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BiSON Birmingham Solar-Oscillations Network

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Abstract

The guider was adjusted and the grease on the mount worm gears replaced. All limit switches were replaced and tested. A new network camera was installed. The loose foam insulation on the dome and on the instruments was repaired.

1 Introduction

Steven Hale visited Las Campanas from 2012 March 8 to March 18. The primary purpose of the trip was to fix the low frequency fluctuations in the autoguider, and to repair the mount limit switches.

2 Autoguider

2.1 Repairs

The new digital autoguider was installed by Brek Miller in 2011 March [1]. Performance was very good. But gradually some low frequency "waves" began to appear in the residuals.

The mount was checked for slop. In Carnarvon the bolts connecting the two worm gears together became loose and allowed the mount to "rock". Everything here was tight. All the shaft couplers were checked. Some needed a little tightening, but nothing that would have caused problems.

The cover was removed from the guider and revealed that the eyepiece on the finder telescope that projects light onto the quadrant photodiode was rather loose. It could easily wobble from side to side. The focus was tweaked a little to get it right onto the diode and the clamp tightened up to hold it in place. The focus is a compromise between making the image too big and creating a dead zone as it falls off the diode, and making the image too small so it fits inside the occulting disc and again creates a dead zone. The problem is made worse by the fact that the image changes size as the Earth moves closer to or further away from the Sun.

While the loose eyepiece was probably the main problem, the old grease was also stripped off the worm gears and replaced with fresh. The grease on the mount worm gears was looking a bit old and thick. Brek Miller has been using a spray-on lithium grease at other sites and says it works well. Unfortunately it is a prohibited item on DHL since it is flammable and so it was impossible to send any out here.

It was hoped that Farnell or RS might be able to take an order in Birmingham and have it processed directly in Chile for us. That would have got around the problems of sending prohibited items on DHL. But they could not do it. It would work in areas of Europe where they have depots, but not to Chile.

Marc Leroy looked in the warehouse and couldn't find any lithium grease in Las Campanas, but he did have some other sorts of spray-on grease. Unfortunately they were all rather thin and unsuitable.

In the dome there were two tubs of Castrol grease — one called "LM Grease" and another called "Moly Grease". The "LM" appears to be the normal amber-coloured grease. The "Moly" is thick black stuff.

Google tells me that "Castrol LM Grease is a lithium based, high melting point grease, specifically designed as a wheel bearing grease for use over a wide range of temperatures. It is also suitable for general purpose applications". Google says about Moly grease that "Molybdenum disulphide is often a component of blends and composites where low friction is sought. A variety of oils and greases are used, because they retain their lubricity even in cases of almost complete oil loss, thus finding a use in critical applications such as aircraft engines. When added to plastics, MoS2 forms a composite with improved strength as well as reduced friction. MoS2 is often used in two-stroke engines; e.g., motorcycle engines. It is also used in CV and universal joints."

A worm gear turning against a worm wheel is basically a sliding joint, so the Moly grease should be ideal. All the old grease was removed using degreaser and a toothbrush, and a fresh layer of Moly grease applied.

The spring tension on the gear mechanism was also tightened a little to help reduce the backlash and keep the mount steady. If the springs are too tight then it can stall the motors, so it's a bit of a compromise. If the mount starts to get stuck then the friction can be reduced again.

The repairs seem to have fixed the problem.

2.2 Autoguider Scans

The guider adjustment changed the calibration and so a guider scan was required. Two scans were performed. One with the cells cold and another with the cells hot. The calibration hadn't move too far off since the last trip. The declination micrometer remained set to 2.0 mm and the RA micrometer changed from 4.0 mm to 3.5 mm. The calibration looks good.

The results can be seen in figures 1, 2, 3, 4, 5, 6, 7, and 8.

