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Analyzing the δ Sco binary in anticipation of a disk-star collision

Ashley Ames[1], **Christopher Tycner**[1] **and Robert Zavala**[2]

[1]Dept. of Physics, Central Michigan University
[2]USNO, Flagstaff Station

Abstract. A current investigation is underway into the possible collision between a circumstellar disk and the secondary star in the δ Scorpii binary system. δ Scorpii is a prime candidate for a disk-star collision since the primary star has a circumstellar disk and the secondary star has a highly elliptical orbit with a period of approximately 10.5 years making the periastron passage very close to the primary star. The Navy Prototype Optical Interferometer (NPOI) was used to spatially resolve the two stars as well as the cirumstellar disk around the primary. A revised orbit with new orbital parameters has been calculated using observations obtained between 2005 and 2010. Our results indicate periastron passage will occur on 2011-07-03.

Keywords. instrumentation: high angular resolution, astrometry, binaries: general

1. Introduction

δ Scorpii (HD143275, HR5953, FK5 0594) is a well known binary system with a highly eccentric orbit and a period of 10.5 years. The primary star is classified as a Be star with a gaseous circumstellar disk and the secondary is a B2-type star (Tango *et al.* 2009). The goal for this project is to refine the orbit of the secondary with respect to the primary and test for the possibility of a disk-star collision. The δ Sco binary system was observed with the NPOI for a total of 108 nights. Data on two nights were obtained in July 2000 and the rest were obtained from June 2005 to August 2010.

2. Experimental Data

All the raw observational data, based on 108 nights, have been reduced using a standard NPOI reduction pipeline. The astrometric information is extracted from the reduced data giving the position of the secondary with respect to the primary. The NPOI observations were compared to orbits based on parameters from Mason *et al.* (2009), Tango *et al.* (2009), and Miroshnichenko *et al.* (2001). The new astrometric data, combined with radial velocities from Miroshnichenko *et al.* (2001), were used to calculate a refined orbit (shown in Figure 1) with the revised binary parameters listed in Table 1. Since the instrument used has a wide range of baselines, the resulting narrow-angle astrometry has high precision. In combination with extensive orbital coverage, including observations close to the previous periastron passage reults in the best orbital parameters to date.

3. Summary

The binary orbit has been refined using astrometric data obtained from NPOI and radial velocities from Miroshnichenko *et al.* (2001). The orbit that is obtained gives a better fit to the data than previous findings. The next periastron passage date has been

Table 1. The orbital elements for δ Sco.

Element	Mason *et al.* (2009)	Miroshnichenko *et al.* (2001)	Tango *et al.* (2009)	This Work
Period(y)	10.68 ± 0.05	10.58[1]	10.74 ± 0.02	10.81 ± 0.002
Semimajor axis (mas)	104 ± 6	107[1]	98.3 ± 1.2	99.0 ± 0.05
inclination, i (deg)	39 ± 8	38 ± 5	38 ± 6	30.3 ± 0.24
Long. of asc. node, Ω (deg)	153 ± 9	175[1]	175.2 ± 0.6	172.3 ± 0.6
eccentricity, e	0.94[2]	0.94 ± 0.01	0.9401 ± 0.0002	0.941 ± 0.0007
Long. periastron, ω	29 ± 12	-1 ± 5	1.9 ± 0.1	2.6 ± 0.7
T (Epoch of Periastron)	*J*2000.693[2]	*J*2000.693± 0.008	*J*2000.69389± 0.00007	*J*2000.6942± 0.0011

Notes:
[1] Parameter adopted from Hartkopf *et al.* (1996) solution.
[2] Parameter adopted from Miroshnichenko *et al.* (2001) solution.

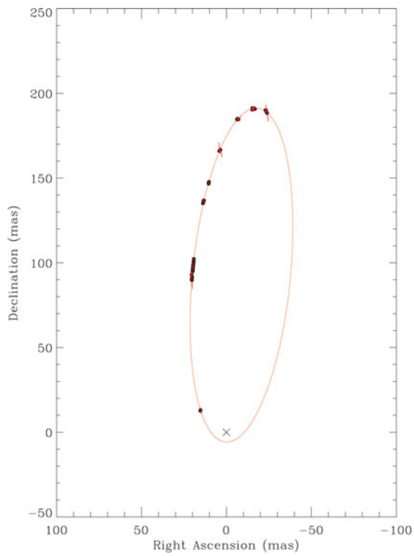

Figure 1. Binary orbit based on orbital parameters obtained from NPOI data. The black circles are the data points and the locations of the primary is marked with an X.

calculated to be 2011-07-02, $22h \pm 1.1d$. Our results indicate the periastron passage will occur 24 days later than the prediction of Tango *et al.* (2009).

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References

Mason, B. D., Hartkopf, W. I., Gies, D. R., Henry, T. J. *et al.* 2009, *AJ*, 137, 3358
Hartkopf, W. I., Mason, B. D., & McAlister, H. A. 1996, *AJ*, 111, 370
Miroshnichenko, A. S., Fabregat, J., Bjorkman, K. S., Knauth, D. C. *et al.* 2001, *A&A*, 377, 485
Tango, W. J., Davis, J., Jacob, A. P., Mendez, A. *et al.* 2009, *MNRAS*, 396, 842

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