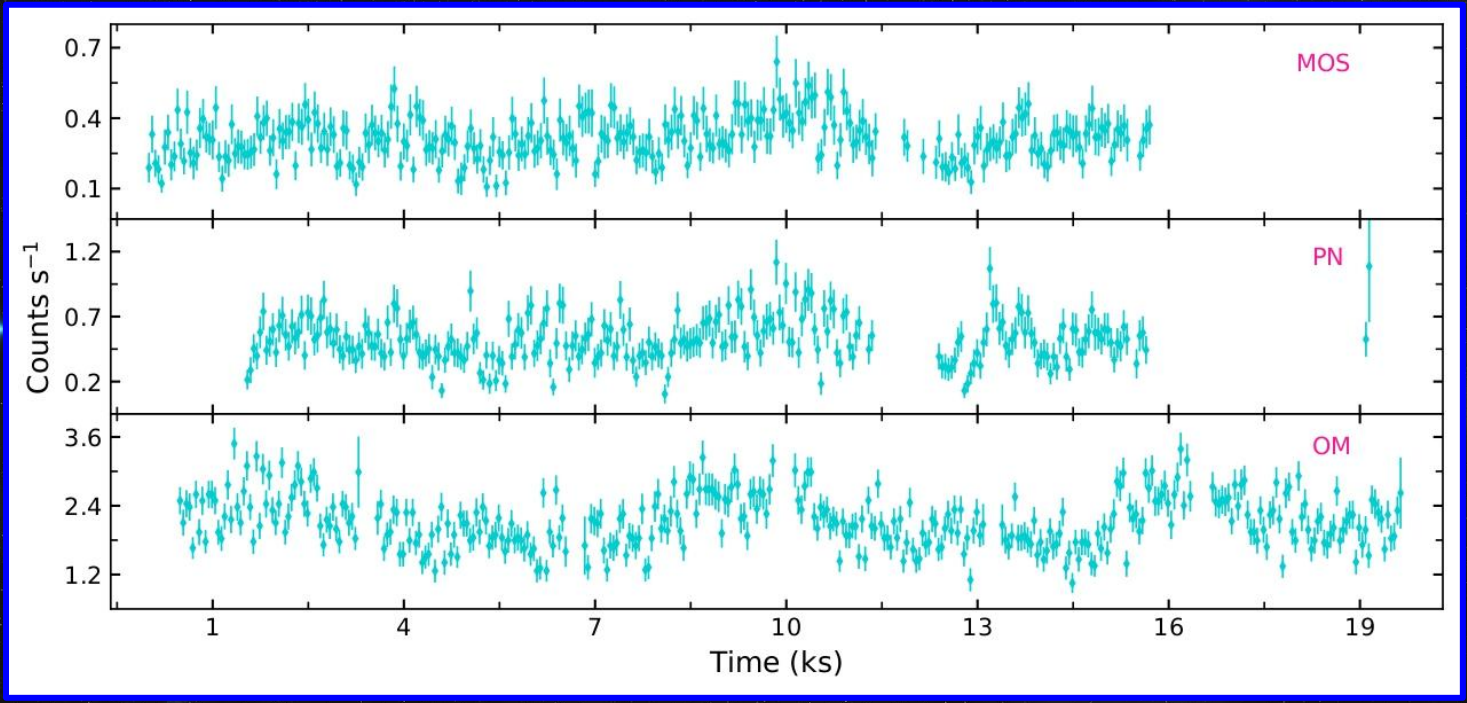
Facility	Filter/Band
1.04m ST	R
1.3m DFOT	R
0.6m Zeiss-600NT	R
1.5m AZT-22	R
2m HCT	3800-6840 Å
1.9m SAAO	OG570
TESS	6000-10000 Å
XMM-Newton	0.3-10.0 keV

Timing Analysis (J1743)



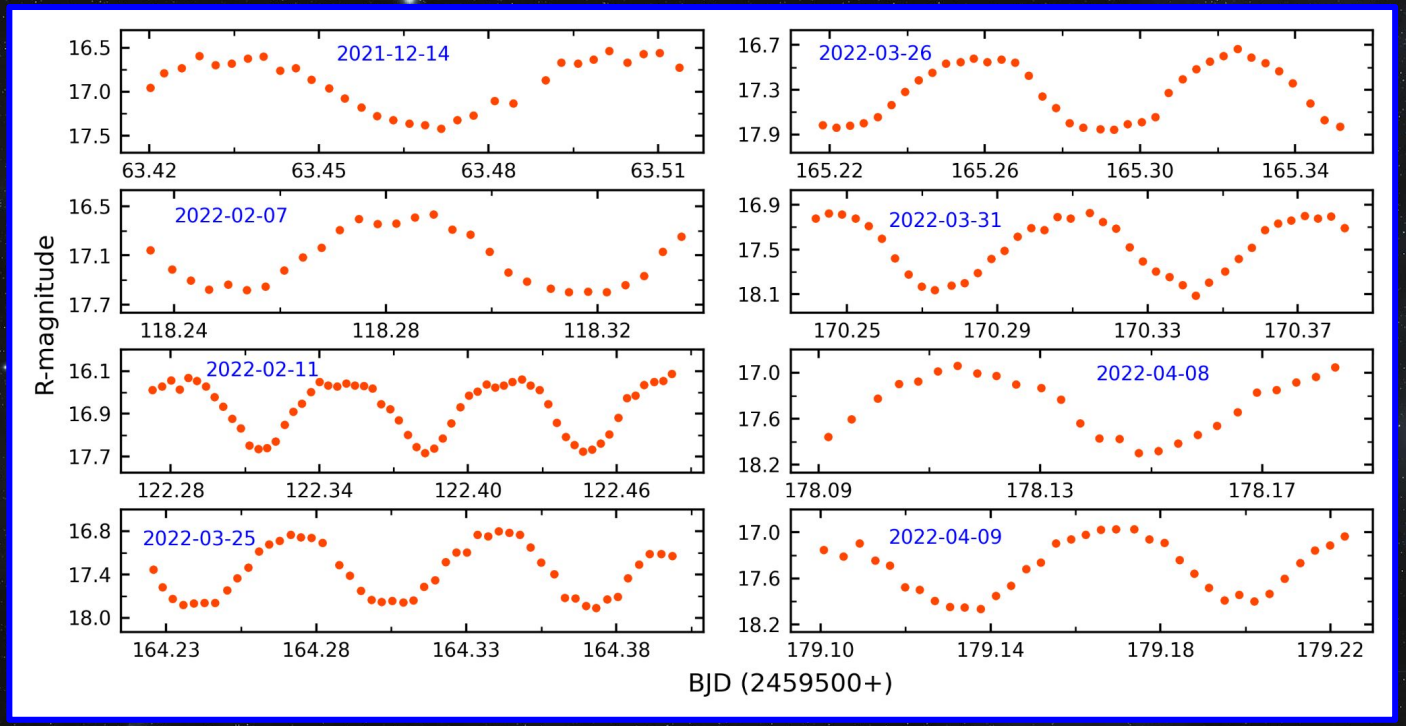
Optical light curves of J1743 obtained from our own optical observations

