The post-common-envelope binary central star of the planetary nebula ETHOS 1

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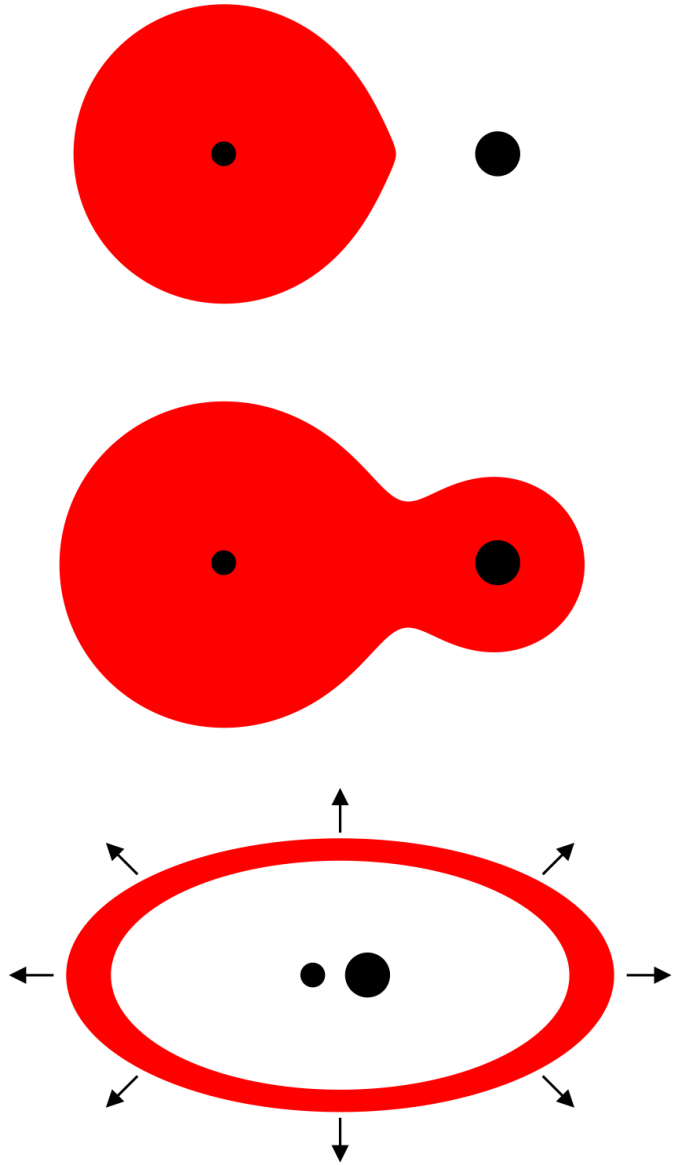
The central star of ETHOS 1 is known to be a post-common-envelope binary. Simultaneous modelling of newly-acquired light and radial velocity curves reveal the binary to comprise of a hot and massive pre-white dwarf with a low-mass main-sequence companion. Preliminary results indicate that the nebular progenitor is one of the most massive known amongst the population of binary central stars. As such, the central binary of ETHOS 1 could potentially be a type Ia supernova progenitor via the single-degenerate channel.

