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Summer 2018 Interim Report #2

Over the past several weeks, I have worked on multiple different small projects in the High Contrast Imaging Testbed facility (HCIT), many of which are still in progress:

1. **Turbo Vacuum Pump Outlet Control (TVPOC)**. TVPOC is a combination of hardware that I have installed for HCIT1, the small vacuum chamber within HCIT, and its corresponding software routine that I developed. The purpose of TVPOC is to provide a fail-safe measure to HCIT1, in which the turbo vacuum pump gate valve will automatically close if an environmental error is detected, sealing the chamber and protecting the hardware inside. The code has been written, the planned hardware has been installed, and the code and hardware together have been tested lightly. However, TVPOC still must be tested on the chamber itself before we can consider the project completed. In addition, I have to find and order more hardware and modify my code in order to include the new hardware after a potential flaw in design was pointed out. This may take another two weeks to complete.

2. **Moving and Installing the Decadal Survey Testbed (DST)**. Around the fourth/fifth week of my internship, we lifted the DST and moved it into HCIT2, the large vacuum chamber within HCIT. I spent several days working alongside Keith D. Patterson and Camilo M. Prada to install the DST into HCIT2. This included hours of cabling D-sub connectors, taping wires, bolting thermal heaters and sensors, and painstakingly uncoiling, untangling, and threading bundles of optical fibers. When everything was hooked up, we ran tests to see if all the motors, cameras, heaters, and coolers were working properly. After testing was complete, we sealed the chamber and pumped the air out, leaving the DST in vacuum. This project is completed.

3. **Tuning the DST Thermal Heater PID Controllers**. The 16 heater and sensor pairs on the DST will be controlled with a PID controller. My goal is to tune the PID in order to find the optimal parameters for our purposes. At first the parameters which I had determined through calculations were resulting in unanticipated behavior, with K_p values nearly 10x the expected magnitude and out of control heating patterns. A bug was discovered in the code that has been fixed, however I have not been able to work further on this project due to other people using the DST for various tests. Next week I will have an opportunity to complete my work on this project.

4. **Calibrating a Deformable Mirror (DM) Mount.** One of the new DM mounts is equipped with three crystal motors that adjust the tilt of the attached mirror when voltage is applied to each motor. My task was to use an interferometer and a substitute mirror to record the change of mirror tilt in microradians per volt on each motor. We originally tried using a piece of polished stainless steel, machined to match the general size and weight of the DM as a dummy mirror, however we found that the reflected light was subpar for the interferometer to pick up. Luckily, we were able to find an aluminum mirror that had a similar weight and mounted that instead. I used a voltage box to cycle through voltages on each motor, recording the data received through the interferometer and plotting the data into charts for later reference. This project is completed.

5. **Mounting and Calibrating a DM.** Current main project in progress. I am working with Keith D. Patterson and fellow intern Jordan A. Rupp to mount a DM onto a different DM mount and then calibrate the mount with the interferometer. This is much like the procedure in my project 4, except this mount must be tuned by hand and the mirror is the real thing this time. We have run into many problems so far, amplified by the fact that we are working with extremely sensitive and expensive equipment. Therefore, our work has been very slow and this project may not be completed until after my internship has ended. This mirror will be placed in the DST and be tested and calibrated for vacuum conditions later on.