Timing Analysis (J1743)



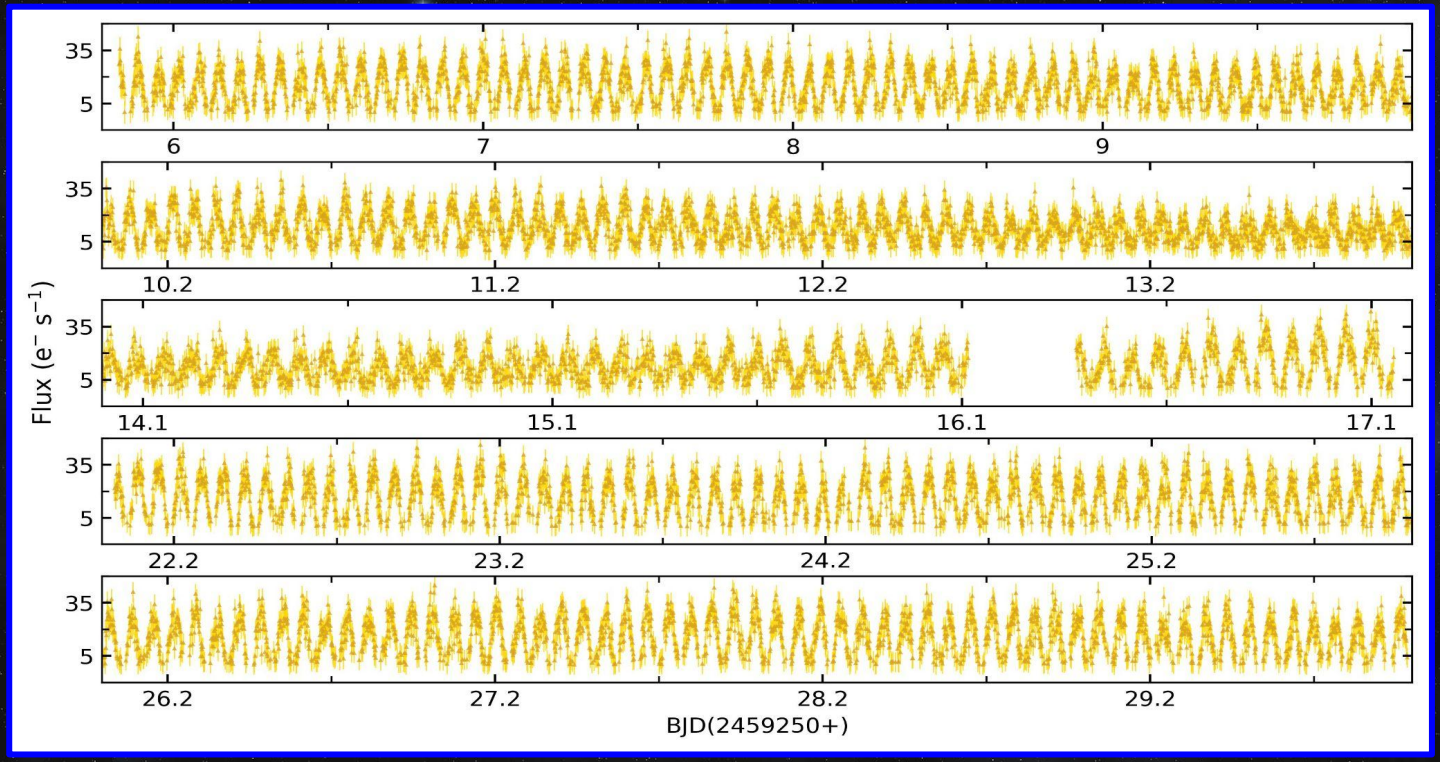
X-ray and optical light curves of J1743 obtained from XMM-Newton

Timing Analysis (YY Sex)



