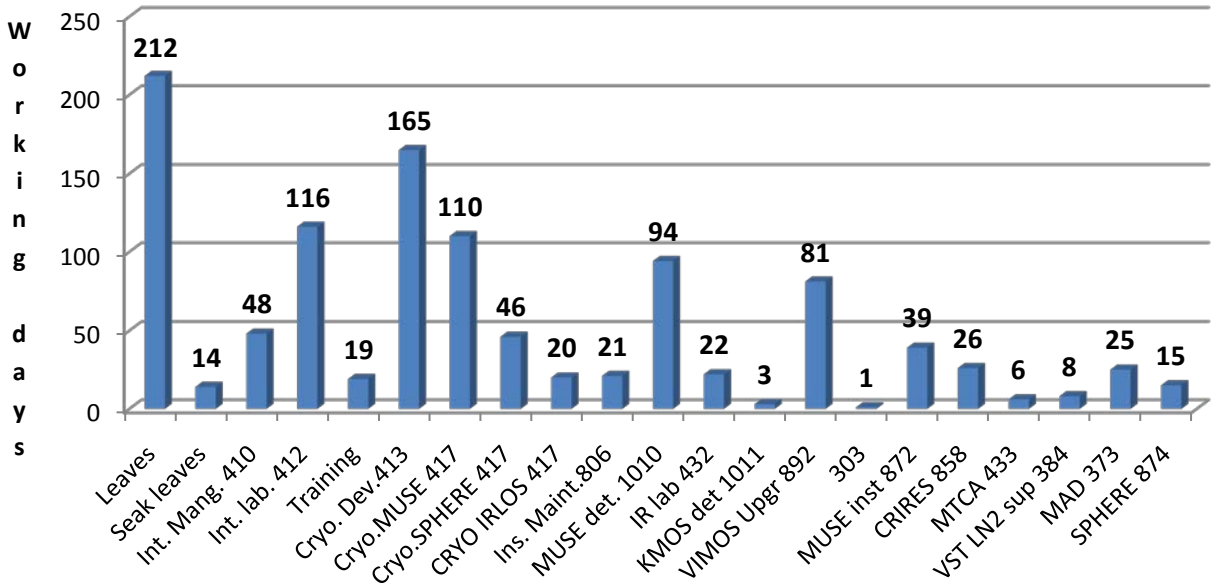
Annual report of activities 2010
Integration and cryo-vacuum department

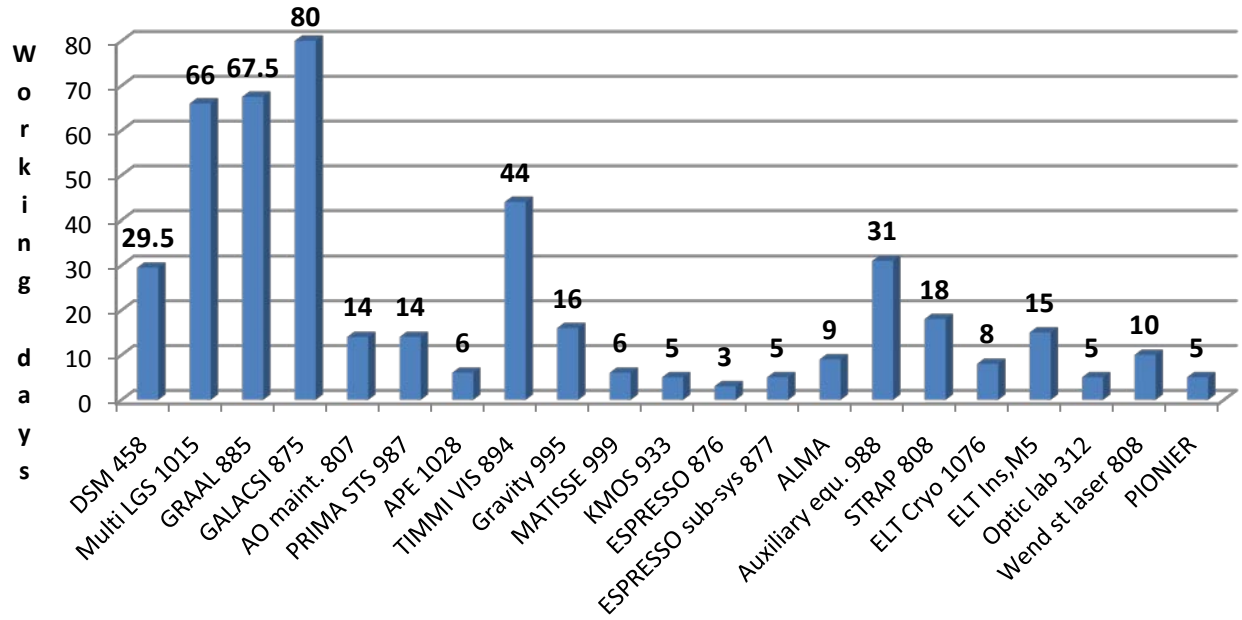
JL Lizon (16.12.2010)

The two folowing diagramms shows the dustribution of the 1764 working days of the department staff.

The folowing report gives a short summary of the task accomplished for the most significant positions.

The department staff has participated in a total of 8 missions at Paranal for a total of 109 days





Job 412: Integration laboratory (116 WD)

This is manpower for the daily running of our various laboratories (integration, cryogenics, and workshop). It includes some small developments as well as purchasing of standard components. It includes the running of the various contracts for gas bottle and liquid nitrogen supply. This includes also the final large re-organisation of the laboratory in preparation of the AOF start. We also purchase a new CAM system which allows simple transfer from CAD drawing to machine execution files. The system has been tested for the realization of some complex parts for the Detector Mosaic Test Facility.

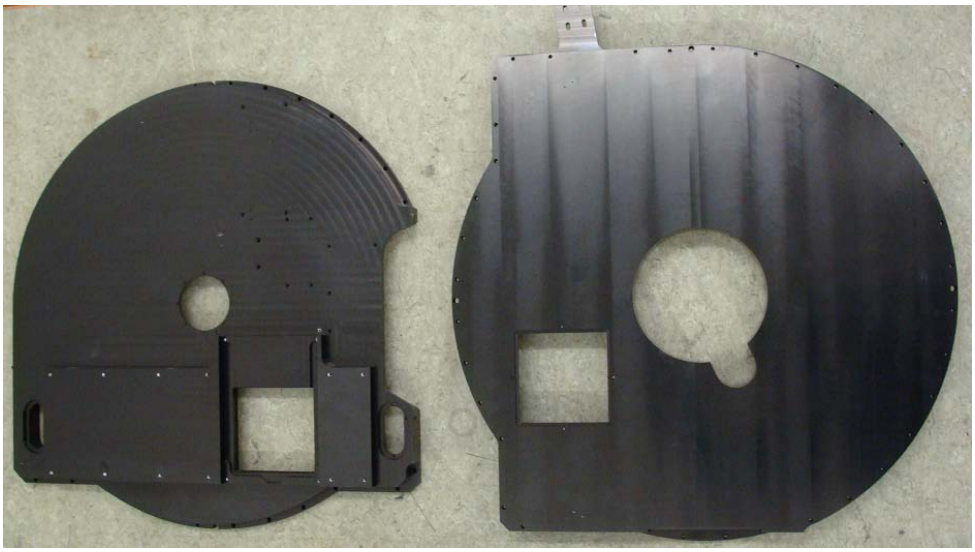


Figure 1: Mosaic test facility filter wheel housing (in house manufactured)

One of the main actions was to dismount the VLT Cassegrain simulator and pack it correctly in order to survive for a few years of storage outside. During the two last working days of the year we will erect the two clean tent which will be necessary for the integration of the both the LGS system and the DSM.

