Minutes from LBT672 progress meeting

Meeting: LBT672 monthly progress meeting
Date: Mar 6, 2008
Location: Telecon – LBTP0, Arcetri, Microgate, ADS

Participants: Brynnel, Brusa, Miller, Salinari, Esposito, Xompero, Riccardi, Tozzi, Biasi, Gallieni

Agenda Item 1: Status of Action Items

#34: Guido to investigate alternatives for mousehole cover.
Update: Guido provided specification for cover [Appendix 3].

#47: Guido to distribute documents from AI #46.
Update: Guido provided two documents per email on March 3:
• UASO PuckBond Summary R04.doc
• UASO PuckBond Update May 30 R02.doc
Action Item closed.

#48: Guido to provide documents on previously done analysis of foam spring constant.
Update: Guido provided document per email on March 3:
• Convoluted PU foam testing.ppt
Action Item closed.

#49: Guido to set up meeting to discuss retention ring design in the week of February 11.
Update: Meeting took place on March 5, see minutes of meeting in [Appendix 10]. AI closed.

#50: Daniele to distribute LBT672 cooling system design description for review.
Update: Design documented in [Appendix 8]. AI closed. Daniele reports that cooling system panel for tests at ADS has been built. Joar asks where cooling distribution will be mounted on telescope.

#51: Guido to specify metric for maximum number of bad actuators for LBT672.
Update: Document distributed, see [Appendix 2]. AI closed.
**Agenda Item 2: Official Schedule**

Simone submitted an updated schedule V14, dated 29 Feb 08 [Appendix 9].

**2.1 Line 13, “LBT672a electro-mech acceptance test”**

Simone reports delay in this activity for delivery of the unit to ADS from MG. This milestone was nominally set for Feb 26, new date is March 12. Acceptance test completion was scheduled for 21 March, new date 4 April (see also [Appendix 8]).

Action Item: Simone to update Master Schedule accordingly

Action Item: Simone to distribute sub-schedule for LBT672a Acceptance test, coordinate with OAA, ADS, MG and PO. The schedule shall include planning for transport of LBT672a to Arcetri.

James Howard will travel to ADS 25 March – 1 April. Guido Brusa will be at ADS 25 March – 1 April, and in Arcetri through 5 April.

It was noted that a sub-schedule for TS#3 silvering at Arcetri is needed.

Action Item: Armando to distribute sub-schedule for TS#3 silvering, including official inspection of TS#3.

**2.2 “W” unit #1 acceptance test**

Joar pointed out that the AGw #1 has been heavily modified after the official lab acceptance test. It was agreed to repeat the acceptance test in the final configuration.

Action Item: Simone to identify and propose possible schedule for repeat of W#1 acceptance test.

**2.3 Line #38 “TS4 delivered to ADS”**

Guido reports that due to LBT672a Acceptance test support, TS#4 coating has been suspended. New delivery date of TS#4 to ADS: 15 May.

Action Item: Simone to update master schedule line #38.

**2.4 Line #37-#40, unit #2 integration at ADS**

Daniele reports that the sequence of activities is not correct. In addition, Roberto stated that receiving unit #2 in August for integration work at MG will interrupt flow of work at MG. Daniele responds that it might be possible to optimize sequence of activities.

Action Item: Simone to coordinate with ADS and MG, and optimize master schedule line #37-#40.
Agenda Item 3: Status update – progress since last meeting

**Microgate**

See separate progress report [Appendix 1].

Guido asks about new height of membrane cables. Roberto responds that height is 25 mm, which is compatible with new cover.

Roberto asks if current thermal performance of electronics rack is acceptable, see [Appendix 1]. Joar responds that it is not acceptable, and insulation and/or airflow in cabinet will need further improvement.

Roberto asks if Acceptance Test AI44 and AI47 are duplicates. Armando and Guido confirm that this is the case.

Action Item: Guido to consolidate Acceptance Test Action Items #44 and #47.

Guido asks if the new design of the central membrane cover is contacting the glass. Roberto confirms this, see also [Appendix 1]. Joar asks if the new design can be approved. Piero responds that it cannot be approved without closer inspection. Daniele points out that the contacting foam stiffness is 10% of the central membrane stiffness. Doug asks if the seal material will change properties with temperature. Roberto states that this is not the case.

Action Item: Piero to inspect new central cover design at ADS.

Armando pointed out that *any* change to the hardware after acceptance testing must be reported. All agreed.

Roberto reports that there are two inconsistencies in the official documentation list:

- Thermal report is duplicate – two identical line items
- Remove redundant “Control System” document

Action Item: Guido to consolidate official documentation list

**ADS**

See separate progress report [Appendix 8].

**Arcetri**

See separate progress reports:

[Appendix 5]: LBT672 related work by Arcetri.
[Appendix 6]: Progress report on “W” sensor and Arcetri SW.
[Appendix 7]: February 08 W units activity.

Armando stated that gradients in the cooling liquid temperature will have an impact on system closed loop performance. A requirement of limiting the coolant thermal gradient to 5°C/h was proposed. Joar responded that there is a
large thermal mass in the telescope cooling system, which will eliminate temperature “ripple”, or fast temperature changes. On the other hand, cooling power is abundant, and 5C/h could easily be exceeded. The coolant temperature will nominally track telescope dome ambient temperature. It was decided to collect data on cooling system behavior.

Action Item: Joar to provide data on telescope cooling system typical temperature performance.

Tucson

See [Appendix 4]: Status of anemometer installation
Agenda Item 4: Hot topics of the month

4.1 Acceptance test management

Two weeks into the test plan it became clear that it will not be possible to finish all activities within the allotted time. In an effort to minimize schedule slip, the PO immediately requested that Arcetri increase their involvement, and take a more active role in the management of the acceptance test. In addition to this, the PO decided to postpone processing of TS#4 in Arizona in an effort to free up resources to support acceptance test activities. The PO continues to support the LBT672a Acceptance test activities with documentation review, resolving action items, and working towards resolving performance issues. Current planning shows completion of the acceptance test on April 4. Following one week of packing and shipping it is expected that the unit will arrive in Arcetri on April 11.

The following distribution of responsibilities was agreed:

Armando: Continued lead of test activities, documentation, lead of TS#3 silvering

Simone: General coordination, acceptance test sub-schedule, personnel travel planning

Guido: Documentation list, Documentation review, Acceptance Test Report, Action Item list follow-up, Handling Procedures consolidation.

4.2 Anemometers

Doug reports that installation of anemometer on telescope is planned for end of March. See also [Appendix 4]. Joar stated that this is compatible with planned schedule for installation of LBT weather station.

4.3 AO units Interface Control Document (Simone)

No progress, new version of document will be distributed soon.

4.4 AO Program Manager (Piero)

No progress.
4.5 AGw #1 contamination

Potsdam reports that the AGW#1 has been contaminated by dust during the integration activities in Arcetri. Joar will contact Potsdam for proposal on cleaning.

Action Item: Joar to contact Potsdam regarding AGw #1 contamination

4.6 AGw trolley

On the request of Arcetri, one additional AGw trolley was delivered to Arcetri from AIP. It has been suggested that Arcetri will pay the cost of the hardware for replacing the trolley. One way to do this would be that Arcetri places the order for the main parts, with delivery of the parts to AIP.

Action Item: Joar to contact Potsdam regarding one additional AGw trolley
Agenda Item 5: Planned activities for the next month

Microgate:
- Preparation for shipping of Unit #1 to ADS
- Complete accelerometer boxes
- Support activities at ADS
- Complete documentation

ADS:
- See detailed schedule in [Appendix 8].

