SPINOR Engineering Observing Run Log

What we learned about optics

Versalight works well in the polarizing beam splitter, as the calibration linear polarizer and in the entrance window polarizer array. A single polarizer can be used as an analyzer without a PBS, but care must be taken to reflect the 100% polarized beam out of the system.
Observations at 850nm using the versalight and polymer calibration retarder and modulator worked well. Using the polymer modulator at longer wavelengths (1083nm) the modulation efficiency drops and at short wavelengths (<500nm) circular modulation drops off.
The cross disperser worked well for telescope calibration. This is single beam only due to the large range of orders across the CCD.
The achromatic calibration retarder shows spectral fringing, 6 fringes across the V spectral field and 3 fringes across the Q and U spectral field.
The achromatic modulator creates fringes in V at 557nm all the time and at 630nm sometimes. Early in the morning the fringes seemed not to be present. This is quite confusing.
The polarizing beam splitter shows tilts of spectrum lines that are different for the two beams.
The AO acts as nearly a quarter wave retarder when the outside surfaces of the steering prisms are used. This was verified by placing a linear polarizer before and after the cubes and noting that the two beams are only slightly modulated by the polarizer, nowhere near extinguished. The AO prisms were changed so that reflections came off the interior surfaces of these prisms and the light level dropped by more than 2x. There are two solutions, fold prisms that are broad band AR coated on the glass surfaces and have a high reflectivity interior reflection such as Ag. I suspect the current prisms have a nickel coating over coated with silver, then protected. The other option is to put an achromatic retarder in the beam before any polarization analysis. This could be after the last fold mirror if polarization analysis is happening off the slit, or behind the slit if not. This is costly.
Action Items: Calibrate the data to determine the severity of the spectral fringing.
Decide how to avoid the AO polarization, new fold prisms or an achromatic retarder.

What we learned about network disconnects

For some unknown reason the network communication path between oscar (control GUI) and cookie (the ASP synchronizer computer) fail after typically 40 minutes. This has happened only for a few months.
The only known solution is to reboot cookie.
The problem is local to the ASP system.
All other communication paths among oscar, cookie, bert, and ernie are reliable, including cookie to oscar.
Both TCP and UDP fail, but TCP fails quicker.
There are no stack problems on cookie.

There are no message queue or semaphore problems on cookie
The order of bringing up connections makes no difference.
Closing the socket, deleting the communications task and restarting them does not fix the connection.
Meanwhile: TCP was implemented between cookie, bert and ernie so that bert and ernie do not have to be rebooted, thereby saving tapes.
Cookie checks for and reads in the values from the previous log so that logging does not have to be restarted after each reboot. It now takes 2 minutes to recover from a disconnect.
The observer can complete calibrations by using the 'Continue' command when cookie is expecting a response to an OK box in a window.
Action Item: Replace the ASP computers with SPINOR

What we learned about attaching a Pluto camera

This worked well.
I could not get the parallel I/O board to generate hex signals on another output port so we just did a 'T' of the existing one.
Serial worked well at 19200 baud, but not slower.
We were able to ftp data to the SAN.
Action Item: Implement a networked virtual camera for SPINOR.

13 June

Hector and David drove to Sunspot
Unpacked at DST. Everything looks OK
Installed Pluto computer into Control Functions rack. LCD monitor, keyboard, and mouse are on a table in front of the rack.
Connected parallel cable from Pluto computer to Synchronizer Sync and Timing Panel PB2.
Connected serial cable from Pluto computer to Synchronizer Serial I/O panel second port.
Edited mod_hex_isr.c in 'synchro' so that hexadecimant is sent out PB1 and PB2 as well as the original PA1 and PA2

