



## Astronomy Camps 2009 on Kitt Peak

*Katy Garmany (NOAO) & Don McCarthy (Steward Observatory)*

Imagine what it would be like if you were a young teen spending a week at Kitt Peak National Observatory as a junior astronomer. For over 20 years, Dr. Don McCarthy, Steward Observatory, has run residential Astronomy Camps (Camps) on Mt. Lemmon for teens and adults. This year three Camps were held at Kitt Peak National Observatory (KPNO) to take advantage of additional telescope facilities and darker skies: Beginning Camp for junior high-school students, Advanced Camp for high-school students, and a Camp for students from a school in Mexico. These weeklong events utilized astronomy as a teaching tool so students could experience science, engineering, and math in action.



Noah Shenker, Don McCarthy, and Dayanara Sixkiller at the Mayall 4-meter telescope. (Photo credit: Don McCarthy)

McCarthy and his staff offered a rich experience including multi-wavelength observing both day and night; hands-on experiments in physics, astronomy; and engineering; hiking the Solar System to scale (down the old road!); and a chance to have fun getting to know other students from around the world. In this immersion experience, campers acted like real astronomers: watching the night sky, operating research-class telescopes and instrumentation, keeping nighttime hours, interacting with leading scientists, interpreting their own observations, investigating their own questions and curiosities, and,

most importantly, having fun. These Camps emphasized a hands-on learning approach, and activities were driven by student involvement and interest. The students also contributed to KPNO by undertaking service projects each day.



Beginning Campers remove weeds from the Kitt Peak volleyball court as one of their daily service projects. (Photo credit: Don McCarthy)

This summer teenagers from 18 states, seven Arizona cities, and four foreign countries (Honduras, India, Mexico, and Spain) traveled to Kitt Peak. During a typical day at the Beginning Camp, students conducted experiments in science and engineering and performed astronomical observations at night. At the research-oriented Advanced Camp, the students undertook specific projects in CCD imaging and spectroscopy at multiple wavelengths using many different facilities on Kitt Peak. The third Camp involved students from the Tecnológico de Monterrey school in Hermosillo, Mexico, in a combination of all these activities. Each Camp included 24 students (campers), Director McCarthy, and up to 11 additional adult counselors. Many of the counselors are now professional astronomers who became hooked on astronomy when they attended the Camps.

The campers undertook many different types of observations, some of which are illustrated below. With the McMath-Pierce solar telescope, they measured spectroscopic velocities of convective granulation cells, monitored the daily development of four small sunspots, and watched the sunset. At the WIYN 0.9-meter telescope, they obtained multi-band CCD images of the asteroid 2059 (Baboquivari) and measured its V-, R-, and I-band colors for the first time. Images were also obtained for projects involving pattern speed of spiral galaxies, chemical evolution of nebulae, quasar photometry, and cometary activity. The Bok 2.3-meter telescope was used for visible spectroscopy of comets, planetary nebulae, quasars, and T Tauri stars. With the

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Arizona Radio Observatory's 12-meter dish, each camper mapped his/her own Infrared Dark Cloud with the 3-millimeter Atacama Large Millimeter Array prototype receiver. Finally, with the Kitt Peak Visitor Center (KPVC) 16- and 20-inch telescopes used for the EPO-run Nightly Observing and Advanced Observing Programs, the campers not only took pretty pictures but also recorded the transit of an extrasolar planet (TrES-3) and obtained the light curve of the rapidly pulsating variable star CY Aqr. Campers will continue to work on these projects as they pursue both local and national science fair competitions.



Beginning Camper Alan Francisco prepares to launch his team's Newton's Car down a line of relatively frictionless wooden dowels. Hopefully, this car will take the best advantage of Newton's Laws and travel the farthest. (Photo credit: Don McCarthy)

This first experience in hosting campers who are much younger than most visitors to the mountain was very positive. All of the Kitt Peak staff who interacted with the students were very impressed, hopefully paving the way for future Astronomy Camps.