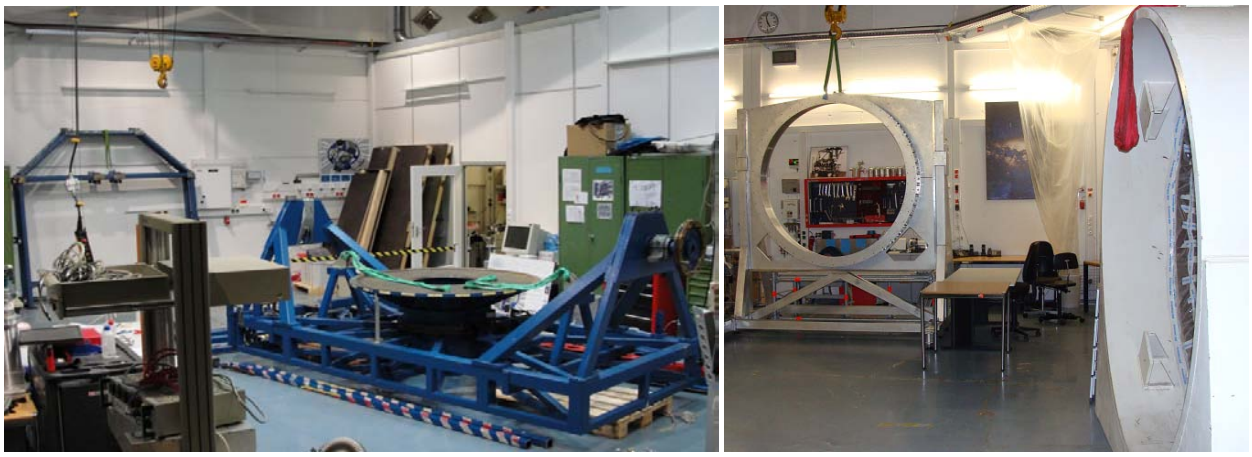


Figure 2: Cassegrain simulator (Lab re-organisation)

This year more than 250 PR and 40 TR have been issued by the department. In some cases, Gas bottles in a very complicate way as we have also to do the acceptance (For “safety reason” the good delivery refused to receive them)

Job 410: Department management (48 WD)

This accounts for all department and division meetings. This year the department staff has met 10 times to discuss of advancement and future objectives. It includes some special review (new building..) and visit of special exhibitions. It includes also the complete performance.

The department has also prepare the requirements for the new integration hall at Paranal.

The department has been strongly represented at the SPIE in San Diego with 7 posters in the field of cryogenics, 1 poster about optical alignment and one oral presentation about cryogenics and associated vibrations. In addition the team took care of the installation and dismounting, packing of the ESO stand.

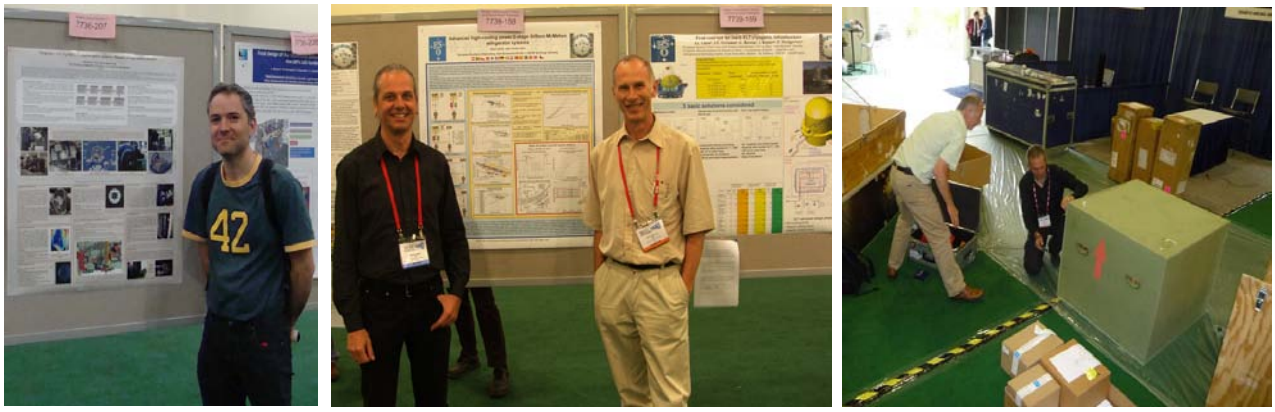


Figure 3: Involvement in the SPIE conference

Job 413: Cryogenic development (165 WD)

- **Vibrations, Closed Cycle cooler**

The dummy instrument to be used to perform the vibration test on the telescope has been completed. The instrument is fitted with 6 cold head in two different arrangements: 3 radial and 3 axial. This should allow not only to establish some specification for future instruments but also to identify if there is some preferable arrangements.

This dummy instrument is also an ideal test bench for parallel switching of cold head. The 6 cold heads are supplied in Helium only via 2 compressors which are mounted on a copy of the CRIRES compressor stand. In order to be closer to the real life the 6 head are cooling a dummy copper mass. A series of heater are also used to provide a reasonable heat load in order to have the cold head working in a normal operation.

A vibration campaign has been carried out in November, December on the three VLT instrument possible locations: Cassegrain focus, Nasmyth adaptor and Nasmyth platform.

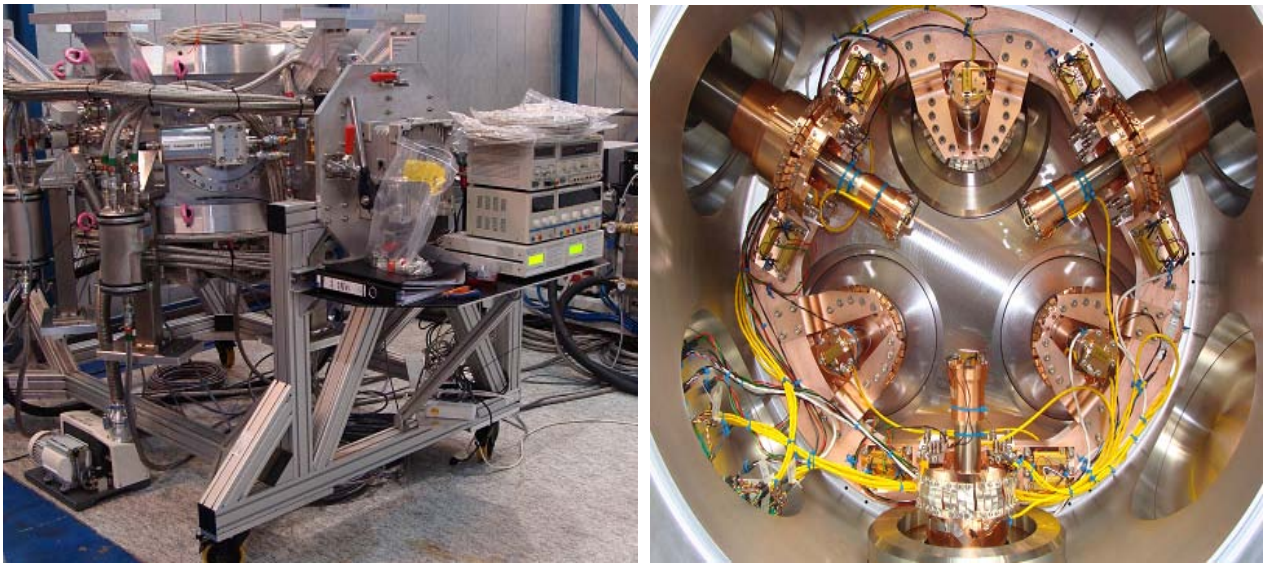


Figure 4: Dummy test instrument on its carriage and open

The measurement has started with the Cassegrain which was the most critical as we have no free Cassegrain focus. It was necessary to remove XShooter, mount the dummy instrument, carry out the measurements, remove the dummy instrument and re-install Xshooter. In addition to the Manhatan measurement we took also data with a set of three accelerometers on the instrument it-self.

