



Stocker Astroscience Center

Observatory Director's Report

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by

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I. Introduction.

FIU astronomy moved into the Stocker Astroscience Center on January 8th, 2014 and classes were held for the first time in the building that week. Work continued on the control room electronics, and also on the downstairs projection equipment in the main teaching lab room. On January 12th, the first ever public Star Party at the Observatory was held. The event attracted over 150 students, faculty, alumni, and people from the community and was a huge success. We installed the 12-inch Meade telescope in the dome and took tours into the dome and the nearly finished control room. On January 24th, 2014 the "Star Trek Bridge" control room lifted off, connecting to SARA North and SARA South and observing several Messier objects for astronomy classes. In addition, over 100 images of several Southern hemisphere Blazars were obtained for Dr. Webb's research program from the control room which operated efficiently and exactly as designed. Much of the credit for the operation should be given to Bob Werner of FIU who basically took our design and made it happen. The Stocker Astroscience center was officially certified as LEED Silver in July 2014. The Stocker Astroscience "Picture of the Week" was established with a new astronomy picture featured every week beginning in September of 2014. October 25th saw the arrival of the ACE 24" telescope. A crane

arrived and hoisted the telescope and pier up nearly 6 stories, then carefully lowered it into the dome through the opened slit. The next few weeks saw the installation of the telescope. From the beginning, the telescope produced amazing images with its piggy-back CCD camera. Regular use began in November. (See the Stocker Picture of the Day for images from the telescope).

I put together a “*Stocker Astroscience Center Observatory Operations*” handbook which contains rules, regulations, and safety regulations. It contains everything you need to know to operate the 24-inch telescope and the cameras on the telescope. It also contains the details of certification for observers, advice on how to plan observations and several appendices which have instructions on image reduction with our MIRA programs. Students or other potential users will be asked to study this document, then receive on-site training from a certified observer for at least two nights before they are allowed to observe unassisted. The manual also contains instructions on what to do when things go wrong and how to get assistance. We also have a new emergency call box installed on the observing pad for safety.

It was clear from the beginning that this building was a special place on campus. So many times when one designs a facility, something is forgotten, not thought of in time, or just doesn't work as designed. Remarkably enough, this observatory has everything we wanted (except more closet space) and has operated much more smoothly and efficiently than we could have expected. The Stocker Astroscience Center building has been all we hoped for and much, much more. It is a magnet for the community to visit campus; we have hosted concerts in the main lab room, and it has been used for special presidential events, physics department events, as well as student events.

II. ACE 24-inch Telescope.

The Astronomical Consultants and Equipment (ACE) 24-inch Ritchey-Chretien F/6.2 automated reflecting telescope was installed in November of 2014 with my assistance and that of FIU physics undergraduate Patrick Ford. From the time the telescope was installed, it has seen constant use for teaching, research and outreach. Funds for the telescope and installation were provided by tech fee grant 12-004 (\$381,080). Due to the time between the grant and actual installation, and due to some unforeseen complications, the telescope installation ran over budget by \$14,525. A new tech fee grant (15-48) was funded in 2015 to pay for the budget overrun. This makes the total funds for the telescope through Tech Fees at \$395,605.

The telescope can be operated from the lower dome, from the Stocker Control room, or from the Stocker laptop anywhere there is an internet connection. The ACE control system allows menu-driven operation identical to the SARA research telescopes. When new users are on the telescope, I can log in using the Stocker Laptop and check on them, answer questions, or give advice from home. This has been a valuable feature when students are on the telescope by themselves. As noted above, the telescope

performance has been exceptional. The observatory design by Tim Khan, lead designer, was very effective and yielded effectively no vibrations above background seeing even after an initial move, regardless of what is happening in the building. Thus the telescope has a good base from which to operate. Dr. Peter Mack's mount and telescope design provides good tracking which will be improved as we work on tweaking the polar alignment. The largest error in tracking is polar misalignment. The dome automation is great, effectively following the telescope automatically to allow us the freedom of ignoring dome position and to use the telescope remotely (with no one in the dome).

The telescope was used in CCD imaging mode and images were acquired on 37 nights. Observers included myself and qualified members of the astronomy club (Daniella Roberts, Andres Medina, Patrick Ford and Daniel Puentes). Images of planets Saturn, Mars, Jupiter and Neptune were obtained with the CCD camera and reduced using MIRA in the Stocker control room or the CCD reduction lab (room 305). Venus was difficult to image without overexposing the camera because of its extreme brightness, so we didn't manage to get any good images of it. The Moon was also imaged on four separate nights in different phases. We also tracked comet Lovejoy as it made its way through the inner solar system in early January. We imaged seventeen Messier objects including the *Ring nebula*, *Orion nebula* and the *Dumbbell nebula*.

