The Relative Proper Motion of HLD 120AB (WDS14527+0746)

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Abstract: Using two new measurements made in 2007, I present a new relative proper motion, a rectilinear path, and ephemeris for the double star HLD 120AB.

Description

HLD 120 is a double star in the constellation Bootes. Its structure was discovered in 1882 by Edward Singleton Holden. Both components have a brightness of 8.3 and 9.9 magnitude. Since its discovery in 1882 it was only observed 7 times. The last observation was done in 1980. This is the reason to list it as neglected double star. HLD 120 has a proper motion of -046 mas/year in declination and -062 mas/year in right ascension.

Table 1 shows the seven measurements of HLD 120 listed in the Washington Double Star Catalog (Mason 2007).

About my measurements

My double star measurements were made with an 8-inch Newtonian telescope with a focal length of 1500 mm. To record the observations, a standard webcam is used. This webcam has a small CCD chip with square pixel of 5.6 x 5.6 micrometers. The resolution is 640 x 480 pixels. The reproduction scale of the optical system is about 0.792 arc seconds / pixel. The faintest magnitude of stars which can be recorded is about 10.5.

For analyses of the webcam records I use the REDUC software package, written by Florent Losse. For double stars with components of equal brightness, the typical standard deviation of my optical system is about 0.25 arc seconds. In cases of high contrast differences between the components or low signal to noise ratio of faint components, the standard deviation is about 0.5 arc seconds. Anyway, reproduction tests show mostly better results (Schlimmer 2007).

I observed HLD 120AB in 2007.531. The best 60 frames of my record were analyzed. I got a separation of 16.03 a.s. ± 0.47 a.s. and a position angle of 224.2° ± 2.0°

Date	PA	Separation	Mag A	Mag B	Rev. Code	Aperture
1882.	220.	15.0	.	2.3	Hld1884	15
1888.456	222.1	24.65	8.2	9.8	Com1890	16
1906.21	222.7	23.35	.	.	Bu_1906	40
1909.207	222.5	23.12	.	.	Fox1915	40
1913.44	223.4	23.13	8.0	9.6	Doo1923	18
1921.35	223.8	22.31	8.0	11.4	Abt1922	11
1980.000	231.0	24.00	8.3	9.9	Cll2003	04

Table 1: Past measurements of HLD 120.

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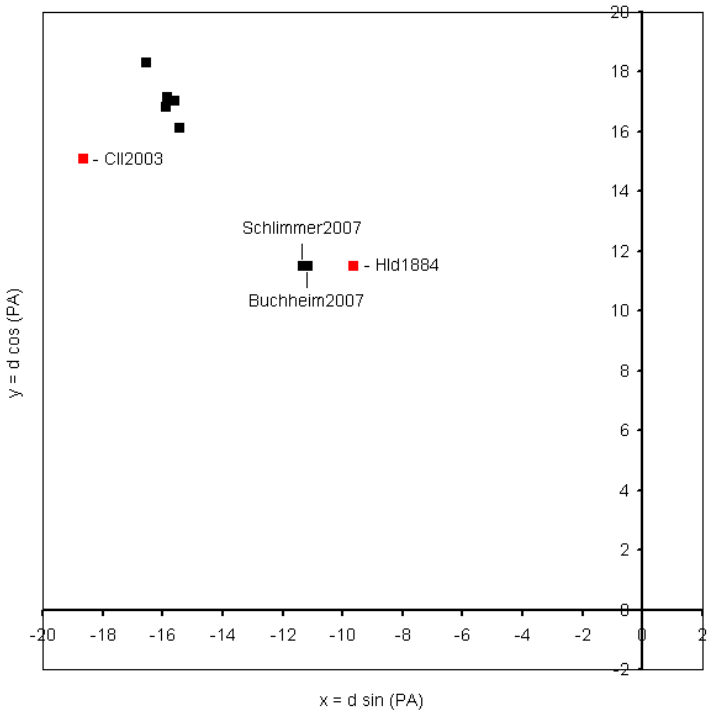

Figure 1: Plot of the measurements of HLD 120AB, labeled Schlimmer2007 and Buchheim2007, along with past measurements. Maverick points are in red.

Further Measurements of HLD 120AB in 2007

A further measurement was done by Robert K. Buchheim at Altimira Observatory in 2007.541 (Buchheim, 2008). He observed HLD 120AB nearly at the same time that I did. He reported a separation of 16.13 a.s. ± 0.05 a.s. and a position angle of $224.6^0 \pm 0.32^0$.