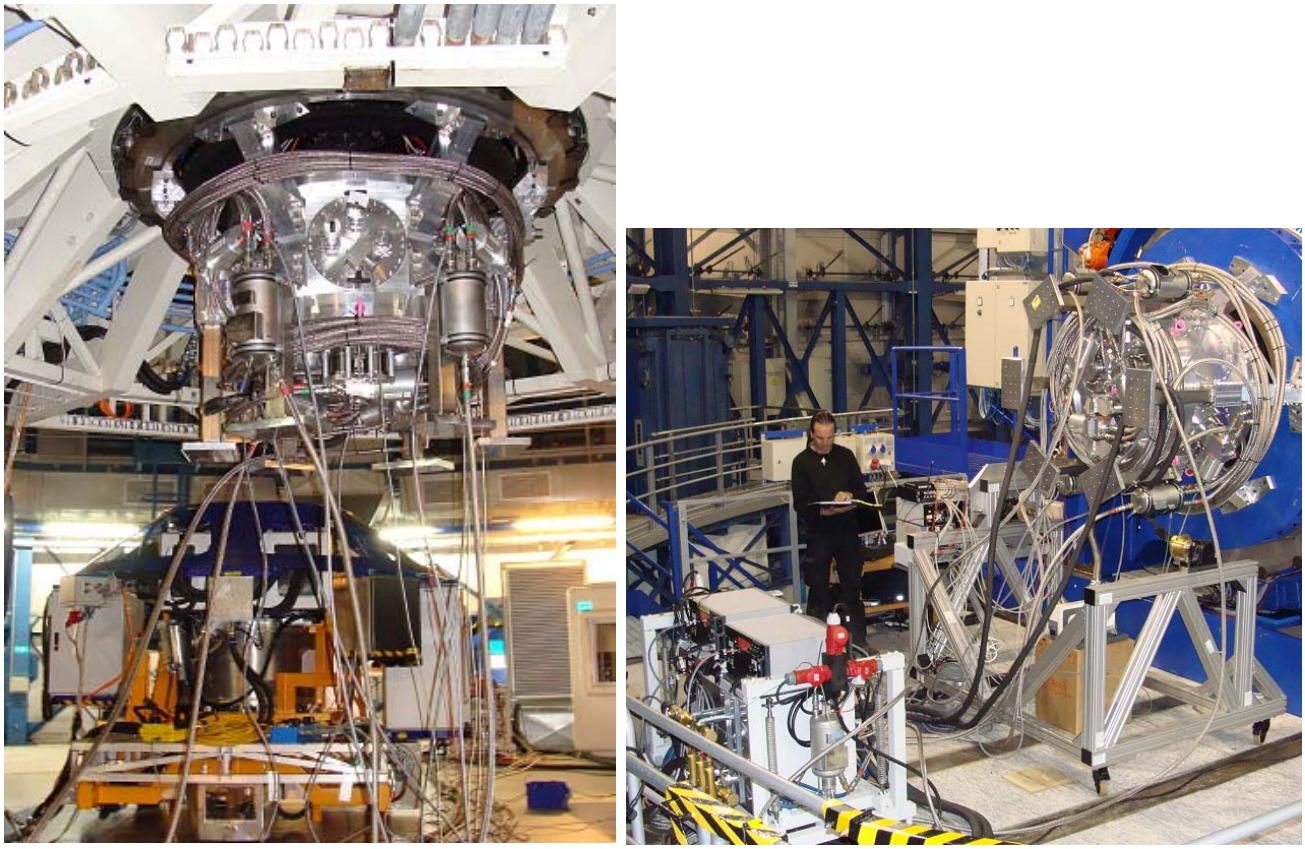


Figure 5: Dummy instrument mounted at the Cassegrain focus (left) and at the Nasmyth focus (right)

As a continuation on the Closed Cycle Coolers vibration testing new larger helium buffers have been defined and procured. A 6 Kelvin pulse tube cryo-cooler has also been procured.

- **ELT Cryogenic**

Some progresses have also been made on the definition of the cryogenic facility for the ELT. The investigation study carried out by UK ATC under ESO contract has been concluded. A summary paper has been presented as poster in two different conferences: At SPIE in San Diego and In ICEC at Wroclaw. The next step has been started with the definition of two projects: one to define more precisely the ELT cryo facility (this should end with a clear specification of the facility) and another project in order better to define the cooling technique for the ELT instrument (this should end with a catalog of tested and qualified solutions).

Job 417: Cryostat construction for SPHERE (46 WD)

The IFS cryostat has also been designed beginning of this year. The cryostat has been integrated and tested together with the IR detector team who installed a Multiplexer. Two iterations have been necessary to reach the specified temperature for both the detector and the filter. The tests have been done with ESO provisional optics as the consortium is facing a delay in the delivery of the final optics. The cryostat has been delivered to the consortium and there we are in a process of improving the dark current. The attempt is to try to minimize the effect of radiation left by a badly defined filter using special baffle technique.

The parts for the liquid nitrogen and the vacuum delivery have been all delivered to Garching and are all ready to be send to the consortium as soon the instalation can start on the main structure. The pumping system has been delivered to Grenoble for the integration with the control electronique. A aditional vacuum system has been delivered in loan to Marseille in order to allow safe and rapid evacuation of IRDIS as long the final system is not ready.

Job 417: Cryostat and VCS construction for MUSE (110 WD)

The integration of the VCS (Vacuum Cryogenic System) has been completed. After this it undergoes sytem test peiod of 6 weeks where every aspect of performance and operation has been verified carefully. The test has been documented in a test report which has been submited for review in the frame of the MIA (Manufacturing Intermediate acceptance) together with a number of other documents (Transfer plan to consortium, spare part list and a draft operating manual). Finally the MIA took place on September 21$^{st.}$.

The tests were carried out with 12 completely tested DVs which were fitted with dummy detector out of aluminum. The DVs were first installed on one half and after full qualification of the first half they have been moved to the second half. At the end of the test when the system was fully qualified, the VCS has been used to cool 6 real DV fitted with operational from the series CCD detectors. This allows to perform the first testing of the 6 slot NGC controller.

