TITLE: CQM warm alignment verification: summary of tests and results

By: Marc Ferlet (RAL)

DISTRIBUTION

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CHANGE RECORDS

ISSUE	DATE	SECTION	REASON FOR CHANGE
1.0	11/09/03	All	First issue of the document
2.0	07/07/04	All	Addition of pic + reformatting of text

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APPLICABLE & REFERENCE DOCUMENTS

RD1 *Herschel-SPIRE: Optical Error Budgets*, LOOM.KD.SPIRE.2000.002-3 (22/08/01)

1. INTRODUCTION

This note reports on the optical alignment verification activities performed during the SPIRE CQM integration phase in August/September 2003. Reports were already sent in form of email to relevant SPIRE project personnel and they are simply reproduced here for the info and archive tracking in SPIRE database.

Optical alignment activities are limited on CQM due to re-used of STM (or AM) FPU structure and optics except for the modification described in the following sections (i.e. change of mirror CM3, modification to the Photometer 2K box).

Recently, pictures taken during the test have been added to this report to illustrate the test set-up, measurements and eventual issues.

2. ALIGNMENT VERIFICATION AFTER REPLACEMENT OF MIRROR CM3

- Report on optical alignment verification activities on SPIRE CQM, performed on 21 & 22/08/2003

Set-up:
We (Marc Ferlet from RAL & Alain Origne from LAM) performed an optical verification (at room temperature) of the SPIRE CQM optical chain (based on the STM + new CM3 mirror fitted beginning of August). This was restricted to the Photometer side (better image quality over full filed in the visible).

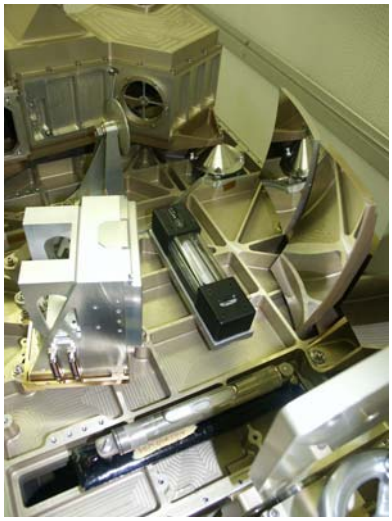


Figure 1: Levelling of the SPIRE Optical Bench, Photometer side. Spirit levels as monitoring tools along 2-axes while compensation at supporting white trolley feet is applied.

The original procedure (i.e. assuming no specific actions to perform as new CM3 expected as per design) for OGSE set-up & alignment was re-used. Pupil imaging tests were performed (no Hartmann test) with sources (LEDs + fibre to maximum signal especially in PLW because of the low transmission of the dummy dichroics) and CCD image acquisition data are stored at RAL with copy to LAM.

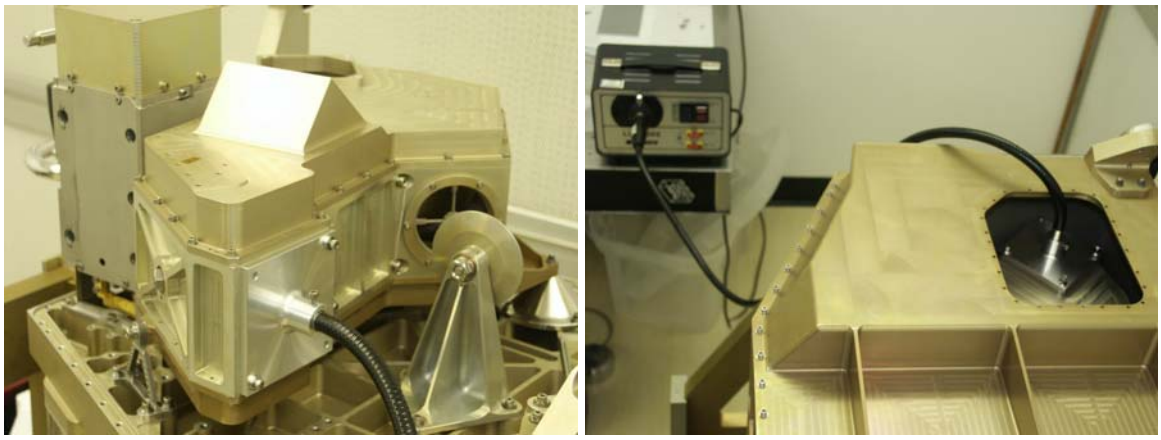


Figure 2: White light fibre source in place of PLW no cover (left) and PSW with cover (right) for pupil imaging test. In both cases, the fibre is centred on-axis in the Phot FoV.