Context - Close binary central planetary nebulae

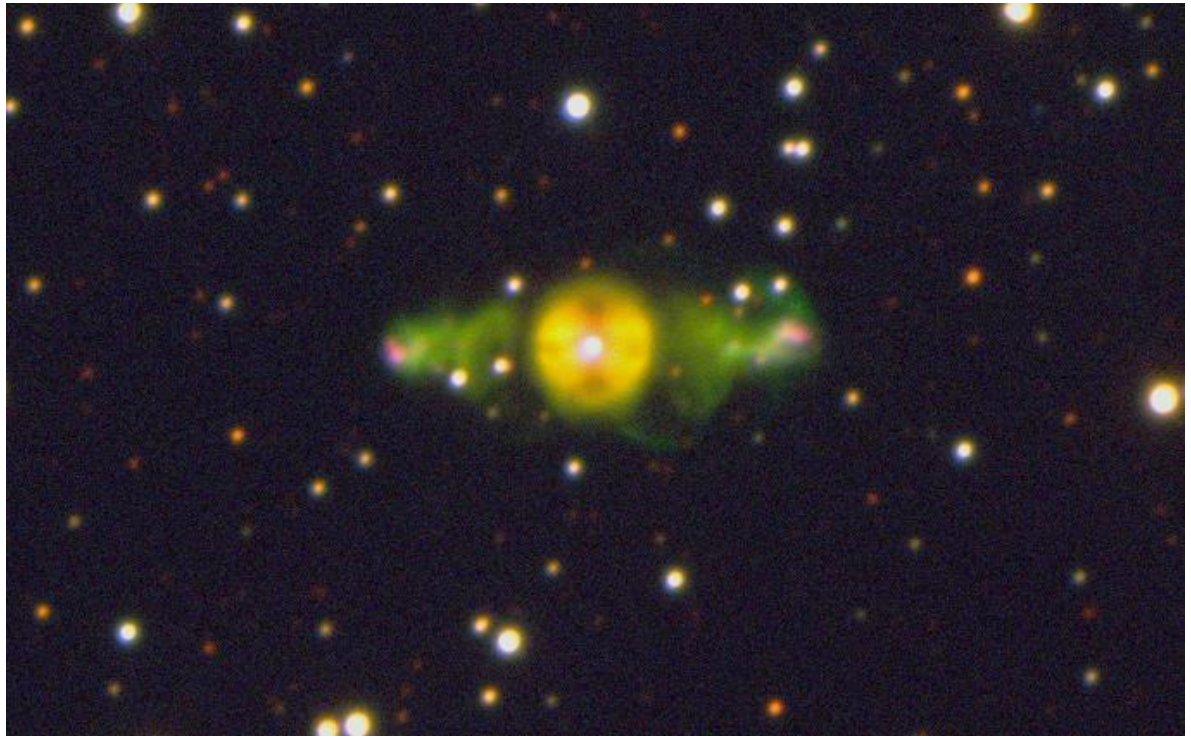
- Central star binarity is now a favoured hypothesis for the formation of aspherical PNe
- However, there is significant uncertainty over the processes at work - in particular, the common envelope phase
- Studying post-CE PNe can help us to understand!



Project – ETHOS 1

Why the central stars of ETHOS 1?
ETHOS 1's discovery (B. Miszalski et al, 2011) revealed exciting elements:

- Post common envelope phase with rapid polar outflow jets (120 ± 10) kms^{-1}
- Short orbital period ~0.5d
- Very large irradiation effect (one of the largest amongst binary central stars)