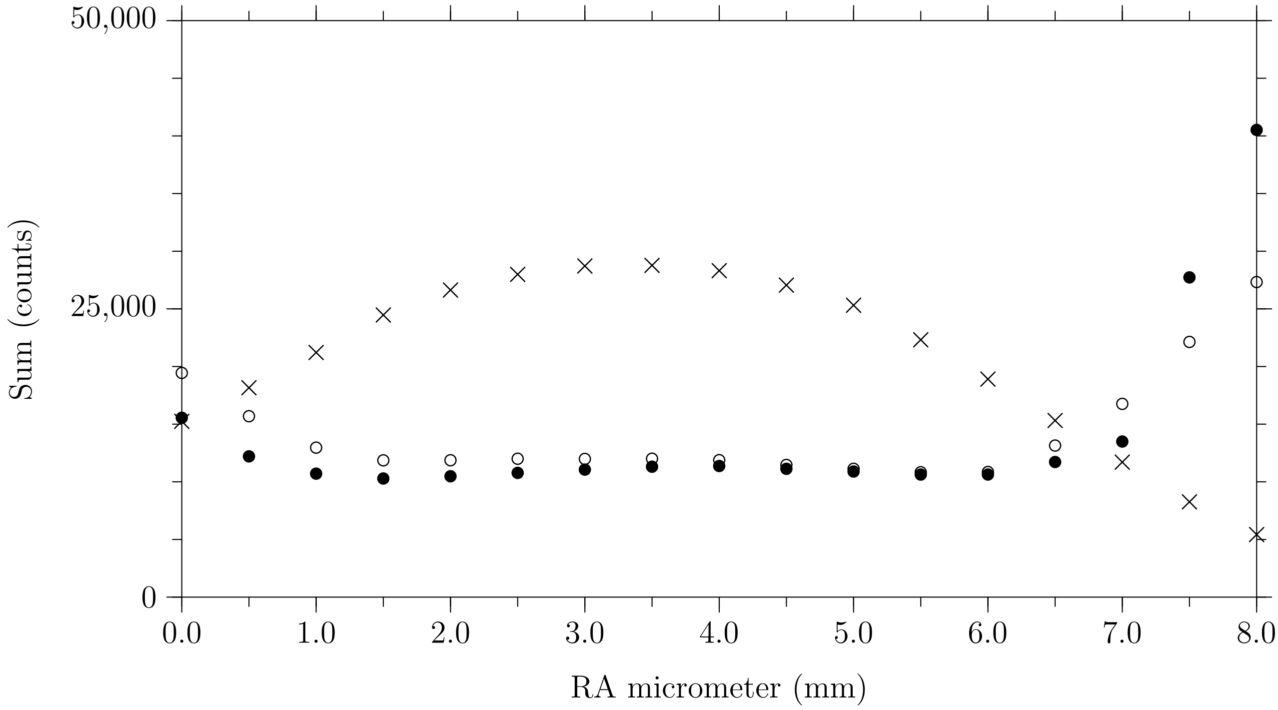

Figure 1: RA scan (Hannibal) - The guider was scanned right ascension. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. This scan was done with the declination micrometer set at 2.00 mm and the cell cold.