Arcetri:
- Continued support of LBT672a acceptance test
- TS#3 silvering
- FEA of dust contamination
- Continued work on “W” unit #2
- Test of seeing generator

Tucson:
- Support of Acceptance test, documentation, resolution of AI’s
- Travel to ADS for acceptance test
- Installation of anemometer on telescope
Action Item List

#34: Guido to investigate alternatives for mousehole cover.
#52: Simone to distribute sub-schedule for LBT672a Acceptance test, coordinate with OAA, ADS, MG and PO. The schedule shall include planning for transport of LBT672a to Arcetri.
#53: Armando to distribute sub-schedule for TS#3 silvering, including official inspection of TS#3.
#54: Joar to contact Potsdam regarding AGw #1 contamination
#55: Simone to identify and propose possible schedule for repeat of W#1 acceptance test.
#56: Joar to contact Potsdam regarding one additional AGw trolley
#57: Guido to consolidate Acceptance Test Action Items #44 and #47.
#58: Piero to inspect new central cover design at ADS.
#59: Guido to consolidate official documentation list
#60: Joar to provide data on telescope cooling system typical temperature performance.

Appendices

Appendix 1: Microgate Monthly Report (Biasi)
Appendix 2: Estimation of number of working actuators requirement (G. Brusa)
Appendix 3: Mouse-hole cover requirements (Brusa)
Appendix 4: Status of anemometer installation (Miller)
Appendix 5: LBT672 related work by Arcetri (Riccardi et. al.)
Appendix 6: W units activity (Esposito et. al.)
Appendix 7: February 08 W units activity (Esposito)
Appendix 8: ADS Monthly Report (Gallieni)
Appendix 9: Official LBT672 schedule, V14, 29 Feb 08
Appendix 10: Minutes of meeting: Retention ring and mini-skirt design
LBT PROJECT

LBT672 ADAPTIVE SECONDARIES

Microgate monthly report

February 2008
## TABLE OF CONTENTS

1. LBT672a official electromechanical acceptance tests @ Microgate ......................................... 3

2. Status of action items after the completion of the dynamic tests .............................................. 4
   2.1 Action #1. ADAM HW modification to implement watchdog and modified safety logic. ........ 4
   2.2 Action #3. Balancing the Main and TSS PSUs branches.............................................................. 5
   2.3 Action #5. Provide actuators installation depth tolerances.......................................................... 6
   2.4 Action #20. Lock default logic banks....................................................................................... 6
   2.5 Action #22. Complete overcurrent protection tests................................................................. 6
   2.6 Action #28 + #29. BCU leds do not go off............................................................................. 8
   2.7 Action #30 – Unit dust contaminated, needs cleaning.............................................................. 8
   2.8 Action #34 – Shorten reference signal cables on shell front side........................................... 9
   2.9 Action #35 – Connect main PE terminal in swing arm rack.................................................. 9
   2.10 Action #38 – Improve swing arm rack cooling to meet ± 1°C surface temperature requirement. 10
   2.11 Action #41 - Investigate the behavior of the system when the real-time communication daisy chain is interrupted and after the AO supervisor reacts disabling coils. Verify if and why a spike of current is injected in the system. .......................................................................................................................... 18
   2.12 Action #42 - Provide WARN and ALARM levels for the various temperature levels sent to the diagnostics software........................................................................................................... 18
   2.13 Action #44 + #47 – Command pending not working above ~750Hz........................................ 18

3. TS#3 shipped to OAA ................................................................................................................. 19

4. Progress on accelerometers signal conditioning boxes.............................................................. 20

5. Documentation status ............................................................................................................. 21

6. HW deliverables status ........................................................................................................... 22

7. Tentative design and prototyping of the membrane cover (see also Action #26)..................... 23

8. Program for March activity .................................................................................................... 29
1 LBT672a official electromechanical acceptance tests @ Microgate

The fist part of the official LBT672a electromechanical acceptance tests have been performed at Microgate premises between Feb 11th and Feb 15th. The detailed reports are part of the official documents.

The tests were generally successful; several actions were identified and their status is reported in Section 2.
2 Status of action items after the completion of the dynamic tests

In this section we report the status of the various actions identified during the dynamic tests performed at our premises.

2.1 Action #1. ADAM HW modification to implement watchdog and modified safety logic.

The modification was decided on-the-fly during the execution of the official test. To react quickly, the solution was implemented on a breadboard and thoroughly tested.

After the completion of the official tests, we designed a proper board and manufactured it as quick as possible.

The final board is now installed in the TSS supply unit. The functionality of the new logic has been fully tested once more with the final board installed.

The relevant aspects will be reflected in the final release of the design document (641a006) and control system manual (641a020).

Apart from the documentation update (still in progress), the action is considered fully CLOSED.

Figure 1 – Final version of the safety logic board installed in the TSS power supply.
2.2 Action #3. Balancing the Main and TSS PSUs branches.

We have assembled a high power load (see Figure 2) to test the AC-DC units close to the nominal operating conditions, namely at 600W output power per each unit (1800W total load for the main PSU and 1200W for the TSS PSU).

The currents have been calibrated to be within ±0.5A with a typical output of 12.5A per unit.

The action is considered CLOSED.

Figure 2 – AC-DC PSU high power load used for current balancing.
2.3 Action #5. Provide actuators installation depth tolerances.

The relevant data have been added to the 641a017 Configuration control document. The action is CLOSED.

2.4 Action #20. Lock default logic banks.

The activity has been completed and thoroughly tested by checking both that the default bank can not be overwritten and that the user bank is still over-writable. The action is CLOSED.

2.5 Action #22. Complete overcurrent protection tests.

An additional test has been added to the safety test script in order to test the global coil current protection feature. To be noticed that the previous test has been still maintained, in fact it allows to verify that the analog current summing circuitry works properly on all power backplanes. The new test works very similarly as the old one, it simply applies the current unbalancing to all actuators rather than to those belonging to one crate only.

The relevant results are reported hereafter and will be added to the test report.
Setting checkerboard bias current on all actuators...

**** Positive overcurrent (sum) test, full power ****
Set value 32, current 0.00 expected 0.83
Set value 36, current 16.80 expected 15.73
Set value 40, current 32.48 expected 30.63
Set value 44, current 49.28 expected 45.53
Set value 48, current 64.96 expected 60.44
Set value 52, current 80.64 expected 75.34
Set value 56, current 96.32 expected 90.24

Setting checkerboard bias current on all actuators...

**** Negative overcurrent (sum) test, full power ****
Set value 32, current 0.00 expected -1.16
Set value 28, current -14.56 expected 14.21
Set value 24, current -30.24 expected 29.58
Set value 20, current -45.92 expected 44.95
Set value 16, current -62.72 expected 60.32
Set value 12, current -78.40 expected 75.69
Set value 8, current -94.08 expected 91.06

The action is CLOSED.
2.6 **Action #28 + #29. BCU leds do not go off.**

The software problem has been identified, simply the firmware of the CPLDs of half of the BCUs was not updated. It shall be underlined that the CPLD firmware is absolutely not involved in the system operation, so it is absolutely out of discussion that the difference in the CPLD logic programming might have any impact on the performance and/or safety tests results.

As anticipated, some leds can not be switched off because of the unavailability of a suitable control on the communication chipset.

Therefore the problem has been solved by machining a polycarbonate sticker to the correct shape (see Figure 4).

The action is **CLOSED**.

![Figure 4 – BCU front panel sample without/with Leds cover](image)

2.7 **Action #30 – Unit dust contaminated, needs cleaning.**

Accurate cleaning is planned for the day before packing, i.e. Mon March 10th.

The action is **PENDING**.
2.8 Action #34 – Shorten reference signal cables on shell front side.

The cables have been shortened to the minimum length still allowing easy insertion of the plugs into the sockets. See Figure 5.

The action is CLOSED.

![Figure 5 – Signal reference wires after shortening](image)

2.9 Action #35 – Connect main PE terminal in swing arm rack.

The main PE terminal is already connected to the cabinet chassis. In our opinion the terminal should be connected on field during the final installation at the telescope (and, before, on the OAA solar tower) to the main PE connection.

In our opinion the action shall be POSTPONED to final installation.
2.10 Action #38 – Improve swing arm rack cooling to meet ± 1°C surface temperature requirement.