Special efforts were made to recruit applicants from local Tohono O'odham students, and we were pleased to have two attend the Beginning Camp and one the Advanced Camp. Scholarships were provided by adults who have attended Astronomy Camp as well as by NASA through Space Grant and Near Infrared Camera/James Webb Space Telescope education funds. Dayanara Sixkiller, in the Beginning Camp, wrote the following letter after her experience:

*Dear Kitt Peak Observatory,*

*Thank you for allowing the Astronomy Camp to take place within your facilities. I was so impressed with the staff, facilities, and getting to work with some of the world's largest telescopes. I did not want to leave.*

*At astronomy camp we learned so much. It was an experience I will recommend to anyone who is willing to work hard and tough it out. Patience and an open mind are needed to work late observing stars and constellations. When my new friends began chatting on our 2009 camp forum, we discussed what objects we wished to see at camp. I was interested in The Cat's Eye Helix and Black Hole. Unfortunately the skies had other plans for us. We had the perfect view to see Saturn and its rings. We saw the Bee Hive, Virgo, and Leo constellations. I also enjoyed the inflatable planetarium. I was so excited to see an animated comet shower.*

*We had the opportunity to experiment with liquid Nitrogen and magnets, and what happens to an oxygen balloon in liquid nitrogen. We made liquid nitrogen ice-cream, which turned out to have an odd taste, to many people stirring the pot. Everyone was adding their own ingredients to the same pot. Would not recommend 25 kids to make anything you want edible. It does not work well.*

*We also had the opportunity to visit The Pima Air and Space Museum. I got to show people what I know about planes, and they shared what they knew. We were just conversing a lot and that helped us learn more about each other. On the way back from Tucson we had even more fun than we did at the museum. We were chatting away but also were napping for the long night ahead of us.*

*I made a lot of friends at camp. I still keep in contact with them. We had fun at camp and, I think they will come back next year.*

*I wish to thank your kitchen staff for the delicious food they prepared. I give them 20 thumbs up. My favorite meal was the chili and beans. It reminded me of my home meals.*

*I had a great experience at camp this year and I will come back next year and have even more fun than this year's camp.*

Dayanara Sixkiller AKA blue rassberry 11

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*Dayanara Jay Sixkiller*

Astronomy Camp is grateful to all the personnel from Kitt Peak National Observatory and Steward Observatory, both on the mountain and downtown, who worked very hard to make a positive impact on the lives of a new generation of astronomers and leaders. The Camps are sponsored by The University of Arizona Alumni Association. More information can be found at [astronomycamp.org](http://astronomycamp.org).

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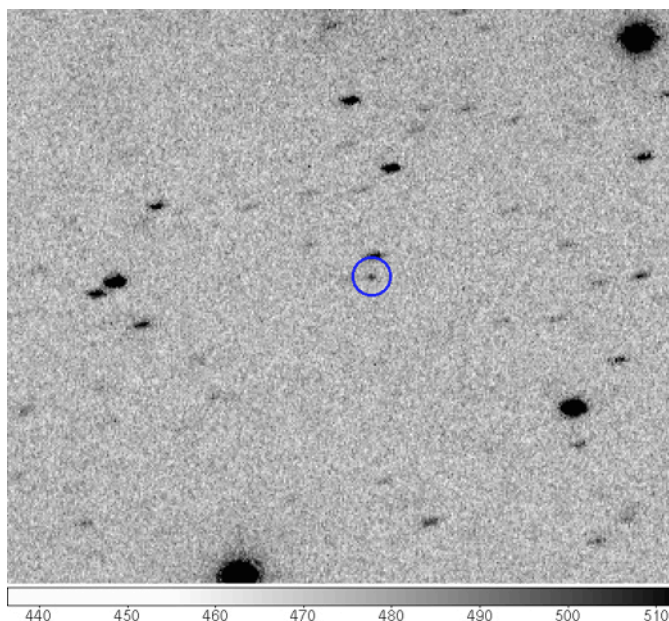