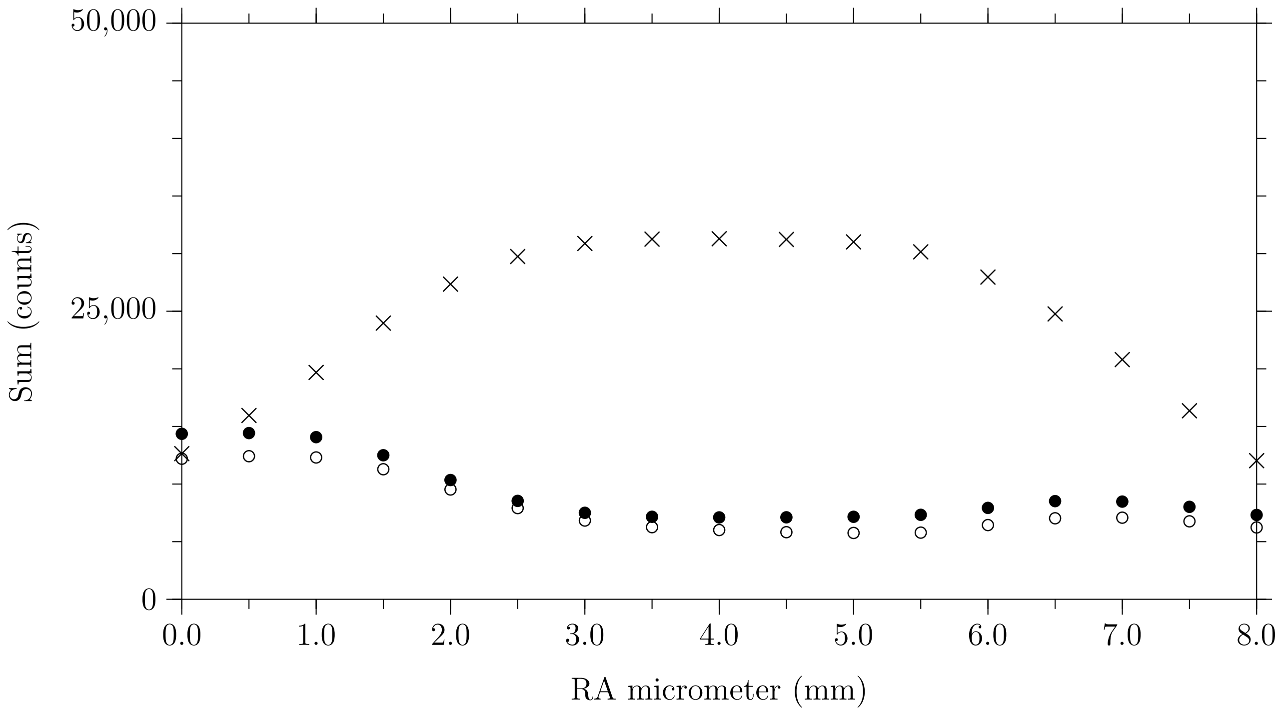

Figure 2: RA scan (Ivan) - The guider was scanned right ascension. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. The transmission monitor data have been divided by ten. This scan was done with the declination micrometer set at 2.00 mm and the cell cold.

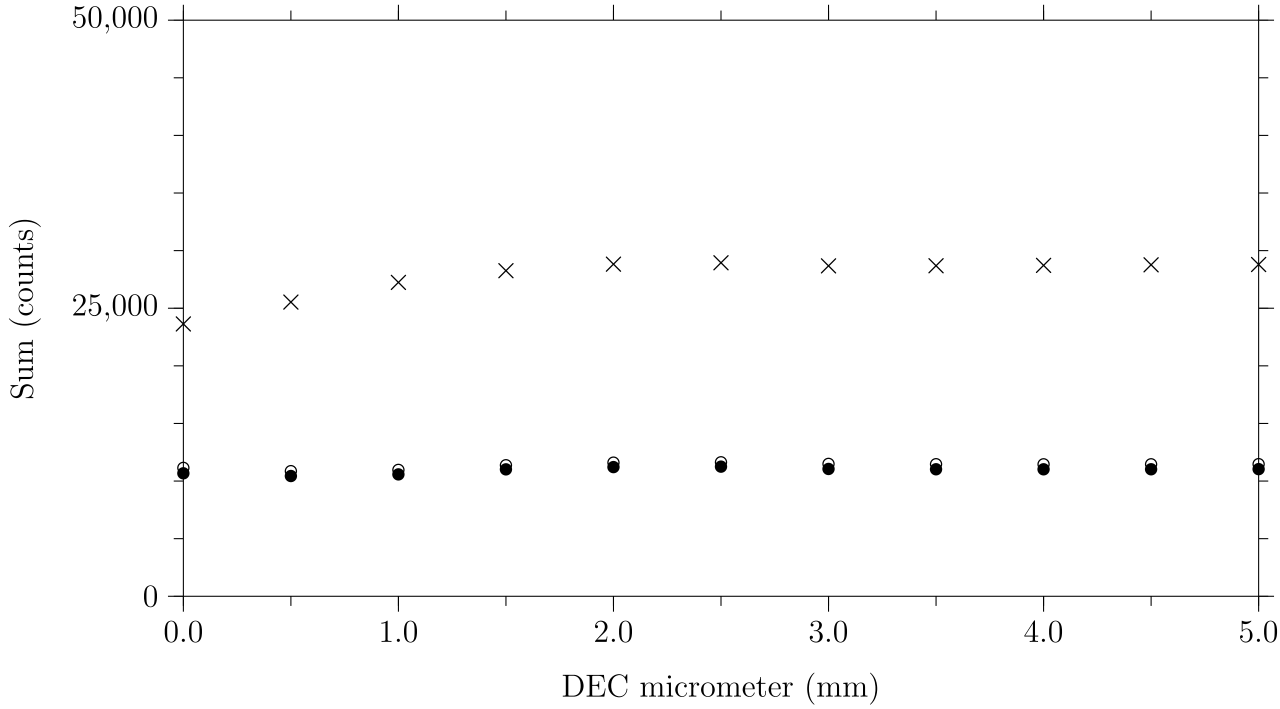

Figure 3: DEC scan (Hannibal) - The guider was scanned declination. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. This scan was done with the right ascension micrometer set at 4.0 mm and the cell cold.