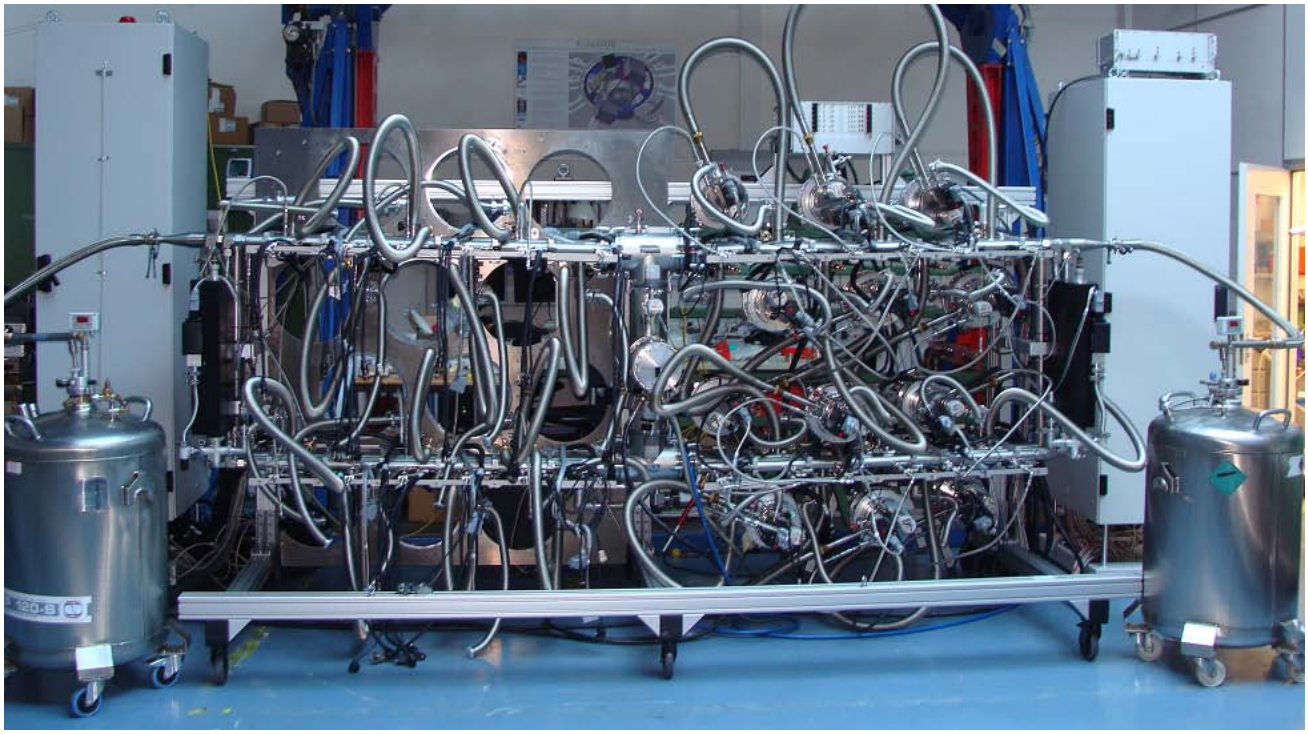


Figure 6: MUSE VCS integrated with the IMS test plate

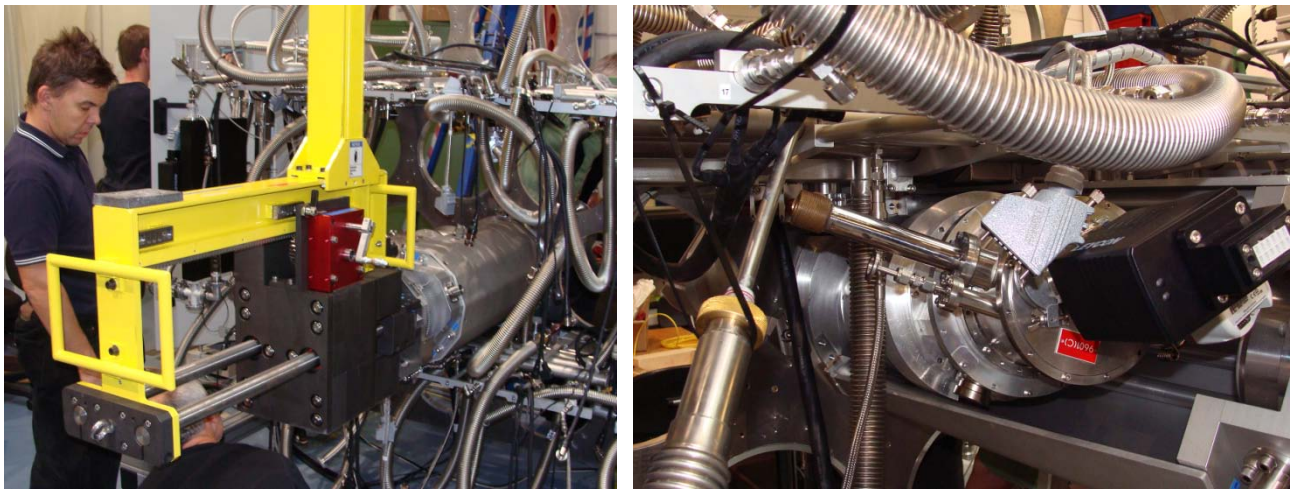


Figure 7: IFU insertion test

Finaly the MIA was granted on November 8th after closing the last actions and after completion of the IFU insertion test together with the consortium. This test was forseen to detect eventual colision between the IFU, the IFU handling tool and the VCS tubing. The VCS has been packed and delivered to CRAL where it will be stored for a few month waiting for the IMS (Instrument Main Structure)

Figure 8: Packing and transport of the VCS

Job 417: IRLOS cryostat construction (20 WD)

The iRlos cryostat design has been completed. It is based on the design of the SPHERE DTTS with some slight modifications. The cooling is provided by a CFC cryostat which has been modified in order to have the LN2 supply in the axis. This in order to avoid conflict with other critical components.

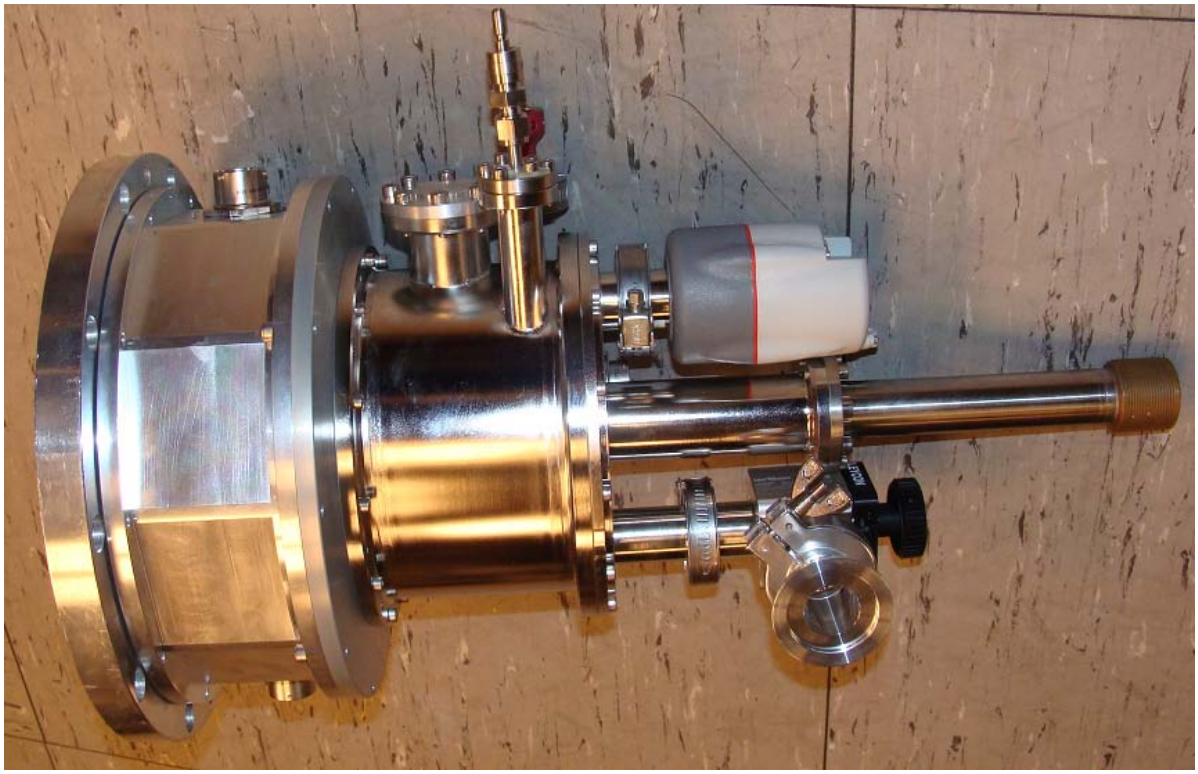


Figure 9: IRLOS Cryostat

Job 417: Cryostat for GRAVITY wave-front sensors (10 WD)

Due to the weakness of the proposal included in the PDR documentation, some discussion started about the cryogenics of the wave-front sensor. It was finally agreed that the best way would be to use the ESO standard cryostat. This will allow the testing of the detector (ESO responsibility) to be

directly carried out in the final cryostat. This also make easy the design of the nitrogen supply (ESO responsibility) as it can be directly similar to the one already used for FINITO and IRIS. Then a pre-design has been elaborated and the first negotiations took place.

Job 417: Cryostat and cryogenic supply (5 WD)

Pre-study and preparation work have been carried out for the LN2 distribution for the 2nd generation of VLT I instruments. This includes MATIS and GRAVITY with its 4 wave-front sensor cryostats. First investigations have also been carried out to develop a new reliable and simple control system.

Job 1010: Detectors system for MUSE (94 WD)

The assembly of the detector head subcontracted to the AIP (Astronomic Institute Postdam has been completed. The 24 Detector vessels have been integrated, tested and delivered to the ODT department for integration of the detectors. Two additional DV have still to be completed in order to have some spare. The Chip Position Measuring Machine has been re-designed in order to improve the reliability and also the light tightness. A Test Dewar fitted with and engineering grade detector as been dedicated to the testing and calibration of the machine. This has helped to improve considerably the accuracy of the measurement, even if the tilt positioning remains an issue. Actually 6 DV have been successfully aligned within the new reviewed tolerances.

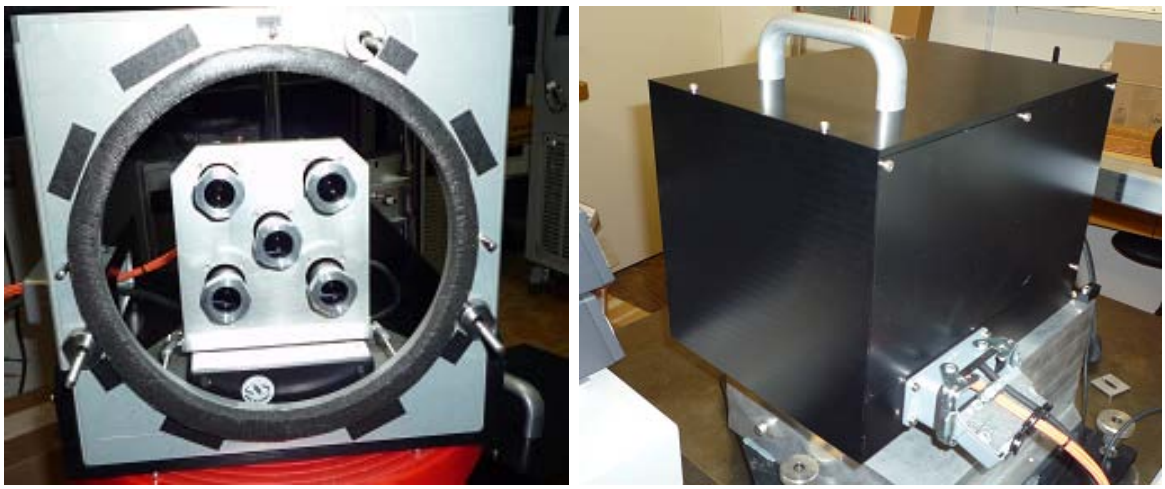
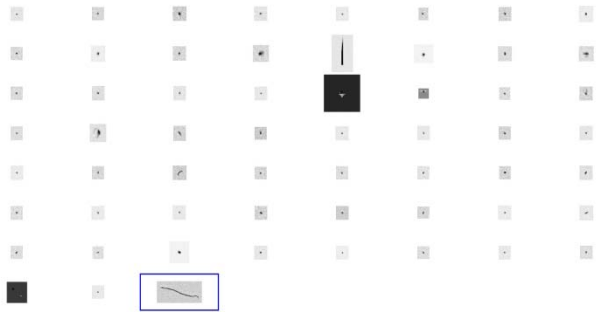


