Feeding Compact Objects: Accretion on All Scales
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Analytical Modeling of Radial Velocity Curves of H_α Emission from WW And

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Abstract. Radial Velocity (RV) plots of emission lines, including H_α, from non-magnetic Cataclysmic Variables (CV), are usually fit with a sin curve. This sin fit sometimes does not prove to be the best fit for some non-magnetic CVs with accretion discs. An analytical model is created based on our 3D Smoothed Particle Hydrodynamic (SPH) numerical code in order to simulate the RV curves. The observational target is WW And, a long period non-magnetic CV. The model takes into account disc ellipticity and inclination angle that provide good non-sinusoidal fits to the observed RV data.

Keywords. Binaries, radial velocity curves, accretion, numerical, cataclysmic variables, etc.

1. Introduction

We develop an analytical model to generate artificial RV curves based on our simulation. The chosen target is binary system WW And, which has a secondary-to-primary mass ratio of q = 0.16 and is believed to have an eccentric accretion disc due to asymmetries found in the light curves (Siwak *et al.* 2012). The SPH code simulates accretion discs around non-magnetic CVs; see Figure 1 for an example that shows an elliptical disc (Montgomery 2012a, Montgomery 2012b and Montgomery 2009). We generated an analytical model like Horne & Marsh (1986) and applied the numerical results to our analytical model for the chosen targets based on these simulations.

2. Results

We test the numerical and analytical H_α emission RV curves against the observational data through an analytical model. In Figure 2 we show the analytical model of the RV curve (solid lines) and the sin fit (dotted lines) compared to the observational H_α emission data (black dots) for the system WW And. For the secondary component seen in Figure 2, with peak velocity at about 100km/s, the sin fit as well as the analytical model line are nearly similar. This is expected and helps to verify our code since only the orbital parameters play a part in determining the RV curve of the secondary. For the primary component in Figure 2, seen with the lower velocities, the analytical model provides a closer fit to the observational data than the sin fit. We find that this is due to the ellipticity of the disc as was suspected in Siwak *et al.* 2012. By comparing the analytical model to the observational RV data points we can gain insight into different parameters, such as disc ellipticity, that may play a role in determining RV curve data. Future studies include modeling RV curves from CV SW Sextanis-like systems.

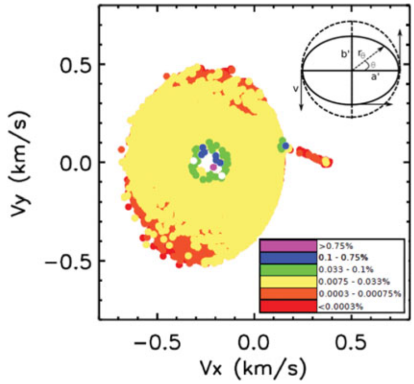

Figure 1. Velocity space face-on view of a numerically simulated accretion disc showing relative velocities, with the slowest velocity in red.The top inset depicts the disc's elliptical shape relative to circular.

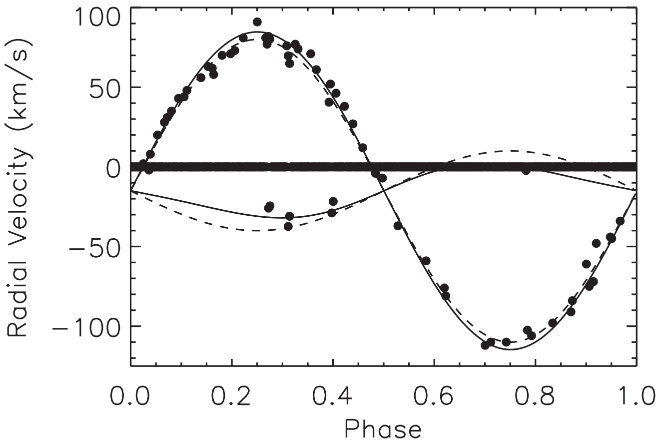

Figure 2. Radial velocity curves from system WW And, including the observational data (black dots), the sin fit (dotted lines) and the model (solid lines).

References

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