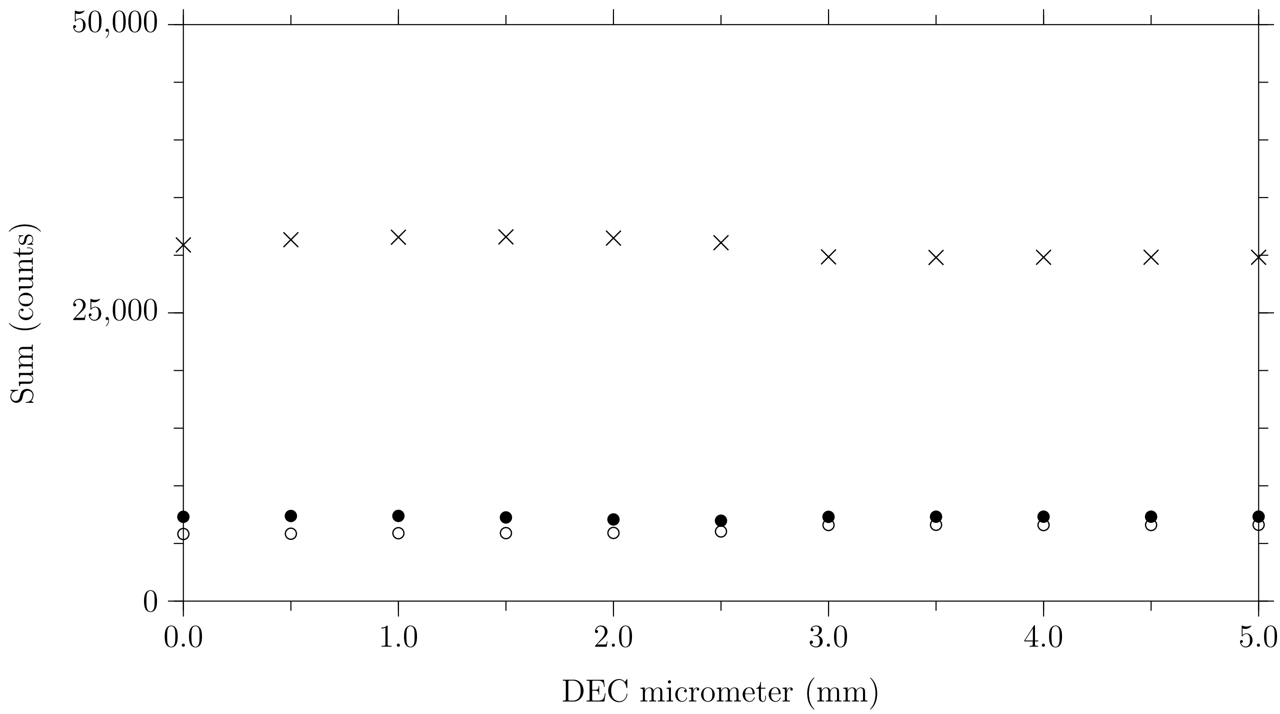

Figure 4: DEC scan (Ivan) - The guider was scanned declination. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. The transmission monitor data have been divided by ten. This scan was done with the right ascension micrometer set at 4.0 mm and the cell cold.