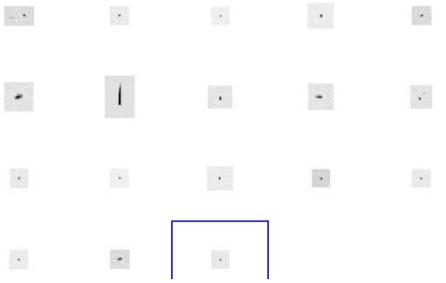
Figure 10: Chip position measuring machine after review (more robust, better reliability, light tight)

The department has also been active in the reduction of the contamination on the detectors. A special stand has been designed in order to support the system with the sensitive surface of the detector looking down during the installation of the adjustment flange and of the field lens. A soft cleaning method using air has also been used successfully as shown on the following figures.

Contamination on the detector before cleaning



Contamination after cleaning



Special set-up developed for the installation of the field lens and adjustment flange.

This allows working with the sensitive surface of the detector looking down and then less sensitive to dust deposition.

Figure 11: Detector 7 cleaning and special stand

	Pixel affectec75%	Spots	Mini-fluffs	Hairs (>30pix)
Before cleaning	255	66	4	1
After cleaning	103	21	1	0

Figure 12: Cleaning result of DV 07

Job 806: Instrument maintenance (21 WD)

During the various visit to Paranal a number of special maintenances or small up-grades have been performed by staff from the department. This includes small fix on instruments like HAWK-I, CRIRES..and more consequent intervention like the installation of the new Blue cross disperser grating on UVES.

In the same category also the emergency dismounting and re-installation of the CRIRES warm to give space for the re-alignment of M3. After Paranal recognize not to be really in the position to carry out the operation alone, it was decided that the Integration department will take the lead. One staff in mission at Paranal for another task dismount the unit and placing the necessary optical references, ten days later taking the opportunity of a mission dedicated to another task, a second staff of the department re-install and re-align the system.

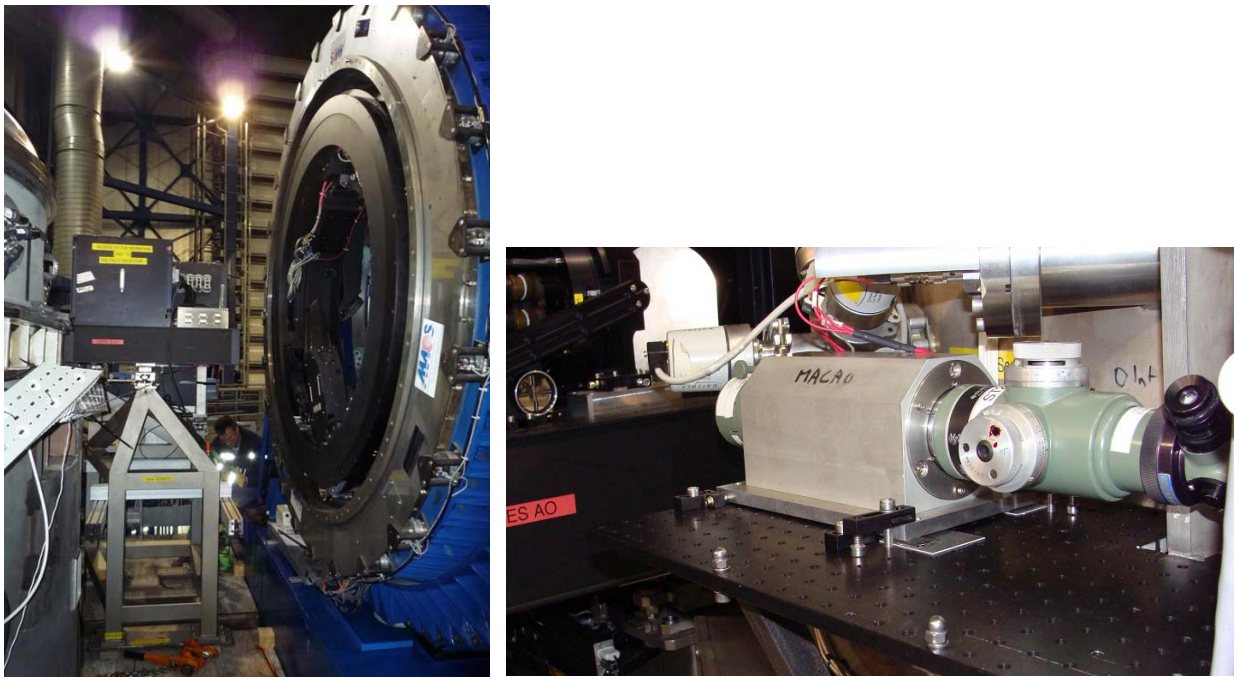


Figure 13: Dismounting of the CRIRES warm part (reference system on the right)

Job 807: AO instrument maintenance (14 WD)

The department has also been involved in one large maintenance intervention on SINFONI. The main task was the exchange of the strap unit. For this the complete instrument (SPIFFI, SINFONI) has been brought down to the integration laboratory and the opportunity has been taken for a complete overall of the optics and verification of the functions.

Figure 14: SINFONI maintenance (STRAP Head exchange, right picture)

Job 892: VIMOS Upgrade (81 WD)

This year started the first step of the new VIMOS upgrade. The department did support the detector upgrade providing new design for the fixation of all Detector electronic components. This was requested in order to have the components electrically insulated and to provide a better access for maintenance.
In addition the department developed the AFC (Active Flexure Compensation), this is a system of 2 motor actuators which via some amplification level push and pull two of the 3 fixation points of the large folding mirrors (mounted on deformable membrane system). The development has been made in two steps: a first prototype has been tested in one channel before the start of the upgrade in order to verify before preparing the four systems. The pictures below show the principle, one quadrant equipped and some flexure curves recorded with the AFC system active. The flexure went done from a few pixels to lower than 1 pixel for every channel.