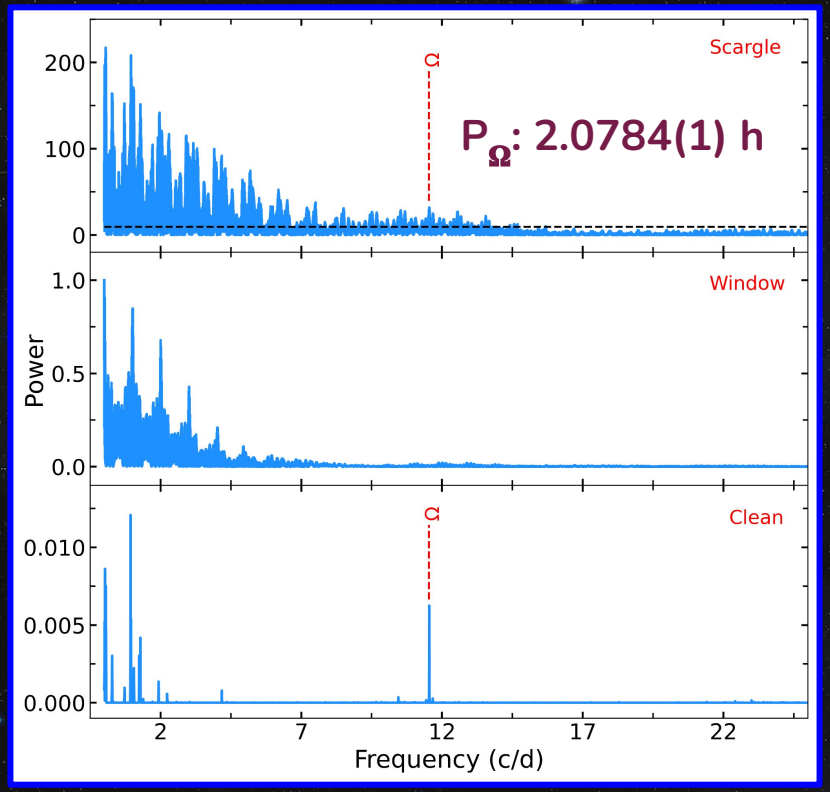
Optical light curves of YY Sex obtained from our own optical observations

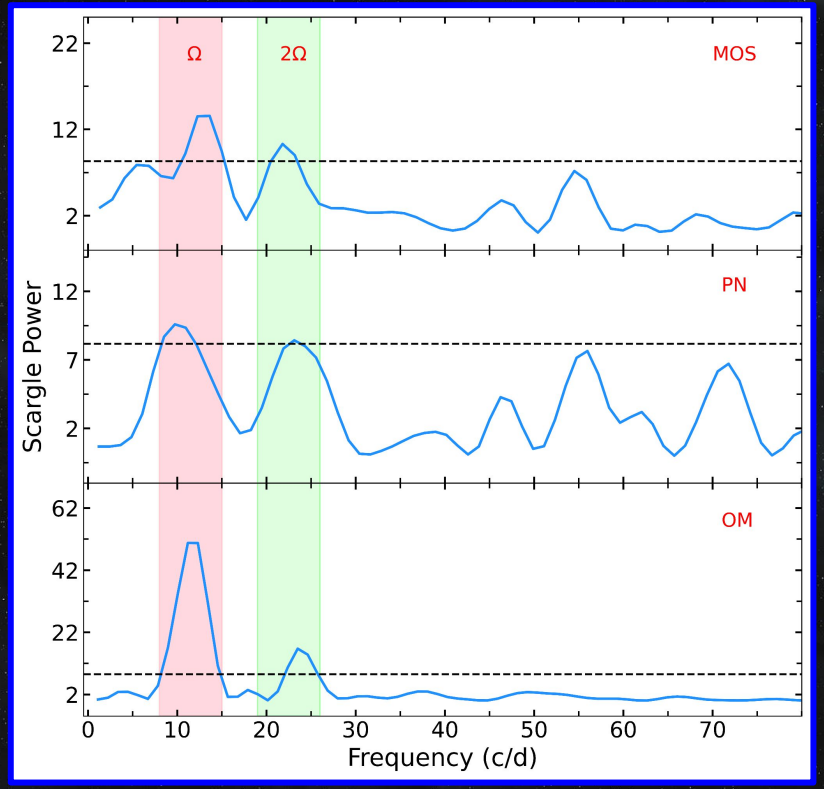
Timing Analysis (YY Sex)



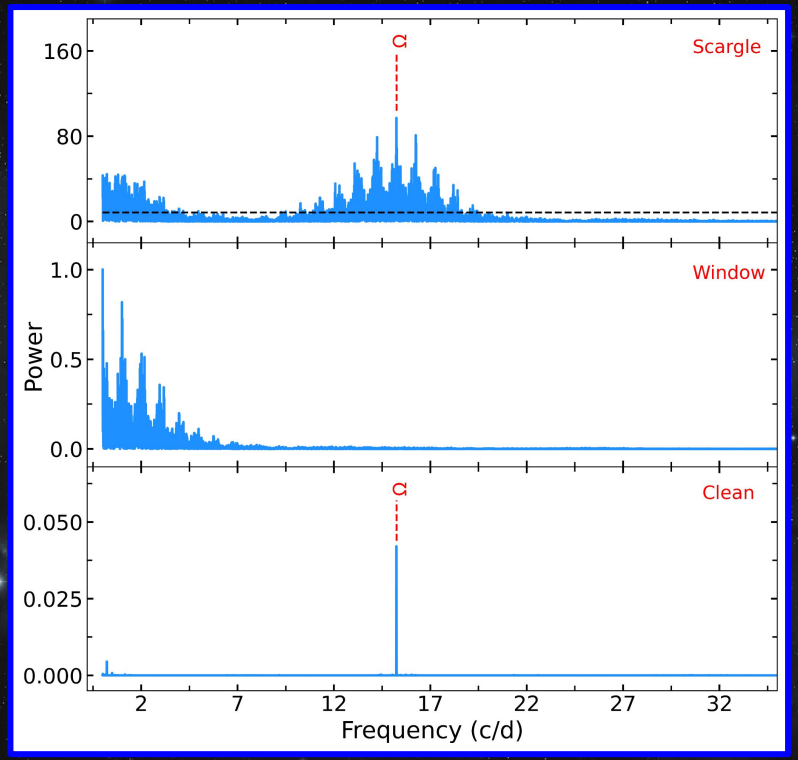
Optical light curves of YY Sex obtained from *TESS* observations