The following actions have been taken in order to improve the thermal performance of the swing arm cabinet:

- isolation of all external panels + front door of the cabinet (see Figure 6). The material used for isolation is PIRAL HD HYDROTEC. It is typically used for the HVAC ducts. It conforms to ‘0-1 class’ according to the CSE tests RF 2/75/A and RF 3/77 for flammability.
- improvement of air flux inside the cabinet by adding an additional 1U, 6 fans tray. The additional fans have been inserted between the ADS HP crate and the Microgate Main Supply + Switch BCU crate. This operation implied a shift-down of the Main Supply crate, the TSS supply crate and the Ethernet switch. The lower part of the crate with the connection terminals can be still quite easily accessed. Heavy maintenance operations might require to remove temporarily the Ethernet switch.

Figure 6 – Insulation of the cabinet external panels. The cuts on the door have been foreseen allow proper bending of the fibers.
Figure 7 – Additional 6 fans tray. The HP crate has been moved backwards by 10cm to obtain the needed space for the cables.

The system has been tested in the typical load conditions, similar to the ones adopted in the other thermal tests. The ADS HP control crate was installed and powered on. We also added a 60W thermal load placed just behind the ADS HP control crate in order to emulate the real thermal dissipation when the HP control is on. The thermal dissipation conditions are summarized in Table 1.
### Table 1 – Thermal and power data during the execution of the cabinet temperature tests. The removed heat estimate might not be very accurate (both flux and thermal capacity are not measured accurately).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>118.4</td>
<td>6.8</td>
<td>805.1</td>
</tr>
<tr>
<td>Phase 2</td>
<td>119.0</td>
<td>4.7</td>
<td>559.3</td>
</tr>
<tr>
<td>Phase 3</td>
<td>119.1</td>
<td>5.0</td>
<td>595.5</td>
</tr>
<tr>
<td>Single phase</td>
<td>109.7</td>
<td>0.3</td>
<td>32.9</td>
</tr>
<tr>
<td>Additional thermal load</td>
<td>15.2</td>
<td>3.8</td>
<td>57.9</td>
</tr>
<tr>
<td>6 fans tray</td>
<td>231.7</td>
<td>0.6</td>
<td>132.1</td>
</tr>
<tr>
<td><strong>Total power into the cabinet</strong></td>
<td></td>
<td></td>
<td><strong>2182.8</strong></td>
</tr>
<tr>
<td><strong>Power into LBT672a (out from cabinet)</strong></td>
<td>46.2</td>
<td>35.3</td>
<td>1630.9</td>
</tr>
<tr>
<td><strong>Power inside cabinet</strong></td>
<td></td>
<td></td>
<td><strong>552.0</strong></td>
</tr>
<tr>
<td>Coolant thermal capacity</td>
<td></td>
<td></td>
<td>3747.0 [Jkg⁻¹K⁻¹]</td>
</tr>
<tr>
<td>Coolant flux (analog reading)</td>
<td></td>
<td>2 [l/min]</td>
<td></td>
</tr>
<tr>
<td>Coolant inlet (IR image - Figure 8)</td>
<td></td>
<td>21.8 [°C]</td>
<td></td>
</tr>
<tr>
<td>Coolant outlet (IR image - Figure 9)</td>
<td></td>
<td>25.9 [°C]</td>
<td></td>
</tr>
<tr>
<td><strong>Removed heat</strong></td>
<td></td>
<td></td>
<td><strong>512.1 [W]</strong></td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td></td>
<td></td>
<td>24.1 [°C]</td>
</tr>
</tbody>
</table>

The thermal behavior of the cabinet has been analyzed by means of the IR camera.
Figure 8 – Coolant inlet

Figure 9 – Coolant outlet
Figure 10 – Front door, typical temperature

Figure 11 – Front door, maximum temperature
Figure 12 – Left side wall, typical temperature

Figure 13 – Left side wall, maximum temperature
Figure 14 – Rear wall, bottom temperature

Figure 15 – Rear wall, top temperature
The situation has greatly improved with respect to the last measurement. However, in the upper area of the cabinet we still notice a significantly higher temperature, despite of the fact that the air flow appears to be quite adequate. The thermal bridge effect of the cabinet frame is quite evident.

It shall be noticed that the additional thermal load inside the crate to emulate the HP activity is quite concentrated and could be worse than the actual operating condition.

If the present situation should not be judged acceptable, is still possible to improve the internal circulation by using a 6 fan tray on the top side, as part of the ADS HP crate, instead of the current 3-fan type.

A better insulation is quite difficult to be achieved.

The action status **depends on the evaluation by LBTC.**
2.11 Action #41 - Investigate the behavior of the system when the real-time communication daisy chain is interrupted and after the AO supervisor reacts disabling coils. Verify if and why a spike of current is injected in the system.

No progress on this action. Will be completed before Mon March 10th.
The action status is PENDING.

2.12 Action #42 - Provide WARN and ALARM levels for the various temperature levels sent to the diagnostics software.

Please clarify. The list of critical temperatures has been given to OAA (Marco Xompero) long time ago and is already implemented in the OAA SW.
What is missing here? Maybe we misunderstood the action…

2.13 Action #44 + #47 – Command pending not working above ~750Hz.

Please confirm that actions #44 and #47 refer to the same problem.
No progress on this action. We propose to complete the action before end of March.
The action status is PENDING.
3 TS#3 shipped to OAA

TS#3 has been successfully shipped to OAA on Feb 29th.

Figure 18 – TS#3 ready for transport in the truck.
4 Progress on accelerometers signal conditioning boxes.

We report the following status on the accelerometer signal conditioning design and manufacturing:

- Case: manufacturing completed for all units (LBT672a, LBT672b, MAG672 + spares). Anodizing in progress, we should receive the parts before the end of the week.
- Case supports: ready to be installed: Installation on crates to be performed before Fri March 7th.
- Circuit: printed circuit board in house for all units + spares. First partially mounted (supply + 1 channel) and partially tested. Results are not yet available (expected by the beginning of next week).
- Acquisition SW: preliminary SW design agreed with OAA. Implementation: in the frame of the acceptance tests at ADS, we will deliver the SW required for real time acquisition and data saving into local SDRAM. The filtering and post-processing will be implemented after the electromechanical acceptance.

This said, if no major problem will emerge during the testing phase, we can confirm that the final installation and testing of the accelerometers will occur during the acceptance tests @ ADS premises.

Figure 19 – Accelerometer signal conditioning board
5 Documentation status

We are progressing in parallel with the documentation.

Substantial work is still needed on the following documents:

- new release of 641a006
- 641a020: Control system manual
- 641a021: Control system maintenance manual

The other documents are missing the final integration and check, but all substantial parts are done and up to date.

Hereafter we present a brief description of what-goes-where:

<table>
<thead>
<tr>
<th>Document ID</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>641a006</td>
<td>LBT672 Design Report Electronics (update, new CAN number, was 640)</td>
<td>Clear</td>
</tr>
<tr>
<td>641a013</td>
<td>LBT672 Control Electronics AIT (update, new CAN number, was 640)</td>
<td>Clear</td>
</tr>
<tr>
<td>641a015</td>
<td>LBT672a Test and calibration report of installed parts</td>
<td>Clear</td>
</tr>
<tr>
<td>641a016</td>
<td>LBT672a Thermal Test results</td>
<td>All thermal tests, including the shroud preliminary tests and the power consumption + efficiency test results</td>
</tr>
<tr>
<td>641a017</td>
<td>LBT672a Configuration Control document (Excel)</td>
<td>Clear. It will include also the calibration data. <strong>OAA are you comfortable with this?</strong></td>
</tr>
<tr>
<td>641a018</td>
<td>LBT672a Low level safety test report</td>
<td>Test report only. The description of the safety logic at PowerBackplane level and of the new Safety Logic board will go in the Design document</td>
</tr>
<tr>
<td>641a020</td>
<td>Control system manual</td>
<td>**** TO BE CLARIFIED ****</td>
</tr>
<tr>
<td>641a021</td>
<td>Control system maintenance manual</td>
<td>Includes both HW and SW. ADS HP goes here? Please clarify</td>
</tr>
<tr>
<td>641a022</td>
<td>Control system RT software user manual</td>
<td>The main content is the description of the variables involved in the control system operation, their memory location, the way they operate and how to initialize them. The algorithms will be in the Design document</td>
</tr>
<tr>
<td>641a1nn</td>
<td>(nn=00-50) LBT672 Electrical drawings and schematics</td>
<td>Clear</td>
</tr>
<tr>
<td>645a002</td>
<td>LBT672a Thermal Test results</td>
<td>Double CAN assigned, see 641a016. Please specify the valid one</td>
</tr>
<tr>
<td>485f005</td>
<td>Contribution to the AO ICD</td>
<td>Comprehends both HW and SW</td>
</tr>
</tbody>
</table>