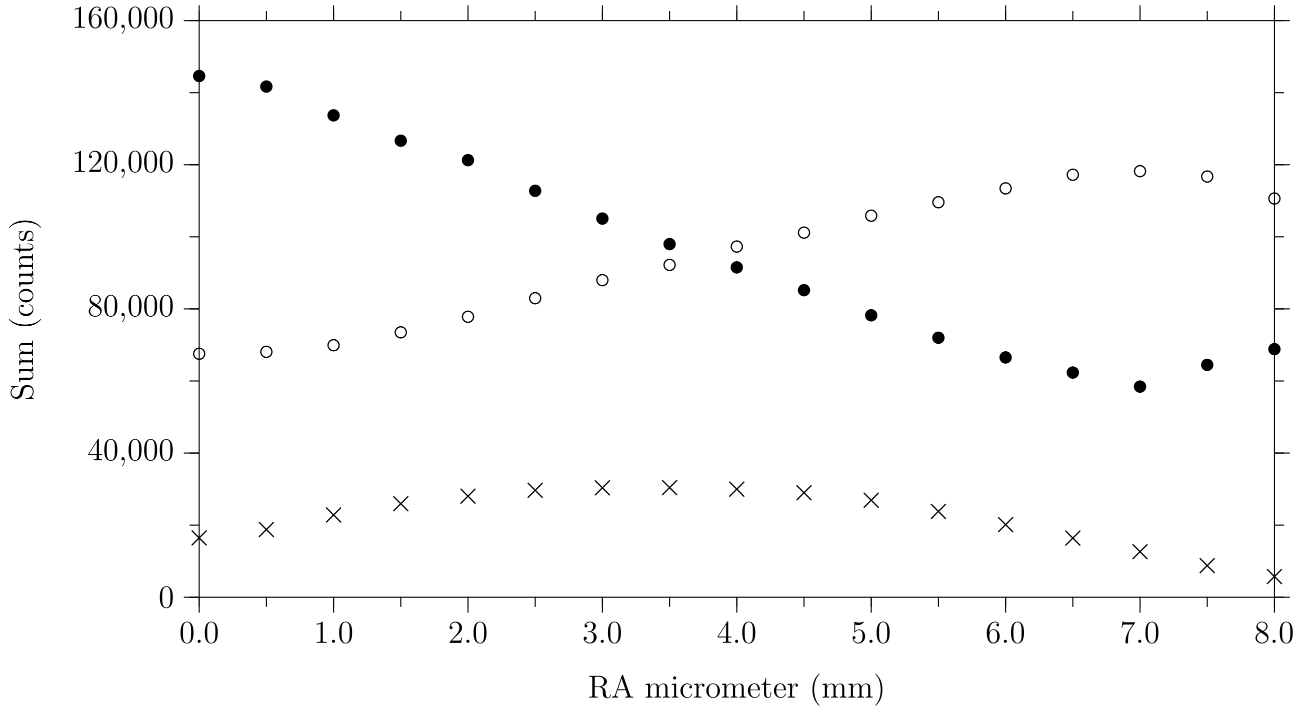

Figure 5: RA scan (Hannibal) - The guider was scanned right ascension. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. This scan was done with the declination micrometer set at 2.00 mm and the cell hot.