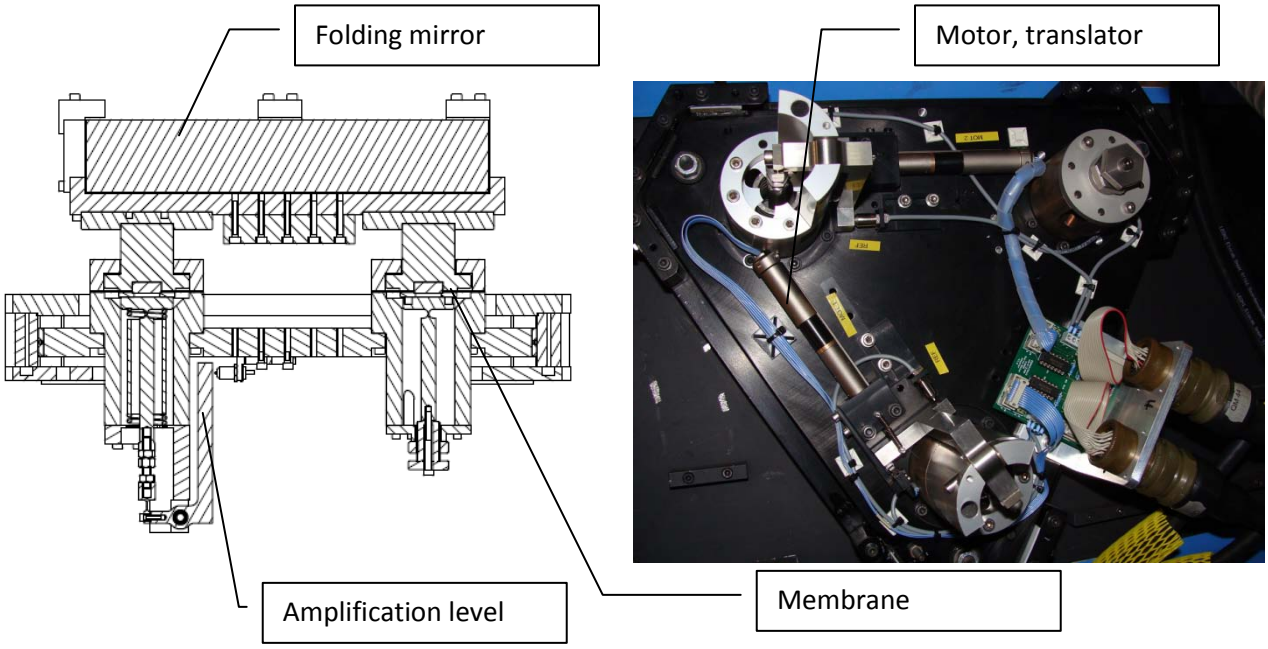


Figure 15: VIMOS AFC principle

The first investigation for a new generation of better and more reliable mask cabinet have been done. A prototype is actually in realization and should be tested early 2011. Together with the new cabinet (with a better holding of the masks inside) we are also working on a reduction of the weight of the cabinet and more important on a better and easier positioning and installation system. Actually the installation of the mask cabinets is rather painfull with the tightening of 4 hardly accessible screws. The new system should be locked with a single action.

Some pre-study have also been done on the large up-grade of the grism unit which will require the re-design of 12 functions.

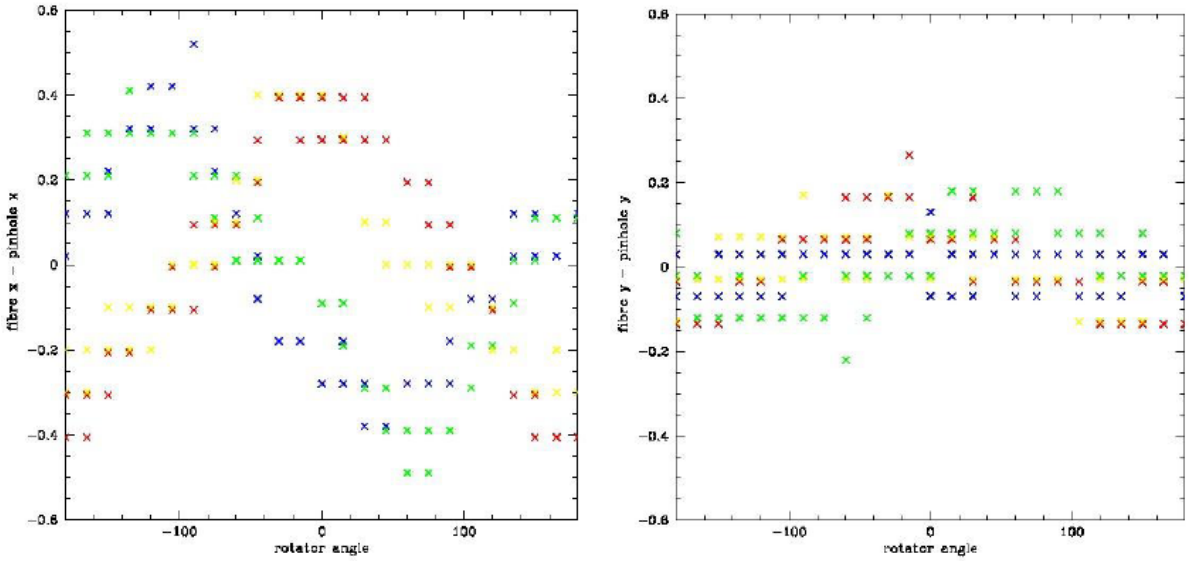


Figure 16: VIMOS flexures recorded with the AFC active (4 colors for the 4 different channels)

Job 872: MUSE instrument (39 WD)

The department has been deeply involved in the MUSE instrument in order to keep a good control of the development of the MAIT activities. The AIT coordinator has attended a number of meetings on integration, optical alignment and also the first MIA.

The department also has been specially active in the design of the protection cover. Knowing the importance of the light tightness of the cover (to allow calibration with light during the day) we have been organizing a number of discussions and technical meeting with the consortium in order to get them aware of the problem.

Finally we have been testing various construction technologies using one of the detector systems from the series. The measurements were done on small test boxes prepare by the consortium

Figure 17: MUSE test box

Job 1015: Multi LGS (66 WD)

A first version of the re-integration plan has been prepared for the AOF general review. In addition the parts for the first prototype shutter have been procured. The prototype shutter has been assembled and the first tests have shown the need for further modifications. The FDR AIT plan is in preparation.

Job 885: GRAAL (67.5 WD)

Members of the department paid a few visit to NTE the Spanish company who is responsible for the mechanic construction and assembly of GRAAL. Dedicated mission were for the installation of the encoder and for the flexure measurements.

Figure 18: GRAAL instrument on the stand during testing

The first prototype of wavefront sensor has been integrated in the frame of GRAAL. In reality this unit will be dedicated to SPHERE. This unit has given problem not so for the very critical alignment of the lenslet array but more with the strong tightness requirements. Finally all problems were solved and the sensor was delivered to SPHERE.

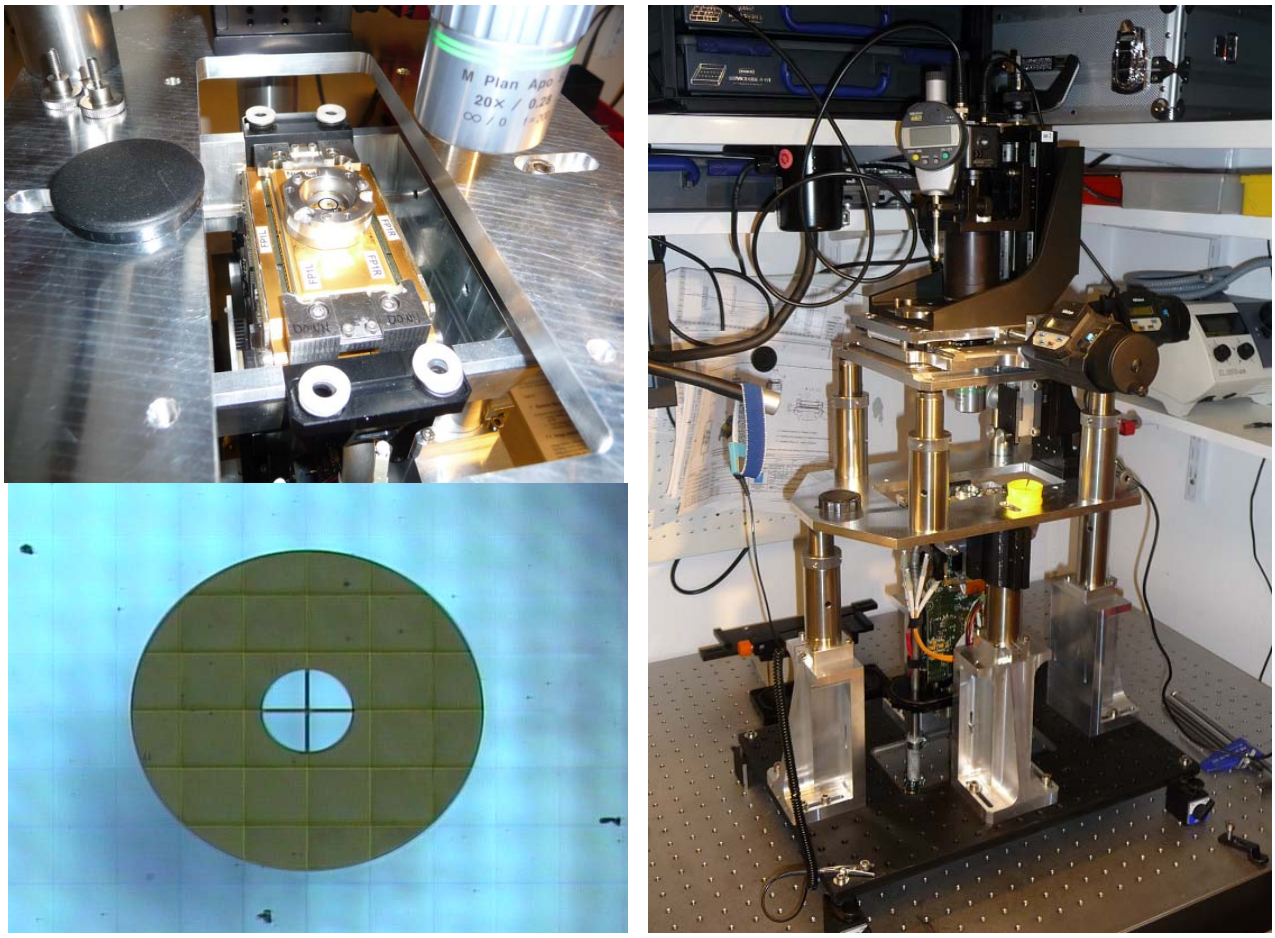


Figure 19: WFS lanslet array and lenslet array adjustment

Job 875: GALACSI (80 WD)