We imaged several interesting NGC galaxies for class projects, and the big surprise was that in addition to imaging for teaching and outreach, we looked at four quasi-stellar objects. These objects are distant proto-galaxies and are the subject of my research. I had no anticipation of getting scientific quality data from the telescope. However, we easily obtained high quality, high signal-to-noise observations of two sources, BL Lac and S5 0716+71. During February of 2015, we contributed three nights of photometric data on S5 0716+71 to an international campaign on this object led by former FIU graduate student Gopal Bhatta. These data will be published in an upcoming summary paper of the project in the respected *Astronomy & Astrophysics* journal. A subset of this data has already been published in the *Astrophysical Journal Letters* (The *Astrophysical Journal Letters*, 809:L27 (6pp), 2015 August 20). In August, we observed BL Lac and detected it was in outburst, brightening up near its historical maximum. We were the first to see this and to alert the AGN community to this recent flare.

The telescope can be used for visual observing and yields excellent site-limited (1.5"-2") seeing with the eyepiece supplied by ACE. It has been an attractive feature for our outreach and star parties, but access to the eyepiece is limited and thus closely restricted. For most public events, a video camera is installed in place of the eyepiece and the signal is routed to an outdoor TV screen so everyone can see what the telescope is looking at without venturing up to the observing platform. This, plus the excellent C-11 and Meade 12" telescopes mounted out on the observing deck, provide exceptional views of a variety of astronomical objects including the Moon, nebula, galaxies, planets, and comets.

The auto-guider is still not operating correctly. I am told the ACE code needs to be revised for our system and a new cable needs to be installed before the auto-guider will function properly. However, this is really not an issue: the tracking is sufficient for short exposures, and due to the sky brightness long exposures are not possible anyway.

As the telescope is used over time, the mirror will become dusty and need to be cleaned. A prospective grant from the Orbital/ATK Corporation might provide funds for upkeep such as this. The need remains for more equipment, equipment repair, and computer and equipment update funds. Further grant possibilities are being explored. The observatory has become the focal point for the award-winning astronomy club. It is critical in teaching students interested in obtaining an astronomy minor, to gain experience using the telescopic equipment and cameras.

On a more humorous note, the astronomy club has started calling the telescope the JWGT (James Webb ground-based telescope) (named after me) as opposed to the JWST (James Webb Space Telescope) (not named after me). So for now, the unofficial name of the telescope is the JWGT.

III. Control Room

The control room has been an amazing success. The electronics in this room and in the main 1st floor lab room were purchased through Tech fee 12-003 (\$157,271). Although control room interior design was scaled down from the initial design due to funding issues, it has captured the imaginations of countless visitors, from children to FIU administrators! Even though the control room is an inspiration for students, faculty and visitors, the real value of the control room is the efficient design for controlling telescopes. Whatever the “inspirational successes,” this aspect has been eclipsed by the excellent teaching and research capabilities of the control room.

- **Teaching** – Observational Astrophysics offered in Spring of 2015 met with 14 students (physics and engineering majors) and frequently used the control room for training on telescope control and actually using the SARA telescopes at Kitt Peak and Cerro Tololo Interamerican Observatories. The use of the 75” screen and the switching capabilities allowed every student to get a close-up view of the steps and procedures necessary to make observations from a large telescope. Every student got the chance to “push the buttons” and observe everything other students did. It was an amazingly efficient setup for teaching observational astrophysics.
- **Research** – Observing overnight with one or both of the SARA telescopes was an amazing experience in the control room. We frequently had visitors or guests wanting to experience observing and there was plenty of room for everyone. The abundance of monitors allowed us to observe efficiently with all three telescope simultaneously without missing anything or endangering the telescope. The large monitor was sometime critical for difficult field determination. The amenities in the control room (CD player and video player) made long observing nights much easier to deal with.
- **Training** – During the day, we sometimes had a high school intern (Bobby Martinez), a graduate student (Doug Laurence), and undergraduates working side-by-side at different stations reducing data or working on numerical computer codes to model the observations. The high school intern worked on color combining CCD images taken with either of the SARA telescopes or the local 24: telescope for use on the Astroscience website as the Stocker Picture of the Week

(SPOW). Undergraduates worked on their own projects, individual work class projects, or Dr. Webb's Blazar research. One undergraduate, Jordan DeWitt, worked for the summer of 2014 and fall 2014 semester as an intern in the lab. His work consisted of reducing images, doing photometry, organizing data and data storage.