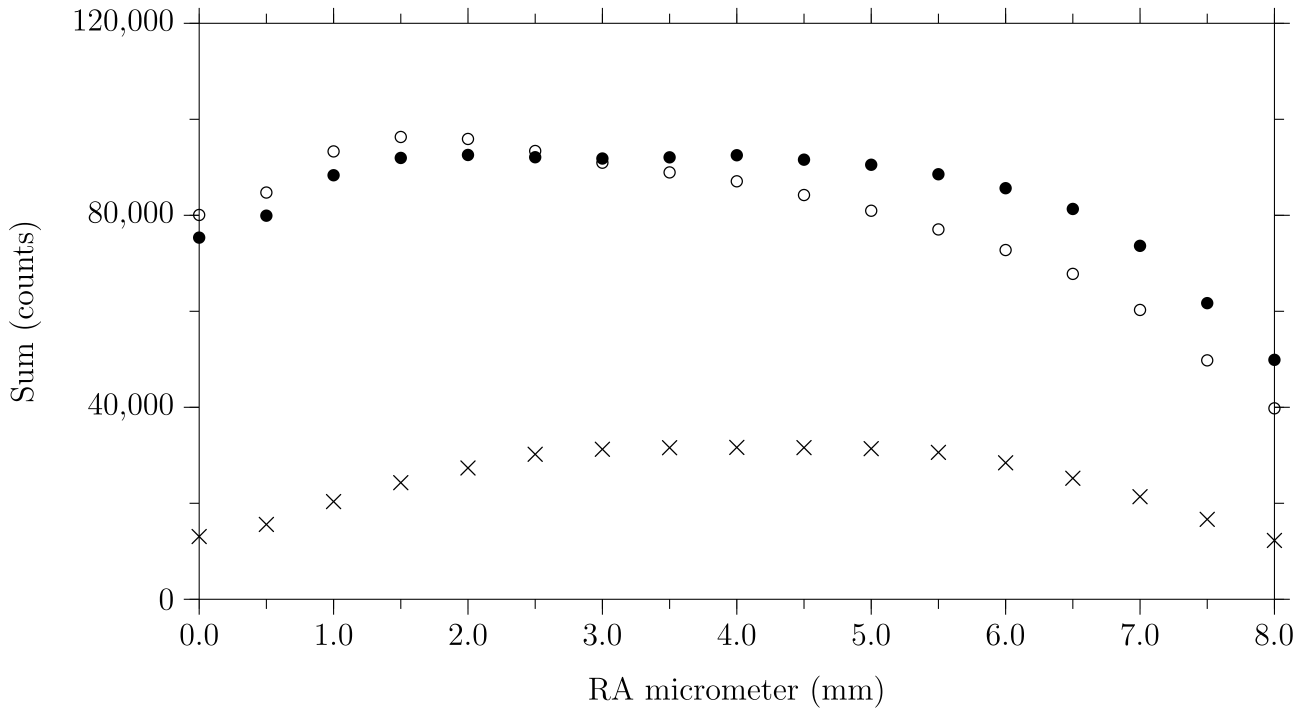

Figure 6: RA scan (Ivan) - The guider was scanned right ascension. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. The transmission monitor data have been divided by ten. This scan was done with the declination micrometer set at 2.00 mm and the cell hot.

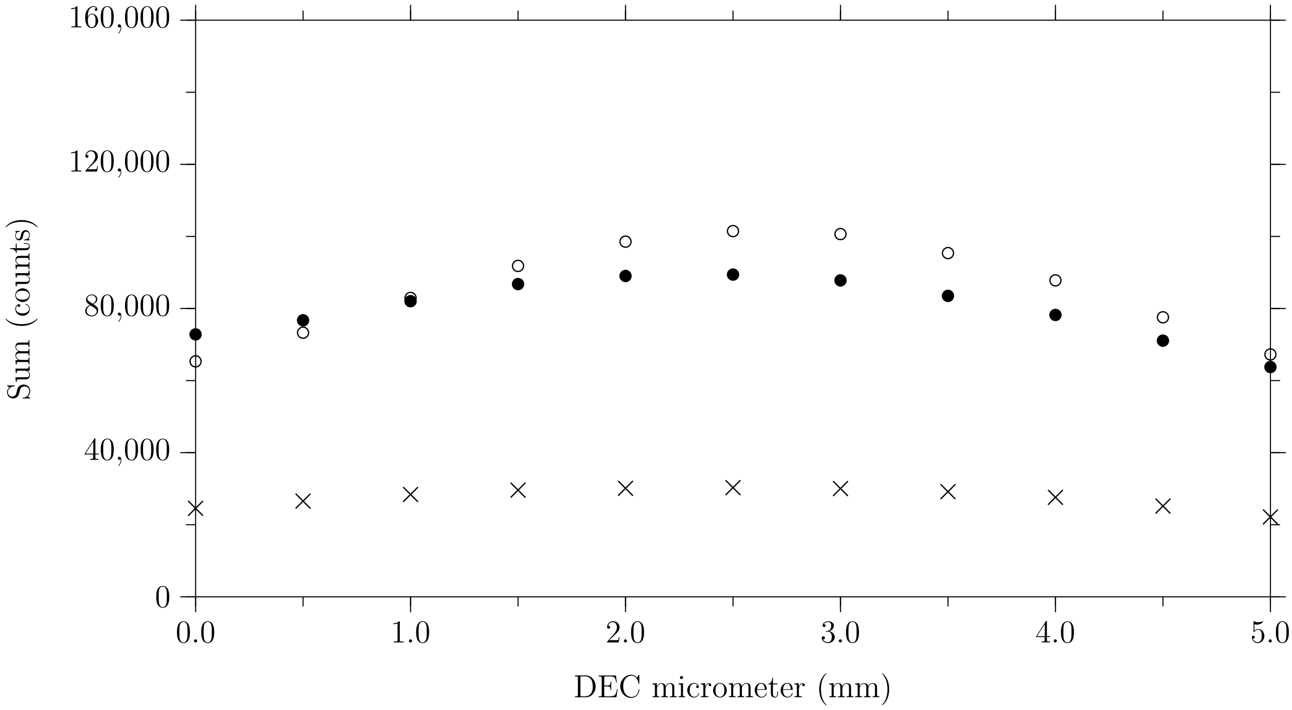

Figure 7: DEC scan (Hannibal) - The guider was scanned declination. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. This scan was done with the right ascension micrometer set at 4.0 mm and the cell hot.

