Campaign of installation of the dichroic interfaces

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Prepared	L. Busoni	2011/10/25
	Name	Date
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Change Record

Issue	Date	Section/ Paragraph Affected	Reasons / Remarks	Name
1.0	24 Oct 2011	all	created	Busoni
2.0	24 Oct 2011		In response to JB email of 24 Oct 2011	Busoni

1 Scope

The Argos dichroic will be installed in the LUCIFER focal station in front of the AGW unit. It will be bolted to the two lateral beams of the focal station. The dichroic mount will be removed every time a major maintainance will be needed by the primary mirror; as a consequence of that, it is important to provide an easy way to re-install the structure with sufficient accuracy.

Figure 1 AGW unit at the Lucifer focal station. Area occupied by the dichroic. Beams 1 and 2 indicated

The installation of the dichroic structure will face off two main problems both deriving from the fact that the interface surface where it will be bolted has not been constructed with this use in mind. In fact we expect to have problems both with the alignment and with the shape (roughness and planarity) of the surfaces of the two LBT beams.

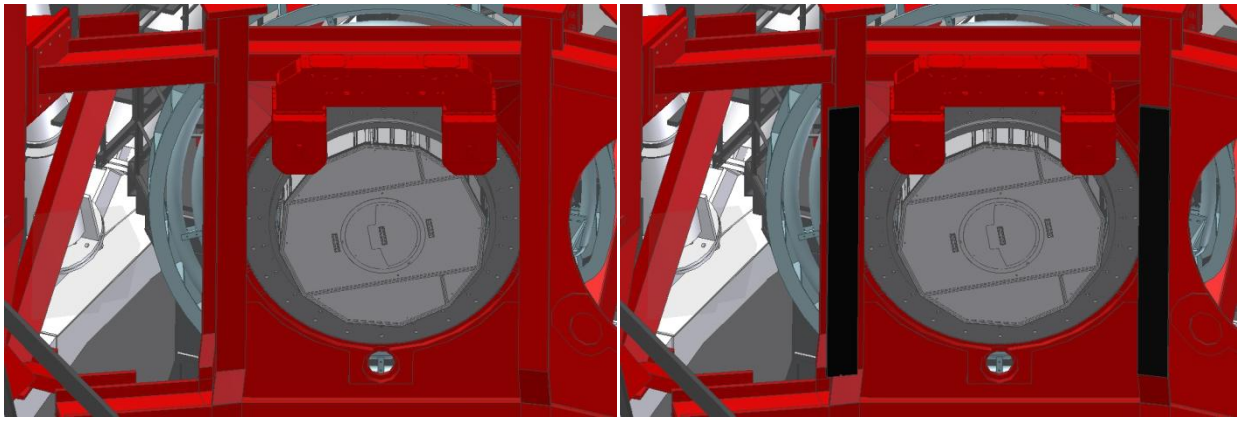

Figure 2 Comparison between the LBT 3D model and the position (in black) of the beams according to CAN document n° 650s003. There is a difference of approximately 19.5mm and .6° for beam 1 and 28.5mm and .73° between the model and the measurements. The design of the dichroic structure has been done on the 650s003 model.

The idea is try to regain the desired planarity and position by the insertion of two plates bolted to the LBT structure. The plates are intended to be one-time a life installed and to became a part of the LBT structure. In this way we will create an interface flange to use, with the help of pins, for a correct positioning and re-positioning of the dichroic mount.

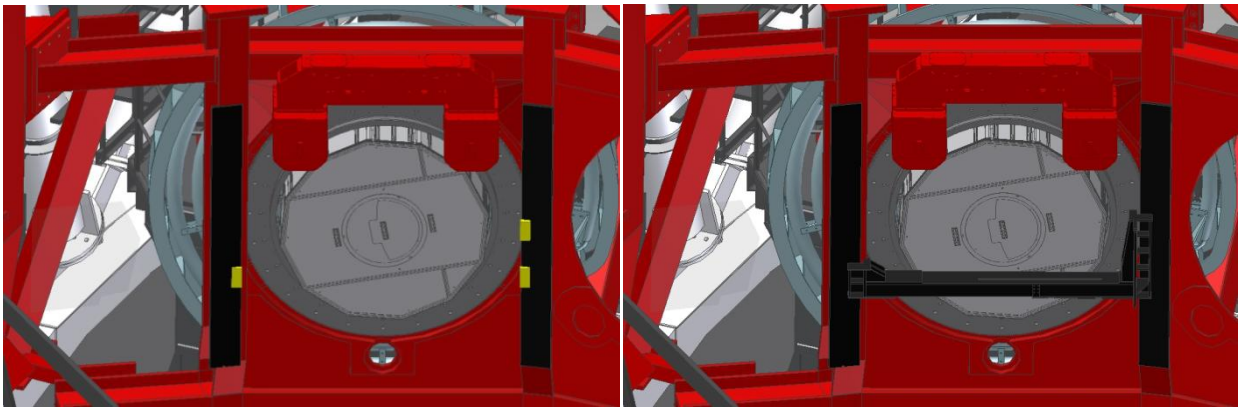

Figure 3 The plates bolted in their places (yellow, left) and the dichroic beam secured to the plates (right). This is an old picture, in the current design only two plates are used.