Timing Analysis (J1743)

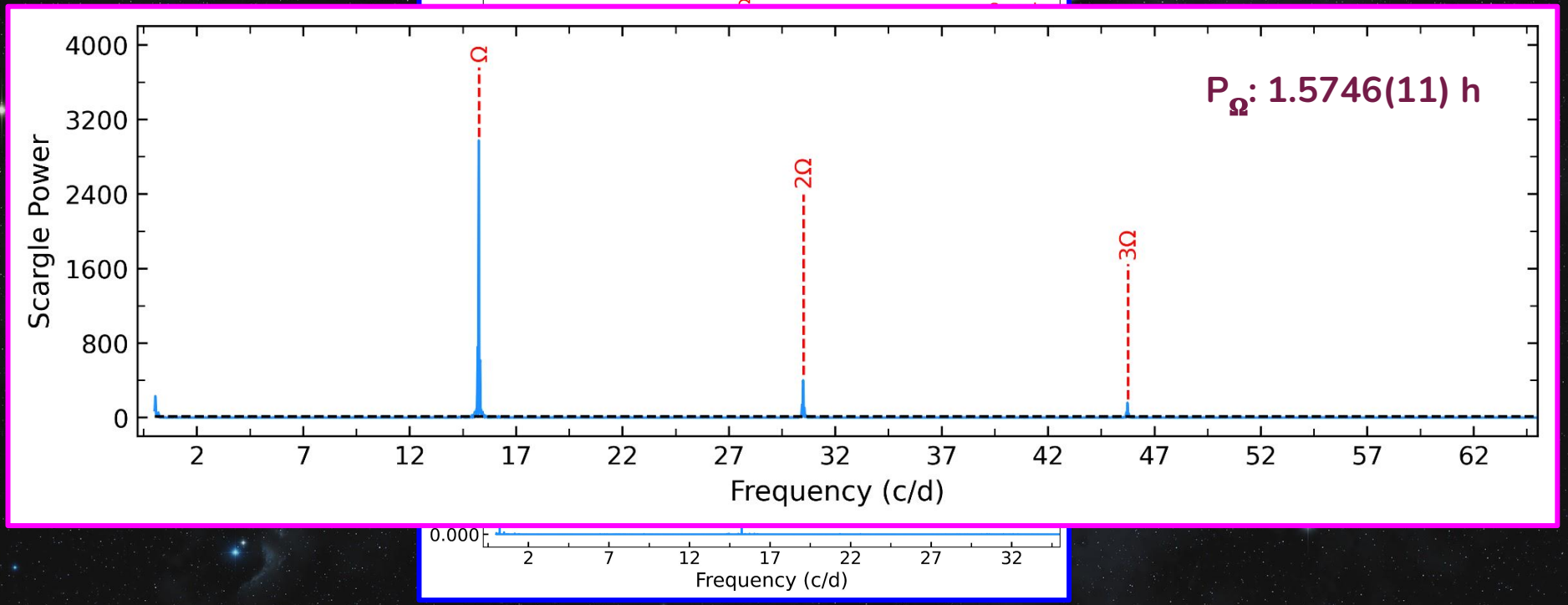




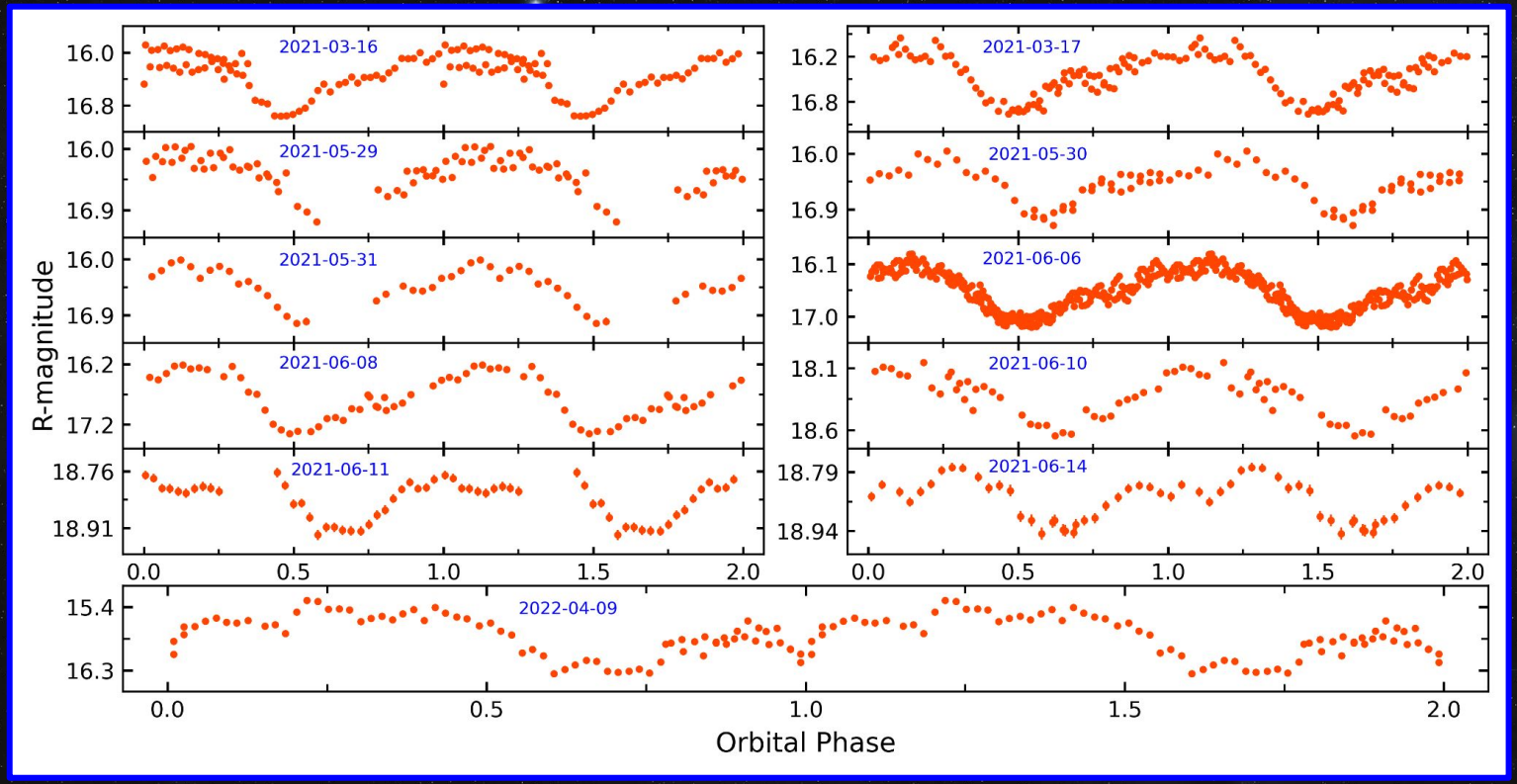
Timing Analysis (YY Sex)