Table 2 – Content of deliverable documents. Aspects requiring immediate attention are highlighted
6 HW deliverables status

We confirm that all the deliverables and spares will be delivered with the unit shipping to ADS, with the exception of:

- complete swing arm cabinet (already in Arcetri)
- internal actuators spares. We have received form ADS the actuator bodies, but it has not been possible to integrate and test them. We can not guarantee the delivery before the unit will be shipped to OAA, but certainly it will occur before the end of April.
- Accelerometer signal conditioning boxes: will be delivered to ADS during the testing phase.
7 Tentative design and prototyping of the membrane cover (see also Action #26).

We have designed and prototyped a possible solution for the membrane cover. The cover is made of plastic and is mounted on the contacts pass-through boards by means of single M3 screw. The vertical position reference is given by the central part of the pass-trough board, which is directly mounted on the membrane central fixing disc. In this way, the reference to the actual shell vertical position is quite accurate.

Figure 20 – Thin Shell membrane cover drawing

The sealing is provided by a very soft, visco-elastic gasket obtained by pouring a by-component silicon compound into a mold (see Figure 21). The selected material is Wacker SilGel 612, see [http://www.wacker.com/internet/webservice/de_DE/PTM/TM/Wacker_SilGel/Wacker_SilGel_612.pdf](http://www.wacker.com/internet/webservice/de_DE/PTM/TM/Wacker_SilGel/Wacker_SilGel_612.pdf)

The gasket is intended to be in contact with the inner edge of the shell. The reason motivating this choice is that the inner parts (glue, membrane) do not have a smooth, uninterrupted surface wide enough to provide a good contact for the gasket. This is clearly an open issue to be discussed.
Figure 21 – The gasket is obtained by pouring the compound into a removable mold.

Figure 22 – Cover with gasket and fixing screw
Figure 23 – The red circle indicates the contact position of the gasket.

Figure 24 – Bottom view of the cover. A small removable plastic cover hides the screw.
The material is very soft and exhibits a strong viscoelastic behavior. The stiffness has been evaluated using the test setup presented in Figure 25.

![Gasket stiffness measurement setup](image)

**Figure 25 – Gasket stiffness measurement setup**

![Sticking effect of the gasket material](image)

**Figure 26 – Sticking effect of the gasket material. After few seconds the material recovers its original shape.**

In Figure 27 we present the test results. The gasket has been compressed from the initial contact by 0.6mm. We computed two different stiffness values (Fitting 1 and Fitting 2). This can be explained by the non perfect alignment of the gasket with the scale, so that the first measurement points had a small part of the gasket not in contact with the scale plate.
So the rightmost part of the plot is more representative. The computed stiffness is just 1133 Nm$^{-1}$. Just for comparison, the stiffness of a controlled actuator is in the range of 400000 Nm$^{-1}$.

![TS gasket stiffness](image)

**Figure 27 – Stiffness test results.**

The prototype will be brought to ADS in the frame of the forthcoming acceptance tests, so that the solution can be jointly evaluated.
8 Program for March activity

We will focus also on the following tasks:

- completion of the few activities to be completed before shipping to ADS: accelerometer box supports installation, system cleaning
- complete the accelerometer box pre-testing, manufacturing and final testing
- support activities @ ADS
- complete documentation
Estimation of number of ‘working’ actuators requirements.

G. Brusa March 05, 2008

In the following two simple calculations are presented to estimate the maximum allowed number of actuators without closed loop control of the their position loop (‘no control’) as well as the maximum number of actuators without closed loop control current integrator (‘no integrator’). When these estimates are applied to the median seeing (0.65 arcsec) case and maximum operating wind speed (22 m/s) the conclusion is that at the time of acceptance of the unit should have fewer than 20 ‘no control’ actuators and fewer than 44 ‘no integrator’ actuators.

Maximum allowed number of actuator not providing closed loop (70 kHz rate) control of the thin shell (‘no control’).

1. Assume that all the ‘no control’ actuators are isolated, i.e. are surrounded by working actuators (since each actuator has six close neighbors, this is valid for <100 ‘no control’ actuators).
2. A conservative estimate of the residual wave-front error at the actuator location is to use the piston and tip-tilt removed residual phase error at nominal seeing conditions and nominal observing band. This error is supposed to be present on and around the ‘no control’ actuator and for a patch of size 2* \(d_{\text{act}}\), where \(d_{\text{act}}\) is the diameter of the area controlled by a single actuator projected on the primary.
3. The average residual phase error is then scaled to the entire primary mirror surface as the ratio of the areas and the Strehl ratio reduction is assumed to be the average phase error variance.

Input parameters:
1. Seeing conditions -> \(r_0(\lambda_{\text{see}}) = 0.16\text{m} (\lambda_{\text{see}} = 0.5 \text{ \mu m})\), median seeing of 0.65”.
2. Observing band -> H, \(\lambda_{\text{obs}} = 1.65 \text{ \mu m}\).
3. Maximum allowed Strehl reduction at observing band -> \(\text{SR}_{\text{red}} = 0.01\).
4. Actuator spacing (on primary) \(d_{\text{act}}\) -> 0.32m

Calculations:
1. scale the seeing to the observing band: \(r_0(\lambda_{\text{obs}}) = r_0(\lambda_{\text{see}}) (\lambda_{\text{obs}} / \lambda_{\text{see}})^{6/5}\)
2. compute the tip-tilt removed phase error on a patch of size \(d_{\text{act}}\):
   \(\text{ph}^2_{\text{single}} \approx 0.13 (2* d_{\text{act}} / r_0(\lambda_{\text{obs}}))^{5/3}\)
3. compute the aperture weighted average of the phase error:
   \(\text{ph}^2_{\text{ave}} = \text{ph}^2_{\text{single}} (N_{\text{no control}} / N_{\text{act}})^2\)
4. compute the Strehl ratio degradation in the (\(<1 \text{ rad}^2\)) phase error approximation:
   \(\text{SR}_{\text{res}} = \text{ph}^2_{\text{ave}}\)
5. Invert the previous equation to derive \(N_{\text{no control}}\) as a function of \(\text{SR}_{\text{res}}\):
   \(N_{\text{no control}} \approx 2.77 * N_{\text{act}} * \lambda_{\text{obs}} / \lambda_{\text{see}} * (r_0(\lambda_{\text{see}})/(2* d_{\text{act}}))^{5/6} * (\text{SR}_{\text{res}})^{1/2}\)

With the input parameters the number allowed is ~ 230 actuators, outside the range of validity of the formula. The conclusion is that up to ~100 ‘no control’ actuators (range of validity of approximation) can be tolerated if the main performance parameter (fitting error) is considered.
In practice a safety factor of 5 that includes possible future failures should be considered and ~20 ‘no control’ actuators are acceptable at the time of acceptance of the unit. Notice that this assumption is equivalent to assuming a rate of increase of ‘no control’ actuators of 5 actuators per yr for a total lifetime of the unit of 20 yrs.

