THE ORBITAL PERIOD OF THE GALACTIC Z SOURCE SCO X-2

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Abstract. Sco X-2 is a bright Galactic bulge Z source, whose optical counterpart was discovered in 1990 [?], and observed to exhibit strong Hα emission. We have therefore obtained spectroscopic data in order to determine the orbital period and investigate the nature of the companion star. From an analysis of the Hα emission line velocities, we find a most likely orbital period of 13.94 d. This implies an evolved companion, and is consistent with the currently known orbital periods in other Z sources.

1. Results and discussion

Spectroscopy of Sco X-2 was obtained in 1991 July/August and 1992 July with the WHT on La Palma. Narrow Hα emission is seen, but no structure is resolvable. A period search of the line velocities was undertaken by folding the data on a series of trial periods, and determining the χ^2 of a sinusoidal fit. In Fig. 1, we show the results of this search. The minimum χ^2 of 1.25 is attained for $P_{\rm orb} = 13.94 \pm 0.10$ d. We note there is little to

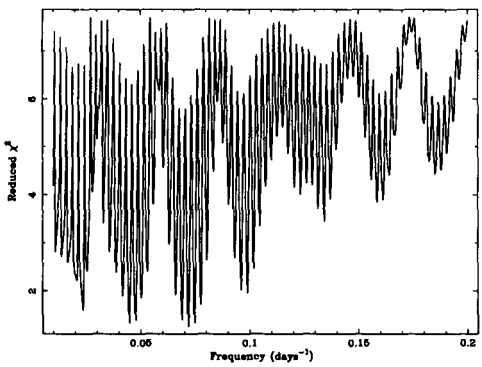

Figure 1. Minimised χ^2 versus trial frequency of sinusoidal fit to radial velocity data.

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choose between this and the $\chi^2 = 1.33$ value ($P = 22.25 \pm 0.16$ d). However, [?] derived a likely upper limit of $P \sim 19$ d for Sco X-2; furthermore, our radial velocities are reasonably fitted by a sinusoid when folded on 13.94 d, but show no obvious modulation when folded on 22.25 d. We therefore consider 13.94 d to be the more likely orbital period, although we regard this result with caution, given our poor sampling. In Fig. 2, we show the radial velocity curve produced by folding the data on this period. We find $\gamma = -227 \pm 6\,\mathrm{km\,s^{-1}}$ and $K = 70 \pm 8\,\mathrm{km\,s^{-1}}$ for the systemic velocity and semi-amplitude respectively. Adopting the relation $P^2(\mathrm{h}) \approx 110\,\overline{\rho}$, where

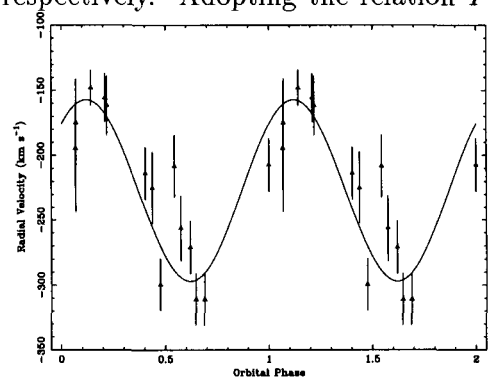

Figure 2. Radial velocity curve for Sco X-2, produced by folding the data on a period of 13.94 d. A sinusoidal fit is shown.

$\overline{\rho}$ is the mean density, and using the tabulation of [?] yields a spectral type of K0 III. We derive a value for the mass function, $f(M) = 0.5\,\mathrm{M}_\odot$. The H$\alpha$ emission could arise in the accretion disk (in which case the narrowness of the line suggests a low inclination), or in the X-ray heated face of the secondary. However, the mass function does not allow us to favour one of these sites over the other, particularly since K may be biased (either by a bright spot in the former case, or by the heating of the inner face of the companion star in the latter).

We find equivalent widths of 3.8 ± 0.4 Å and 9.2 ± 5.8 Å for our 1991 and 1992 observations respectively. However, our results are somewhat erratic due to poor signal-to-noise ratio, and no convincing periodicities were found. The Hα FWHM in our average spectrum is 7.3 Å corresponding to $327\,\mathrm{km\,s^{-1}}$. Doppler correcting the velocity modulation results in a value of 5.6 Å ($281\,\mathrm{km\,s^{-1}}$).

References

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2. Penninx, W., Augusteijn, T., 1991, A&A, **246**, L81