Timing Analysis (YY Sex)



Folded Light Curve Analysis (J1743)



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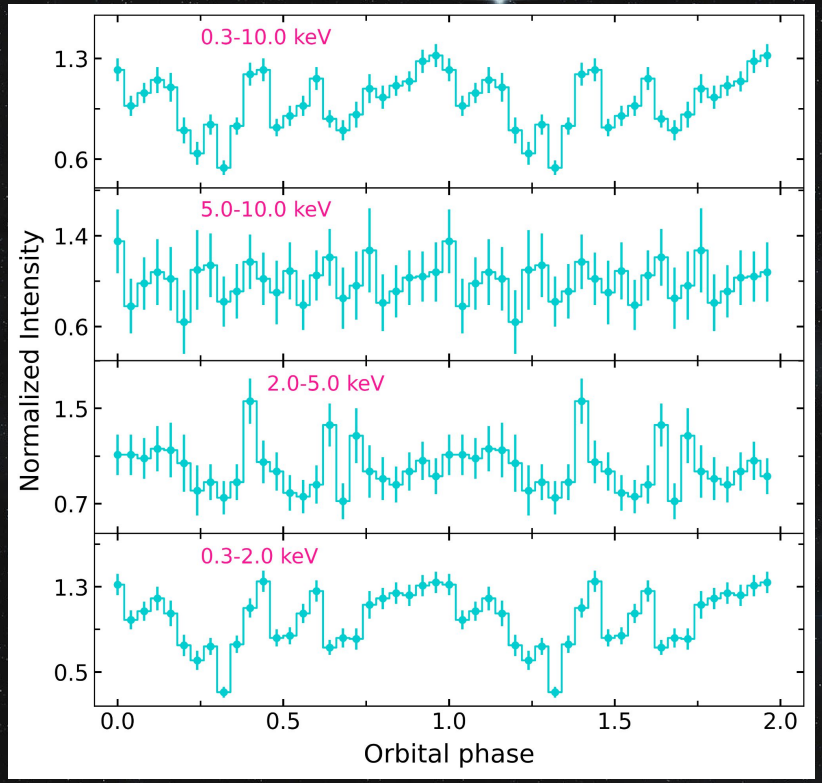
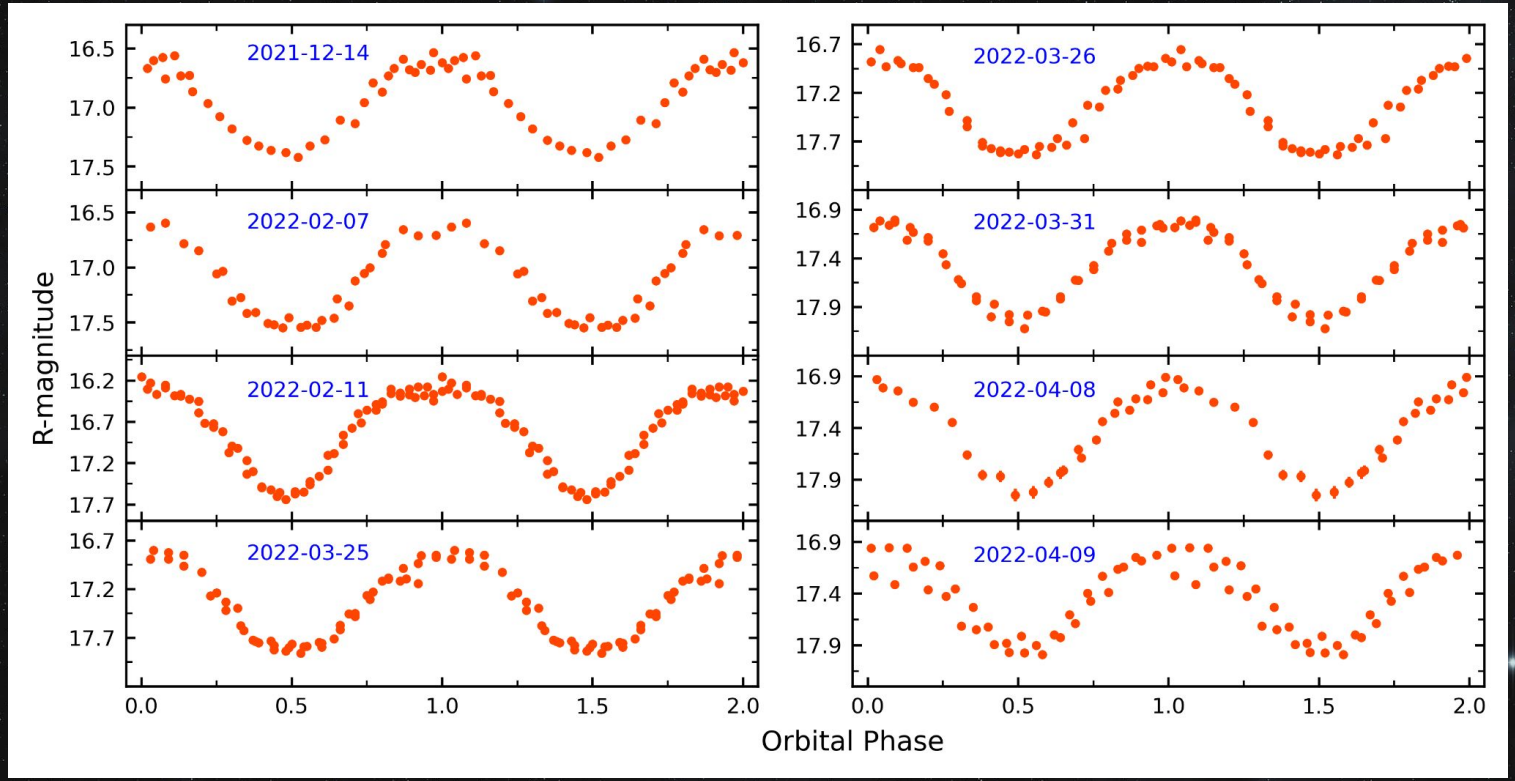
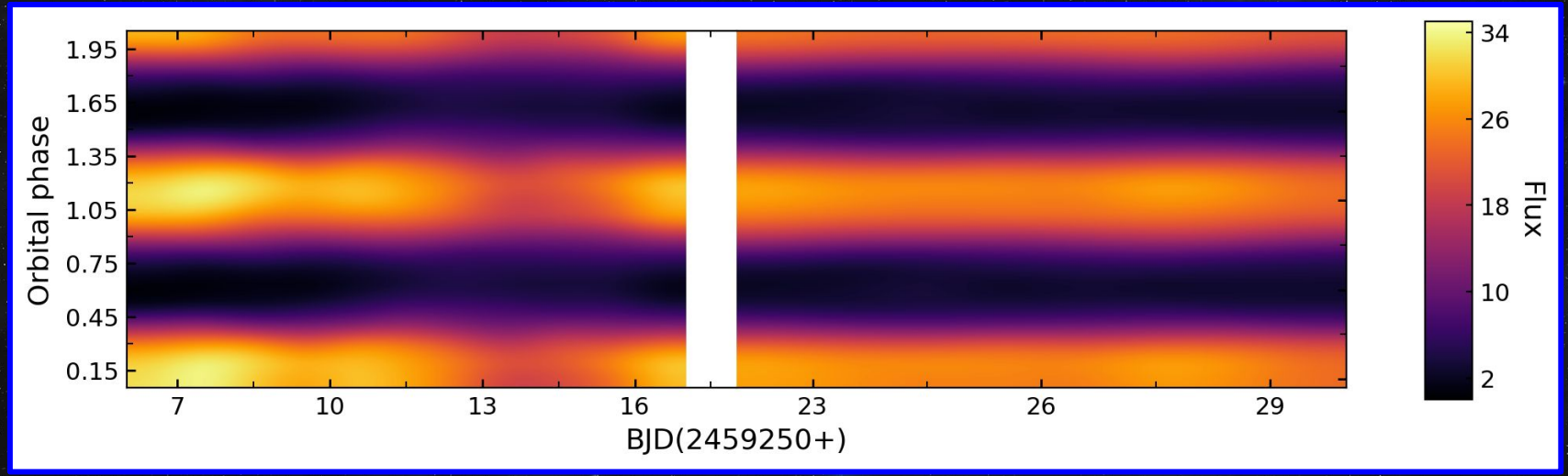


