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A NEW 3-DIMENSIONAL ORBIT FOR CAPELLA

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RESUMEN

Se calcula una órbita, basada en 221 observaciones speckle e interferométricas y 161 velocidades radiales, para la estrella binaria Capella.

ABSTRACT

An orbit for Capella, based on 221 speckle and interferometric observations and 161 radial velocities, is calculated.

Key Words: methods: data analysis — methods: numerical — binaries: spectroscopic — binaries: visual

1. INTRODUCTION

Capella is a well studied system, both as a visual and as a spectroscopic binary. There exist, nevertheless, reasons for a new study of its orbit. The orbit in the *Washington Double Star Catalog* (`http://ad.usno.navy.mil/wds`) is based on high quality interferometric observations, and likewise the spectroscopic orbit in the *9th Catalogue of Spectroscopic Binary Orbits* (Pourbaix et al. 2004) on the best radial velocities. But one can argue that an orbit should be based not only on the best observations, but on all of the available observations. The work presented here uses 169 interferometric observations, including the observations made in the early 1920's with the Mt. Wilson interferometer, and 221 radial velocities, 135 of the primary and 86 of the secondary. The interferometric observations cover the period 1919 to 1999 and the radial velocities the period 1896 to 1991. The observations are reduced simultaneously by use of the recently developed, in the decade of the 1990's, mathematical technique of "semi-definite programming" (SDP). SDP offers the advantages of calculating a global minimum of the reduction criterion and, unlike competing techniques, permits one to mix norms in the reduction. Because the interferometric observations show greater scatter, they are reduced with the robust L_1 criterion whereas the radial velocities, more internally consistent, with the familiar least squares criterion. See Branham (2007) for the details of the reduction procedure.

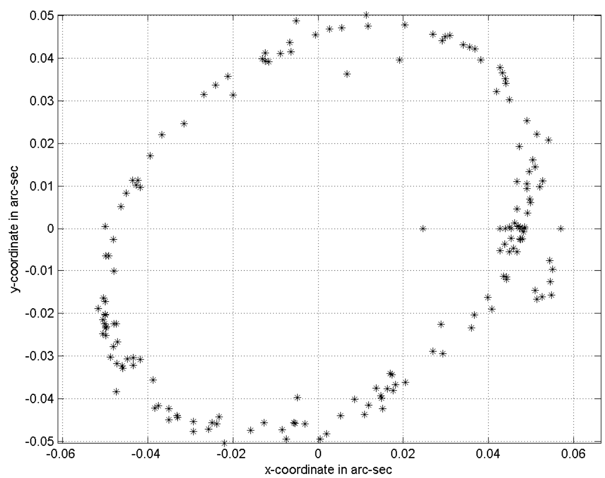

Fig. 1. Interferometric and speckle observations and final orbit.

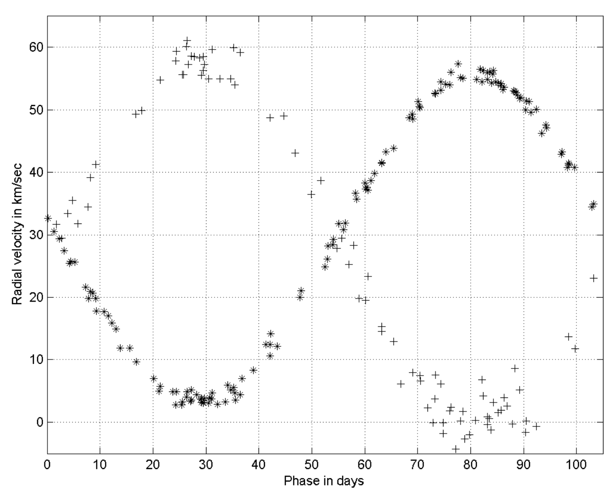

Fig. 2. The radial velocities and fitted orbit.

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TABLE 1

ORBIT FOR CAPELLA

Element	Value
Semi-major axis a	$0.''0560 \pm 0.''0004$
Eccentricity e	0.00508 ± 0.00084
Inclination i	$136.^\circ 856 \pm 0.^\circ 650$
Node Ω	$39.^\circ 162 \pm 0.^\circ 858$
Peri-astron ω	$251.^\circ 531 \pm 0.^\circ 524$
Systemic velocity V_0	28.894 ± 0.009 km s^{-1}
Half amplitude K_1	25.630 ± 0.014 km s^{-1}
Half amplitude K_2	29.152 ± 0.014 km s^{-1}
Peri-astron T	1989.922 ± 0.008
Period P	$104.^d 018 \pm 0.^d 041$
Mass primary M_1	3.20 ± 0.125 $M_\odot$
Mass secondary M_2	2.81 ± 0.110 $M_\odot$
Parallax ϖ	73.17 mas±1.17 mas

2. THE SOLUTION

The orbit calculated is shown in Table 1. It exhibits certain deviations from randomness, see Figure 1. A runs test for randomness shows 52 runs out of an expected 84 for the interferometric observations and 70 runs out of an expected 110 for the radial velocities, see Figure 2, but these are most likely attributable to systematic errors in the observations. The orbit, nevertheless, agrees well with what others have calculated, and the calculated parallax for the system lies not too far from the value given in the *Hipparcos* catalog, 77.24 ± 0.89 mas.

This research made use of data from the *Washington Double Star Catalog*, maintained at the U.S. Naval Observatory, and sent to me by Dr. Brian Mason.

REFERENCES

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