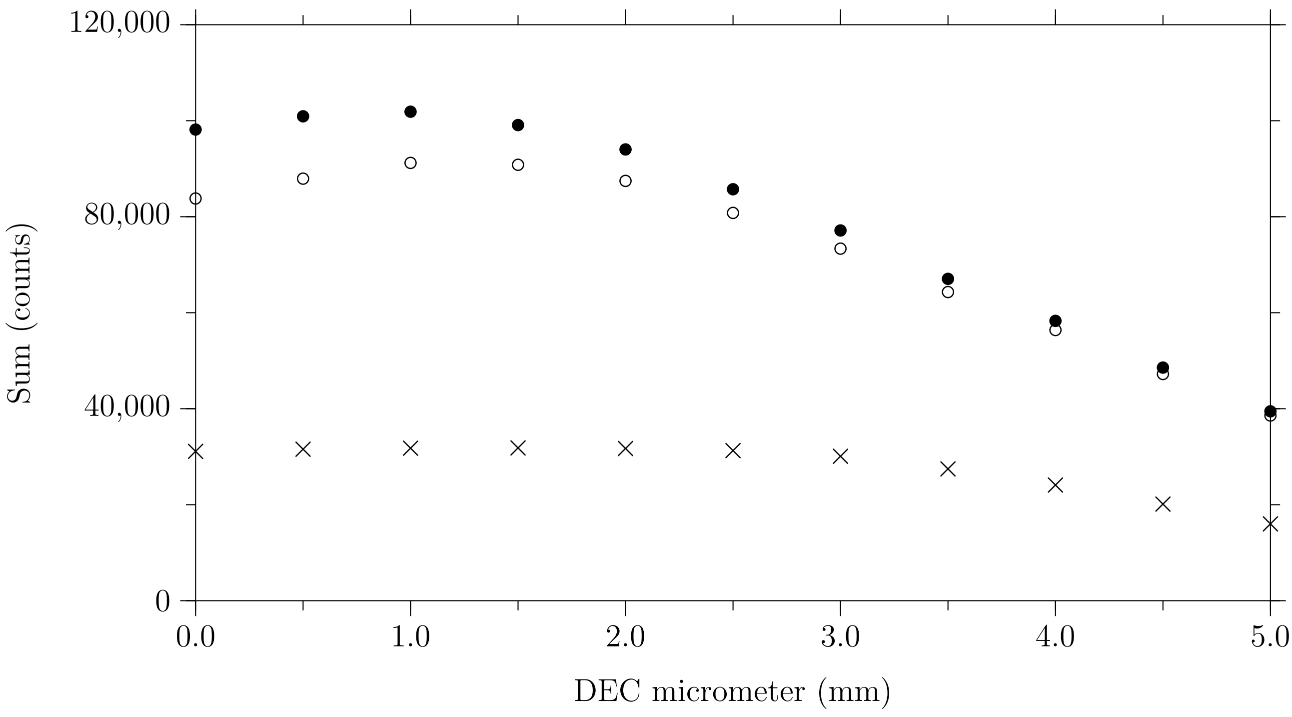

Figure 8: DEC scan (Ivan) - The guider was scanned declination. The plot shows how the starboard sum (•), port sum (○), and the transmission monitor (×) varied. The transmission monitor data have been divided by ten. This scan was done with the right ascension micrometer set at 4.0 mm and the cell hot.

3 Limit Switches

The RA limit switches were broken. They would “flicker” and cause the mount to think it is on a limit when it was not. For the past few months the limit switches were on ignore.

On this trip, all RA and Dec limit switches were replaced.

The DEC switches were a bit awkward to remove, but the job was easy enough over all. The RA limit switches were much more difficult.

There are five RA switches. One switch each for left and right, and another third switch that trips later than the other two which totally cuts off power to the motor. That way if the mount drives through either of the first two switches it is saved by the final ”Armageddon” switch. The forth and fifth switches cut power to the tracking motor and slew motor.

With the new mount controller we don’t use a tracking or slew motor and so two of the five switches are spare. Instead we use two switches for each direction. The idea is left1/right1 trip first and left2/right2 trip second if the first don’t work. But there was a problem. The cam-wheel that trips the microswitches simply isn’t set up to work like this. If the switches are labelled from 1 to 5, here is the order they trip:

LEFT - 4, 5, 1, 3.

RIGHT - 5, 4, 2, 3.

So only two switches can be used in the new system because only two are unique. The wheel has been modded at some point to “extend” cam 3, but it still becomes the far most limit switch for both axes and so can’t be used to sense direction.

Switch 1 and 2 have been connected to LEFTLIM1 and RIGHTLIM1 respectively. Switch 3 has been connected up to both LEFTLIM2 and RIGHTLIM2. When the mount hits the first limit switch the mount controller immediately starts to drive away from the limit. If it sees a left limit and a right limit at the same time then it enters the STOP state. This means that if the mount should ever run completely to one direction it will trigger LEFTLIM2 and RIGHTLIM2 at the same time and the mount will stop.