Photoelectric absorption in the accretion stream.

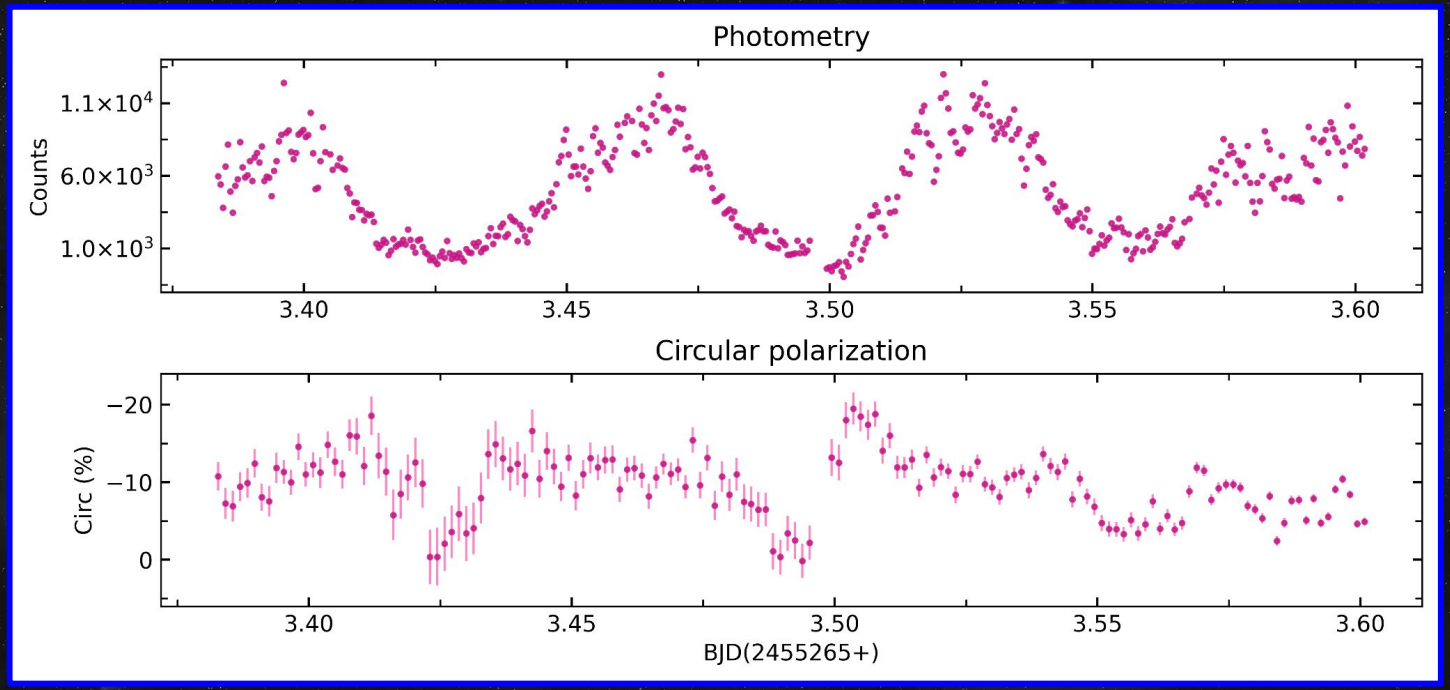
Folded Light Curve Analysis (YY Sex)



