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Mentoring Astronomy Students Through Extensive Research (MASTER)

JUNE 25, 2019 BY [ADMIN](#)

Dr. Michael Joner, Physics & Astronomy

Student Participation Post-Baccalaureate Observing Supervisor

Michelle Spencer**

Undergraduate Students and Observers at West Mountain Observatory

Rochelle Biancardi (Steele) *** *

Nevyn Tyau

Maria Martinez *** **

Emily Ogden

Timothy Sitze

Gilvan Apolonio

Seth Clarke ** *

Jared Kruger

Jason Trump ** *

Aaron Sears

Dahlia Maxwell

Adam Bugg ** *

- * Author or Presenter at the American Astronomical Society Winter Meeting
- ** Author on refereed journal article
- *** Summer REU student

Academic Deliverables

Refereed Paper –

Johnson, Marshall C., Rodriguez, Joseph E., Zhou, George, ..., **Clarke, Seth., Trump, Jason, Martinez, Maria,** Spencer, Michelle, E., **Joner, Michael D., ...Bugg, Adam,** Hintz, Eric G., Stephens, Denise C., and 58 coauthors, "KELT-21b: A Hot Jupiter Transiting the Rapidly-Rotating Metal-Poor Late-A Primary of a Likely Hierarchical Triple System," 2018, AJ, **155**, 100

American Astronomical Society Presentations

Bugg, Adam, Hintz, Eric G., and Joner, Michael D., "Monitoring Pulsating Variable Stars with Five Robotic Telescopes," 2019, AAS, 233, 360.07

Trump, Jason, Hintz, Eric G., and Joner, Michael D., "An Analysis of the delta Scuti Variable V402 Cephei," 2019, AAS, 233, 360.11

Steele, Rochelle, Draper, Christian, Moody, J. Ward, McNeil, Stephen, Joner, Michael D., and Steele, Jackson, "Surveying for Void Galaxies with New Photometric Methods," 2019, AAS, 233, 356.09

Clarke, Seth, Hintz, Eric G., and Joner, Michael D., "H-alpha Variability in the Young Open Cluster Cygnus OB2," 2018, AAS, 231, 348.05

Bugg, Adam G., Hintz, Eric G., and Joner, Michael D., "Monitoring Cepheid Variables using the New BYU Observation Deck Robotic Telescopes," 2018, AAS, 231, 146.12

Additionally, in her role as observing supervisor at West Mountain Observatory, Michelle Spencer appeared as a coauthor on nine refereed articles that appeared in first tier journals in 2017 and 2018.

Summary

This Mentoring Environment Grant (MEG) proposed using the Brigham Young University West Mountain Observatory as a mentoring environment where students would experience what it is like to do research at a fully operational observatory by doing a wide variety of observations at regularly scheduled times over the course of several months during the spring and summer terms. The primary project in 2017 involved making nightly monitoring observations of the active Seyfert 1 galaxy Mrk 509 in support of a worldwide campaign involving more than a dozen ground-based and space-based observatories. In 2018, the primary monitoring campaign for extragalactic objects was centered on a group of blazars that included Mrk 421, Mrk 501, and BL Lac. In addition, during both years, observations were made that supported research on continuing projects such as the LAMP16 campaign with standardization of the different AGN fields, observations of open clusters using the H-alpha and H-beta photometric systems, evaluation of transiting exoplanet candidates from the KELT survey, observing rotation curves for various distant solar system objects, and observing various pulsating variable stars.

Academic Objectives

It is expected that students will do superior research at the observatory that will not only contribute to the primary monitoring project but will also form the basis of their required senior thesis, and presentations they may make in the form of a published journal article or a contribution at a local, regional, or national scientific conference. In addition to making presentations at the CPMS Spring Research Conference at BYU and the annual APS Four Corners Meeting, we urge our students to also participate in a national meeting, such as the Winter Meeting of the American Astronomical Society. As has been indicated in the list of student participants, four of the students appeared as authors on refereed Astronomical Journal article detailing the discovery and confirmation of the exoplanet KELT-21b and four of the students made presentations at a national meeting using data. In addition, the REU students I had during 2017 and 2018

both spent time at West Mountain along with other regular student observers who were supported by this grant in gaining experience doing significant astronomical research.