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## ***Astronomy Camps' Science Results***

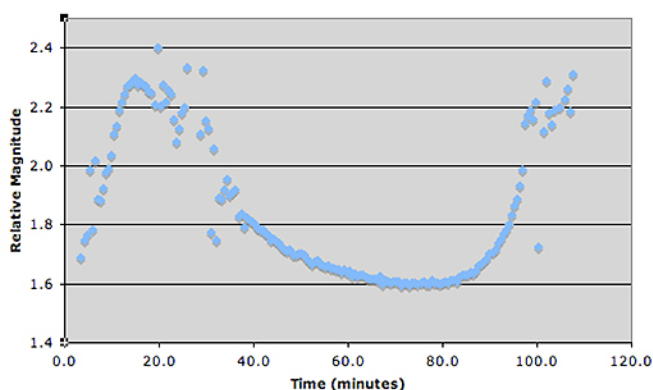


The Crescent Nebula (NGC 6888) imaged through the KPVC 20-inch telescope by Beginning Campers Radhika Arora, Anna Carter, Madeleine Fort, and Joshua French, with assistance from Steve Peterson.



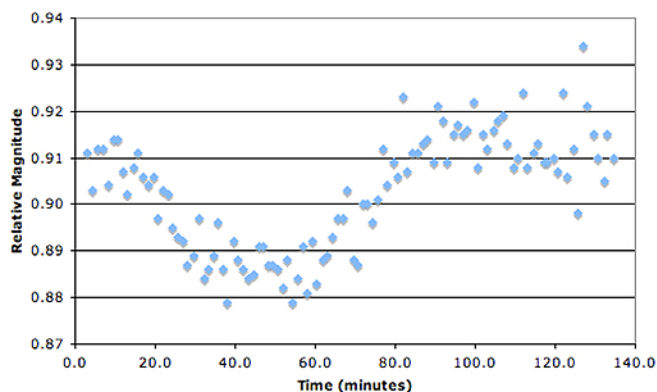
An R-band CCD image of asteroid 2059 (Baboquivari) obtained by the Advanced Campers with the WIYN 0.9-meter telescope and processed by Eric Hooper. This object is very faint ( $V = 22.2$ ) and required stacking images of a moving object so background stars appear streaked.

**CY Aqr Lightcurve**

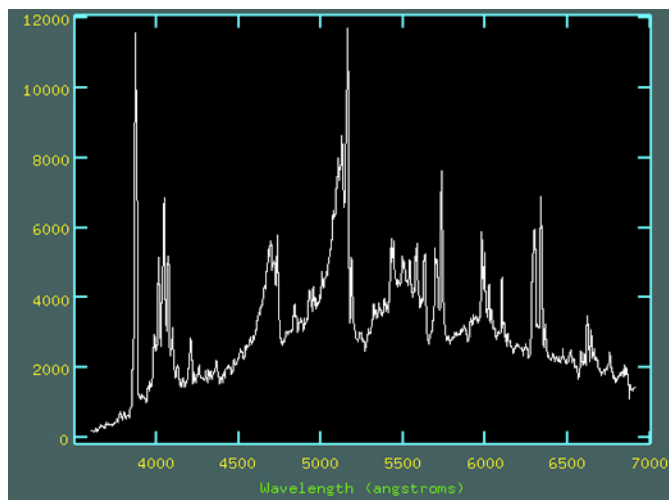


Light curve of the pulsating variable star CY Aqr obtained by a team of Advanced Campers led by Nancy Thomas at the KPVC 20-inch telescope with assistance from Kevin Bays.

**TrES-3 Lightcurve**



Light curve of the transiting extrasolar planetary system TrES-3 obtained by a team of Advanced Campers at the KPVC 20-inch telescope with assistance from Flynn Hasse.



Visible spectrum of Comet Garradd (C/2008 Q3) obtained at the Bok 2.3-meter telescope by a team of Advanced Campers led by Brianna Smart with assistance from Tim Bowers and Betsy Green.