An installation campaign of the plates at LBT is foreseen in the days 28 Nov to 3 Dec 2011.
The installation will be divided in three main phases for each LBT's eye:

1. Locating the plates position on the rotator gallery beams surfaces.
2. Installation of the plates on the rotator gallery beams.
3. Accurate measurement of the position and orientation of the plates after the installation.

After this campaign, the dichroic structure will be produced accordingly to the measurements of point 3 in order to be positioned with the required accuracy in front of the AGW. The installation of the complete units is currently foreseen for the summer shutdown 2012.

2 Preparation, measurement on site and plate fixing

2.1 Measurement preparation

The measurements on the plates and on the rotator gallery will be executed with telescope at zenith, by means of an Articulated Arm Measuring Machine SPAZIO 3200 manufactured and certified from Tomelleri company, which has a measuring field that corresponds to a sphere having a diameter of 3200 mm and an accuracy of 0.040 mm for each measured point. SPAZIO is endowed by a geometrical measuring program named Power Inspect of the company DELCAM.

SPAZIO is not motorized; the arm is balanced and has a locking feature to prevent unexpected movements.
On the base of the 3D model of the telescope, a lay out of the measuring conditions has been prepared, and the position of the SPAZIO arm has been derived. A suitable "measuring support" (see Figure 4) has been designed; it will be bolted to the machined plate on the LUCIFER side of the rotator gallery (see Figure 6). The required accuracy in positioning the measuring support is very loose, in the order of 30cm.

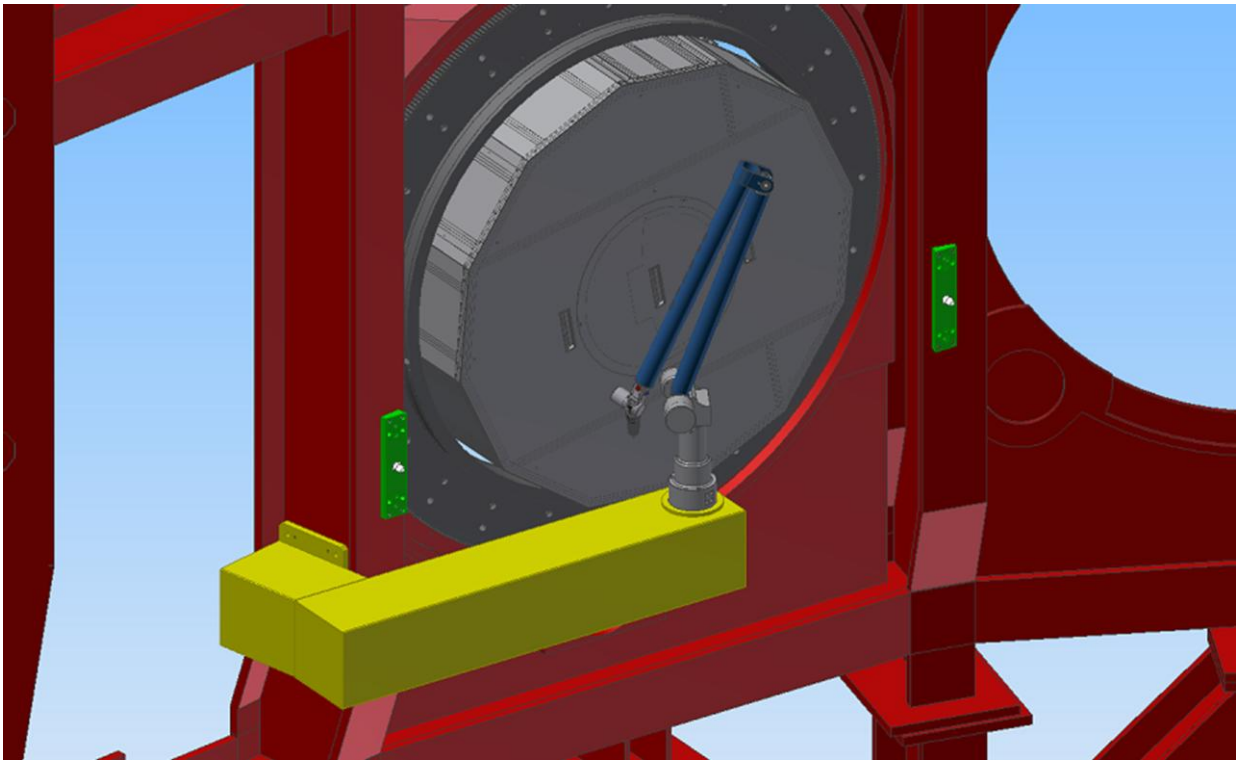

Figure 4 SPAZIO measuring arm (grey & blue), measuring support (yellow), dichroic interfaces (green)