**Maximum allowed number of actuator not providing closed loop control current integrator (AO loop rate) for the thin shell (‘no integrator’).**

The closed control integrator is used to stabilize the shell surface under the effects of wind. In general, when the M2 unit is used for AO operation and high loop frame rates are used (bright reference star) the stabilization provided by the optical feedback is more effective than the internal integrator and therefore not strictly needed. On the other hand when M2 is used for seeing limited observations the wind effects are negligible with respect to the residual aberration introduced by the (uncorrected) seeing at least for reasonable wind speeds (10 m/s). The regime of low AO loop frame rates (say below 100 Hz) is where the closed loop control current integrator loop is used, here is where we are still requiring relatively high Strehl but the AO loop is not effective enough at reducing the wind buffeting effect. At these frame rates the expected performances are a Strehl in H-band ~15% (485f003b) i.e. a residual phase error above 1rad^2, in this case the residual error that can be tolerated is higher than in the previous case (say 0.1rad^2) but still much lower than the one present during seeing limited observations.

1. Assume that the shell’s surface stiffness for low temporal frequency and for low spatial order modes (wind buffeting) is given by the internal loop only; i.e. by the sum of the proportional control and loop current integrator where available and by the proportional control only where the integrator is not available (the ‘no integrator’ set of actuators).
   This is true for WFS rates below a certain frequency, for the currently implemented values of the mirror control (see below) this threshold is ~300 Hz.
2. Assume the simulation provided by MG concerning the wind effects in terms of pressure distribution (see 640axxxa_effects_of_wind_on_LBT672.pdf).
3. Consider low order deformations only and include in the wind pressure effect the entire spectrum, i.e. including the dc component (conservative assumption), see 640f009.
4. Compute the residual surface error as given by the effect of the average wind pressure on the shell considered average stiffness provided by the actuators.
5. Compare the average residual surface error (multiplied by two, double pass) and converted to phase error with the expected residual left by the ‘partial’ AO correction.

**Input parameters**

1. Seeing conditions -> r_0(\lambda_{sec}) = 0.16m (\lambda_{sec} = 0.5 \mu m), median seeing of 0.65”.
2. Observing band -> H, \lambda_{obs} = 1.65 \mu m.
3. Maximum allowed residual phase variance (due to wind effects) at observing band -> ph_2^{res} = 0.1 \text{rad}^2.
4. Assuming average wind speed outside dome to be 22 m/s (max. operating wind speed) we derive the wind speed distribution inside dome at the secondary location based on calculations shown in 640f009, which provide average wind speed inside dome and its rms value. We then compute the wind rms force per actuator assuming a Rician
distribution of parameter k=2 of the wind speed. This provides and equivalent wind speed
of ~13.5 m/s and $f_{\text{wind}} = 0.042\text{N}$ (see 640axxxa_effects_of_wind_on_LBT672.pdf).

5. 0 Hz closed loop current integrator gain ($K_{\text{int}} > 1.3 \text{N}/\mu\text{m}$, cut-off frequency (<1.3
$\text{N}/\mu\text{m}$) >> wind cut-off frequency (this is a lower limit to currently implemented values,
see 640f016a_LBT672a_acceptance_tests.doc).

6. Proportional control gain $K_{\text{prop}} = 0.13 \text{N}/\mu\text{m}$ (this is based on currently implemented
values, see 640f016a_LBT672a_acceptance_tests.doc).

Calculations:
1. We compute the effective axial stiffness of each actuator as: $K_{\text{eff}} = (K_{\text{int}} + K_{\text{prop}}) \times (1 - N_{\text{no_integrator}}/N_{\text{act}}) + K_{\text{prop}} \times N_{\text{no_integrator}}/N_{\text{act}}$
2. Given the average wind force $f_{\text{wind}}$ we compute the optical path error (opd) as:
   $\text{opd}_{\text{err}} = 2 \times f_{\text{wind}} / K_{\text{eff}}$
3. We scale the opd error to phase error at the observing wavelength:
   $\text{ph}_{\text{err}} = \text{opd}_{\text{err}} \times (2 \pi)/\lambda_{\text{obs}}$
4. We then set $(\text{ph}_{\text{res}})^2 = \text{ph}_{\text{err}}^2$
5. The maximum number of actuators without integrator can be derived by first solving for
   $K_{\text{eff}}$ from the previous equation, obtaining: $K_{\text{eff}} = 2 \times f_{\text{wind}} \times 2 \pi/\lambda_{\text{obs}} / (\text{ph}_{\text{res}})^{1/2}$ and then
   computing $N_{\text{no_integrator}} = N_{\text{act}} \times (K_{\text{int}} + K_{\text{prop}} - K_{\text{eff}})/K_{\text{int}}$ as obtained from the equation in
   point 1.

Substituting the input parameters we compute that up to ~32% of actuators can be operated
without control current integrator. We will assume the same safety margin of 5 and consider that
up to 44 uniformly distributed actuators can be tolerated at the time of acceptance. Notice that
this assumption is equivalent to assuming a rate of increase of ‘no integrator’ actuators of 11
actuators per yr for a total lifetime of the unit of 20 yrs.
Mouse-hole-cover design requirements

G. Brusa, March 05, 2008

Summary

Shell #4 has a central hole with a more complicated geometry than the other shells since part of the glass near the inner edge had to be removed. The ‘as built’ geometry of this hole is reported in figure.

The geometry is essentially a slightly reduced ID (with respect to specifications) and an extra hole (mouse-hole) that extends significantly into the shell. When the shell will be completed and operated a cover for the mouse-hole will be required in order to protect the gap from dust contamination. At the moment the plan is to install this mouse-hole cover just after aluminization of the convex surface of the shell. In the following the basic requirement for this cover and a preliminary discussion of these requirements is presented.

Requirements for the mouse-hole cover

1. do not introduce any significant local stiffening of the shell’s surface
2. allow future inspection of the small flaw
3. protect the gap from dust contamination
4. be compatible with cleaning and coating of the concave surface
5. be compatible with ozone and UV
6. be compatible with installation of the central membrane

Discussion

The main idea is to have a thin (50-100 microns) pre-cut plastic sheet that is glued to the concave surface in the perimeter around the mouse-hole. This should take care of point 1.
The plastic should be transparent (point 2). Ideally for chemical compatibility the material should be PTFE but probably other plastics could be used. The adhesive should also be compatible with the chemicals, i.e. green river solution (5% HCl + 5% CuSO4), 5% KOH water solution, 5% HNO3 water solution, isopropyl alcohol and acetone. The adhesive should also be able to work in relatively thin layers. For chemical compatibility silicone based adhesives would seem to be the best on the other hand these tend to be relatively viscous and tend to make thick layers.

One issue might be how to protect from the dust at edge of the mouse-hole cover near the ID of the shell. There the cover cannot extend past the shell’s ID or else it will hinder the installation of the central membrane interface ring and therefore after the installation of the central ring there will be a small gap between the mouse-hole cover and the ring. This can be fixed by installing a small ‘flap’ on the ring that sits ‘on top’ of the cover.

Notice that the maximum radial extent of the mouse-hole is 44.3 mm, if to this we add 3mm to allow the gluing of the mouse-hole cover we end up with a maximum radial extent of 47.3mm. This is very close to the projected diameter of the primary’s central hole (48-50mm). If we require no vignetting and include any significant field the result is that we will have to aluminize the concave side at inner radii that intercept the mouse-hole cover. This is an issue that will need to be resolved before the aluminum coating since it affects the procedure and methods to be used. For the silvering a similar issue might be at stake as well.
Status of anemometer installation (D. Miller)

Attached below is the status report for the AO Anemometer from the early February AO monthly meeting, with some updates.

The goal is to have the Anemometer software running in the lab (my office) by the March 17th and the system mounted and running at the telescope by the end of March.

Items yet to be done: (some are now done)

8) Build, debug and test the Anemometer acquisition software. (actually modify software developed for the MMT AO system)

=> The basic communication routines in C have been written and tested to acquire Anemometer data via a serial port. The framework for the archiving software has been written, but not yet tested.

