

## Chapter 18

# Pine Mountain Observatory Summer Research Workshop

Russell M. Genet<sup>1,2</sup>, Richard Berry<sup>3</sup>, Jolyon M. Johnson<sup>4</sup>,  
and Thomas G. Frey<sup>2</sup>

1. Cuesta College, San Luis Obispo, California

2. California Polytechnic State University, San Luis Obispo

3. AstoPIX

4. California State University, Chico

### Introduction

In 2008, as an extension of the Cuesta College astronomical research seminar for undergraduate students, Russ Genet initiated a student summer research workshop at University of Oregon's Pine Mountain Observatory (PMO) near Bend, Oregon. The workshop's primary objective was to complete several research projects that would result in published papers in a short length of time, initially one week.

Pine Mountain Observatory has two main functions: research and public outreach. The research program concentrates on CCD photometry of galaxies with low surface brightness. This research is carried out primarily by the Director of the Pine Mountain Observatory, Dr. Gregory D. Bothun, University of Oregon, Department of Physics. Most of the observations are made by the Resident Observer, Alan Chambers, with a 32-inch Sigma Research telescope located inside a large dome. The summer research workshops also became part of the research program at Pine Mountain Observatory, albeit with smaller telescopes and rather modest scientific goals.

The public outreach program at PMO features public nights every Friday and Saturday evening during portions of the year when the observatory is open to the public (the observatory is closed to the public during the winter). Kent Fairfield gives public lectures on these nights, and the visiting public views objects through the 24-inch Boller and Chivens telescope as well as smaller telescopes often set up by amateurs. Dan Gray recently retrofitted the 1950s 24-inch Boller and Chivens telescope with a modern control system from Sidereal Technology (which Dan owns).

Keeping a remote, mountaintop observatory functioning is a major task that is handled primarily by Mark Dunaway, the on-mountain Manager for the observatory.



Figure 1: Pine Mountain Observatory's telescope facilities. The dome on the left houses a 32-inch telescope, the middle dome contains a 15-inch telescope, and the right dome has a 24-inch Boller and Chivens telescope.

The first PMO summer research workshop was held in July of 2008 and consisted of several students, astronomers, and engineers. A week before the workshop started, Russ Genet met with Kent Fairfield to visually measure double stars. They used the 24-inch Boller and Chivens telescope with an astrometric eyepiece and later with a CCD camera. Russ also set up his 6-inch Celestron NexStar 6 SE to do preliminary trials, using it as a portable observatory for science.



Figure 2: Russ Genet (left) and Kent Fairfield (right) reduce their observations of double stars using a CCD camera on the 24-inch Boller and Chivens.

The following week, during the 2008 workshop, Jo Johnson, a student at Cuesta College in San Luis Obispo, California, and Eric Carlson, a student at the University of Oregon, used the Boller and Chivens as well to observe double stars with an SBIG ST-8 CCD camera. They also attempted several transits of the exoplanet HD 189733b predicted on TransitSearch.org. No transit was detected after data reduction.

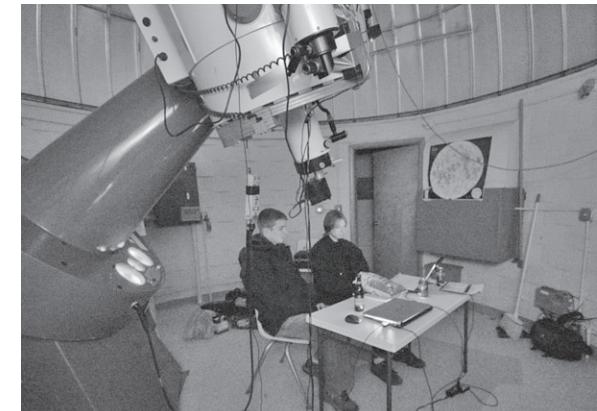


Figure 3: Eric Carlson (left) and Jo Johnson (right) observed for the predicted transit of the exoplanet HD 189733b with an SBIG ST-8 CCD on the 24-inch Boller and Chivens telescope.

Meanwhile Dan Gray, President of Sidereal Technology, developed a software program to automatically observe variable stars using a 14-inch alt-az telescope that he had designed and built and equipped with a near infrared photometer, the Optec SSP-4. This photometer normally requires an operator to change filter slides, flip a mirror, and center stars. Dan's goal was to fully automate this process. He observed Algol, a bright red eclipsing binary with a large amplitude eclipse.

Howard Banich, an astronomer and telescope designer, made visual measurements of double stars using his 28-inch portable alt-az telescope and an astrometric eyepiece. Richard Berry, former editor of *Astronomy Magazine*, helped with the installation of a 14-inch telescope for research in one of the domes.



Figure 4: Howard Banich and his portable 28-inch computer controlled telescope. He can unload it and set it up, by himself, in about ten minutes.

This first workshop acted as a trial run to see if original research could be completed and published in one week. Although no research was published as a direct result of observations made during the workshop, the observations had been completed in the prescribed amount of time. It was concluded that the following summer, experienced instructors should lead each announced project with students and educators, to assure publication.

