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ASTROMETRIC MEASUREMENTS OF THE DOUBLE STAR γ LEO, STF 1424 AB AT LA SORBONNE OBSERVATORY

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Abstract. In 2021, the SAF* and the IPSA VEGA association† have started an astrometric measurements campaign of visual double stars using telescopes operated by SAF. In this article, we present our measures of γ Leo - STF 1424 AB: $\theta = 126.7\,\mathrm{deg} \pm 0.1\,\mathrm{deg}$ and $\rho = 4.74'' \pm 0.20''$. The 6th Catalog of Orbits contains two equally probable orbits; our observation is in good accordance with the orbit calculated by Romanenko 2014 with a negative β angle.

Keywords: double stars, astrometry, orbits, PRO/AM

1 La Sorbonne Observatory

Located in the center of Paris, La Sorbonne Observatory, built in 1900, is equipped with a refracting telescope (diameter 153 mm, focal length 2300 mm) constructed in 1935 and an equatorial mount with graduated circles. We used a modern CMOS camera (ZWO ASI 178MM with 2.4 μm pixels) which enabled us to observe stars up to magnitude 14.

2 The γ Leo system

The double nature of γ Leo (Al Gieba, HIP50583, HD 89484, HR 4057, STF 1424 AB) has been discovered by William Herschel (1784) in 1782. Despite the fact this double star is one of the most frequently observed, the determination of its orbit is difficult due to a very elongated orbit (Ruben G. V. 1961) and a slow orbital motion. Several predictive calculations have been made, represented by ellipses in Figure 1. Only orbits judged of highest quality for each system are included in the 6th Catalog of Orbits, a few systems have two different orbits in the catalog if both have comparable grades. This is the case for γ Leo, with two grade 4 calculations established by Romanenko L. G. (2014), both with a 554 years period. The difference between the two orbits lies on the sign of the β angle (angle between the vector connecting the two stars A and B and the tangent plane to the celestial sphere) which is not known. Romanenko L. G. (2014) stressed in his paper that observations over the ten following years will demonstrate which of the computed orbits is closer to the true one. To measure position angle and separation of STF 1424 AB, we used 542 images selected among 1,500 by the ELI process (Easy Lucky Imaging) in REDUC program. We used 2MASS J10194483+1953309 and 625477049389495552 Gaia EDR3 source id star as calibration pair; taking into account their proper motions, the precession effect and the Gaia EDR3 astrometry. Our measure of STF 1424 AB for the epoch 2022.22 is: $\theta = 126.7\,\mathrm{deg} \pm 0.1\,\mathrm{deg}$ and $\rho = 4.74'' \pm 0.20''$. The WDSTOOL platform contains 5 measures of STF 1424 AB taken between 2015 and 2020. Considering the 2015-2022 time-span short in regard of the 554 years period, we made a linear extrapolation of these measured position and separation angles up to the observation epoch. The comparisons of the measures with the two calculated orbits is in Table 1.

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hypothesis	prediction	this work				previous measures extrapolation			
		measures		O-C		measures		O-C	
	θ	ρ	θ	ρ	θ	ρ	θ	ρ	θ	ρ
β = - 38°	126.8	4.74	126.7	4.74	-0.1	0.00	126.4	4.89	-0.4	0.15
β = + 38°	127.6	4.76	126.7	4.74	-0.9	-0.02	126.4	4.89	-1.2	0.13

Table 1. Comparison between the two orbits calculated by Romanenko L. G. (2014) with our measure and previous measures extrapolation.

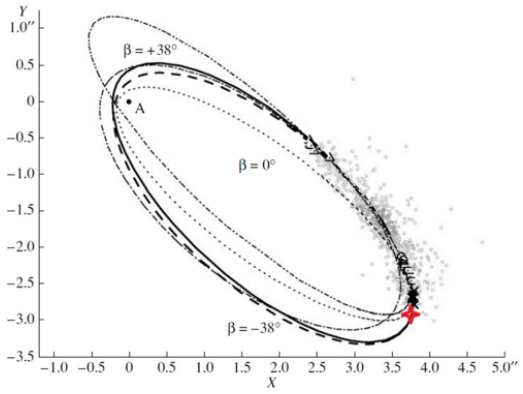

Fig. 1. From Romanenko L. G. (2014). Position measurements during 1782-2010 and projections of the orbits onto the plane of the sky. Point A is the position of the main component, triangles, circles, squares and crosses are previous measured positions of the companion, the red star is our measure. The solid and dashed lines show $\beta = +38°$ and $\beta = -38°$ orbits calculated by Romanenko L. G. (2014) and selected in the 6th Catalog of Orbits. The other orbits are not selected in the 6th Catalog of Orbits.

3 Conclusion

We have measured STF 1424 AB using lucky imaging method at La Sorbonne Observatory, the result is: $\theta = 126.7\,\mathrm{deg} \pm 0.1\,\mathrm{deg}$ and $\rho = 4.74'' \pm 0.20''$. Two grade 4 orbits are published in the 6th Catalog of Orbits, both calculated by Romanenko in 2014 with equal probability, depending on the sign of the β angle. Our result shows a better correlation with the hypothesis β being negative, in accordance with the extrapolation of previous measures made during the 2015-2020 time-span. Further observations will be needed to confirm that the orbit calculated by Romanenko L. G. (2014) with a negativ β angle is closer to the true one.

This research has made use of the Washington Double Stars catalog[‡] maintained at the U.S. Naval Observatory, Gaïa EDR3 data and Aladin images made available by the Centre de Données astronomiques de Strasbourg, the REDUC[§] software of Florent Losse, the WDSTOOL[¶] platform data maintained by David Chiron.

References

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[§] http://www.astrosurf.com/hfosaf/fr/tdownload.htm#reduc
[¶] https://wdstool.com/