Mentoring Environment

The mentoring environment at the West Mountain Observatory operated as desired during the course of this project. In general, the observatory provides an ideal environment where students can experience life as a research scientist. One irregularity experienced during the 2017 and 2018 spring/summer observing seasons was an increased number of cloudy nights during July and August of 2017 and June and July of 2018. This resulted in cancelation of several observing shifts for the different student groups that were scheduled. In several cases, it was necessary to give students other research work that could be worked on in town while the weather was poor.

In order to successfully operate the observatory to the benefit of all involved, it is necessary that each of the student observers act in a responsible manner and work with the different telescopes to secure observations on a variety of different projects over a time period of about four months during the spring and summer terms. This experience is ideal for teaching about the nature of collaborative science. It is important that each observer learn about setting priorities and scheduling observations so that a large number of different endeavors are supplied with necessary data. During the time covered by this project, observations were secured on every available night with either the 0.3-m or 0.9-m telescopes at the observatory. It is also instructive for the students to gain experience with normal disruptions to a routine such as unexpectedly poor weather conditions, equipment failures, or even ordinary events such as the changing phase and position of the moon. All these factors provide an education about real-world experience as opposed to idealized cases that are much more rare.

Research Findings

It would be easy to make a case that the West Mountain Observatory was incredibly successful during the two years covered by this grant. Just the fact that there were 23 refereed articles in first tier academic journals from projects done at WMO during this period provides strong evidence of this success. However, this would be a bit misleading since publications tend to lag behind the observations by several years with this type of work. It is significant that observations done in 2017 by student observers made their way into publication in the *Astronomical Journal* early in 2018 but that is not a typical occurrence. The reality of the 2017 and 2018 observing seasons with long periods of poor observing conditions is that observations were made at every opportunity but there were also many improvements made at the observatory that will increase productivity in the future. Examples of this include the new control system that was installed on the 0.9-m telescope during the summer of 2017 and the new data acquisition software that was used during the late summer of 2018. Both of these major upgrades needed to be commissioned and tested and have resulted in improvements in data quality at the observatory. Having the student observers work with and test these improvements is an unseen benefit realized from mentoring programs.

Even though conditions were not ideal during the time covered in this proposal, the observations secured were valuable to a number of ongoing long-term campaigns. The student observers were able to make observations of several target of opportunity objects that were noticed. All of the projects that were worked on during this period were successfully observed during the time the student observers were working. By this several other measures, the project was successful on many different levels.

Several of the student who have worked at the observatory have made changes and decided to go a different direction in their academic pursuits while others have continued to graduation in Physics and Astronomy. Some students wanted to work at the observatory to gain diversity in their educational experiences and others want to do the work because they intend to pursue a career in astronomy. A major accomplishment of this proposal has been providing those experiences. All of the students working

at the observatory have helped numerous researchers move projects forward. Students who have needed data for their own projects have been able to have those observations made. The student observers have all had the opportunity to experience a working observatory and gain an understanding of what is needed to produce quality observations for a major monitoring campaign. All of these experiences are rare for typical undergraduates at many universities and it is rewarding to see them being common at Brigham Young University through the different mentoring programs.

Budget Expenditures

It was originally anticipated that a graduate student would work as a mentor part of the time to supervise observations at West Mountain during the time covered by this proposal. However, I did not have a graduate student during this time and had just finished a somewhat unexpected nine-month sabbatical leave at the end of May in 2017. Thus, it was necessary to utilize a part-time observing supervisor over both years covered by this MEG. Approximately \$17K was used to pay the observing supervisor position and wages for the undergraduate student observers during the months from May to September of 2017 and 2018. Additionally, \$3K was spent for travel to the AAS Winter Meetings in 2017 (Grapevine, TX) and 2018 (National Harbor, MD).

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