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New Computer in Mount Wilson

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Abstract

The PC in Mount Wilson had failed. A replacement was built in Birmingham and installed on this trip. A new UPS and mains controller were installed. The effect of the primary mirror position on beam alignment was investigated.

1 Introduction

Steven Hale visited Mount Wilson between March 2 and March 12. The main tasks that were planned for this trip were:

- Replace PC.
- Buy UPS.
- Install mains controller.
- Look at mirror alignment.

2 Installation of New PC

The PC in Mount Wilson had failed. The fault appeared to be the usual problem of bulging capacitors near the CPU on the motherboard. If this is ever seen on a motherboard, then it's time to replace the board because failure is likely to be imminent.

The new PC was installed on 2009 March 2. Since the new PC had only one serial port, the computer now uses one of the 8-way serial port PCI cards. The Temperature Monitor and the GPS are connected to the first two channels, with the remaining six being spare. The operating system is Fedora 10.

3 UPS and Mains Controller

A new UPS was purchased on this trip. It is an APC 1500-VA model.

All of our hardware is now on the UPS, along with Ed's main PC also. With everything on, including our monitor, the UPS indicates sixteen minutes of up time. Without the monitor it indicates twenty-five minutes. Without Ed's PC it indicates thirty-five minutes. The display indicates the device to be running at 30% load. Hopefully it should help out with the poor power on the mountain. There have been many brown-outs lately, especially on windy days.

A mains controller has been installed, allowing us to power cycle everything remotely.

Table 1: Mains Controller Channels

Channel	*Device*
0	Main Crate
1	Temperature Controllers
2	Temperature Monitor
3	Velocity Pockels-Cell Driver
4	GPS
5	*n/c*
6	*n/c*
7	*n/c*

4 Primary Mirror Position and Beam Alignment

Unlike most of our other sites, the instrument in Mount Wilson sits on a bench and does not swing on an equatorial mount. Here, the sunlight is collected using a cœlostat at the top of a sixty-foot tower. The cœlostat has two mirrors. The primary first flat is 546 mm in diameter and faces the Sun. The secondary has a diameter of 425 mm and reflects the light vertically downwards through the center of the tower to the observing room below.

Normally a cœlostat has two mounts for the second flat, one for the summer where the Sun is generally high in the sky, and another for the winter where the Sun is considerably lower. In Mount Wilson the primary mirror is offset from the secondary so that there is no need for a winter mount. However, this does mean that for most of the year a small amount of data is lost when the primary is moved from the East position to the West position in the middle of the day. The primary mirror has three basic adjustments, the East/West translation, an up/down translation to avoid tilt in declination, and a tilt in right ascension. The primary mirror has a simple tracking motor that makes it follow the Sun throughout the day.

The secondary mirror is fixed in position, but can tilt along both axes to ensure the beam is projected down through the tower correctly. Two motors are used to drive these movements, and they are controlled by an auto-guider to lock onto the Sun.

At the top of the tower there is an "Ellerman" lens. This was installed by Ferdinand Ellerman in 1905. It is 305 mm in diameter, and has a focal length of 60 ft. It is used daily to take a direct-view photographs of the Sun. During normal running, the Ellerman lens is moved out of the way and the secondary is tilted towards the East to center the beam on a different lens towards the bottom of the tower. This lens is used to send the beam into Ed Rhodes' instrument. In between Ed's lens and his instrument is a beam-splitter that picks off a percentage of the light and sends it towards the auto-guider head.

In line with Ed's lens, but slightly further East, we have two "periscope" mirrors that pick-off part of the beam. The first periscope mirror directs the beam around one foot sideways, and the second periscope mirror projects the beam down again. Yet another mirror on the bench at the bottom of the tower reflects the light into our instrument. In total there are five mirrors in the system required to get light into Klaus. All have to be aligned correctly or the light quite simply goes in the wrong direction.

The first task after opening the dome in the morning is to setup the primary mirror. The mount is translated to the East position, and placed as close to the center of the tower as possible. The mirror is then manually tilted until the light is seen to fall centrally onto the secondary mirror. The declination adjustment is made every other day and is done by placing a cover with an aperture of approximately three inches diameter over the primary to produce a narrow beam. A rubber band is stretched over the secondary to provide a central line, and the primary moved up or down until the narrow beam is seen to be central on the rubber band.

Finally, the secondary mirror is manually tilted until the beam is roughly centered on Ed's lens. The "track" and "guide" buttons are then hit to switch on all the motors, and the auto-guider pulls in the secondary mirror to achieve guider-lock.

Around the middle of the day, just before the secondary mirror mount starts to cast a shadow on the primary, the primary is translated to the West side of the tower and tilted in the opposite direction. It should be moved to the equal and opposite position, but there are no stops to ensure this happens.

The problem is this procedure is not particularly accurate or repeatable. The guider will quite happily pull in the alignment so long as the manual positioning is basically correct. But the physical position of the primary causes the beam to move around inside the tower from one day to the next, or indeed from morning to afternoon. This is fine for the lens at the center of the beam, but since our periscope mirrors are off to one side it can cause problems if we are too close to the edge of the beam.

It is also possible that the whole tower moves with changes in ambient temperature as things expand or contract. This makes a procedure for accurate alignment even more critical.

With the pier in the normal morning position, East of the secondary, but as close to the shaft as possible, the beam was slightly to the South and East of Ed's lens. This is very good for us, since our periscope mirrors are mounted on the East side of the shaft and to the South of Ed's lens.

With the pier fully to the East as far as possible, the image moves South a little. This would be good for us, but the increased distance between the primary and the secondary reduces the diameter of the beam and puts us closer to the edge. That is bad.

With the pier back in the normal position, we shifted the primary up and down. Whenever the mirror was moved away from the point at which the beam is vertically central on the secondary, the beam in the shaft was pushed slightly South and slightly East, but the difference is hardly noticeable.

It appears that the best position is with the primary as close to the secondary as possible. Although really it doesn't seem to make a huge difference. It has to be a gross error in positioning for any major movement of the beam in the shaft.

So unfortunately we haven't come to any major conclusions. Regardless of positioning, the beam always appeared well over our periscope mirrors — we weren't right on the edge of the beam at all.

The alignment of the periscope mirrors was also checked. They appeared to be too close together — they overlapped slightly shadowing each other. The "down" mirror was moved further to the South to give more clearance, and then adjusted to maximize the light on the bottom mirror.

Finally the alignment of Klaus was checked by removing the cover and the interference filter, and visually checking the beam through the instrument.

5 Miscellaneous

The heating in the tower has failed. Several small fan heaters are being used: three in the computer room, two in the observing room, and one in the dark room. They wanted to put two in the dark room, but the extra one causes the circuit breaker to trip out. There must be over 10kW of fan heaters running — that's quite a few Amps! Glad I don't have to pay the electricity bill.