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Infrared Emission Around Cyg X-3

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Abstract. We present UKIRT infrared images of the X-ray binary Cygnus X-3. We address the possibility of extended infrared emission and show that it could be either warm circumstellar material or a star near the binary's line of sight.

1. Introduction

In 1994, Fender *et al.* (1996) observed Cyg X-3 using the IRCAM3 array of UKIRT. This paper presents work done in modelling the point-spread function and searching for any extended emission around Cyg X-3.

Cyg X-3 is thought to be a compact object orbiting a Wolf-Rayet star. Any infrared extension would be important to the system and would add to the enigmatic qualities of this object. For any extension to be modelled, a point-spread function has to be created. Two techniques were used, the first being to calculate it mathematically and the second using images of standard stars.

2. PSF modelling

A mathematical model for the point-spread function was obtained from the J-, H- and K-band images of observed with UKIRT. The model consists of a central Gaussian component and an exponential roll-off; both components are modified by a Lorentzian component.

The PSF was modelled using three parameters, the Gaussian sigma, σ, the fraction of the peak intensity at which the Gaussian function changes to an exponential, τ, and the fraction of the Lorentzian function to add to the Gaussian and exponential components, Q. Results are shown in the table below.

When we searched for objects that fitted the profile in the K-band, we discovered that the Cyg X-3 image contained two components separated by $0.56''$. The ratio of the K-band fluxes of these two objects is 11:1. A more detailed discussion together with an image of the stellar fits is given in Ogley *et al.* (1996).

Table 1. Modelled PSF parameters for a group of wave-bands. The parameters are the Gaussian sigma, σ, the fraction of the peak intensity at which the Gaussian function changes to an exponential, τ, and the fraction of the Lorentzian function to add to the Gaussian and exponential components, Q.

Band	Wavelength (μm)	σ	τ	Q
J	1.25	2.39 ± 0.21	0.21 ± 0.16	0.106 ± 0.026
H	1.65	1.97 ± 0.11	0.23 ± 0.14	0.106 ± 0.029
K	2.20	2.03 ± 0.12	0.32 ± 0.23	0.109 ± 0.025

3. Direct image subtraction

As an alternative to calculating a mathematical model for the point-spread function, we took several standard stars taken at the time of observation and calculated a point-spread function from these. We automatically removed telescope wobble which causes ellipticity in the RA axis. The eccentricity of the ellipse was calculated to be

$$e = 0.64 \pm 0.22 \text{ at } -0.4^\circ \pm 5.5^\circ.$$

From the standard stars, we subtracted a Gaussian function from the Cyg X-3 frame to find any extended components. We found that a simple Gaussian could not fit the Cyg X-3 image sufficiently but left a ring of emission around the object.

4. Conclusions

It would appear that there is some "confusing emission" from the vicinity of Cygnus X-3. Two separate methods of image analysis fail to model the source as a single, simple object, requiring either an additional stellar image or extended emission.

References

Fender, R.P. & Bell Burnell, S.J., 1996, A&A, 308, 497

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