Orbital evolution and search for eccentricity and apsidal motion in the eclipsing HMXB 4U 1700–37

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Curious case of 4U 1700–37

- How do you measure orbital parameters and orbital evolution of a X-ray binary system ?
- In case of a X-ray pulsar, by pulse timing analysis.
- **4U 1700-37 has not shown any X-ray pulsations yet**.
- High Mass X-ray binary. We can estimate the orbital parameters using radial velocity measurements of the companion star.
- It is complicated due to extreme mass loss rate of the companion HD 153919 which is a O6f star. Previous estimates on eccentricity can be as low as zero (circular orbit) and as high as 0.22 (Hammerschlag-Hensberge et al. 2003).

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- Why do we care about this system ??
- Massive X-ray binary system with an orbital period of 3.412 days. Indication of orbital period evolution and apsidal motion.
- Accurate determination of the orbital parameters of this source and hence the mass of the compact object, is of high interest as it is either a very high mass neutron star or a very low mass black hole (Clark et al. 2002).
- Presence of X-ray eclipses.

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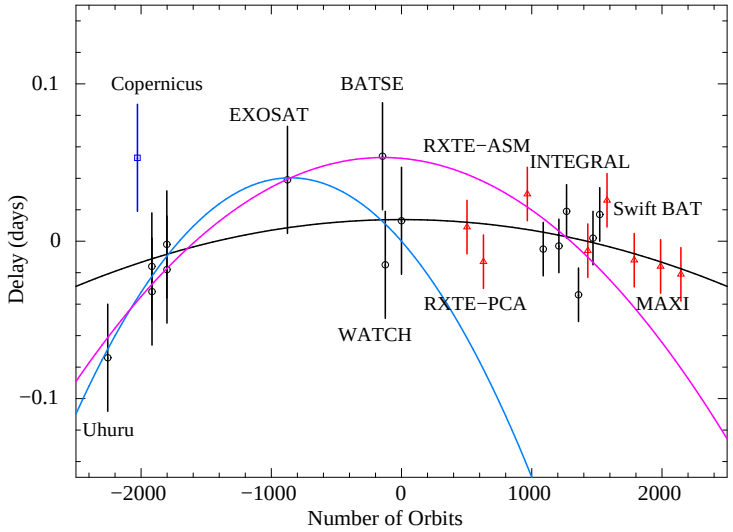
Orbital period evolution



- In this work, we have re-estimated the orbital period decay of this system. Plot of delay in mid-eclipse epochs with respect to a constant orbital period with black solid line represents the quadratic portion of the best fit to the epochs. Using 40 years of mid-eclipse times, the orbital period decay $\dot{P}/P = -(4.7 \pm 1.9) \times 10^{-7}$ yr^{-1}, smaller compared to its previous estimates as well as compared to orbital period decay seen in other HMXBs.

Constraints on eccentricity

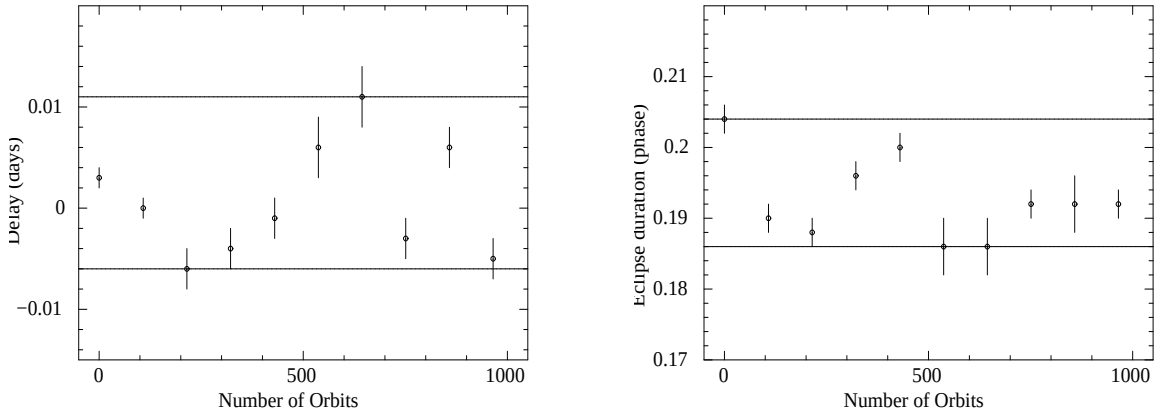


Figure : Left panel: Delay in mid-eclipse times with respect to a constant orbital period for 10 segments of 1 year Swift–BAT light curves, along with solid lines showing the maximum and minimum value of the delay. Right panel: Plot of eclipse duration as function of orbit number calculated from 10 segments of 1 year Swift–BAT light curves, along with solid lines showing the maximum and minimum value of the eclipse duration. We use these plots to derive an upper limit on the value of eccentricity of 0.008 and 0.05 respectively. Independent constraint on the eccentricity of the binary system from X-ray eclipse measurements.

For more details on the work, please visit poster number 19.

Thank You