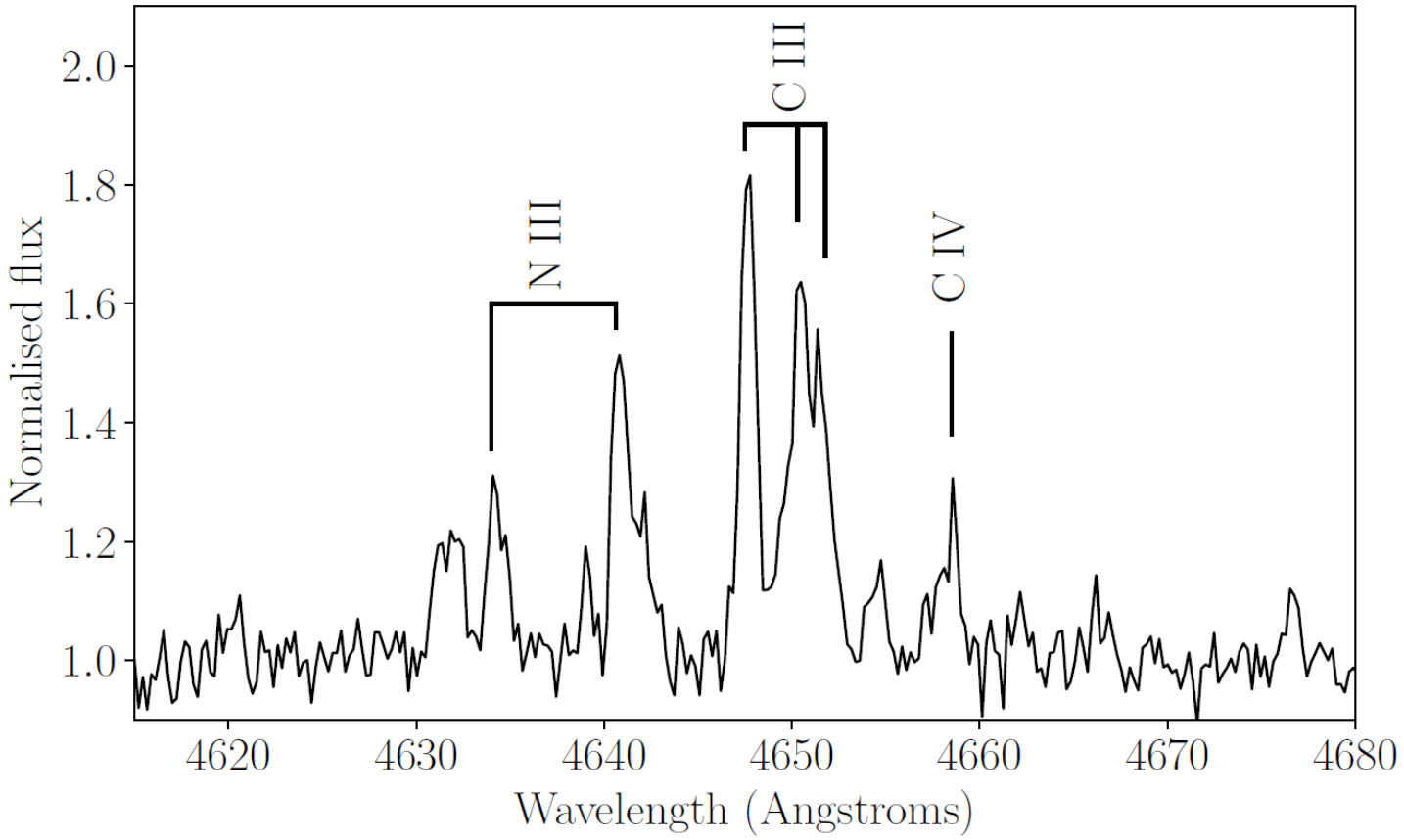


Credit: B. Miszalski, R. Corradi, H. Boffin et al.

Project – ETHOS 1

The central binary spectrum shows clear emission lines characteristic of a main sequence star whose outer layers are highly irradiated by the hot central star. Can be used to probe the secondary star's radial velocity.

Newly-acquired WHT-ISIS spectroscopy, plus photometry from INT-WFC, LT-IO:O give full phase coverage for radial velocities and multi-colour photometry.



