Apple Valley Double Star Workshop

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Abstract: A three-day double star workshop was held at the Lewis Center for Educational Research in Apple Valley, California. Participants gathered from California, Arizona, and Utah to teach and learn about various methods of double star measurements and analysis, and were given the opportunity to do hands-on research with the end goal of publishing their results. The participants learned to operate several telescopes equipped with either an astrometric eyepiece, video camera, Lyot double image micrometer, or a CCD camera. The participants learned how drift analysis, separation, and position angle could help describe a double star. All four teams successfully gathered data on their target stars and will be publishing their results.

The International Association of Double Star Observers (IADSO) and the High Desert Astronomical Society (HiDAS) held a three-day, two-night double star workshop on June 13 – 15, 2013. The workshop was held at the Lewis Center for Educational Research (LCER) (Thunderbird campus) in Apple Valley, California. This was the second annual double star workshop held by the HiDAS taking place in Southern California.

The first day of the workshop, the participants arrived at the Courtyard Marriott Hotel in Hesperia, CA. Afterward the participants went to Las Brisas Restaurant, serving authentic Mexican food, located in Apple Valley, for a meet and greet. After lunch, the participants gathered at the Lewis Center for Educational Research, where they listened to several power-point presentations.

The presentations were designed to help the participants understand double stars and the equipment used for measurements of separation and position angle. Reed and Chris Estrada explained what a double star is and how to use an astrometric eyepiece. In their presentation, they described the functions of the linear scale and the two outer protractors in their Meade eyepiece, and explained how raw data is used to find the separation and position angle of a double star. Eric Weise presented a description of the Lyot double image micrometer. He explained how the crystal inside the micrometer splits the image of the double star into two images. Eric also described the method of using the micrometer by aligning two separate images and applying two equations to measure the separation and position angle of a

Figure 1: A group photo of all participants. Notice Anthony Rogers posing in the slit of the observatory's dome.

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Figure 2: From left to right: Eric and Nancy Nelson, Megan Camunas, Mark Brewer, Anthony Rogers, and Deanna Zapata at Las Brisas Mexican restaurant.

Figure 3: Before heading over to the Lewis Center for Educational Research, Russ Genet, Eric Weise, Ryan Gelston, Bobby Johnson, and Vera Wallen take a group photo outside Las Brisas Mexican restaurant.

double star. Rick Wasson explained what a standard monochrome video camera is. He explained how a drift analysis could measure the separation and position angle of a double star. Rick also described the different software and cables needed for data transfer and analysis. Mark Brewer gave a presentation on what a CCD camera is. He explained how a two-dimensional chip gathers electrons from photons to display an object. He also described the software and equations needed to determine the separation and position angle of a double star. After the presentations finished, everyone gathered for dinner at Mama Carpino's Italian restaurant located in Apple Valley.

After dinner, the participants traveled back to Lewis Center for Educational Research. The participants were then split into four different teams. Experience in astronomy and research determined which participants were assigned a particular team. Beginner astronomers and researchers were placed on the astrometric eyepiece team or the Lyot double image micrometer team. Moderate to advance participants were placed on the Video Drift team or the CCD Imaging team.

Six participants were assigned to the astrometric eyepiece team, where they learned the methods of double star measurements with a 22-inch Alt/Az Dobsonian telescope equipped with a modified Meade 12.5mm Micro Guide astrometric eyepiece that had an attached high definition camera. Eight participants were assigned to the Lyot double image micrometer team, where they learned the methods of double star measurements with a

Figure 4: Eric Weise presenting on the Lyot double image micrometer. Notice how he scared everyone out of the first row!

Figure 5: Mark Brewer and Megan Camunas enjoying themselves before dinner arrived.

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Figure 6: Eric Weise (left) and Russ Genet (right) inside the Luz observatory.

Figure 7: Anthony Rogers (middle) giving some insight on his Alt/Az Dobsonian telescopes to Earl Wilson (left) and Rick Wasson (right).

14-inch Meade Schmidt Cassegrain telescope equipped with this rare and historic instrument, crafted in the mid twentieth century. Four participants were assigned to the video drift team, where they learned the methods of double star measurements with a 12-inch Alt/Az Dobsonian telescope equipped with a standard monochrome video camera. Seven participants were assigned to the CCD imaging team, where they learned the methods of double star measurements with an 8-inch Meade Schmidt Cassegrain telescope and a 14-inch Meade Schmidt Cassegrain telescope equipped with an SBIG ST8 CCD camera.