14 June

Mounted 16.5mm polarizing beam splitter (PBS) into ASP beam splitter mount.
Removed half wave retarder and stored it and old beam splitter in ASP cabinet.
Doug and Mike set up relay optics to spectrograph using new protected silver mirrors.
Mounted PBS in HSG. Found it was too high. Moved the head to a lower screw in the rotation stage and got it to the correct height.
Set up Pluto and ASP cameras. Got ASP cameras on 850nm Calcium lines, but missed 1083nm on the Pluto because of using the wrong lambda/2 filter.
Got serial communications to work from ASP to Pluto camera. For some reason 19200 was required. Camera will synchronize if hex is driven from an ASP camera port, but not from one of the two additional outputs. Software debugging needed.
Network connections to the storage area network. We were able to ftp data from Pluto to the SAN and Hector was able to ftp it to his laptop.

Rick Dunbar fashioned a plastic 2-inch OD insert for the calibration polarizer mount. This made it possible to mount the new Versalight 0.7mm thick polarizer into the mount designed for a much thicker part.

15 June

Found 1083.0 by setting up HSG on 541.5.
ASP cameras needed to be moved to follow IRT.
Ernie camera adjustments were difficult. A focus micrometer drove itself out of the mount. Spectral was way off because of the brace on the upper CCD being forced to one side.
Wayne Jones put a connector into one of the flat ribbon cables carrying hexadecimant information. This worked whereas all attempts to get additional outputs in software failed.
With a linear polarizer after the last fold mirror before the slit, it was possible to extinguish one of the beams. With the polarizer after the AO, it was still possible. With the polarizer before the AO, there was nearly no extinction. The two fold mirrors really polarize! The old ASP modulator was discovered at NSO and today it was put to good use just after the last fold mirror before the slit. It could be adjusted so that a polarizer before the AO could extinguish one beam. The long term solution is a half wave bicrystalline achromat.

A forest fire started in Dog Canyon on the far side of West Side Road. After some helicopter water runs, it seems to be under control. The flames were quite visible from the back porch of the DST.

Some problems today. A fan in bert is failing. The video switch monitor has failed. I moved the cookie monitor to its place. The video board in the Pluto computer is inadequate. The display is nearly useless due to the few number of bits. On numerous occasions today, cookie and oscar lost network connection. This is new since the last time I was here.

First light for the new polarization optics. We observed 854.2, 849.8, and 1083.0 in a sunspot and at the East and South limbs.

16 June

Today was clear with a few bands of clouds.
We ran maps of AR 0634 - large scan of the big leading spot, time series 5 step movies of the small spot in the middle of the region, and a fixed slit many sample scan of the large spot. We also did two polarizations and a flat (with lines in place).
Network communication was a huge problem. There are three identified net communication problems. Oscar to Cookie fails after some time with Cookie failing to receive commands from the Oscar GUI. There were at least 8 failures of this type during the day. The ICC would not reconnect twice and was rebooted. The ICC could not control the Spectral Instruments camera twice and the camera had to be rebooted. After each failure of the Oscar/Cookie or Cookie/ICC communications, Cookie had to be rebooted. When Cookie is rebooted, Bert and Ernie needed to be rebooted and they

would not re-establish net communications with Cookie. This meant that Exabyte tapes had to be ended and new ones mounted. The whole reboot process takes about 10 minutes when a couple of folks are working on tapes and computers and we lose a set of tapes. We ran through 5 sets of tapes (multiple reboots between tapes on occasion).
Chris Berst helped us with the camera issues. There is a camera time out after only a couple of seconds. If commands were not received it would quit listening to ICC. Cookie tells ICC to tell the camera to set exposure and then do an exposure at each scan step. Normally this would be enough to prevent disconnect by the camera, but if anything slowed down the scan we could have a problem. This has been resolved by manually setting the frame rate to 10 seconds at the camera GUI. This will give us 30 seconds before disconnect. The communications between Cookie and Bert and Ernie have been changed from Remote Procedure Calls to connect and drop TCP socket stream. In overnight tests indicated that Cookie can be rebooted without having to reboot Bert and Ernie. The Oscar to Cookie communications will be changed to connect and drop TCP as soon as time is available.
We also had a problem with Bert camera A failing to correctly set its spectral window. All the MaxBus cables were reseated and we have not seen it since.