9) Purchase a rack mount computer

=> the Anemometer software in 8) above will run on on one of the computers that live in the control room. This requires a modification to the communication scheme in 13)

** Done (NA)

10) Possibly purchase an inclinometer so communication to the TCS is not required (in the near term).

=> Joe Kraus has made progress building software to read telescope information through the IIF, which it will make available to the Anemometer software (via file or socket?)

** Done (NA)

11) Determine mounting position of the Anemometer

=> The decision was made to mount the Anemometer on the end of the DX M2 swing arm, the future position of the Adaptive secondary. The swing arm will only be deployed when LBC is not being used for observing (and in the retracted position).

** Done

12) Design and manufacture mounting bracket

=> James Howard completed the design of the mounting bracket and the shop has complete its fabrication. James and I checked that its interface to the Anemometer is correct. The mounting bracket has been attached to M2 swing arm and is ready for the Anemometer.

Thanks James for quick work.

** Done
13) Mount Anemometer, run power and communication cable and install Power and Communication Interface Unit and PC in lower right treehouse.

=> A change in the original design of the Anemometer system. To reduce the chance of damage to equipment in the tree house, the copper communication to the Anemometer will be replace with fiber. Also, the power supply will be mounted in the AO Power supply box at the top of the DX C-Ring extension. Joe has ordered a Moxa media converter that will convert the RS422 Anemometer communication protocol to TCP/IP. Thus, any computer can connect to the Moxa computer and acquire data from the Anemometer. Thus, as described in 9), a computer in the control room can be used for data acquisition and archiving.

14) Design and build weather station data acquisition software

=> Doug and Joe have some preliminary discussion, but software has not been designed or built yet.
1 LBT672 related work by Arcetri – LBT AO meeting 06 Mar 2008
A. Riccardi, M. Xompero, D. Zanotti, C. Del Vecchio, P. Ranfagni, P. Salinari

Contents
1 LBT672 related work by Arcetri – LBT AO meeting 06 Mar 2008 ................................................................. 1
  1.1 Action Items ....................................................................................................................................... 1
  1.2 Schedule ........................................................................................................................................... 1
    1.2.1 LBT672a Acceptance Test .......................................................................................................... 1
    1.2.2 TS3 box transfer to Arcetri .......................................................................................................... 1
  1.3 Status update ....................................................................................................................................... 1
    1.3.1 LBT672a Acceptance Test .......................................................................................................... 1
    1.3.2 TS3 Shell inspection .................................................................................................................... 4
    1.3.3 TS3 silvering ................................................................................................................................. 5
  1.4 Hot topics of the month ...................................................................................................................... 5
    1.4.1 Acceptance test management ...................................................................................................... 5
    1.4.2 Chopping requirements ................................................................................................................. 5
    1.4.3 Acceptance test of Unit #1 ......................................................................................................... 5
  1.5 Planned activities for the next month .................................................................................................... 5
    1.5.1 LBT672a mechanical acceptance test ............................................................................................ 5
    1.5.2 TS3 silvering ................................................................................................................................. 5
    1.5.3 Dust contamination with TSS FEA ............................................................................................... 5

1.1 Action Items
none

1.2 Schedule

1.2.1 LBT672a Acceptance Test
Arcetri performed the acceptance tests under its responsibility (performance and high-level safety) in schedule (11-15 Feb 2008). Test report delivered for reviewing.

1.2.2 TS3 box transfer to Arcetri
Arcetri received and handled the TS3 box on 1st March 2008 as scheduled (was scheduled within week 9). Report is still pending.
Formal shell inspection pending waiting for agreement on procedure with Guido. Inspection has to be scheduled. In order to reduce the number of box openings a possibility is to do it in occasion of the flipping for the silvering. That will allow to inspect also the front surface before and after the removal of Opticote.

1.3 Status update

1.3.1 LBT672a Acceptance Test
See report: 640f016a_LBT672a_acceptance_tests.pdf.
Briefly: all the specifications are met, but running the tests some critical behavior has been found that was not covered by any specification, for instance:
- Thermal stability test showed the need of a specification on the temperature stability (ex. ripple, bumps or steps) of the coolant temperature on the telescope (<5°/h TBC)
- Inner ring actuators have severe drift with elevation slewing (1.5um)
Moreover chopping test was no part of the acceptance test in MG. Scheduled on the first week following the arrival of LBT672a unit in Arcetri; Preliminary measurements at 80um gap (target gap for chopping) show room for optimization (see step response section of the cited report).

1.3.2 Critical oscillation of external actuators

During the pre-acceptance tests with TS3 (very first performance tests with scientific shell) in January a couple of very low-damped oscillation, never seen with TS1, was found when exciting trefoil mode. That has been associated with external actuators that were missing with TS1. The oscillation forced to reduce the internal loop gains using TS3 with respect to TS1, in particular for the external ring.
<table>
<thead>
<tr>
<th></th>
<th>TS1</th>
<th>TS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>proportional gain on</td>
<td>0.15N/um</td>
<td>0.13N/um (internal acts)</td>
</tr>
<tr>
<td>position error loop</td>
<td></td>
<td>0.06N/um (external acts)</td>
</tr>
<tr>
<td>derivative gain on</td>
<td>40Ns/m</td>
<td>30Ns/m (internal acts)</td>
</tr>
<tr>
<td>position loop</td>
<td></td>
<td>25Ns/m (external acts)</td>
</tr>
<tr>
<td>Force command</td>
<td>0.7ms</td>
<td>0.8ms</td>
</tr>
<tr>
<td>preshaper setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We reported a possible problem in chopping performances for that feature. The possible source of that problem was:

1. sync mechanism among crate BCU timers producing an 800Hz disturb (at least in one crate)
2. resonance frequency of external actuators cold fingers

Because the gain configuration with TS3 - that was found during pre-acceptance - assured the system running in spec for the AO configuration (60um gap), we decided to go ahead with the electromechanical acceptance test and investigate better the problem during the week following the acceptance in MG.

We repeated the test of the critical oscillation using the same loop gains as before and performing the equivalent exciting trefoil step. The test showed an unexpected reduction of the effect as shown in the following PSD plot: Red before, Blue after with same step excitation.

The pre-acceptance test was run before installing the miniskirt for the first time. The post-acceptance test was run after the miniskirt removal. No exactly the same hardware configuration: beams for mounting the shell were installed in the pre-acceptance test, no beams in the post-acceptance (this difference was due to schedule reasons). Moreover in the post-acceptance crate BCUs were modified by MG to test a new re-sync method (Arcetri asked to do that using spare BCUs, but MG preferred to do other way). The difference in PSD suggested that cited hardware differences (or other hardware differences Arcetri has not been informed about) caused the change in behavior.

We ran also a post-acceptance test with and without miniskirt showing an effect of it on damping the oscillation (red: without, blue: with).
We ran also a post-acceptance test with and without the new re-sync method (i.e. without and with the supposed 800Hz disturb injection). No significative difference was noted as shown in the following PSD plot. In both cases, however, the used BCU were the hardware modified ones, just the new re-sync external signal has been connected or disconnected (when disconnected the old sync mechanism automatically restarts).

The behavior is better, but no explanation has been identified (only suppositions). No more tests are allowed without impacting the schedule. The effect on the chopping will be tested (as already scheduled) during the first week of operations in Arcetri with the unit.