As noticed in [AD1], the measuring support may interfere with one vertical lateral beam of the working platform over M1. An alternative design of the measuring support is available (Figure 5); in this configuration the support is fixed to the vertical beam that separes the LUCI focal station from the LBTI one. Since the working platform width covers 2 focal stations (LUCI and LBTI in this case), this approach will avoid the above mentioned interference.
In this alternative design the support has to be bolted to the vertical beam on which 4 holes have to be drilled. The holes can be either pass-trough holes (if the LUCI rotator motor cablings routed along the vertical beam are in a safe position) or blind holes (in the opposite case).
Note that in this alternative solution, drilling the holes for the support will require to install the working platform over M1.
As mentioned, the accuracy in the absolute position of the support is not important, while it is of fundamental importance the firmness of the fixing.
The support in this alternative design has been slimmed down to 40kg and therefore it can be easily installed by 3 people working in the platform (2 holding the support and a 3rd one screwing it to the rotator structure. Some handles will be added to the design of the support to ease this task.

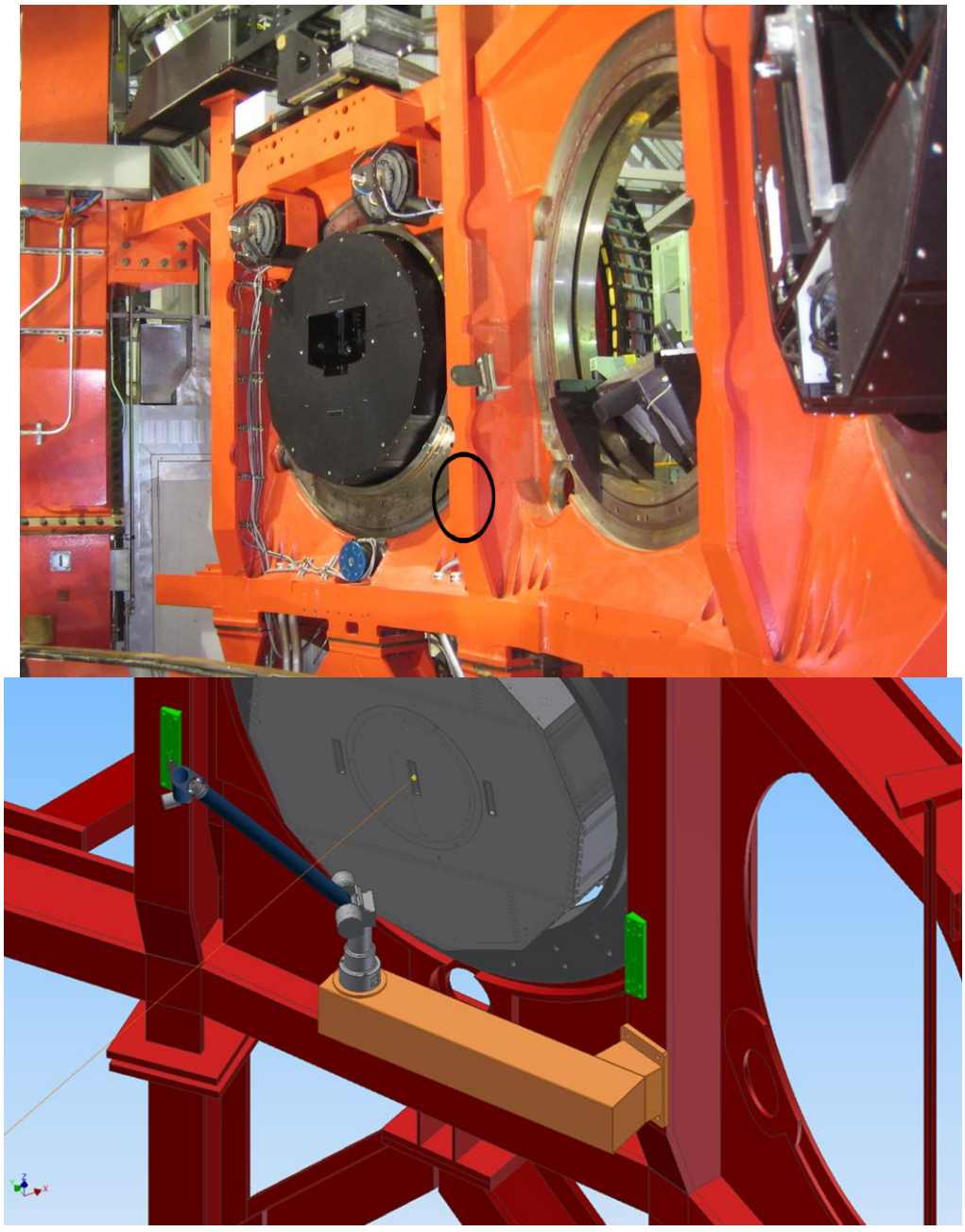

Figure 5 Alternative design of the measuring support to avoid interference with the M1 platform. The support can be fixed to the vertical beam separing the LBTI and LUCI focal stations. This will prevent interference with the M1 platform that extends over 2 focal stations (LUCI and LBTI in this configuration). The circle in the photo highlights the area of the beam that has to be drilled to prepare the 4 holes needed to bolt the support.

