Report – OSCA move to GRACE, 8-17 April 2003

8-10 April

OSCA was removed from GRACE and taken down to the test-bench in the aluminising area. It should be noted that this area was not ideal for installing the new masks (1 arcsec sharp edged mask + 2 gaussian masks) due to the dust environment.

The three new masks were installed successfully. This procedure was demonstrated to Tom Gregory and Maarten Blanken, but if a full detailed method is required this can be provided. The remaining substrates in the wheel were cleaned. Before removing OSCA from GRACE it had been brought to our attention that one or two of the masks had been noted as being smeary on images. Closer inspection revealed a large and very greasy (perhaps mechanical grease?) fingerprint smeared across the 0.4 arcsec mask. A less greasy fingerprint was also present on the 1.6 arcsec mask. Corrosion due to this grease resulted in the 0.4 arcsec mask being washed off completely on cleaning and the 1.6 arcsec mask now has slightly ragged edges. This highlights the importance when handling OSCA or working close the focal plane wheel that **the substrate masks must not be touched.** All the positions in the OSCA focal plane wheel are now occupied, as per the following list (in an anti-clockwise direction):

Gaussian A (fwhm 0.5”)
Gaussian B (fwhm 0.6”)
1.0”
2.0”
1.6”
0.8”
0.65”
Clear (previously the 0.4” mask)
Target
0.25”

However, the clear position is definitely worth keeping as it allows accurate photometry with and without coronagraphy, and hopefully a better PSF subtraction.
Please note that the fwhm, is not the main difference between Gaussian A and B, but the profile instead. Gaussian B has a more extended profile and slightly different grey-level scalings than Gaussian A – on sky testing with OASIS should reveal which is preferential, although initial lab tests suggest that Gaussian A gives the better suppression.

To accommodate the new gaussian masks (which are thicker than the standard masks), a modified detent-arm was installed. A razor-edged anti-scatter mask was also fitted just in front of the focal plane wheel, which successfully masks the edges of the substrates. Additionally the new Lyot stop holder was fitted which we posted out in August 2002, this allows for easier interchange of Lyot stops if needed.

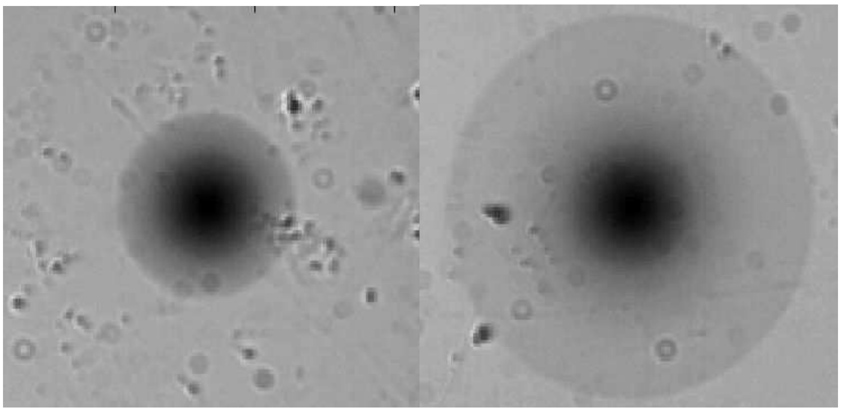

Fig 1. GausA (left) and GausB (right), captured with a SBIG camera under white light source (defects seen are dust on the SBIG camera).

An f/16 beam was set up at the correct height on the bench and OSCA aligned to it. The internal alignment of the OSCA components were checked and adjusted where necessary so that the focus was maintained with OSCA in the beam and with minimum lateral displacement.

<u>11-16 April</u>

OSCA was taken back up to GRACE and re-aligned on the bench. The laser was set up to ensure the beam went through the centre of all the OSCA mirrors and the Lyot stop. With the artificial star, the whole of OSCA was manipulated on the bench until the star was in focus and clamped down. The OSCA mask wheel assembly was then carefully adjusted until the target mask was sharply in focus. In pupil viewing mode, the Lyot stop assembly was adjusted using the 3 kinematic screw mounts so that the Lyot mask was aligned over the centre four NAOMI mirror segments.