1.3.3 TS3 Shell inspection

Riccardi made a visual inspection of the shell at the end of the transport as shown in the picture attached to the Piero’s mail announcing the successful TS3 box transport and handling in Arcetri. The visual inspection was done to check damages like cracks or chips on the visible surface and all around the shell edges as a consequence of the transportation (ok from this point of view). We did not a deep inspection to map dirt, aluminum status or minor problems. Riccardi can report only the following:

- aluminum (not glass) is superficially scratched somewhere as unavoidable consequence of touching the shell (optical polished) against the reference body (not optical polished) during standard operational unit life. That has been experienced with MMT336 and all the prototypes.
- aluminum scratches on few spotted areas where sticky dirt was removed in past cleaning processes
- some aluminum damage around the central edge due to the removal of glue for temporary reference signal wires
glue residuals on shell in correspondence of the three reference plate cylindrical cuts, where reference signal wires were glued

- the external protection of shell edge (the three foam segments) was in touch with the shell edge during the inspection in two points (one 20cm apart wrt the other). No info if the foam has been installed touching the shell in MG before inserting the tray in the box, or if the shell moved on its plane during the transportation. The accelerometer records should exclude the latter. In case of movement on shell plane we lost the shell alignment giving trouble in the flipping procedure. In any case the procedure of putting the shell in the box has to be changed in order to insert the external protections allowing a visual inspection of the edge (i.e. before covering the shell with anything).

No inspection is possible on the front surface. We have to wait for flipping to do that.

1.3.4 TS3 silvering
TS3 box is sitting in a safe place in the “measurement lab”. Key of the lab is available to a limited number of people all of them are working for LBT672 or W and all of them are aware about the critical item. Flipping machine is in Arcetri together the slumped shell to do practice. Arcetri people (Ranfagni e Salinari) already made first flipping together ADS people in Lecco before moving the tools in Arcetri. Detailed schedule about silvering process will come in the following days.

1.4 Hot topics of the month

1.4.1 Acceptance test management
An Acceptance Document Repository have been built up in Arcetri as Secure FTP site:
host: lucifero.arcetri.astro.it
username: lbt672
directory: LBT672_em_acceptance
Guideline for uploading documents have been distributed.

Simone joined the acceptance management, See his report for details.

1.4.2 Chopping requirements
Pending

1.4.3 Acceptance test of Unit #1
See Arcetri’s report 640f016a_LBT672a_acceptance_tests.pdf

1.5 Planned activities for the next month

1.5.1 LBT672a mechanical acceptance test
Arcetri will support the mechanical tests in ADS for running the unit with Arcetri’s software.

1.5.2 TS3 silvering
Detailed schedule in next days

1.5.3 Dust contamination with TSS FEA
Ciro started the FEA of dust contamination effects in case the TSS is applied in terms of stresses. Work in progress. Mechanical acceptance test in ADS foresees the test of application of TSS forces with TS1. The test has to be scheduled in order to do it after the release of Ciro’s analysis.
W#1 unit
------------

1) AGW #1 has been positioned on its movable supporting structure to perform preliminary test of the phase screen set-up.
2) modified the 110 Vac power supplies in the definitive configuration.
3) The phase screen has been installed into the auxiliary unit.
4) The holder of telecentric lens has been mounted on the AGW #1 structure. Telecentric lens can now be installed in the unit.

W#2 UNIT
---------

[for some images of electronic boxes and mechanics see attached ppt presentation]

MECHANICS
---------

The mechanical integration of the WFS board #2 has progressed considerably in the February month. All mechanical mounts are ready and allow an almost complete electrical functionality test in the lab. Missing parts are:

1) CCD platforms where we are performing test on the best electrical configuration for such platforms. The original platforms mounted on WFS#1 are already available.
2) mechanical mount to install the camera lens in the xy stage.
3) ADC unit has been received and after some tests in Arcetri will be assembled in the next month.
4) Pupil rotator unit should be delivered to Arcetri by the end of the month from an external mechanical workshop.

Integration of the WFS board will be finished after receiving the part listed in 2 and 3 and is planned for the beginning of April.

Details of the activity
-----------------------

1) mechanical rails to provide optical alignment has been fabricated by an external company under instruction of AO group. Centering pivot for mentioned rails on the WFS board has been done.
2) Adjustment of the Tip-Tilt mirror mounting base, to have a better access to the mounting screw has been done.
3) Interface frame between tip tilt unit and tip tilt mount has been done.
4) Adjustment of all the mirror holders (telescope unit plus spare) for the Folding Mirror 1 has been done. A cylindrical reference part has been manufactured to check circularity of FM mounts.
5) FM mounts #1 and #2 has been completed.
6) Preparation and mounting of the micrometer screw to move the ccd’s plate.
7) Manufacturing of the DB-50 connectors support. The DB50 connector connects the control electronic boxes to the WFS devices.
8) Manufacturing of one support for the thermometers in the board. Two supports remain to be done.
9) Manufacturing of the system for Homing of the Filter Wheel 1 and 2.
10) A new design for the tilt stabilization system of the FW 1 has been done and realized.

OPTICS
-------

Page 1
The first input pyramid (the front pyramid of the pyramid unit) has been polished using the new rotational encoder for base angle measurement. The back pyramid is now being finished. Laboratory test of the achieved accuracy of base angles are scheduled for March.

MAIN PARTS OF W2 RECEIVED IN FEBRUARY
--------------------------------------
- Auxiliary unit bench
- Cooling plates from DAU
- AGW#2
- CCD39 arrived from costum. Functional test of the CCD is positive.

ELECTRONIC BOXES
................
1) test of BOX39, BOX47, XYZBOX
   - The box has been fully assembled at tekna by the 20th of February. Two functionality tests have been carried out at Teckna (6th and 20th of February) and after that the electronic boxes and the cabling have been finally delivered to Arcetri (for a test description see the attached file: W Test at Teckna).

   - Currently we have started testing the electronic boxes here in Arcetri, assembling and adding all those parts that were missing at Teckna (WFS board, aux units). The test of the complete set-up is foreseen for the beginning of March.

   note:
   - The CCD47 control electronic was not installed in box47 because is not yet delivered by SciMeasure. SciMeasure state that the CCD will be delivered here by the end of March.

2) boxes cabling
   All cabling of boxes and auxiliary unit bench is now completed.

3) Custom boards
   - The relay board of the XYZBOX (WFS Stages Driver Box) has been reworked. Two new samples of the board have been assembled, tested. One unit has been integrated in the W unit #2.

   - The new version of reference source BPS101 has been installed in the auxiliary unit. The aux unit controller has been modified to be compatible with the reference source power supply and control circuit. Currently two additional small boards have been added to the main circuit to achieve a control of the intensity of the reference source on 256 level. A new pcb with these modifications will be design and realize in the next month.

   note:
   - The remote sensing feature of the power supplies is still an open issue: after spending several days debugging our cabling and testing the sensing circuit, the XP Power finally admitted that it was an error made in the factory and we are waiting the company to replace our units with new working units. Currently the power supplies are working with the remote sensing pins disconnected.

10) cabled the W#2 in laboratory: BOX39, Box47 (dissassembled because of PI tip tilt driver), aux unit, dummy board cabling, motor driver box.
Everything works: devices are responding. Custom electronic circuits are properly working.

W#2 SOFTWARE
---------------
- The implementation of the control software for the new Copley motion stage drivers that control the new XYZ stages of the WFS board has been started. Code implementation is supposed to be finished in a week from now.

MARCH ACTIVITIES
----------------
ELECTRONICS
-------------
- Full power on and electronic test of W#2.
- PCB board for the auxiliary unit bench incorporating modification for reference source intensity control.

MECHANICS
------------
- Manufacturing CCD platforms.
- Telecentric lens mount of unit #2
- Installation of electronic boxes in the AGW frame

Solar tower test
----------------
Test of seeing generator with unit 1

Software Progress Report February 2008, provided by L. Fini
-----------------------------------------------------------
AdOpt Software
* More work on Adam software
  o Watchdog tested
  o Network code fixed
  o Modbus/TCP protocol support added
* Implementation of SW support for the new linear stages to be used in AGW2
* The AdSec arbitrator code has been reviewed and partly updated.
* The logging mechanism has been thoroughly reviewed
  o Some relevant pieces of information added to the MsgD log messages
  o A mechanism to help correlate different log files has been added
  o A policy for log file management has been established

* Software support to lab test activities

AOS
* Some code for implementing AOS commands has been added
* Paths of include files have been adapted to the TCS policy
February 08 W units activity

Electrical test @ Teckna (20Feb08)

The electronic boxes at Teckna premises during electrical functionality test.
Some other parts at Teckna.