To save on shipping costs and time procurement we ask LBTO to produce and install the measuring support on the base of the executive design that will be delivered by Tomelleri one month before the intervention on site.
The measuring support is designed to satisfy the two symmetrical measuring conditions of the two telescope sides, so only one measuring support has to be produced.

The original idea of operating with the telescope pointing at horizon has been discarded after an inspection at the telescope with the telescope manager (J. Urban). There are concerns for the safety of the operators and of the AGW and sorrunding instrumentation when drilling and tapping the holes working on the C-ring extensions. Moreover the working area is difficult to be reached with the tools and the measuring machine.

Figure 6 The machined interface on which the measuring support has to be bolted

In the current proposal the working platform over M1 (“the platform” in the following) is used in a “daytime configuration” hanging by the crane over the primary and “tie-wrapped” to the rotator structure in order to be mounted and dismounted in a short period (approx. 1h) to allow for nighttime activities.
We are aware that some modifications have to be done to the platform to allow the access from the passage between the FBG focal station and the C-Ring extension.

2.2 Interface plates installation

This is the sequence of operations to be performed, for each telescope eye:

1. The measuring support and the SPAZIO arm are lean on and secured inside the platform.

2. The platform hanging by the crane is secured to the rotator structure. Exact procedure to be reviewed by LBTO. A plastic sheet is installed to protect the AGW.
3. 3 technicians enter the platform and bolt the measuring support to the rotator structure
4. A Tomelleri technician enters the platform and installs the SPAZIO arm on the measuring support. Horizontality of the base is checked and adjusted.
5. A reference system is acquired (see Figure 8). The following points shall be measured:
    a. Centre P1 of the upper surface of the derotator that has coordinates x1, y1, z1.
    b. Centre P2 of another lower surface of the derotator that has coordinates x1, y1, z2.
    c. An orientation point P3 that shall be marked on the vertical of the point P1 that has coordinates x3, y3, z3 (this measure is not critical and will only affect the ARGOS structure orientation).

    After having set the coordinates of the three points and repeated their measurements, the coordinate directions shall be, x horizontal and z coaxial with the derotator, and after the position of the four holes and pins of the two plates will be defined and marked as in preliminary drawings. The x coordinates shall be as in the preliminary drawings, while the y and z coordinates shall be defined in order to be centered in the LBT beams.
6. Drill jigs are positioned on the rotator gallery beams and hold by magnets that allow the fine positioning of the jigs (see Figure 9). A target engraved on the jig and the SPAZIO arm is used to fine adjust the jig position (see Figure 10). Putty can be used to help in catching the chips (see Figure 11). The jig is clamped to the rotator gallery (TBD) for the drilling step.
7. The drill bits are guided by a set of drilled bolts of increasing diameter (see Figure 12) until the request hole diameter is obtained.
8. The holes are tapped with the help of a magnetic tapping jig (see Figure 13) to assure coaxiality between the hole and the threading. The holes are blind-holes; depth is 15-20mm.
9. Each interface plate is fixed to the rotator structure using no. 4 M10 cap screws.
10. Each interface plate is pinned to the rotator structure using no. 2 cylindric pins of 6mm diameter. The corresponding holes on the structure are blind holes; depth is 15-20mm.
    A final set of measurements of the actual position and orientation of each interface plate is done. In particular the following checks are done:
    a. Encumbrances of the derotator.
    b. Encumbrances of LUCIFER calibration unit in the x, y and z directions in relation to the ARGOS structure and lens in the parking position.
    c. Maximum admitted dimensions of ARGOS, and particularly of its welded structure.
    d. Further measures that shall be considered useful for the executive design.