Folded Light Curve Analysis (YY Sex)

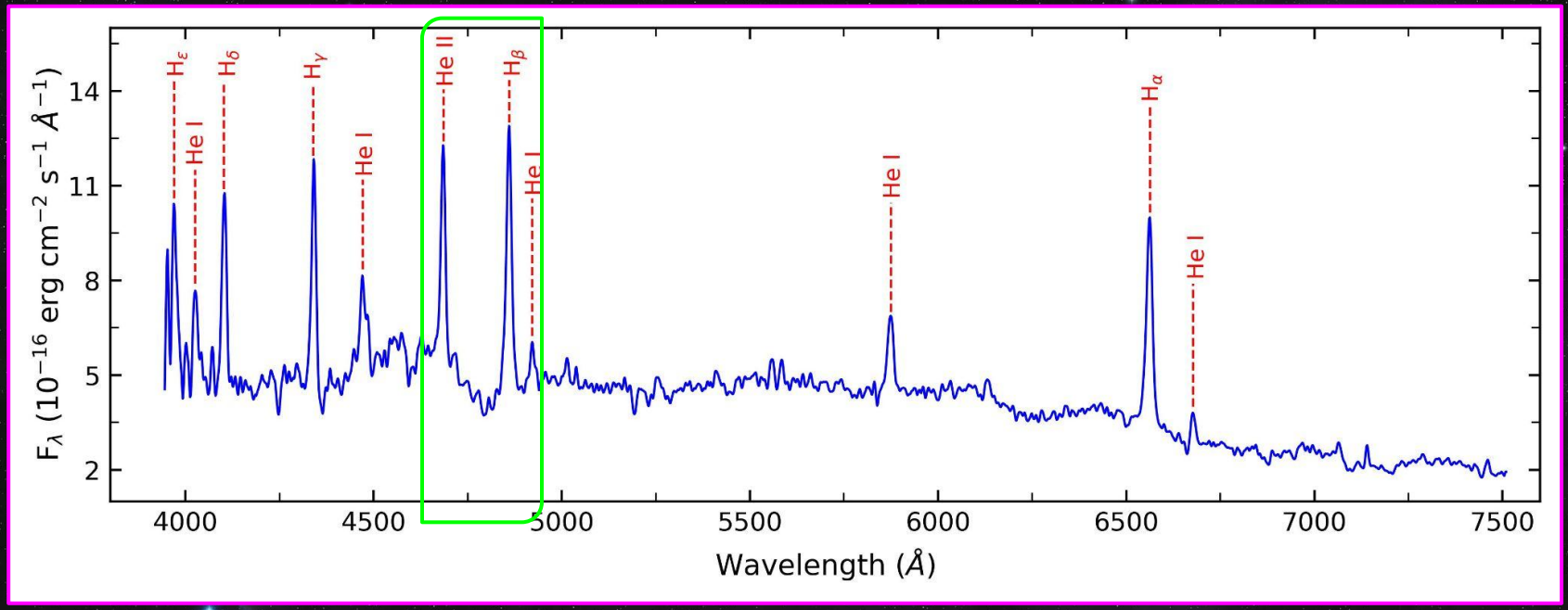


Polarimetric Analysis (YY Sex)