AGW #2 received

The AGW#2 unit in the AO lab in Arcetri ready for the AGW unit integration phase.

The XYZ stages connected to the motor driver for testing.
W#2 Unit integration @ Arcetri

Integration of WFS#2

WFS board of W#2 mechanical integration is almost completed. ADC unit will be installed in March. The rerotator installation is scheduled for end of March too. This last item will be manufactured by an external company in the March month.
2. Schedule

-- Unit 2: BP#3 coating, to be postponed AFTER LBT672a mechanical acceptance @ ADS and support to installation @ OAA, by April 2008 w. contingency – at this time we will do also the BP#1 re-coating to avoid the chemicals will expire before we use them

-- Unit 2: ADS integration, to be postponed AFTER TS4 magnets gluing which we schedule in May 2008, thus the LBT672b integration will be completed by June 2008 (July 2008 w. contingency)


3. Status update - progress since last meeting

- ADS
  -- flipping bench and silvering support activity

Tested w. Arcetri crew and delivered to Arcetri on 27 Feb. – 640a016c-Procedure for Thin Shells flipping
-- refurbishing of cooling plant by MIC

DONE: circulation pump replaced by rotary pump (3.2 bar max overpressure, 60 lit/min max flow rate)

-- integration & test of other MGSE on LBT672b
Done

-- transport of LBT672a & TS1 from MIC to ADS
Planned on March 10

-- installation of LBT672a w. cabinet
Planned (see next section)

-- test of all MGSE w. LBT672a and HUB#1 and HP#2 and HPC#2
Planned (see next section)
5. Planned activities for the next month

- ADS
  - 06 March: hub rotator bench integration
  - 07 March: mirror cover integration
  - 10 March: telescope simulator bench and hub installation
  - 11 March: ADS @ MIC to pack LBT672a+TS1+cabinet
  - 12 March: LBT672a+TS1+cabinet TRANSPORT MIC→ADS
  - 13 March: LBT672a enters the yellow room plus external cleaning, preparation of LBT672a for handling, preparation of new support beam for installation, dismounting electrical + cooling connectors from current test bench (MIC representative needed), unloading of LBT672a from current bench, replacement of support beam with new one, final installation of LBT672a on the refurbished test bench
  - 14 March: installation of new Swagelock connectors on the LBT672a, final installation of electrical and data connectors, dust top cover preparation, cooling system switch on and functional test, LBT672a switch on and electrical dry test (no shell installed) - (MIC representative needed)
  - 17 March: contingency, final installation of the accelerometers on the LBT672a
  - 18 March: installation of the HP into the hub, the latter already positioned on the telescope simulator bench, handling interfaces installation, dry test (no shell installed) of the LBT672a installation into the hub, then LBT672a goes back on the test bench
  - 19 March: installation of the guiding poles for the shell mounting (MIC or OAA representative needed), TS1 installation, guiding poles removal, installation of the miniskirt, handling interfaces installation, installation of the shroud and dust top cover, installation of the mirror cover
  - 20 March: LBT672a+TS1 installation into the hub - (MIC or OAA representative needed), final harnessing (electrical+data+cooling) into the hub (MIC representative needed)

Easter weekend
  - 25 March: system functional test (MIC or OAA representative needed)
  - 26 March: Acceptance test DAY 1 – system inspection and review (MIC or OAA representative needed)
  - 27 March: Acceptance test DAY 2- system performance test @ ambient temperature (MIC or OAA representative needed)
  - Overnight thermal test (1st attempt) (MIC or OAA representative needed)
  - 28 March: Acceptance test DAY 3 - system performance test @ ambient temperature (MIC or OAA representative needed)
  - Overnight thermal test (2nd attempt) (MIC or OAA representative needed)

weekend
  - 31 March: Acceptance test DAY 4 – hub installation on telescope procedure test (hub hoisted from the telescope simulator bench to the rotator bench, 72 deg hub rotation, hub hoisting test, LBT672a removal from the rotator bench and installation on the test bench, TS1 removal) (MIC or OAA representative needed)

  - 1 April: punch list activity
  - 2 April: punch list activity
  - 3 April: punch list activity
  - 4 April: punch list activity

weekend
Appendix 8 Page 4 of 4

- 7 April: LBT672a installation on transport frame
- 8 April: packing
- 9 April: MITSAFETRANS transport LBT672a+TS1+cabinet ADS→OAA

Open Action Items:

#50: Daniele to distribute LBT672 cooling system design description for review.
Minutes of meeting – Retention Ring and Mini-skirt design, March 5, 2008

Summary of the skype conference that Daniele, Piero and myself have had yesterday on the mini-skirt and retention ring (MS+RR) subject (Armando could not participate to the conference but has reviewed the points discussed and essentially agrees with the plan reported at the end of this summary).

1) Mini-skirt and retention ring installation time and procedure.

a) Guido raises the question of the total time required for the installation of the MS+RR. This is based on a scenario in which a gap contamination occurs during an observing night. The plan should be to remove the unit from the telescope in the early morning (say starting 6am) and be able to re-install the unit (with a 'clean' gap) in the early evening (say 6pm) of the same day. A first estimate of the time required for the various steps needed to carry out the entire operation sets the maximum allowed time for installation (or removal) of the MS+RR to 1 hr (goal should be 0.5 hrs).

Daniele replies that 1 hr for removal should be feasible, considering that all is needed is to remove the screws that fasten the top of the mini-skirt to the cold plate and remove it. In fact the plan is that once properly installed the various segments of the retention ring should remain attached to the mini-skirt. For what concerns the re-installation of the mini-skirt the only difference is that the three segments will need to be properly spaced wrt to the shell.

b) Guido points out that whereas the solution of keeping the retention ring segments on the mini-skirt during installation and removal certainly makes the operation faster it could make it more difficult to carry out. Particularly if the mini-skirt is not rigid.

Daniele points out that worst case we could have a 'contact' between one side of the ring and the shell but this should not be a problem.

c) Guido raises the issue of the large number of screws (~70) needed to fasten the mini-skirt, this makes the installation and removal cumbersome and potentially dangerous for the shell (the screws could fall).

Piero estimates the total time to install all the screws to 15 min and does not agree that the high number of screws is a problem. In any case all agree that a screwdriver that can keep the screw captive while they are being fastened should be available for the operation. Piero also point out that having a continuous mini-skirt (instead of three segment) could facilitate the operations.

2) Protection against forces applied laterally on the mini-skirt
The main concern here is whether the mini-skirt provides adequate protection against relatively small forces.

Piero points out that given the geometry (radial separation between mini-skirt and shell edge ~2mm) it would require a significant force to bring the mini-skirt in contact with the shell edge. It is only after that this happens that this force will start loading the central membrane in its plane, causing potential problems.

Guido points out that in fact the effect of the lateral force will also be a rotation of the local segment of the ring (depending on the exact geometry) that could enter in contact with the shell on its top surface for relatively small forces. In this case the shell will first bend and conforms to the reference body and then the ring will apply a compression stress to it. Admittedly the maximum stress allowed for compression is higher than the nominal 5MPa for tension, may be in the range of 10-50 MPa.

Two final points are raised: 1) the mini-skirt was not designed to protect the shell against a significant lateral impact, 2) once all the ring segments are installed the mini-skirt should deform less under a lateral force.

3) Conclusion and plan

The current plan is to build a mini-skirt according to the prototype tested but with the following modifications:

1) all the segment shall be present;
2) the segments will not have slots;
3) the edge of the segments will be smoothed to prevent high stress points;
4) the screws used for the installation of the mini-skirt shall have a Phillips head and the screwdriver used for the installation shall have a mechanism that can capture the screws.

The mini-skirt retention ring will be tested during the second phase of the unit acceptance test in particular for what concerns installation and removal. In case some changes are required these will be addressed asap.