Figure 7 A picture of a SPAZIO arm similar to the one to be used at LBT

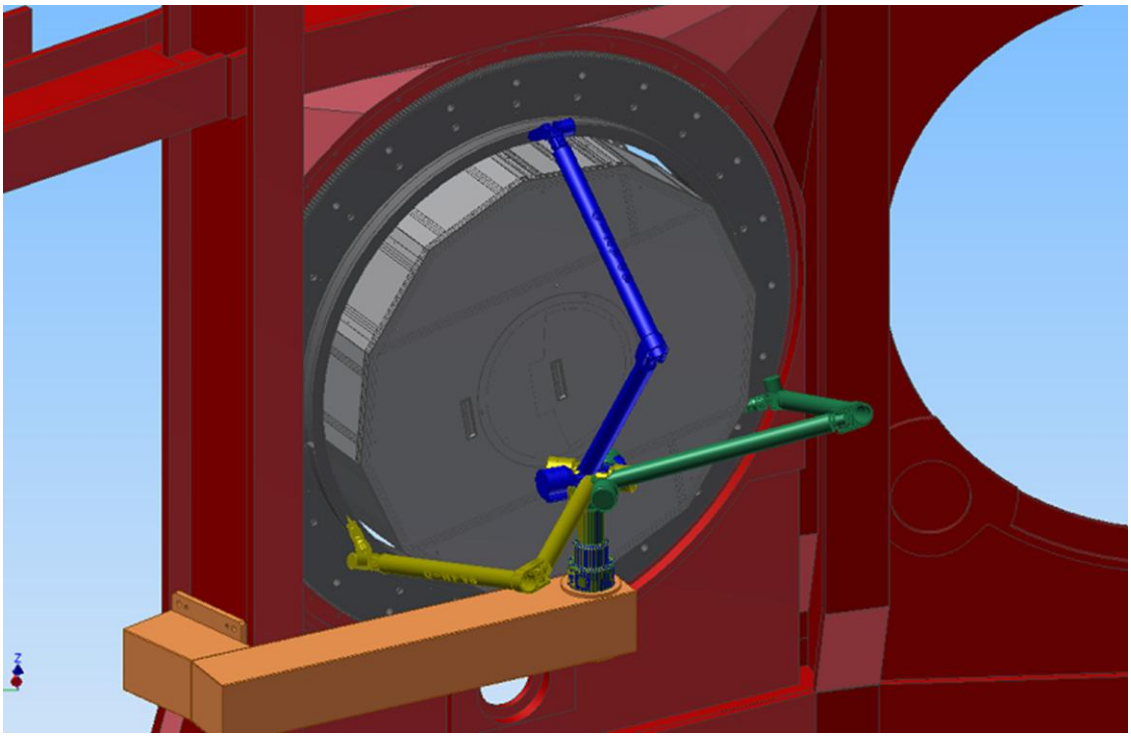

Figure 8 Acquisition of the reference system (step 5 of the procedure)

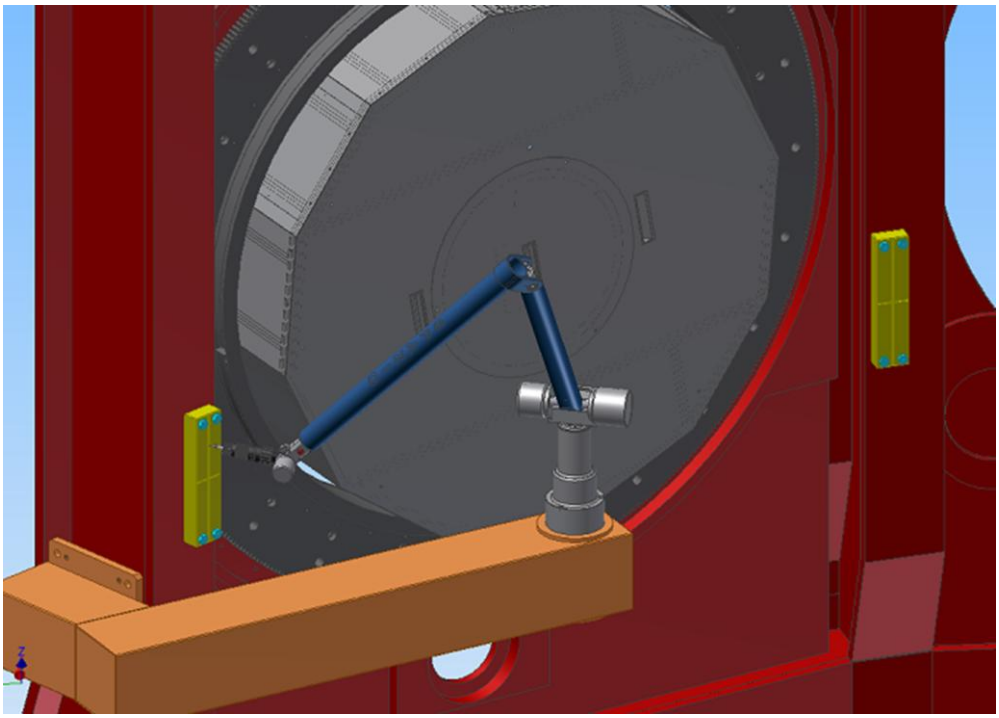

Figure 9 Jigs (yellow) are finely positioned using the SPAZIO arm and an engraved target