This year a lot of work has been done to prepare the tools to align the instrument. Some facilities and test stand to mount GALACSI in a convenient position have been designed with help of external designer. The field selector is the first sub-system which has been integrated and tested.

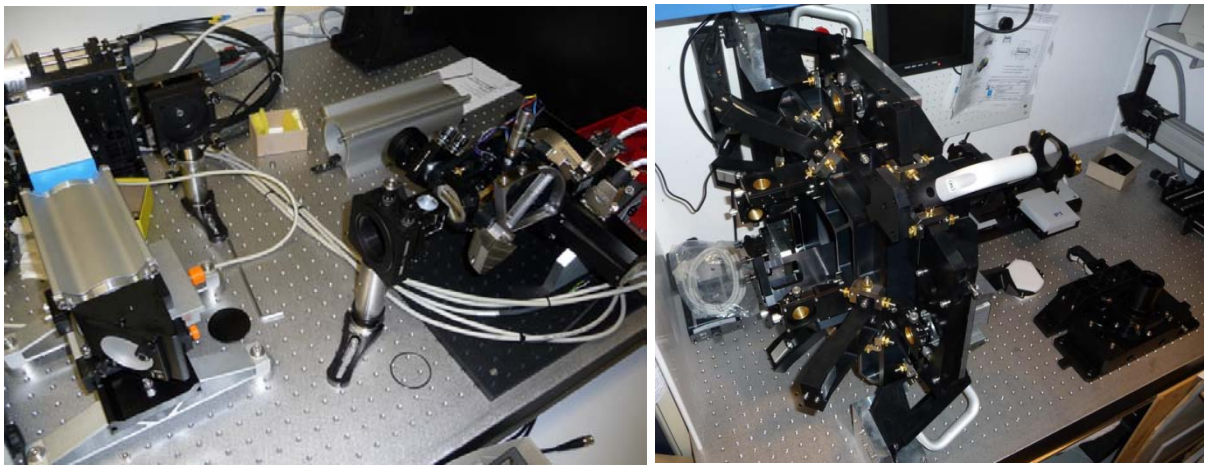


Figure 20: GALACSI NGS test setup, and LGS optical path assembly

Job 894: VISIR upgrade (44 WD)

The department has been active in two different fields for this project.

The TIMMI 2 instrument which has been returned from La SIlla has been first been re-integrated and tested in order to verify that all mechanisms were still working correctly. Then a number of modifications have been done in order to transform it in a decent detector test facility for testing and qualify the Aquarius. These modifications include providing an easy access for installation of the detector. Therefore a new vessel has been designed, procured and installed. Additional modifications were necessary to allow a safe and reliable routing of the detector cables.

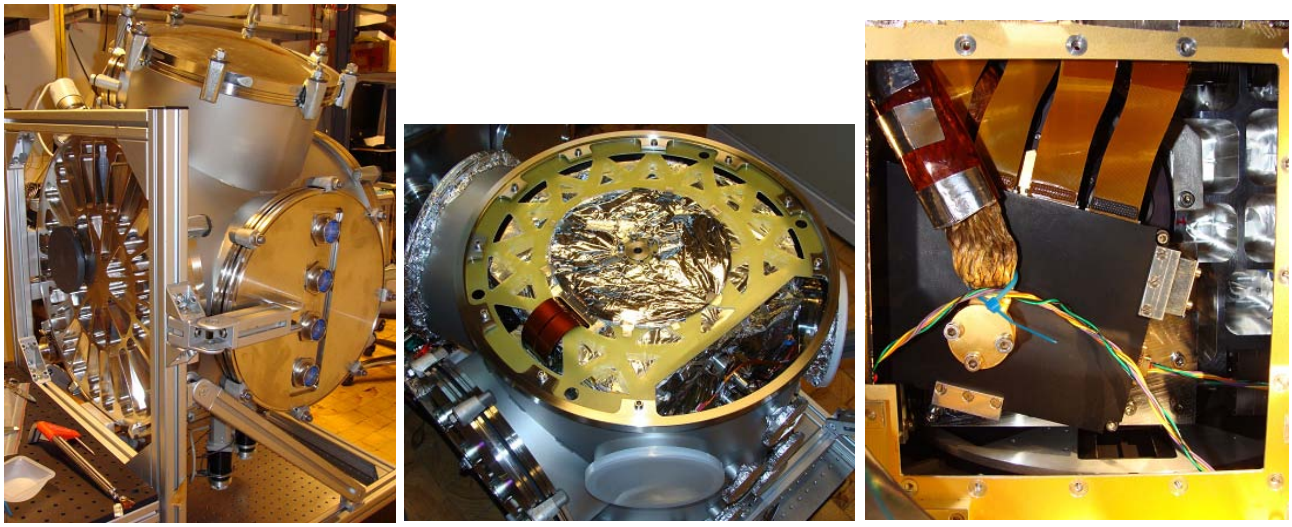


Figure 21: Aquarius test facility

The department has also be in charge of the design of the Aquarius detector mount. The design is based on the principle used already successfully for the Alladin. The design has been completed, the parts have been procured and after integration, a first test with the multiplexer has shown good cryogenic performance. The detector reaches the expected temperature.

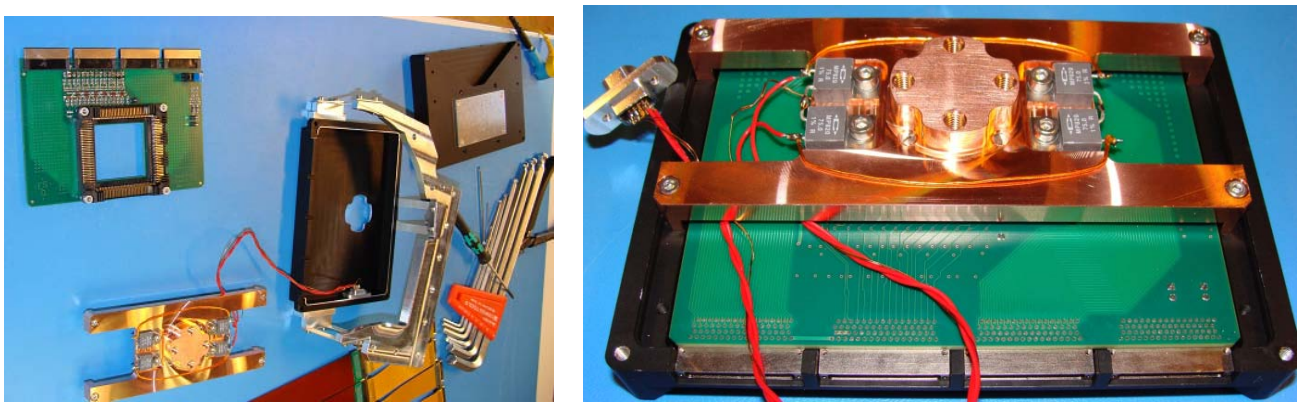


Figure 22: Aquarrius detector mount

Job 988: Auxiliary equipments (31 WD)

We also finally conclude a development started already a few years ago. The first unit of M2 B-CON has been designed, procured and successfully tested on UT1 during the last technical period. This very compact and light system is attached on the center of M2 and produce powerful beam in order to mark the center of M2 and the optical axis of the telescope. This is a fantastic tool for alignment which has already be used shortly to verify the re-positioning of the CRIRES warm part.