IV. Teaching

Teaching at the observatory consists of education at all levels. Three hundred and fifty undergraduates come to the Main Lab room for introductory astronomy labs every semester. This large room houses a state-of-the-art projector and computer system, and is equipped with laptops which students use for computer labs. (The laptops were obtained by Dr. Simpson.) Several of the laptops were stolen over the summer and were replaced. Our astronomy lab manager is looking into getting security cameras installed in the observatory to help protect the equipment there. There are two complaints about the lab room that persist: excessive noise of the air handling system and occasional temperature and humidity problems. We have called facilities out several times but as yet no solution has been found.

The Astronomy Resource Room has become a valuable space, occupied most evening by students studying and using the resource materials stored there. It is also used for faculty astronomy-related meetings and talks to small groups. Thesis reports and defenses are also held there. It is truly a multipurpose area that is indispensable to our faculty and students.

The Computer and Image Analysis Lab has eight computer stations with MIRA image processing software and many computerized CLEA laboratories. This room is the main classroom for the Observational Astronomy Lab taken by astronomy minors. Students are taught the various aspects of image processing and data analysis there and undergraduate students working in astronomy use the room for image processing of their images from the 24" telescope. The room also houses our copy machine and printers.

The Astronomy Waiting Room is another special space that is critical to the smooth operation of our night labs. The occupancy of the roof prohibits too many students up there at one time, so there has to be room for the students to wait until a telescope spot opens up for them. This room is one floor below the telescope deck and has served this purpose well (as designed).

The Observing Deck has worked amazingly well as an observing platform. Vibrations from the elevator or people walking on the deck have not affected the viewing through the telescopes mounted on the piers. The deck design is exceptional. The addition of the light switch to turn out the deck light made the deck a superb site for observing. The ground lights and lights on other buildings remain a significant problem for the observatory. This is discussed below in future projects.

Main Telescope Room remains unfinished. I envision walls surrounding the observing station to isolate light from the monitors and lights used to illuminate the keyboards from affecting the observations. Also, it will clean up the area and make it look more professional. The wooden cover for the hole from which the telescope pier rises has not yet been installed. The other problem with the main telescope room is the excessive

size and noise production of the air handling system in there. We just needed a system to keep the temperatures down and dehumidify the room when the dome is closed. The existing system, which now actually cools, is overkill. It gets very cold if left on, and has to be manually shut off to observe or even to visit the dome because of the excessive wind noise.

V. Student Use

The main usage of the telescope and control room has been astronomy minors taking the observational astronomy classes. Students graduating from that course can also use the facility. We have just finished the initial copy of the “*Stocker Astroscience Center Observatory Operations*” handbook for the 24” telescope which contains all of the information necessary to operate the telescope and associated cameras. Students must be properly trained and qualified to use the telescope without supervision. I have established a certification process which will qualify students or faculty to operate the telescope.

Certification Requirements

1. Passed Observational Astronomy Class and Lab, or a faculty member
2. Read “*Stocker Astroscience Center Observatory Operations*” handbook and passed Certification Test
3. Had at least 2 nights on the telescope with certified user
4. Been certified by observatory director.

After they are certified, then they must request time on the telescope from the director and be approved before opening the dome. To date, four students have passed the certification process.

High School Astronomy

The observatory has also been instrumental in high school education in Miami-Dade. Our joint program with Booker T. Washington (BTW) was a result of a \$1,000,000 grant from Lennar which I helped write. The grant funds allowed the installation of a new state-of-the-art digital planetarium projector in the BTW planetarium and opened up a dual enrollment astronomy course at BTW. The dual enrollment program included two trips to the Stocker Astroscience center for the class. The students, along with BTW staff and some of the parents, visited the Astroscience center and listened to a lecture. They then went out on the observing deck and used the telescopes for a lab. They also toured the control room and looked through the 24” telescope. Most students agree this is the highlight of their semester. The “education effect” at Northwestern High School also brought their students to the observatory for a program.

FIU MAST brought students to the observatory for a private star night. Several other local schools (e.g. Miami Springs Montessori School) have visited for a tour and observing on the observing deck.

Last spring we had an informal high school student interning with us (see control room training above). I have accepted a more formal Miami-Dade intern for this coming semester who will take over the Stocker Picture of the Week (SPOW) on our website.