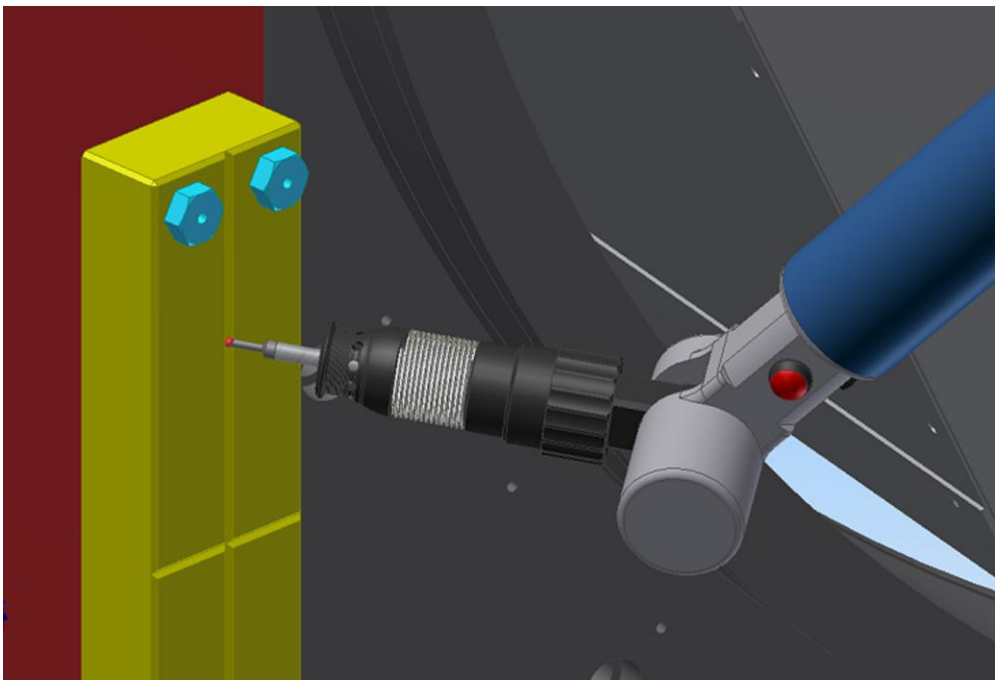

Figure 10 Close-up of the jigs positioning. In cyan: drilled bolts that act to guide the drill bit during the drilling phase.

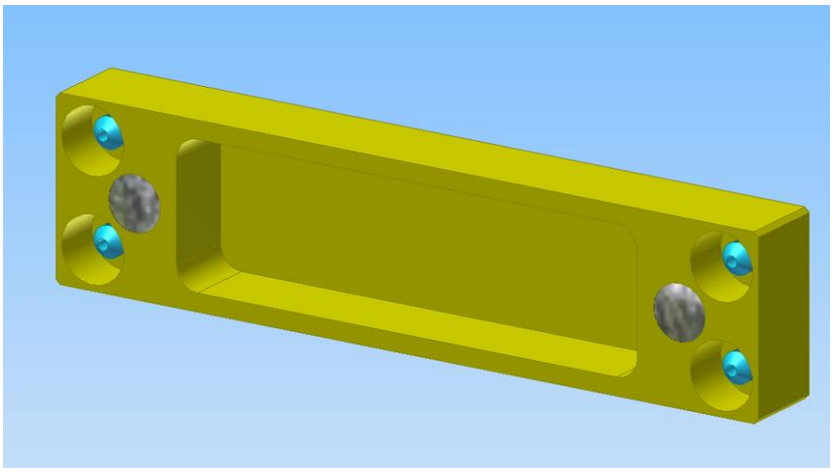

Figure 11 Close up of the drill jig. On the face that is in contact with the rotator structure the 2 magnets (grey) and the drilled bolts (cyan) are visible. The circular holes around the bolts can be filled with putty to catch the chips.

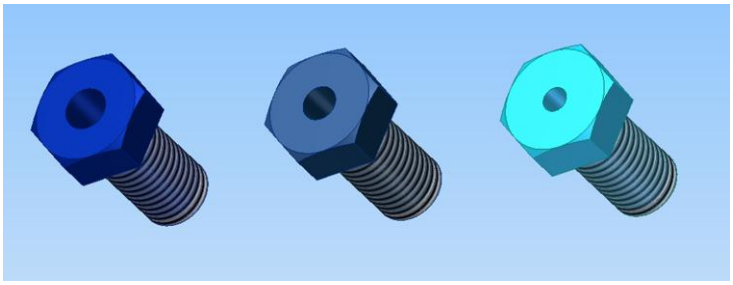

Figure 12 A set of drilled bolts with various diameter of the hole to match the drill tip will be used

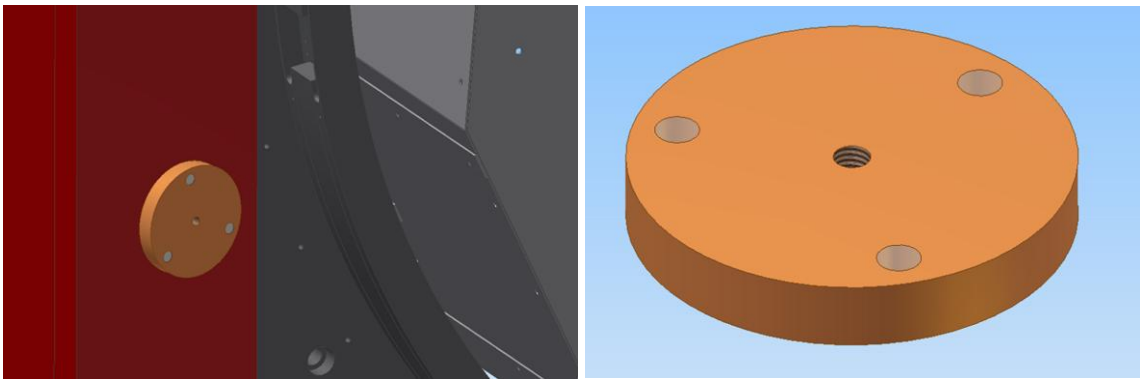

Figure 13 Tapping jigs to assure coaxiality between hole and tapping.