### Pine Mountain 2009

Rick Kang, a Pine Mountain Observatory public outreach volunteer, promoted the 2009 workshop at PMO to many schools around Oregon. Three schools, St. Mary's School in Medford, South Eugene High School in Eugene, and Willamette University in Salem responded. Students and teachers from each school agreed to attend the workshop. However, most could only stay for a few days. Thus the workshop would be only three days long. Could students actually learn how to make observations, reduce and analyze their data, and write papers for publication in only three days? This was the question.

To accomplish the goals of the workshop, Richard Berry and Jo Johnson, now a student at California State University, Chico, were invited to return as Instructors, as well as an amateur astronomer from San Luis Obispo, Dr. Thomas Frey, Professor of Chemistry at California Polytechnic State University, who was experienced in such research. Richard Berry led a variable star photometry project as well as a proper motion astrometry project. Jo and Tom each led a visual double star astrometry project. Each of these instructors also gave lectures on the first day to introduce the students to the topics of their research. None of the students had made quantitative astronomical measurements before.



Figure 5: Richard Berry's Team (left to right): Richard Berry, physics professor Richard Watkins, and physics majors Jared Green and Nick Rebol, planning their evening's observations. Not shown is team member Danyal Medley, Director of Development at Celestron, who was setting up the latest Celestron 11-inch telescope for the observations.

Richard Berry made preparatory observations of his targets a week prior to the workshop. He made photometric measurements of the short period variable star XX Cygni and astrometric measurements of nearby Barnard's Star. When Jared Green and Nick Rebol, both students from Willamette University, as well as Professor of Physics Richard Watkins arrived, they made further measurements and reduced their data using AIP4Win, software developed by Richard Berry and described in his popular book *The Handbook of Astronomical Image Processing* (2006). They determined the period of the variable star XX Cygni with a precision of a few micro-days. Barnard's Star moved slightly in declination in the time between the observations before the workshop and the observations at the workshop.

Jo Johnson's team consisted of Austin Schrader, a graduate of St. Mary's, Mandy Walker-LaFollette of South Eugene High School, and Dan Medley, Principal Engineer of Technology at Celestron. They used Russ Genet's 6-inch Celestron NexStar 6SE and Celestron Micro Guide astrometric eyepiece. Their primary goals were to evaluate the equipment for scientific research and measure a double star from the "neglected star catalog" of the Washington Double Star (WDS) Catalog.



Figure 6: Jo Johnson's team (left to right): Austin Schrader, Russ Genet, Dan Medley, Jo Johnson, and Mandy Walker-LaFollette.

Tom Frey's team was made up of students and instructors from St. Mary's, including students Ryan Gasik and Monika Ruppe as well as science instructors Holly Bensel and Fred Muller. Also joining them was Dave Scimeca, a retired technician who keeps St. Mary's astronomical telescope and equipment in working order. This team's primary objective was to measure a neglected double star using Tom's alt-az 18-inch Obsession telescope and compare their

results to published values. They also wanted to take what they learned back to St. Mary's and apply it to the astronomy curriculum. Their observations and analysis helped to conclude that the double star ARY 52 is an optical pair and not physically bound by gravity.



Figure 7: Tom Frey's team (left to right): Tom Frey, Monika Ruppe and her father, Holly Bensel, Ryan Gasik, Dave Scimeca, and Fred Muller.

Each of these teams was required to give presentations as a group at the beginning and end of the workshop. The first presentation outlined what they planned to accomplish, whether doing astrometry or photometry. The concluding presentations discussed their results and plans for publication. The three final presentations were full PowerPoint science presentations that would have been well received at any astronomical conference! Each team wrote up a paper describing the research they had completed. In the end, six papers from the workshop were submitted for publication.

Howard Banich returned to once again make visual measurements of double stars on his 28-inch telescope. Dan Gray continued his project for automated photometry of variable stars. This time, he also contributed follow-up observations of XX Cygni to Richard Berry's group.

Finally, Russ Genet, besides helping manage the workshop, made considerable progress on the design of a 1-meter alt-az telescope for the Orion Observatory, which he directs. Russ plans to bring this transportable telescope to Pine Mountain Observatory for the summer research workshop in 2010. A couple of students will be invited to join Russ in projects involving high precision photometry, such as exoplanet observations.



Figure 8: Dan Gray and his 14-inch alt-az robotic telescope, affectionately called "Lollipop" (for obvious reasons). Dan was working to fully automate near infrared aperture photometry.

### Conclusions

The workshop organizers and instructors, Russ Genet, Richard Berry, Jo Johnson, and Tom Frey, found that it is possible to conduct publishable student research in a very short time frame—several days. The small size of the workshop was a contributing factor to its success, as was the low student-instructor ratio. Too many students would have been difficult to manage. Also, the projects were detailed enough so the students could have a positive learning experience but were not so extensive as to be overwhelming.

Next year's workshop at PMO will once again include students from high schools and colleges. Students from the 2009 workshop will be invited to return as Senior researchers or Science Advisors to the various projects. The instructors will also be invited to return once again to guide the projects through to publication.

### Acknowledgments

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