Evaluation of the measurements

Figure 1 show all measurements of HLD 120AB from WDS and also the new measurements, labeled Schlimmer2007 and Buchheim2007. Maverick points are in red. For plotting, the measurements were transformed from polar to Cartesian coordinates by following formula:

$$x = d \sin(PA)$$
$$y = d \cos(PA)$$

were d is the distance or separation in arc seconds and PA is the position angle.

Linear Fit and Residuals

For the best measurements (without both mavericks), a linear fit and residuals were calculated. The residuals are a good control for the quality of the measurements.

Following are the mathematical equation and results from the linear fit:

$$y = mx + b$$

$$m = -1.2246$$
$$b = -2.3283$$

Figure 2 shows the linear fit to the measurements

Results

Cartesian coordinates for closest approach:

rev. code	pa	distance	linear fit for distance	residuals for distance	Linear fit for pa	residuals for pa
Hld1884	220.00	15.00	not used	not used	not used	not used
Com1890	222.10	24.65	24.860	-0.21	222.63	-0.53
Bu_1906	222.70	23.35	23.404	-0.05	222.84	-0.14
Fox1915	222.50	23.12	23.257	-0.14	222.87	-0.37
Doo1923	223.40	23.13	22.947	0.18	222.92	0.48
Abt1922	223.80	22.31	22.041	0.27	223.07	0.73
Cll2003	231.00	24.00	not used	not used	not used	not used
Schlimmer	224.20	16.03	16.107	-0.08	224.48	-0.28
Buchheim	224.60	16.13	16.098	0.03	224.48	0.12

Table 2: Comparison of measured values to linear fit

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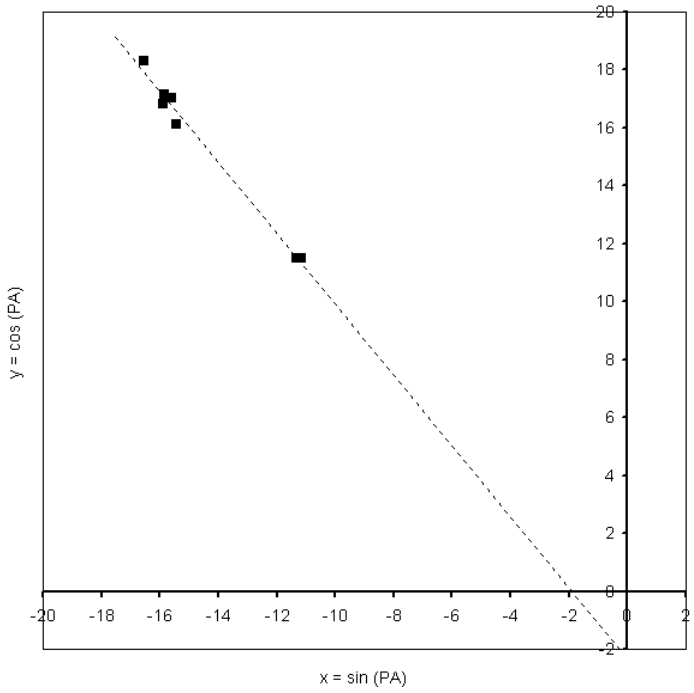

Figure 2: Linear fit to measurements of HLD 120AB.

x_0 = -1.1407
y_0 = -0.9315

Time for closest approach:

T_0 = 2229.42 years

Polar coordinates for closest approach:

ρ = 1.473”
φ = 309.24°

Proper motion:

μ_x = -45.711 mas/yr
μ_y = -55.975 mas/yr
μ = -72.268 mas/yr

Calculation of Errors

Because of the new measurements made independently by Schlimmer und Buchheim, the current position of HLD 120AB is well determined. For calculation of errors the differences between the results of Schlimmer and Buchheim divided by 2 was taken.

ρ = ± 0.2”
φ = ± 0.5°

μ_x = ± 0.72 mas/yr
μ_y = ± 0.04 mas/yr
μ = ± 0.43 mas/yr

T_0 = ± 1.74 years

Ephemeris

Because of the small value of the proper motion, it is a long time to the point of closest approach in year 2229.42. Table 3 shows predicted future PA’s and separations for HLD 120.

References

Schlimmer, Joerg, 2007, Journal of Double Star Observations, **3**, 131-134.

The Washington Double Star Catalog, Brian D. Mason, Gary L. Wycoff, and William I. Hartkopf, 2007, http://ad.usno.navy.mil/wds/

Buchheim, Robert K., 2008, Journal of Double Star Observations, 4, 27-31.

year	ρ (as)	φ (deg)
2050	13.04	225.7
2100	9.47	228.2
2150	5.92	233.6
2200	2.59	253.9
2250	2.09	354.5
2300	5.31	23.1

Table 3: Predicted future separation and position angle for HLD 120AB