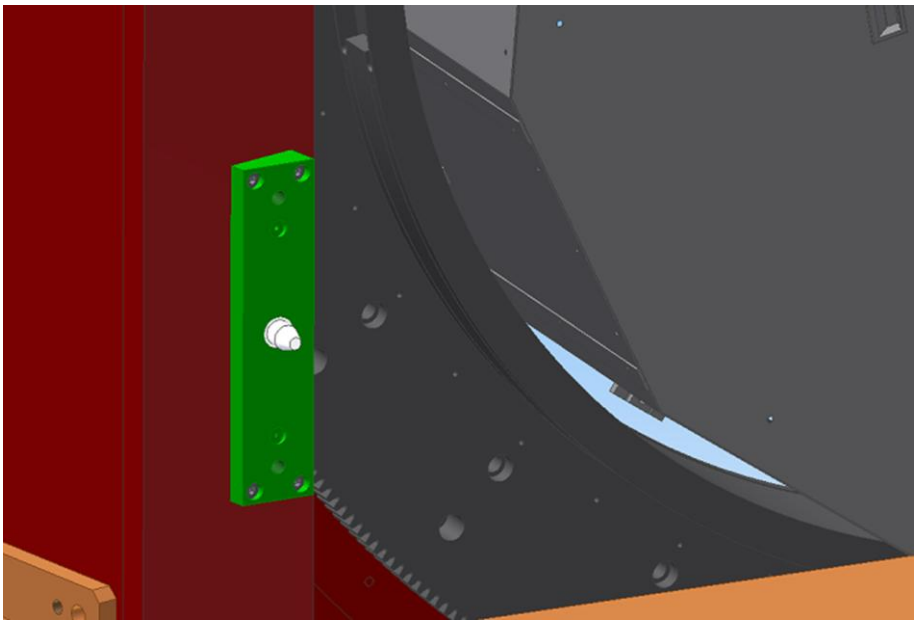

Figure 14 Each interface plate is bolted to the rotator structure by 4 M10 bolts. The holes on the rotator structure are blind holes with 15-20mm threading

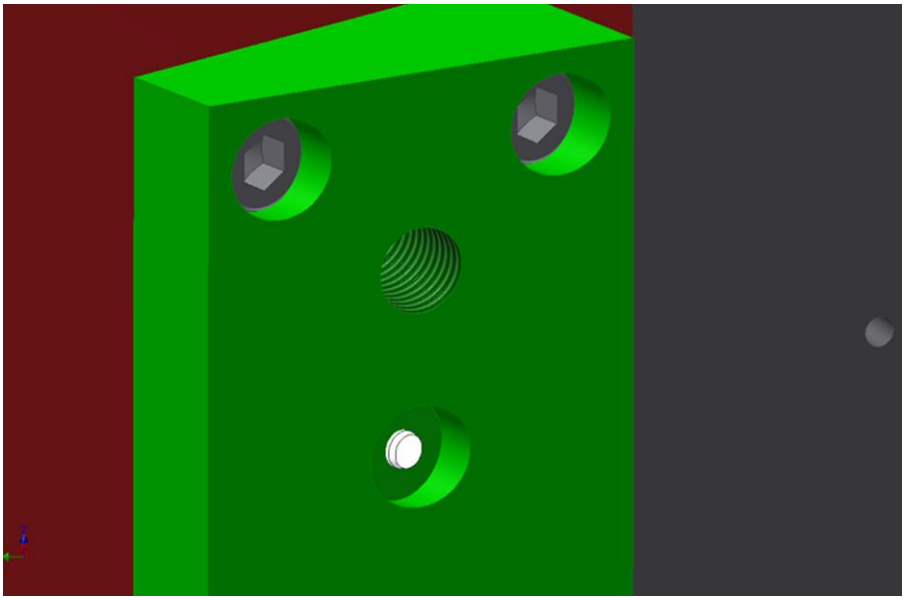

Figure 15 Each interface plate is pinned to the rotator structure with 2 pins of 6mm diameter