The second day of the workshop was focused on data reduction. Several presentations were given describing various methods of reduction, including some time tested, relatively standard procedures as well as methods being developed by participants of the workshop. After the presentations were complete, the participants left for an informal lunch. Once lunch was finished, each team continued reducing and analyzing their data. Before preparation for the second night of observations began, everyone gathered for dinner at Siam Thai Cuisine Restaurant located in Apple Valley. After dinner the participants reconvened at the Lewis Center for Educational Research for their second night of observations.

On the final day of the workshop, the participants met in the lobby of the Courtyard Marriott Hotel where they started structuring the first draft of their scientific research papers for publication in the Journal of Double Star Observations (JDSO). After a first draft was under way, the participants gathered for lunch at the Golden Corral located in Hesperia. This was the last meal of the workshop before the participants headed back to their

Figure 8: William Buehlman (left) and Mark Brewer (right) initializing the SBIG ST8 CCD camera to a MAC computer.

Figure 9: From left to right: Sean Gillette, Reed Estrada, Nancy Nelson, with Vera Wallen taking a measurement. The 22-inch telescope was built by Reed and Chris Estrada.

Figure 10: Eric Weise, Bobby Johnson, Ryan Gelston, and Vera Wallen collaborating on the first draft of their scientific research papers.

Figure 11: Dinner at Siam Thai Cuisine Restaurant.

homes.

Astrometric Eyepiece Team

Workshop participants on the Astrometric Eyepiece Team were Reed Estrada, Chris Estrada, Vera Wallen, Paul Wren, Eric Nelson, and Nancy Nelson. The astrometric team used a 22-inch "push-me pull-me" Dobsonian telescope with a modified Celestron 12.5mm Micro Guide astrometric eyepiece equipped with a Bell and Howell DNV16HDZ 46mm f/2.8-3.5 high definition video camera.

Following Reed and Chris' own method, the team played back their observations with Adobe Photoshop Pro CC software. Both nights, the team measured the drift time, separation, and position angle of double star STFA 58AC, which has a reported separation of about 40.6 arc seconds.

Lyot Double Image Micrometer Team

Workshop participants on the Lyot double image micrometer team were Eric Weise, Russ Genet, Bobby Johnson, Ryan Gelston, Leah Ginsky, Kelsey Dodge, Michael Silva, and Anthony Rogers. The Lyot double image micrometer team used a Meade 14-inch Schmidt Cassegrain telescope with Genet's newly acquired Lyot double image micrometer.

The first night of the workshop yielded the first successful double star measurements using this instrument. The star observed was STF 1744AB (Mizar), which has a reported separation of about 14 arc seconds.

On the second night, the team observed STF 2264, which has a reported separation of about 6 arc seconds. This star and Mizar were both measured 12 times to give the team a reliable standard deviation, and these results will be reported in their paper. For the rest of the night, the team performed a survey of four stars with decreasing separations. Four survey observations were made each of STF 2162AB, STF 2603, and STF 2289, which have a reported separation of 1.3, 3.1, and 1.2 arc seconds, respectively. The purpose of the survey was to find the lower limit of separation that the Lyot double image micrometer could observe. Each system was observed four times to reduce bias for statistical analysis and the report for a scientific paper.

Video Drift Team

Workshop participants on the Video Drift team were Rick Wasson, Earl Wilson, and William Buehlman. In addition, Eric & Nancy Nelson and Deanna Zapata joined the team after the workshop, learning data reduction software techniques and contributing to the paper.

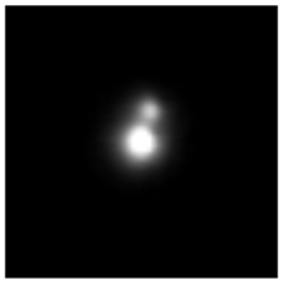
The Video Drift Team used a portable Orion 12-inch f/4.9 Dobsonian telescope, with a video camera in place of a 1¼" eyepiece. A "Kiwi" GPS time inserter, originally intended for accurate timing of asteroid occultations, added a GPS time display to each video frame. A Canon camcorder recorded the digital video stream on cassette tape.

