SABBATICAL REPORT
Westmont College

Name: H. Michael Sommermann             Department: PHYSICS           Date: 5 April 2007

Project Title:  ASTRONOMICAL OBSERVATIONS WITH THE
KECK TELESCOPE AT CARROLL OBSERVATORY

Period of Sabbatical Leave:  Spring Semester of the Academic Year 2005-06

Goals to be met through the sabbatical leave:

1. Supervision of the Carroll Observatory Renovation - Installation of Telescope
2. Setup of Control and Operation of the Telescope and Scientific Instrumentation
3. Astrophotography of Various Deep Sky Objects
4. Astrometry of Asteroids and Photometry of Variable Stars
5. Development of Research Projects and Observational Activities for Students

Projected benefits to the College:

Creation of Research Opportunities for Students in the Physics Department
Development of Astronomy Activities for General Education Students
Expansion of Westmont’s Community Outreach

Introduction

The plans for my sabbatical leave in the spring semester and summer of 2006 focused on work
with Westmont’s new Keck telescope – which was expected to be delivered and installed in the
time frame April – May – June 2006. Unfortunately, for reasons described below, the delivery of
our telescope was delayed. Nevertheless, it was possible to carry out most of the planned work.
Some additional projects (e.g. revision of my GE astronomy course) were added.

The following sections provide an overview of my efforts. Please feel free to contact me if you wish
to receive more detailed technical information.
1. Supervision of the Carroll Observatory Renovation - Installation of Telescope

The renovation of Carroll Observatory was completed in May 2006, at the end of the spring semester. Before and during my sabbatical, I was involved in the design of the new dome, the observatory deck, and control room. After construction was finished, and together with two student assistants, I prepared the observatory for the arrival of the new telescope.

2. Setup of Control and Operation of the Telescope & Scientific Instrumentation

Because of circumstances beyond our control, the delivery of the new telescope has been delayed. DFM Engineering in Longmont, Colorado, was on schedule with the construction of the telescope optical tube assembly, its drive and base. However, the subcontractor for the primary mirror, Optical Surface Technologies in Albuquerque, New Mexico, was unable to complete the main component of the telescope on time. Due to personnel turnover in the company, and due to equipment changes at New Mexico Tech, our project was delayed for almost one year!

I am happy to report that as of this date, 9 April 2007, we have received word that the completed mirror has arrived at DFM. The mirror system will be tested in the coming days. If all goes well, the telescope will arrive on campus at the end of this month, just in time for our summer research session.

Some of the work that I had hoped to complete during my sabbatical, such as the setup of the control room, will be finished in the coming summer. This includes setup of a computer system for the control of the telescopes and the domes, and testing of the CCD cameras and other scientific equipment.
The picture below shows our telescope during the construction process at DFM Engineering. At this point a second telescope, a 200mm refractor built by TEC (Telescope Engineering Company) had already been delivered and was mounted on top of the main reflecting scope.

3. Astrophotography of Various Deep Sky Objects

Even though the telescope was not available to us during my sabbatical, I continued to work on the proposed projects, together with two undergraduate students (Mr. Damian Durruty and Ms. Fern Lim), using our amateur-class 12-inch Meade Schmidt-Cassegrain reflecting telescope. The telescope was set up under the new electric-hydraulic dome on an expanded concrete pier, which represented a great improvement to the old situation.

The details of all the steps necessary for successful astrophotography were presented in reports by Damian Durruty and Fern Lim. They include, first, careful operation (pointing and guiding) of the telescope. Second, CCD imaging and image reduction. Finally, LRGB processing of the digital images with Photoshop. Our results were shown at Westmont’s research symposium in the fall semester of 2007. Two sample images of our work follow on the next page.
4. Astrometry of Asteroids and Photometry of Variable Stars

During my sabbatical, again in collaboration with the student research assistants mentioned above, we studied several RR Lyrae-type pulsating stars. RR Lyrae variables undergo some interesting periodic changes: cooling and heating, contraction and expansion.

The periodic temperature and surface changes result in periodic changes of the stars’ intrinsic brightness or luminosity. The latter effect can be measured and is of interest to astronomers who study (a) stellar models and (b) distances within the universe.
Measurement of the light curves of stars requires very careful calibration of the CCD images. The graph below displays our results for the variable star RR Leonis. A significant rise in brightness (change in magnitude of about 0.85) is clearly visible.

5. Development of Research Projects & Observational Activities for Students

The capabilities of our current MEADE Schmidt-Cassegrain scope are rather limited compared to what will be possible once our new research-grade DFM telescope is in place. The development of additional research projects for our students (which may include astrometry and photometry of minor planets-asteroids, the search for supernovae and gamma ray bursts, and much more) will have to wait until then.

At that time we also plan to reinvigorate our programs for the local community, in collaboration with the members of the Santa Barbara astronomy club (the “Astronomical Unit”).
Conclusion

In each of my previous sabbaticals I also spent some time on improving one of my courses. In spring 2006 I decided to focus on my GE astronomy course. Specifically, I wanted to improve my PowerPoint slides for this class. The idea was to actually reduce the number of slides, and to be careful to apply certain important pedagogical principles. Below I am printing one sample slide.

Finally, sabbaticals are supposed to help us “recharge our batteries.” To this end I decided to spend the early part of my leave (five weeks in January and February) with friends and family in Germany and elsewhere in Europe. This included trips to Paris and Rome, as well as a wonderful time of skiing in Austria. I’d like to conclude by thanking Westmont for making this special time of research and recreation possible.