17 June

Some clouds in the east cleared out early. Seeing was fair to good all day long.
This was Hector's day to explore the Sun. We did maps scanning the east and south limbs. Spicule time sequences on the east limb had the slit perpendicular to the limb with an occulter at the prime focus. Doug used a curved echelle spectrograph slit jaw. A medium sized prominence was mapped. There was some polarization signal, but it may have been cross talk. Both He I components were obvious. After more spicules, we did a map of a plage region free of spots.
There were still numerous cookie/oscar disconnects during the day, but the hassles were greatly reduced through the use of new code that uses TCP socket stream connect and drop communication between cookie and bert and ernie. With this in place bert and ernie do not have to be rebooted (and tapes not changed) at each cookie reboot. We did have some problem with long movies hanging up before completing. Both 'movie' and 'not movie' modes had this problem. The NSO slit jaw camera was some problem, not always setting the correct exposure time. We wound up running it independently of the ASP.
The entrance window polarizer mount was strengthened. The first attempt to drive it from Icc failed.

18June

Clear with fair to good seeing.
Ran Hector's last IRT and HeI targets. AR 0634 was mapped with two 400 step scans. At times seeing was good. We then tried for disappearing spicules for several scans and finished with a calibration and a flat.
I mounted the new polarizers into the window polarizer ring. Scott Gregory designed the plate that holds the ring and doublers for the mount. Rick Dunbar machined the mount. The ring is nicely chemically painted white. The mount is not perfect, Scott would like to fabricate a machined and lightened unit. Tony Spence diagnosed the electrical

connections. There is some magic involved since the actual wiring does not match the documentation and some signals move from conductor to conductor somewhere in the signal train. Three trips to the turret were required. One was to install diagnostic wiring so Tony could figure out the connections. Two was a mounting of the polarizer. It would not turn. Interference between the ring and base was discovered, one that was there previously but due to the floppy ring, did not prevent rotation. Rick machined spacers and after trip three the polarizer rotates smoothly. This could explain why rotation previously was unreliable.
The HSG Pluto camera and ASP cameras were left in place and the Pluto with Tamron 400mm lens with a prism on the front was tilted to see cross dispersed spectra. The AO fold prisms were slid out of the beam. The polarizing beam splitter was removed, and the spare versalight polarizer used for the analyzer located in front of the slit. Orders 5 through 13 are visible, with 6 through 12 useable. Wavelengths are 903nm to 417nm. The telescope software was fixed, it had never been run without the UBF and there was a zero UBF position divide error.

19 June

Cirrus early, clearing somewhat, then cumulus built up around 11:00AM. Telescope calibrations were performed as the Sun rose. Did not get any data around high noon when the azimuth is changing. This set will not be very useful due to only a change in telescope elevation, and the clouds.
In the afternoon I worked on the communications drop between oscar and cookie and made no progress.

20 June

Happy summer solstice! Clouds cleared early. Some wisps of cirrus then afternoon cumulus buildup (but no rain).
We ran telescope calibrations through high noon then dodged clouds until about 3:00PM. Data from 19 June look good for the most part. There is sufficient signal in orders 6 (902.5nm) through 14 (386.8) to extract calibration information. Order 5 (1083.0) is noisy. The modulation efficiency for V at the short wavelengths is rather low. There may not be sufficient SN after calibration. Looking at the raw data the magnitude of modulated polarization is dominated by the polarimeter response that increases with wavelength rather than the telescope polarization that decreases. There is significant undispersed scattered white light from internal reflections at the collimator lens. This can be removed from the data by compressing the spectra to a single line then removing the average minima on each side of the spectral band from the band itself, then summing all spectral positions between the minima.

