Observation of STF 2686 from Haleakala

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Abstract: The visual double star STF 2686 was observed with a small telescope from the summit of Haleakala in Hawaii. Although our visually-estimated separation of 26.6 arc seconds was in close agreement with 19 past observations spread over 186 years, our position angle estimate of 277 degrees differed from the average of past observations by 1.5 degrees, a sizeable 2.4 sigma standard deviation difference. We concluded that in future observations from Haleakala with this telescope our precision could be improved by making multiple observations and by incorporating a Barlow in the optical path. Our position angle accuracy might be improved by rotating the astrometric eyepiece 180 degrees between each observation to avoid initial positioning bias.

Introduction

We recently observed several double stars from the 10,000 foot summit of Haleakala, the dormant volcano on the Island of Maui in Hawaii. Our observations were made with a visual astrometric eyepiece and with both regular and high speed CCD cameras. Our visual astrometry project, reported herein, had two objectives: (1) to determine the scale constant using the drift method, and (2) to provide McGaughey with some experience placing his previous observational results into a published paper (this is his first published paper).

Haleakala Amateur Astronomers (HAA) was founded by Rob Ratkowski, John Pye, and Casey Fukuda to allow amateur astronomers and students to participate in the University of Hawaii's Institute for Astronomy education program. Ratkowski's 9.25 inch Celestron is housed under a roll-off-roof on a pier while McGaughey's own Celestron C-9.25 is mounted on a tripod. A nearby dome houses a Celestron 14-inch Schmidt-Cassegrain telescope. Stored telescopes can be placed on piers for open-air observing (Figure 1). Various other telescopes are brought up to the site by club members.

Figure 1: The Haleakala Amateur Astronomers roll-off roof observatory is on the left, center is the HAA dome, and to the right is the open pad with piers. In the background is the 2 meter Faulkes North Telescope (Las Cumbres Observatory Global Telescope). The 10,000 foot summit is often above the cloud layer.

The observation of Struve 2686 (STF 2686) was

Figure 2: McGaughey and his Celestron C-9.25. This photo was taken subsequent to Steve's STF 2686 observations as we were preparing to make high speed electron multiplying CCD double star observations with an Andor Luca-S camera on loan from Bruce Holenstein. Photo taken by Genet.

made last year by McGaughey with his Celestron C-9.25 Schmidt-Cassegrain telescope equipped with a Meade 12.0 mm laser-etched astrometric eyepiece (Figure 2). This combination provided a magnification of 195 times. A Swan 40 mm wide angle eyepiece was used to locate and initially center the target double star.

STF 2686

STF 2686 was first observed in 1825 by Friedrich Georg Wilhelm von Struve, using what was then the world's largest refractor telescope. This famous 9-inch telescope (Figure 3) was built by Joseph von Fraunhofer and had exquisite optics and featured one of the first equatorial clock-driven mounts. The telescope arrived in Dorpat in 1824 and saw first light on November 16, 1824 (Hirshfield 2001). Struve went on to use this telescope and a filar micrometer (also made by Fraunhofer) to determine the parallax of Vega (although his value was off and priority was ceded to Wilhelm Bessell).

The *Washington Double Star Catalog* (Mason, Hartkopf, and Wycoff, 2012) reports that STF 2686 has previously been observed 19 times; first in 1825 (Struve) and most recently in 2011. The primary and secondary magnitudes are reported as 9.36 and 10.80 respectively.

Observations

To determine the scale constant of McGaughey's system, we observed β Aurigae (Menkalinan, SAO 40750) on the night of February 20, 2012, from the summit of Haleakala. Observations were made with Steve's C-9.25 telescope and Meade astrometric eyepiece without any Barlow. Ten drift timings yielded a scale constant of 9.67 arc seconds/division with a standard error of the mean of 0.02 arc seconds/division.

Figure 3: The Fraunhofer 9-inch "great refractor" used by Struve at the Tartu Observatory in Dorpat, Estonia.

STF 2686 had been previously observed by Steve on the night of August 21, 2011. Observing conditions were wind less than 1 mph, humidity 5%, and a temperature of 48ºF. Seeing was 4 on a scale of 5, while transparency was 6 on a scale of 7. The separation was estimated to be 2.75 divisions which, when multiplied by the scale constant yielded a separation of 26.6 arc seconds. The position angle was estimated to be 277º.

Comparison with Previous Observations

Brian Mason at the US Naval Observatory kindly supplied us with the 19 published past observations of STF 2686. Some 13 observations were made with a micrometer (or astrometric eyepiece). Three observations were wide field CCD astrometry, two were photographic (astrographs), and one was made with the Hipparcos astrometric space telescope (Tycho catalog). The past observations show a possible slight decrease in separation (from 27.7 to 25.8 arc seconds) and position angle (from 279.3 to 278.0 degrees) over the 186 years of observation, although this decrease may not be statistically significant. There does not appear to be a published orbital solution in the *Sixth Catalog of Orbits of Visual Binary Stars* (Hartkopf and Mason 2012).

The average separation of the past 19 observations was 26.76 arc seconds with a standard deviation of 0.61 arc seconds. Our estimate differed from the past average by 0.16 arc seconds, and thus differed by a standard deviation of only 0.27σ. However, the average position angle of the past observations was 278.5 degrees with a standard deviation of 0.6 degrees, while our estimate differed by 1.5 degrees, a very sizeable 2.4σ difference from the mean value of the past observations.

Conclusions

We met our two objectives of reporting one of McGaughey's past observation in a formal, published manner, and determining his scale constant via the drift method. While the scale constant determination was based on 10 observations which provided good precision as well as an error estimate, the separation and position angle of STF 2686 were based on single visual estimates with the Meade astrometric eyepiece without a Barlow. Although our separation value compared favorably with the past 19 observations, our position angle differed by 2.4 standard deviations from the mean of past observations.

For future double star observations from Haleakala we expect that not only could precision be improved by making multiple observations, but of equal importance, error estimates could be made. The use of a Barlow to increase the scale factor would cause the double stars to appear further apart, thus increasing the precision with which the position angle could be determined. Finally, as suggested by Frey (2009), the astrometric eyepiece should be rotated 180 degrees between each position angle measurement to reduce bias and hence increase accuracy.

Acknowledgements

We appreciate helpful external reviews of this paper by John Baxter, Joseph Carro, Sarah Collins, Thomas Frey, and Vera Wallen. We thank John Pye at University of Hawaii Maui College for introducing us to each other several years ago. Steve thanks Haleakala Amateur Astronomers members John Pye, Rob Ratkowski and Casey Fukuda for guiding him in his double star observing. We thank Brian Mason at the US Naval Observatory for supplying past observations of STF2686. This research has made use of both the *Washington Double Star Catalog* and the *Sixth Catalog of Orbits of Visual Binary Stars* maintained at the U.S. Naval Observatory.

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Stephen McGaughey, an artist and musician, is also a sailor and currently works on the Atlantis tour submarine out of Lahaina, Maui. Observing double stars has been a hobby of Steve's for the past two years. Russell Genet, an astronomer, teaches at Cuesta College and conducts research at California Polytechnic State University.