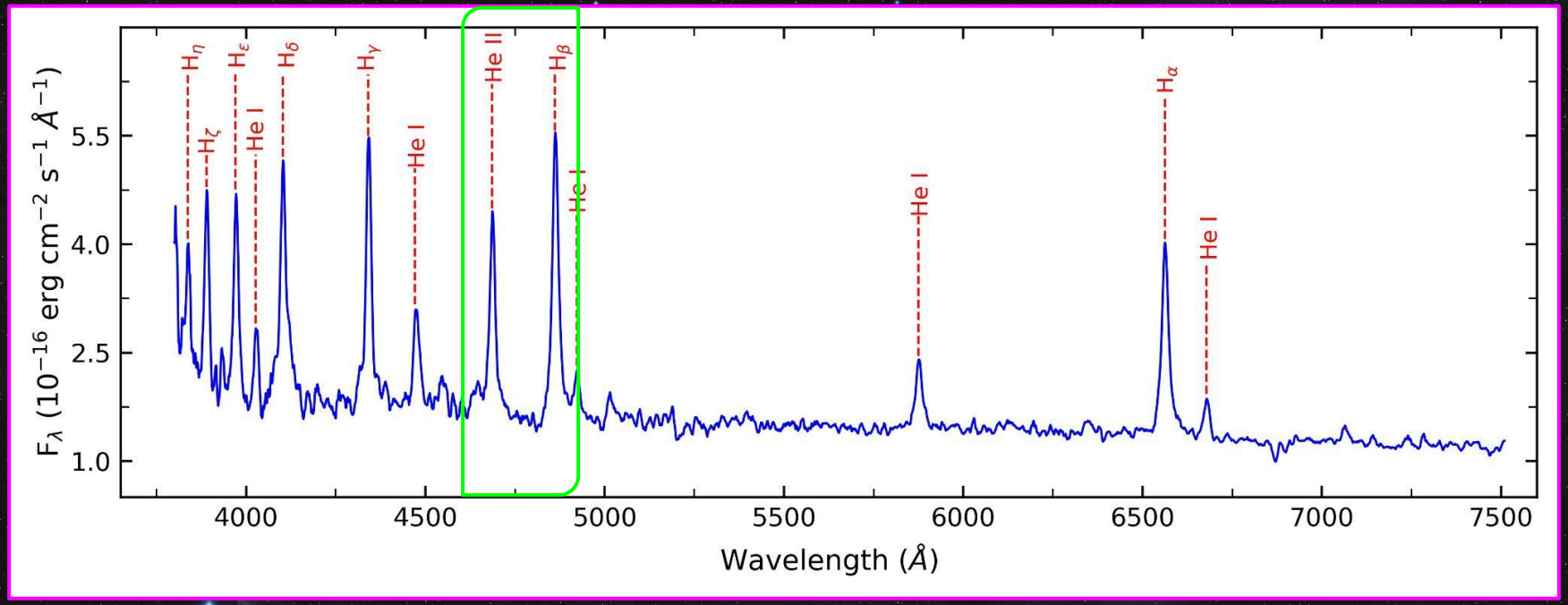
Polarimetric light curves of YY Sex obtained from our own observations

Spectral Analysis (J1743)



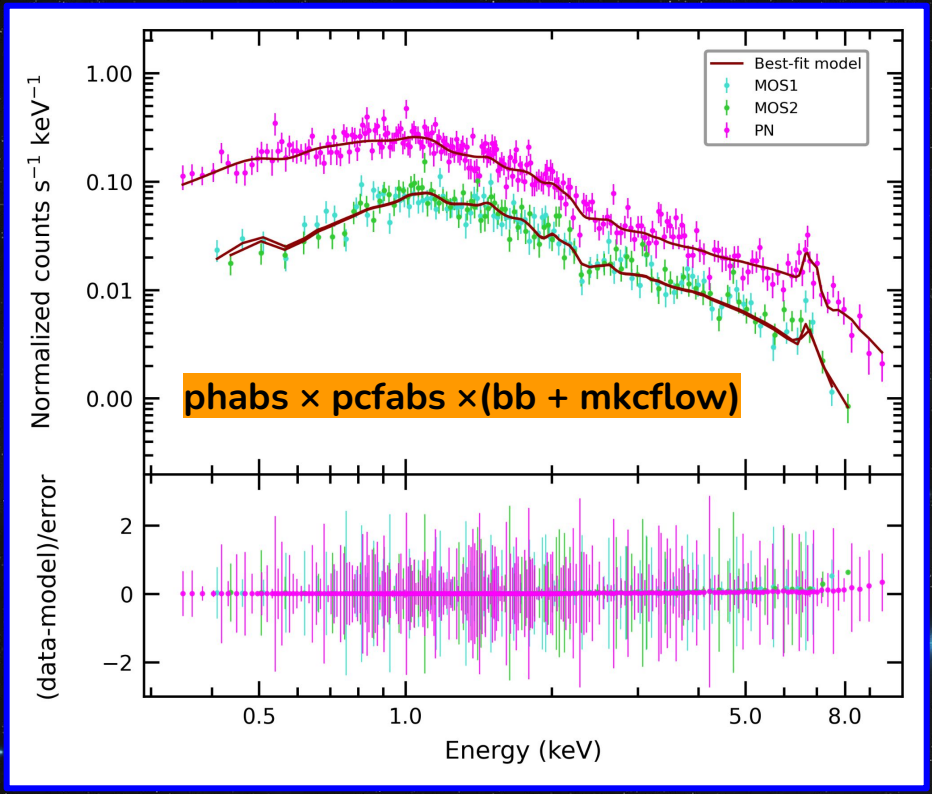
Optical spectrum of J1743

Spectral Analysis (YY Sex)



Optical spectrum of YY Sex

Spectral Analysis (J1743)



X-ray spectrum of J1743

Model	Parameters	Value
pcfabs	pcf (per cent)	56 (+20, -19)
bb	T_{bb} (eV)	97 (+52, -51)
mkcflow	T_{low} (keV)	<0.84
	T_{high} (keV)	31.9 (+12.9, -8.9)
bolometric luminosity	L_{bol} (10^{31} erg s^{-1})	4.21 (+0.08, -0.08)

Summary

Observational features	J1743	YY Sex
Only one periodicity in optical	Yes	Yes
Only one periodicity in X-rays	Yes	NA
EW[He II 4686 Å]/EW[H□] > 0.4	Yes	Yes
EW[H□] > 20Å	Yes	Yes
Strong circular polarization	NA	Yes
Luminosity ($< 10^{33}$ erg s^{-1})	Yes	NA

Silber's criterion (1992)

S4-P5 and S4-P16

Rawat et al., MNRAS, 2023, 521, 2729–2744

THANK YOU.