Results:

The pupil shift as measured at M2 seems limited, at the centre, to ~5-7mm in the vertical direction (Z axis). This value is within the allocated budget for the instrument alignment error with no extra margin (see RD1). The close to 50mm shift previously measured during the STM warm optical alignment (and dominated by first CM3 tilt) has disappeared showing the correction in the new CM3. Some image distortion of the projected CS-tool image is still visible in the vertical direction mostly. Pupil aberrations at the edge seem not too dependent strongly on field position (few mm shift max between extreme field positions).

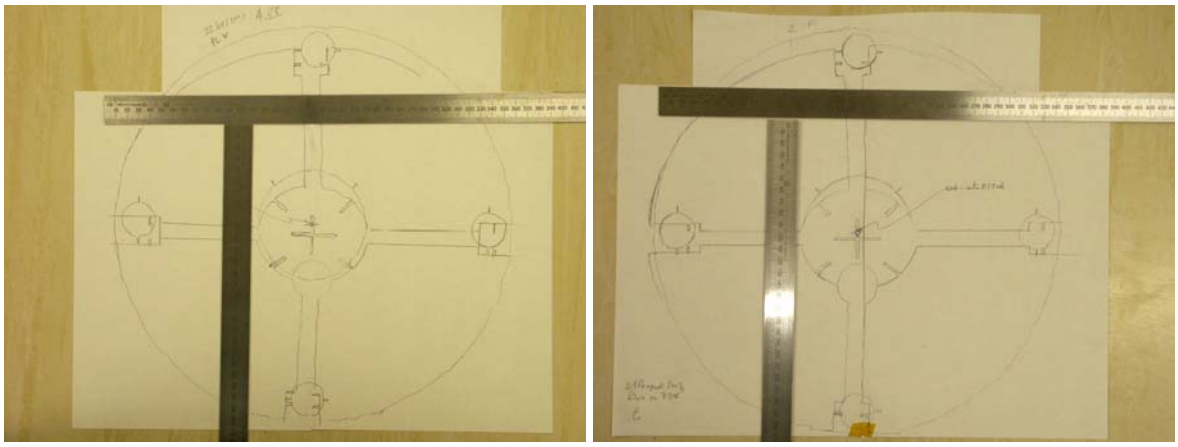


Figure 3: Image, recorded manually, of the projection of internally illuminated CS-tool onto M2tool for source in PLW (left) and PSW (right) respectively.

Focus tests were performed using the aligned MAT and CCD attached to it. Best results are, as expected obtained for the Dtool in PLW position (focal plane position for which there are optimised for their visible wavelength).

Pupil imaging tests were performed with & without Phot cover and with light sources in PSW and PLW. Reproducibility of the results in the different configuration was found good and mostly limited only by signal degradation in PLW due to lack of transmission from dichroics.

Stray path issue:

A ghost stray path may have been found. Actually with this back-illuminated system, several of them exist but all except one can propagate beyond the entrance focal plane (i.e. CFIL1, not present here). The others are stopped or trapped by internal baffle & structural elements.

Investigation of the path showed the following: PSW (half of field positions are affected only) -> ? (inside Phot. box) -> edge of PM8 -> edge of CM5 -> FP entrance cavity sidewall (pocket region). This path is not stopped by the Phot internal baffle and goes directly through CFIL1 aperture with a focal image (caustic) between CM5 and the FP entrance cavity sidewall.
PMW seems unaffected and lack of contrast in the ghost image makes it difficult to conclude about its presence for PLW.
The stray mechanism inside the Phot 2K box is difficult to probe and therefore identify but it was checked that the dummy dichroics or the visible light sources used were not the generator.