After hours Mike and I worked on operation of NSO cameras from the ASP. The ASP camera_init script should set exposure times and camera_scan do only a command that does not force any changes to the camera. A good choice is setting the window used by the camera control computer. This command is actually a dummy, followed by an exposure command. If the user does want to change exposure time, this is still possible, but requires about a second of camera time and a lot of communication. Also I implemented a once per scan strobe for cameras. The strobe line is high with a 1/60

second low pulse once per scan. When camera control software is in good shape, this strobe can be used to run the camera(s) with the vtticc completely out of the loop.

21 June

Cirrus all day.
Acquired calibrations to go with the telescope window polarizer data from 20 June. There was one clean calibration and a few with thin cirrus. This cross dispersed setup did not have the AO prisms in the beam and used no retarder in front of the slit. Slit width was rather narrow, 40 μm due to the large flux on the Pluto camera using the 400mm focal length Tamron lens (with prism in the lens shade). Only ASP cameras A have signal due to the narrow slit jaw decker.

We ran a test of AO polarization. With a polarizer in front of the slit, one beam can be completely extinguished with the polarizer oriented along one diagonal, and the other beam nearly extinguished with the polarizer along the other diagonal. At the exit of the AO, the polarizer effect is about the same. In front of the AO, the best the polarizer could do was slightly reduce the intensity of either of the beams. We removed the fold prisms in the AO, and turned them over. Now light passes through the prisms rather than reflecting off the surfaces. With the polarizer in front of the AO, one beam can be nearly extinguished and the other greatly reduced in intensity. For polarimetery, using the new polarizing beam splitter, this is the way the AO needs to be operated. The ideal solution is an achromatic half wave retarder between the slit and the PBS.

We set up the HSG for 630.2nm, 553.7nm, and 430.5nm. The Pluto covers the 430.5nm G-band (about 1nm width). There is a tight fold between 630.2nm and 553.7nm with ernie on the folded beam at 630.2 and bert in the straight beam at 553.7. We aligned all ASP sensor pairs and the hairlines on all cameras.

Doug worked on finely tuning the AO after rearrangement of its optics. I should be ready to go.

22 June

Cirrus.
Tried to observe 630.2, 553.7, and 430.5. Seeing was terrible. I fouled up set up of Pluto and missed a map and 2/3. There was some indication of signal in the G-band but it may just be crosstalk from I. Hyperfine line showed some signal in spots but not much else. When the seeing was only bad, signal improved. No useful calibration. This day is not much good. DLSP took over at noon. SPINOR will get the telescope back on 24 June at noon.

25 June

Achromatic retarders arrived. Installed calibration retarder at 90º to orientation of polymer retarder since the new one has a net of -.25 waves. Installed modulator with fast axis aligned with mark on polymer. Phased as usual, then slightly rotated the modulator in its mount so that with the linear polarizer at 45º and calibration retarder at 45º, the magnitude of Q was minimized. New Hex is 4 and offset 823.

Ran a calibration using the lamp source and 400 micron slit the afternoon of 24 June. Ran calibrations with 630nm, 557nm, and 430.5nm with AO in and out. Ran calibrations at 630nm, 557nm, and 861nm with AO in and out. When the AO prisms use the internal reflection as now, the flux level is down by more than 2x. Later in the day, tried an active region map, but clouds got in the way. The achromatic calibration retarder shows spectral fringes, 3 across Q and U spectral field of view and 6 across V. There are also fringes seen in V apparently from the modulator.

26 June

Cirrus about early. For some reason the fringes in V from the modulator are not seen in 630nm this morning. There is an indication of fringes in 557. Fringes from the calibration retarder are still present. Map of small spot in 0637. Seeing was fair to good. Fringes in V showing up. One map was a large 400 step, 0.225 arc second one to allow for summing. The SI camera did not work from ASP, so was run stand alone on the big map.