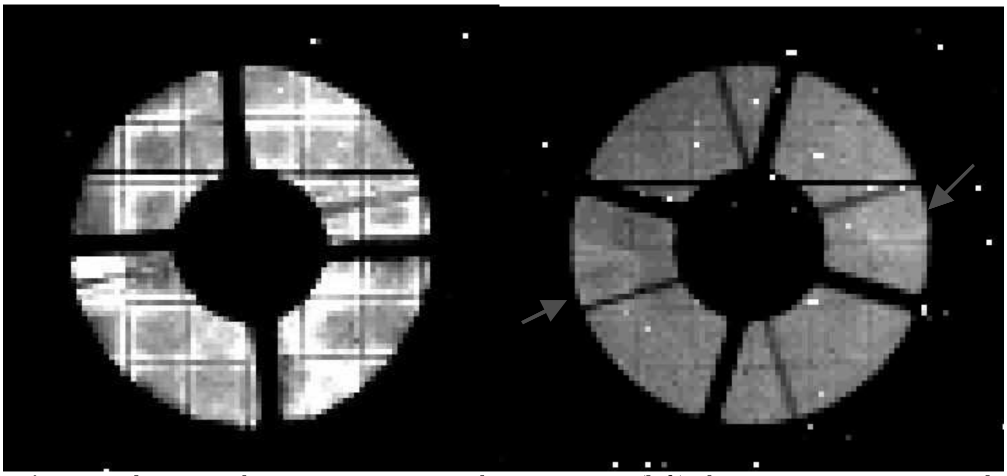

Fig 2. Pupil images taken on two separate nights. For image (left), the seeing was very poor and measured strehl for the NAOMI beam extremely low (~1%), use of OSCA gave no suppression at all due to this and also that it appears the segments were not co-phasing.
For image (right), the seeing was better and the Strehl slightly improved (~4%). The segments appear to be co-phased, although two of the four segments that do not have strain-gauge feedback can be seem to be non-phased with the rest of the mirror (red arrows).

The centricity of the Lyot mask rotation was checked and found to need adjustment. This was carefully rectified by measuring the centre of rotation of the Lyot mask holder on the SR50 and positioning the centre of the Lyot mask over this using a micrometer xy-stage and a magnified video camera + TV. As this took longer than anticipated, the Lyot stop has not been aligned to the telescope vanes, so this offset angle needs to be found and entering into the control software. In an attempt to move the focal plane masks away from the INGRID quadrant boundaries, it is noticed that the field now has a gradient across it due to vignetting – this too will need to be rectified by moving the mask wheel assembly back to a suitable position.

On-sky testing was again plagued by bad seeing conditions or bad weather. The gaussian masks were tested to check their usability in the NIR (H-Z bands) but were found to be unsuitable (the ND levels are manufactured to function correctly only for wavelengths between 0.4 – 0.8 microns).

The night of the 15 April was subjected to bad seeing conditions. Although the OSCA masks were well centred over the star, no or no significant amounts of suppression were recorded. Calculations estimate the NAOMI Strehl to be in the order of 1% and figure 2 indicates the segments were probably not co-phased, OSCA will not work in such a situation.