Since the Dobsonian telescope field continuously rotates, the stars were allowed to drift across the video field with the tracking motors off, forming an east-to-west sequence at the sidereal rate. Several "drift times" are typically recorded to the nearest 0.01 seconds. Analysis with specialized freeware programs "VidPro" and "Reduc" produced accurate calibration of field rotation angle and plate scale (arc-seconds per pixel). These programs were then used to measure double star separation and position angle.

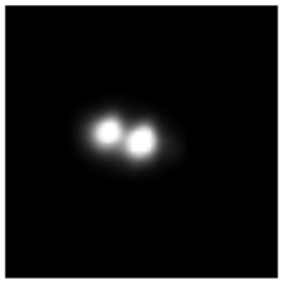
The two bright but challengingly close pairs of Epsilon Lyrae (magnitudes 5 to 6, separations < 2.5") were

observed the first night, with a 3x Barlow and a 13% neutral density "moon" filter. No color filter was used. The second night, several faint but wide pairs (magnitudes 10 to 13, separations 6" to 30") were observed, with no Barlow or filter. Unfortunately, on that night, the telescope was not well collimated, the seeing was poor due to hot, windy conditions, and the target stars were quite low in the south. Therefore, the quality of those observations was not as good as typically achieved with the video drift method.

Shown below are typical images of the two Epsilon Lyrae pairs, created using the "Shift & Add" technique of the Reduc program.



Epsilon Lyrae North-West Pair, STF2382AB. Best 118 of 472 Video Frames, Drift "a".



Epsilon Lyrae South-East Pair, STF2383CD. Best 248 of 500 Video Frames, Drift "a".

CCD Imaging Team

Workshop participants on the CCD imaging team were Mark Brewer, William Buehlman, Sean Gillette, Megan Camunas, Alana Brown, Deanna Zapata, Heath Rhoades, and Travis Gillette. The team used an 8-inch Meade Schmidt-Cassegrain telescope with a German Equatorial mount equipped with a SBIG ST8 CCD camera. CCDOps were used for data acquisition and Astrometrica was used for data analysis.

The first night of observations, the CCD Imaging team experienced issues initializing the SBIG ST8 CCD camera to CCDOps. A driver failure was likely the problem. The rest of the night consisted of troubleshooting without any observations recorded.

On the second day of the workshop, Mark Brewer, William Buehlman, and Megan Camunas spent their lunch solving the CCD initialization problem. They determined that the problem from the first night of observations was due to a PC failure to download some of CCDOps' drivers and install them in the correct sequence. Sean Gillette loaned the team his MAC Pro, which had no complications with CCDOps.

On the second night of observations, the CCD imaging team was up and running. They had issues finding a tight focus, however the data gained was sufficient. They were able to use displacement vectors from the two-dimensional CCD chip to measure the separation and position angle of double star STF 2806AB, which has a reported separation of about 14.8 arc seconds.

Lessons Learned

The first lesson learned was of time. The schedule was prepared so several presentations and breaks were available for the participants, though there were times that presentations fell short of the time allotted. Lesson 2 learned was again related to time. The first scheduled dinner took longer than expected, and those team leaders that needed more time with telescope setup were left setting-up in the dark. Another lesson learned was the lack of images taken of the workshop. Lesson 4 learned was having the participants create a lab notebook of their observations/experiments. The final lesson learned was the problem of not recording which double star(s) each team observed. Of course, email afterwards was enough to get that information, but it would have been much more convenient to have those at the time of the event.

Conclusion

The second annual Apple Valley Double Star Workshop was successful. Preparing and executing the workshop was a rich and rewarding experience for Mark Brewer. Outreach was delivered to a local middle school called Vanguard Preparatory School, and an interstate audience was present from Arizona and Utah. A discussion was held between the participants and the CCD imaging team to decide and develop new methods and ideas for reducing the data through the use of their software. The workshop helped Rick Wasson, Reed Estrada, and Chris Estrada gain more experience with using their techniques to measure double stars. The people that were brought together intend to continue working together on other research projects. The workshop has demonstrated that even a modest gathering of people can produce amazing results through partnerships that will last well beyond the end of the workshop. We enjoyed the second annual workshop and hope the participants will be available to join in for the third annual Apple Valley Double Star workshop.

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