VI. Research

As mentioned above, the 24" telescope with its filters sets and cameras is of such high quality that it can be used for various research projects including monitoring bright blazars, asteroid tracking, binary star light curves and potentially observing the effects of extra-solar planets eclipsing the parent star. This quality was unforeseen when the observatory was being planned and has already born fruit.

We observed 5 different Blazars on 17 nights, getting more that 100 photometric quality images. Remarkably enough, for bright blazars (R~13-14 mag.) the S/N is quite good for even 30 second exposures. Although the auto-guider is still not working properly, the tracking is good enough that there is no issue with 30-second exposures.

VII. Tours

The observatory has had frequent requests for tours from the University community and the Miami-Dade community. In fact, the tour schedule has become quite taxing for astronomy personnel. A calculated total of 305 hours has been occupied by over 70 different tours/events. Some of the groups requesting tours have been from Donors relations, A&S deans office, Geeki girls, Hurricane Center, Broward Sheriff's department, faculty, staff, and alumni. Each tour requires about an hour, some are much longer, consisting of actual lectures or programs and require preparation. Some occur during the day, and many occur at night or on weekends. To date, no tour request has ever been turned away. The observatory has housed special events such as press conferences, joint club meetings, and concerts. The main lab room on the first floor also has a professional sound system in it and already touring musicians have offered concerts at the observatory. The observatory hosted the Christmas party for Barnes and Noble at FIU, a conference dinner for Business Services, and a fund raiser for the Music department. It continues to be in high demand by the university community.

VIII. Web Site

The Stocker Astroscience Center website at: astroscience.fiu.edu has worked out great. Jennifer Gebelein set it up on the web and I have maintained the content since then. It features a clear sky clock specifically calculated for the observatory, a history tab, contributions tab, upcoming events, news, and a "Stocker Picture of the Week" feature. The "picture of the Week" is modelled after the NASA Astronomy Picture of the Day (APOD). We take a picture either from the 24" telescope, or from one of our research telescopes, process it, write a blurb explain with the image is and how and who made it, and post them for a week. Visitors can view a new image every week. During spring of 2015, high school student Bobby Martinez and I maintained the page. Over the summer I have maintained the page and supplied the images.

IX. Fundraising

In addition to the new tech fee grants, a proposal to Orbital/ATK was funded. Additional funding for student operation of the observatory has been promised by the SISH and will make way for more students to have access to the observatory at night. Howard Lipman has assigned Joe Hornstein to assist SISH fundraisers in looking for

grant opportunities to fund the public programs and various projects at the observatory. We are hoping some of these come to fruition in the near future.

X. Exhibition Hall

The Entryway/Exhibition hall has been a resounding success with its Italian glass mosaic on the floor and the “Hubble Deep Field Image” ceiling. The exhibits are being rotated on varied on a semester-to-semester timescale. I have designed and built all of the displays with my own funds and materials. Some examples:

- *The Physics of Star Trek* – original display containing Star Trek star ship models, books about the Physics of Star Trek, and autographed copies of Star Trek books.
- *The History of Observing* – featured models and pictures of telescopes throughout the ages, a timeline, and historical observational artifacts from University of Florida’s Rosemary Hill Observatory.

XI. Conclusions

The first full year of observatory operation has been a resounding success. It has proven a valuable resource in teaching, outreach, and even in research. The design and construction has lived up to the hopes and dreams of astronomy faculty and students. And we are just getting started!

One of our most urgent problems is lighting control on campus. Light pollution is commonplace in Miami-Dade and on campus. A quick survey of our campus shows tremendous waste of light contributing to the bright background of light preventing us from seeing the stars at night. It is also dangerous! I have a short write-up on a proposed test of lighting around the MMC campus entitled “*Bring the Stars Back to FIU*”. It was sent to the head of facilities management but so far no response has come back. Very simple fixes to existing lights around the observatory could help immensely with scattered light and remove dangerous glare that is currently a hazard for students and astronomers on campus at night. We are on campus at night more often than other members of the campus community, so we care deeply about campus safety and the safety that correct lighting could offer. Not only that, but FIU could save enormously on the electric bill if light is not wasted. Copies of the report, complete with pictures, can be obtained from me.

Heading into our next year of operation, we will focus on three issues: fund raising to fund repairs, equipment and student help at the observatory, lighting control around the observatory and campus wide, and the possible building of a planetarium. The planetarium will require a large donation and is of secondary importance compared to the first two critical issues. The second full year with the telescope looks to be very exciting with the Stocker Astroscience Center coming into its own.

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