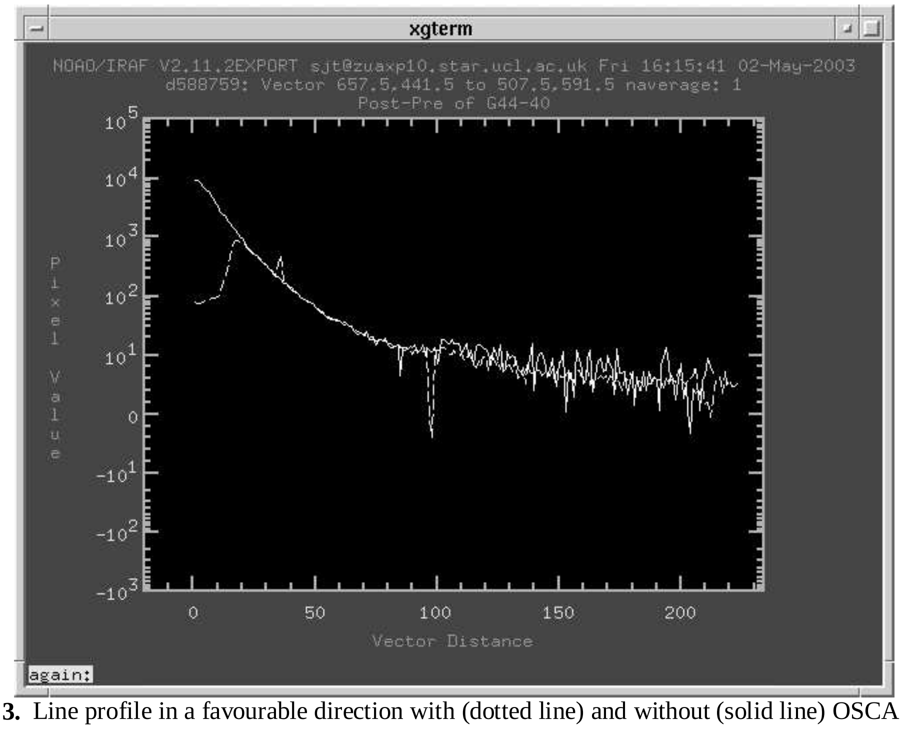

Fig 3. Line profile in a favourable direction with (dotted line) and without (solid line) OSCA – no suppression of the wings is observed.

The night of the 16 April had improved seeing conditions, but there was 100% cloud cover for a significant portion of the night, with only a small clearing appearing near dawn in which the OSCA measurements were taken. Unfortunately the current best method of centring the OSCA masks over the star, is by using a special zoomed in, real-time INGRID window from the NAOMI GUI. The NAOMI operators on this night were unfamiliar with this function and consequently the masks were poorly centred over the star and in some cases the centre of the star missed the masks completely. It is recommended that all NAOMI operators be trained how to use this function, currently Sebastian Els and Roy Ostensen know how to use this with OSCA. Ideally an automatic routine would be best suited to centre the masks over the star to avoid possible errors in the future. The Strehl on this night was approximately 4% and the mirror appears to be co-phasing, although figure 2 shows two faulty segments are causing problems (these are probably segments with straingauge feedback switched off).

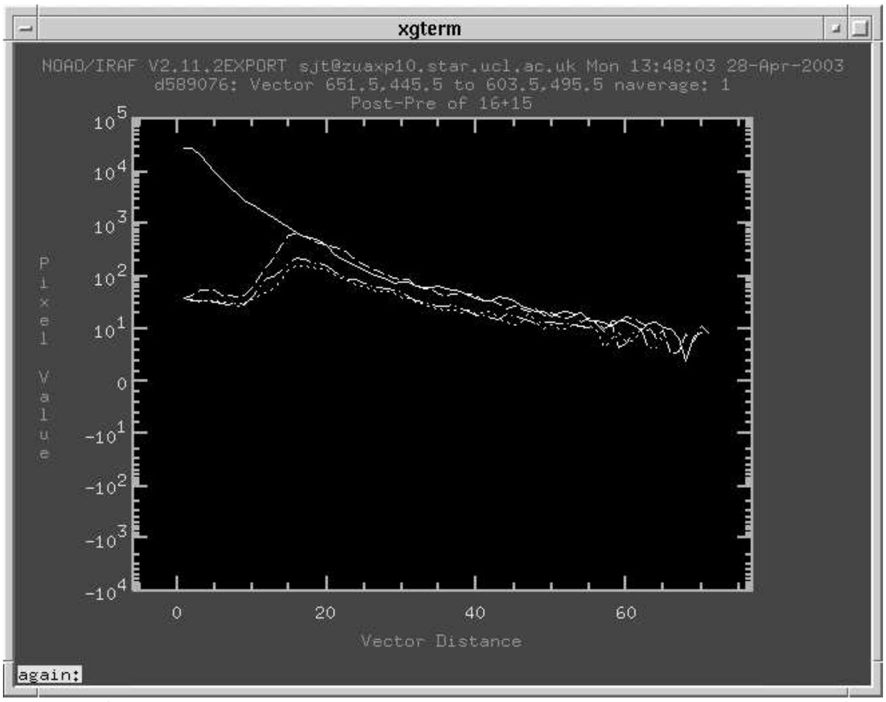

Fig 4. Line profiles without (solid line) OSCA and with OSCA. The dotted lines are profiles taken across the same image but in different directions – the difference in suppression observed is due to bad centring of the masks over the star.

OSCA ideally needs to be tested in good seeing conditions and with NAOMI obtaining better Strehl ratios to get a good idea of the performance that can be expected in good conditions. It would be useful to have a set of suppression curves for all the masks for different seeing conditions. This will give us a good indication under which conditions OSCA is suitable to be used in.