Figure 23: First M2 B-CON

In the near future, 3 additional unit will be produced to equip the 3 other telescopes.

NACO up-grade (6 WD)

The department has actively supported the up-grade of the NACO wave-front sensor system. The intervention mainly from LAOG team has been hosted in our laboratory. We also actively took part to the intervention providing technical support for manufacturing and modification of small parts. We also took care of the vacuum and cryogenic preparation of the cryostat.

PIONIER (5 WD)

Some support has ben given to the new interferometry visitor instrument PIONIER. The first was to provide some adaptation in order to allow the use of the LISA nitrogen distrinbution system. Finally under the request from Paranal we also organise the transfer of the instrument from Grenoble LAOG to Paranal.

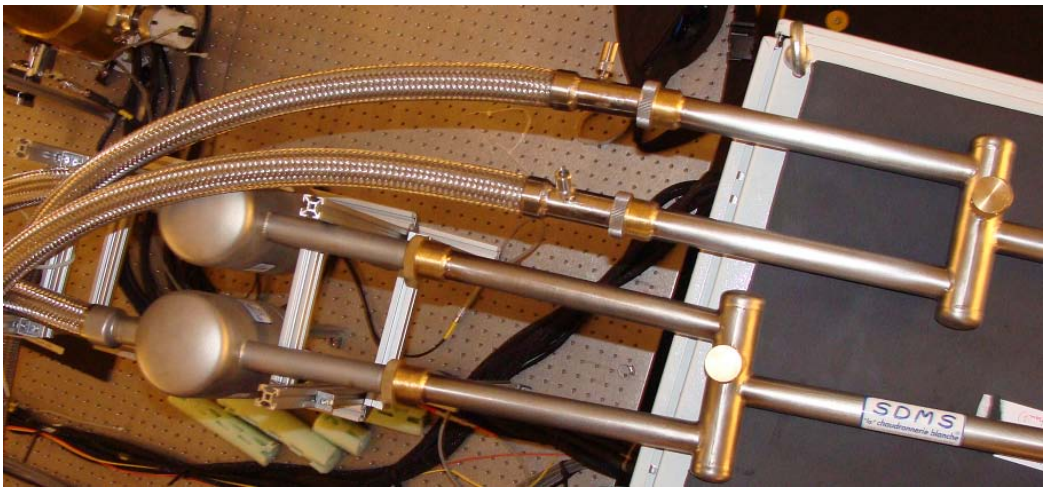


Figure 24: Special connections and lines for the LN2 supply of PIONIER

STRAP (18 WD)

This year we complete the technology transfer for the assembly and testing of the lens-let arrays with a French industrial company. Some special missions have been dedicated first to the installation of the tools and to the training. Within two last missions a series of lens-let arrays has been verified and accepted.

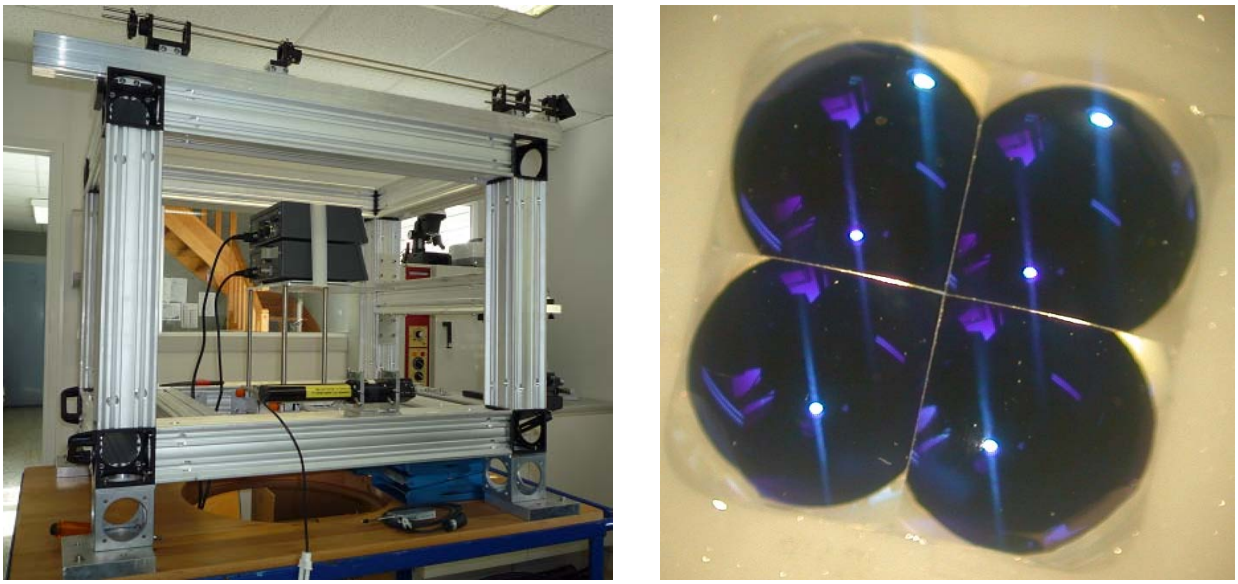


Figure 25: STRAP lens-let array assembly tool, one completed lens-let array

VST (5 WD)

The distribution system to transfer the LN2 from the telescope basement up to the azimuth flour has been designed and procured this year. It has also been transported to Paranal and is ready for installation as soon we get access to the telescope (probably at the time of the OmegaCAM installation)

Main documents prepared during the year 2009

Publications

SPIE conference in San Diego

Integration and alignment of adaptive optics systems (Paper 7736-207)

Liquide nitrogen pre-cooling of large infrared instrument at ESO (Paper 7739-155)
A very accurate filter wheel for a large field IR instrument (Paper 7739-156)
A hybrid liquid nitrogen system for the cooling of the ESO OmegaCAM (Paper 7739-157)
First concept for the E-ELT cryogenic infrastructure (Paper 7739-159)
LN2 continuous flow cryostats, a compact vibration free cooling system for single to multiple detector systems (Paper 7739-85)
Low-vibration high-cooling power 2-stage cry-coolers for ground-based astronomical instrumentation (Paper 7733-139)
Advanced high-cooling power 2-stage Gifford-McMahon refrigerator systems (Paper 7739-158)
Different ways of reducing vibrations induced by cryogenic instruments (Paper 7739-84)

International Cryogenic Engineering Conference 23

First conceptual design for the cryogenic infrastructure system for the new European giant telescope(Paper Nb: 149)
LN2 continuous Flow Cryostats a compact vibration free cooling system for single and multiple detector systems (Paper Nb: 322)

Internal documents

MUSE Detector Head Test report on the chip position measuring method, VLT-TRE-ESO-14679-4779
MUSE VCS final test plan, VLT-PLA-MUS-14679-4995
MUSE Vacuum Cryogenic System Transfer plan to CRAL, VLT-PLA-MUS-14679-5065
MUSE Vacuum Cryogenic System test report, VLT-TRE-MUS-14679-4996
MUSE Vacuum Cryogenic System spare part list, VLT-LIS-MUS-14679-5066
Technical Specifications and Statement of Work for the realization of the 2 Liquid Nitrogen Transfer lines for MUSE; VLT-SPE-ESO-14679 – 4671

CRIRES Hardware maintenance manual Mechanic, optic, vacuum and cryogenics, VLT-MAN-ESO-14500-3688
Update of the cryogenic operating manual and spare part list

X SHOOTER HANDLING MANUAL, XSH-MAN-ESO-2520-0180
Update and completion of the vacuum cryo operating manual

DSM Reintegration plan and installation plan on UT, VLT-PLA-ESO-11250-4883
AIT Facility Requirement for AOF Implementation Plan, VLT-SPE-ESO-22100-4871
GRAAL Re-Integration and UT4 Installation Plan, VLT-PLA-ESO-14850-4880
GALACSI Re-Integration and UT4 Installation Plan, VLT-PLA-ESO-14675-4881
4LGSF Re-Integration and UT4 Installation Plan, VLT-PLA-ESO-16800-4882

VIMOS UPGRADE, Active flexure compensation Technical Feasibility Test II,VLT-TRE-ESO-14610-4891

VISIR upgrade TIMMI 2/Detector test facility. VLT-TRE-ESO-14324-5065

PIONIER Transport specifications, LAOG-SPE-PNR-20000-1187