It does mean that in this condition manual intervention will be required. But that is the same as before - on the old system if the power to the motor was cut someone had to physically move the mount away from the switch. At least with the new system the mount diagnostics can be used without someone needing to be here, and additionally we can now use the camera to actually see what the mount is doing.

4 RA Shaft Coupler

Whilst the RA limit assembly was removed, the RA encoder shaft coupler was also replaced. Some time many years ago it had broken in half. It has run like this for the last twelve months since it was discovered to be broken. When the two halves are jammed together then they work since there is not much load on the coupler.

Nevertheless it needed to be replaced, and this was done.

5 Computer Upgrade

The PC was upgraded to the final revision of Fedora 14 and also updated to the latest version of the Zoo.

The way file locking is handled in the latest Linux kernel changed recently and so some changes had to be made to the zoo device drivers. They seem to work fine.

Fedora 14 is now one year out of date. There are two releases each year and the current version is 16, with 17 due for release in April. The computer was not upgraded further because of known problems with cron and selinux in Fedora 16.

6 Removed old motors

In an effort to reduce the amount of redundant wiring and hardware in the dome, the old tracking and slew motor assembly was removed, all the wiring removed, and the tracking worm wheel locked in a fixed position.

The new guider has been running for long enough now to be sure it works, and should any problems occur the very last thing we would ever consider doing is trying to get the old motors working again.

It has also caused some confusion already, since when we asked someone on site here to look at something for us they were concerned about the motors that were not turning and had no power. Therefore it is best to just remove the hardware that is no longer operational.

This guider configuration now matches Carnarvon.

7 New IP Camera

The new network IP camera is a Foscam device the same as the one in Carnarvon. It is mounted just above the drive-track so it moves around with the dome, and it also has pan and tilt controls.

As with Carnarvon, a few more holes had to be drilled down the right hand side of the shutter in order to install more cable tie bases. It took quite a while to remove the old cables and feed new ethernet and power cables all the way through to the shutter.

The camera had been pre-configured with all the required network settings for Las Campanas before sending the unit out. So once the camera was mounted and all the wiring was in place all that had to be done was turn it on. It worked.

There was a spare channel on the mains controller, so the camera is connected up to channel seven. If it crashes we can turn it off and on remotely to get it to reboot.

The BiSON Live! webpage contains a link to view images from the camera and to move it around — http://bison.ph.bham.ac.uk/live/index.php?page=live,campanas

8 Weather Arm

8.1 Cloud Detector Shadow

On some days the cloud detector produces a false alarm at late afternoon, and causes the dome to close unnecessarily. It looks like the detector is being shadowed by the anemometer at certain times of day. There was not much that could be done about this unfortunately. The cloud detector was moved back as far as it will go on the weather arm to attempt to move it out of the shadow area of the anemometer. It seems to have helped.

8.2 Anemometer and Rain Detector

The anemometer is making a slight grating sound as it spins indicating that the bearings are failing. The spare bearing kit that we had in the dome was used some time ago. A new kit will need to be ordered.

The rain detector was cleaned and tested. It works.

9 Foam Tiles

Some of the foam tiles were coming off the inside of the dome and need to be re-glued. Similarly, some of the insulating foam is coming off the instruments. Barry Jackson suggested that a contact adhesive would be best to stick them back on. Unfortunately that is a prohibited item on DHL and so it could not be ordered in Birmingham and sent out here. Marc Leroy who works in the main warehouse managed to obtain some in La Serena.

The contact adhesive took quite some time to use and didn't really work very well. Some duct-tape had been put on as a temporary repair for us by one of the technicians here at LCO. This was removed. The contact adhesive is too thin to apply to a vertical surface without it going absolutely everywhere.

Most of the tiles were re-attached sufficiently well, but it's not ideal. The bottom of the tiles at the bottom of the dome refuse to stick properly. Unfortunately it's these tiles that are the most important because if they lift off then they can catch on the dome limit-switches and stop the dome rotating. To make sure that doesn't happen more duct-tape was stuck all around the base to hold them securely in place and prevent them lifting. It's not brilliant, but there's not much else that could be done. Really, all the tiles need removing and starting again, but that would take a week or more.

References

[1] Brek A. Miller. The installation of a digital autoguider in Las Campanas in 2011 March. *BISON Technical Report Series,* Number 343, High-Resolution Optical-Spectroscopy Group, Birmingham, United Kingdom, May 2011.