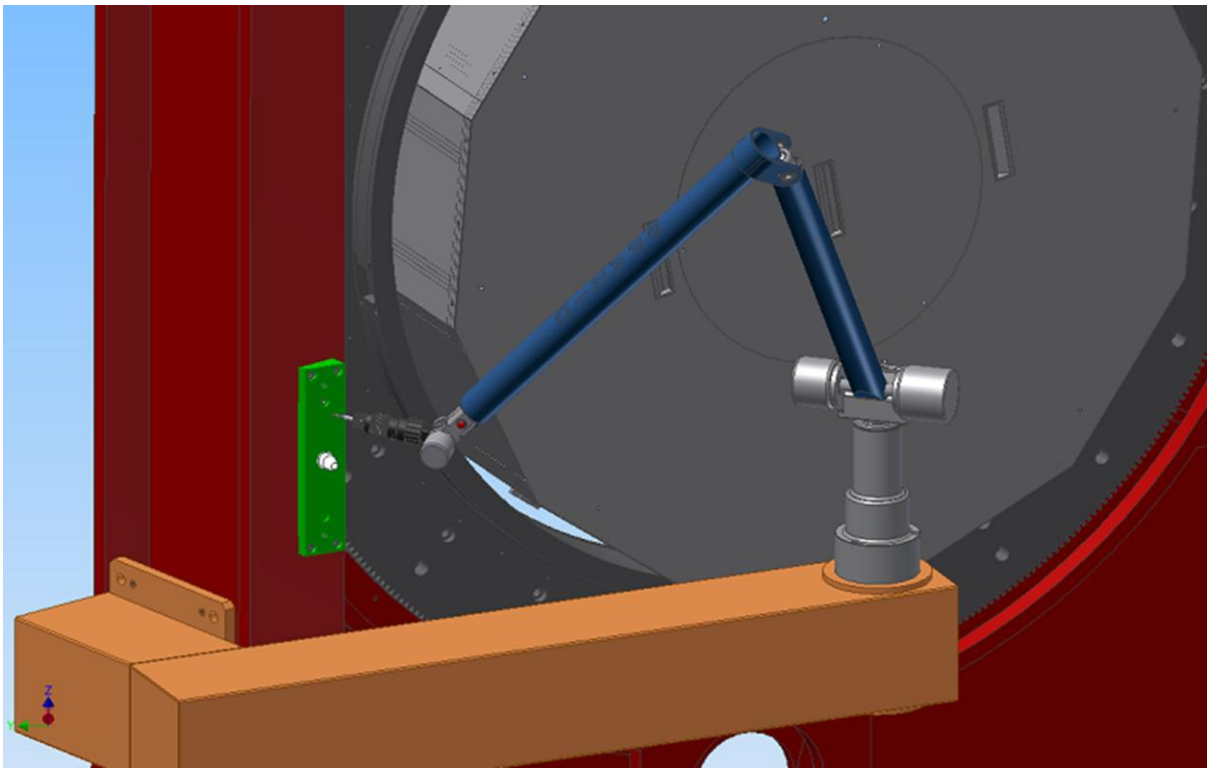

Figure 16 Measurements of the interface plates: dimensions, position and orientation of the reference surface and of the pins of the dichroic structure

3 Procurement and installation of the measurement support

The measurement support is designed by Tomelleri. We propose to produce this part in USA to save time and shipping costs. Tomelleri will send the executive drawings to LBTO that will be responsible for the procurement of the part and its transportation to the LBT.
Tomelleri will also communicate to the LBTO the approximate positioning of the measurement support. Based on these indications, LBTO will prepare the holes to fix the measurement support to the telescope structure.

4 Road map

The goal of the campaign is to have the interfaces installed on both sides in the 28Nov-3Dec campaign. These dates cannot be postponed easily without a major impact on the schedule of the dichroic project. The next possible dates will shift to 2nd half of Jan 2012. A possible roadmap to meet this goal is outlined hereafter.

As soon as possible LBTO will revise this document.

As soon as the campaign is accepted and confirmed by LBTO, Tomelleri will send to LBTO the executive drawing for the production of the measurement support.

Before Nov 28 the measuring support has to be produced and transported to LBT by LBTO

Before Nov 28 the holes to fix the measuring support to the rotator gallery have to been produced by LBTO

Oct, 31st (TBC) is the deadline for shipping of the SPAZIO arm. The instrument (delicate!!!) will be packed on a pallet and shipped to the Base Camp (LBTO will communicate exact address and reference person). LBTO will take care of transporting the pallet to the telescope as soon as it arrives at the base camp. Tomelleri will take care of preparing the custom documents for the temporary importation of the SPAZIO arm in the USA. A LBTO staff with experience in custom duties may be of help to Tomelleri in sorting out custom related issues.

Before Nov 28, LBTO will modify the M1 platform to allow access from aside the FBG focal station.

Before Nov 25, Tomelleri will produce the interface plates and the tools needed for the installation.

	Due date	**What**	**Who**
	Asap	Revision of this document	LBTO
	Oct 31	Send executive drawing of the measuring support to LBTO	Tomelleri
	< Nov 28	Produce and transport the measuring support to the LBT	LBTO
	< Nov 28	Drill the holes to install the measuring support on the rotator gallery	LBTO
	Oct 31	Shipping of SPAZIO arm to Base Camp	Tomelleri, LBTO to communicate shipping address
	< Nov 28	Modifications to the M1 platform	LBTO
	< Nov 28	Transportation of the SPAZIO pallet to the LBT	LBTO
	< Nov 25	Production of interface plates & tools	Tomelleri

5 Resources

Tomelleri srl will partecipate the campaign with 2 people. INAF-Arcetri will be present with 1 person. We require the support of the telescope crew for the crane operations, for all the platform

related issues and for drilling. If possible, it would be of great help to have 3 rooms at the telescope during the whole campaign.

6 Applicable documents

No.	Title	Number & Issue
AD 1	Joar Brynnel email of 25 Oct 2011 7.26AM CET "ARGOS dichroic interface campaign - request for time"	
AD 2		
AD 3		
AD 4		
AD 5		
AD 6		
AD 7		
AD 8		
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