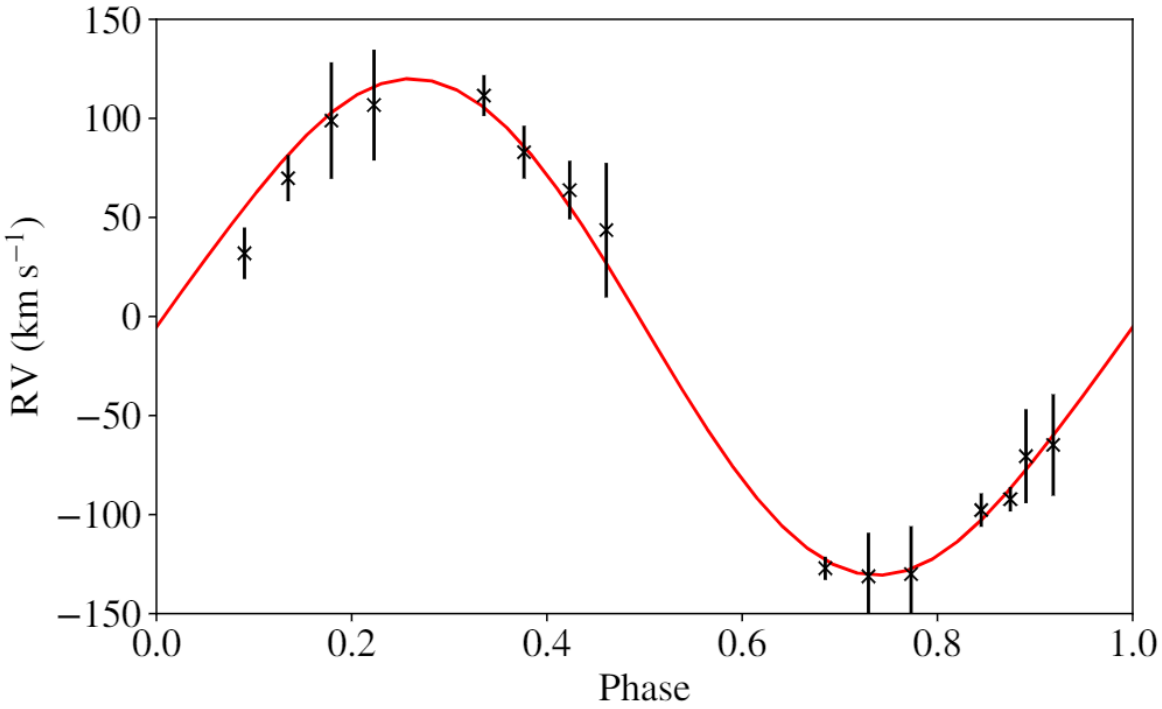
Preliminary Results

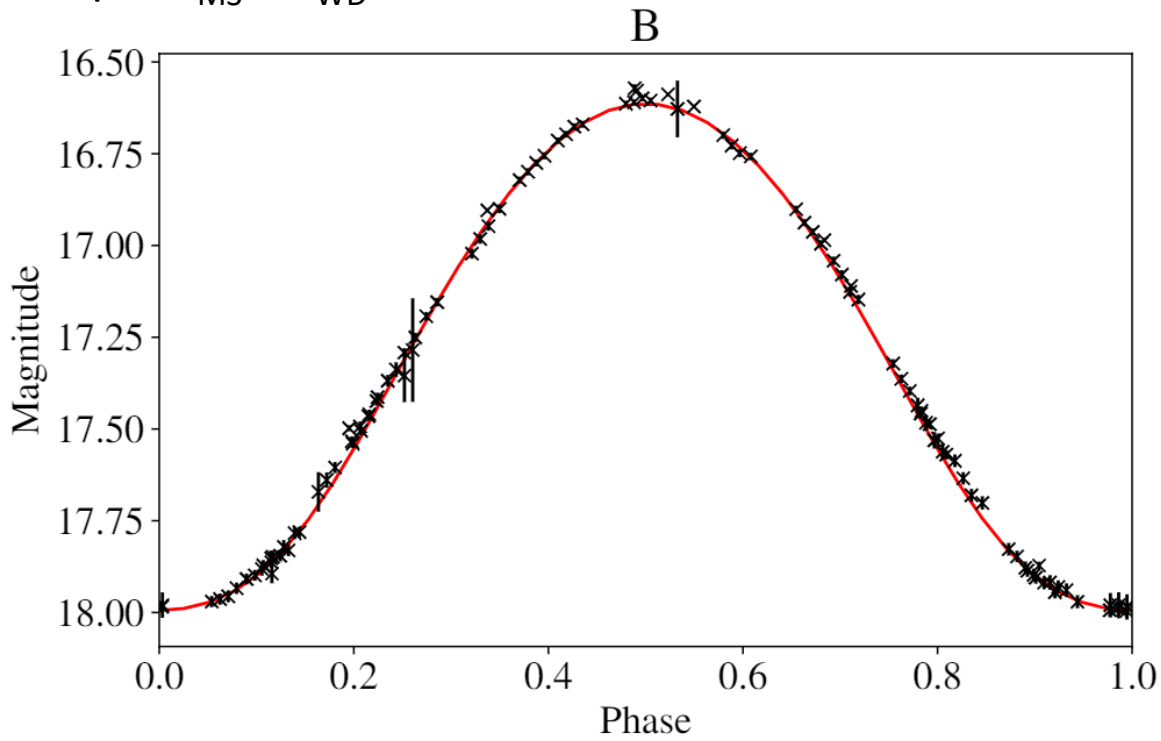
Very hot white dwarf, T_{eff} > 100 kK

Very massive white dwarf, M_{WD} = 1.1-1.3 $M_{\odot}$

Modelled using the PHOEBE code (Jones et al. 2020)
http://phoebe-project.org/

K/M-type main sequence companion, with a mass ratio q = M_{MS}/M_{WD} < 1





Conclusions – Impact – Future Research

Preliminary models suggest the central star of ETHOS 1 is a very hot and massive pre-WD.

Short orbital period (0.5d) means that mass transfer, from the companion to the central star, will likely occur in the future. Potential for the central star to reach the Chandrasekhar limit and lead to a supernova type Ia via the single-degenerate channel.

Further study of the nebula itself (mass, kinematics, chemistry, etc.) are important in order to complete our picture of the evolution of this system