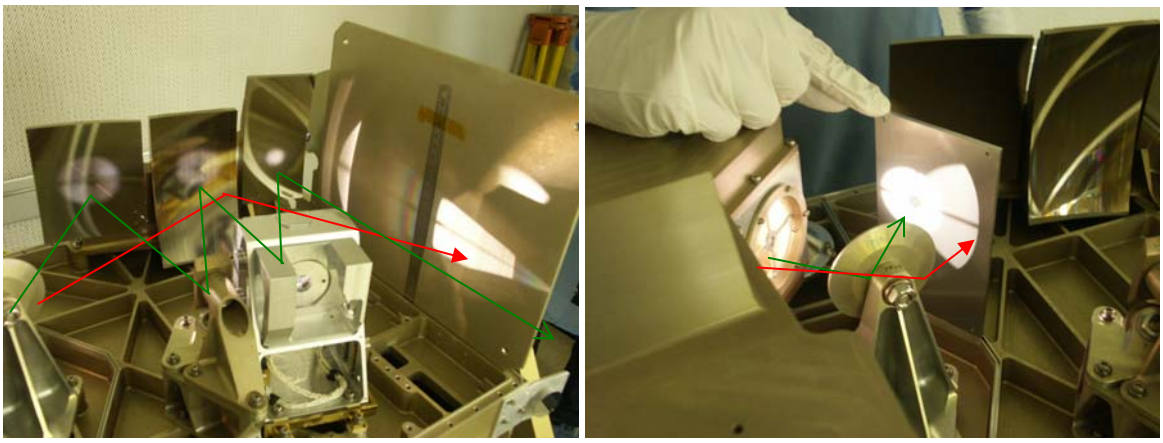


Figure 4: Identified stray path for PSW (half of FoV). ***Left:*** path PM8-CM5-Entrance cavity wall shown in red wrt to design common optical path in green. ***Right:*** view of the between nominal design path from Phot detector box to PFIL2 plane in green and stray one in red, reflected by PM8 edge at higher angle. It was checked that this stray path is the only one (i.e. including central Phot baffle and entrance cavity) remaining when Phot cover on.

Final remark:
The OGSE (mainly MAT bench + Theo) was left in place (i.e. aligned if nobody touches it) as well as the instrument on the white trolley so as to be able to be of quick used for further check (e.g. after eventual further planned Phot box modification). The spacers below the BSM (PCAL hole compensation) are left in place until no more optical verification (limited to Phot. only) are needed.

3. ALIGNMENT STABILITY CHECK AFTER PHOTOMETER 2K BOX FEET MODIFICATION

- Report on optical alignment verification activities on SPIRE CQM, performed on 28/08/2003 after modification on SOB/Phot detector box interface modification

For electrical reason, modification on the feet of the Photometer 2K box have been performed today in the lab on the CQM. Following this task, verification of the impact on instrument alignment was suggested.

This verification was made in 2 steps: measurement of the pupil shift at M2 (from image of the cold stop) before & after the modifications on the feet.
The internal optics of the Phot box being not affected as well as the common optics attached to the SOB, the change in feet interface with SOB would induce a displacement of the cold stop re-imaged by common optics on M2.
Results show a small displacement of the CStool projected image at M2: centre ~0.5-0.6mm, +Y edge: ~0.9mm (manual-visual recording); -Y edge: ~0.25mm (measured via CCD camera images from Dtools central LED in PLW, see Appendix below). With a magnification of ~6.67 between SPIRE cold stop and M2 this leads to an average cold stop displacement <0.1mm laterally which is in line with what was

expected from the magnitude of the modification (see text below). These values are close to the uncertainty error level of the verification method and are an order of magnitude smaller than the overall offset found during the previous (i.e. a week before) alignment check (see section 3 above).

The interface change, baseline to be of the order of ~0.1mm of extra electrical insulation layer at interface, may as well slightly displaced the overall box affecting path length between PM8 and 9 and pointing. This was qualitatively (due to weak signal) checked via monitoring (before & after) of the Dtool central LED in PLW from the previously aligned MAT and no significant change was detected.

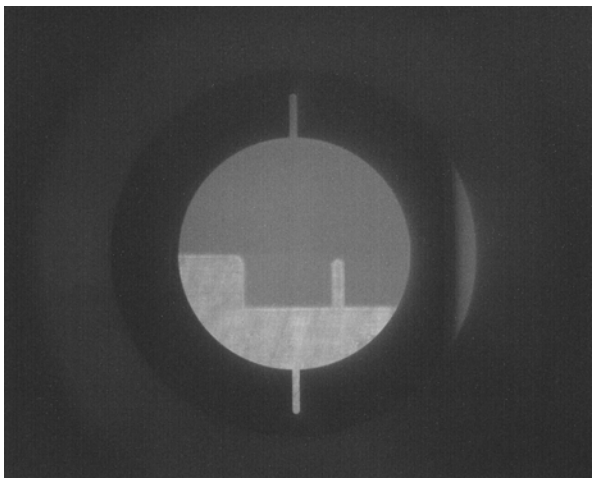
Remark: Eventual effect (on the instrument+MGSE set-up stability) of removal and refitting of the Phot 2K box was monitored by theodolite on SOR and taken out by adapted distribution of weights on supporting HOB. CCD camera acquisitions with Dtools in PLW have also been sent to LAM (via FTP).

Due to need to use the white trolley, for MTD transfer into cryolab, the instrument has been moved, consequently the external alignment lost and as no need of further complete check was foreseen, external OGSE was moved out of the way.

4. APPENDIX

SPIRE CQM: CCD image of CS-tool projected on M2 edge for PLW central field position
(Marc Ferlet, 28/08/03)

-Before change of feet in Phot. 2K box:



-After change of feet in Phot. 2K box: