Virgo change request

Title:

Replacement of the Virgo MC payload

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Abstract

In the current ISYS system a large fraction of the injected power is lost. The exact amount of losses must be still determined, but the most probable responsible is the MC end mirror, because of its large scattering and poor quality substrate. A new substrate, having the same geometry of the current mirror, has been sent to the polisher, but many experimental facts pushed to investigate the possibility to replace the current mirror (and consequently the full payload) with an heavier one.
In fact, the current mode cleaner mirror is realized with a substrate of 80mm of diameter and about 31mm of thickness; this mirror is so light that the radiation effects are easily visible in the MC and instabilities can occur. Furthermore the entire payload is very light, exalting all the control issues of the MC.
Two scenarios are described in this document; a minimal one, where the MC mirror will be replaced by a similar size substrate and a more advanced one, where the MC end mirror will be substitute by a heavy mirror. This second option seems also preferable in the Virgo+ case.

Motivations

Optics and power loss

A fraction[1] of the power injected in the ISYS is lost in the injection system and the main culprit is the MC end mirror; as reported in the minutes of the MC transport box opening (http://wwwcascina.virgo.infn.it/IBupgrade/StacPresOct2004/pv%20Mmc%20op-1.doc) and in the mirror characterization sheet (http://wwwcascina.virgo.infn.it/IBupgrade/StacPresOct2004/C03004-New-Concave-Mirror-MC.pdf) the mirror substrate shows many defects that are responsible for the scattering. Furthermore, during the super-attenuator tuning a wrong operation exposed the mirror to the external (unfiltered) atmosphere, polluting it; a cleaning attempt, using CO_2 snow and N_2 ionized gas, had no visible effect. During the preparation of the 2005 shutdown, devoted to the injection bench replacement, the substitution of the MC mirror with a new one, having the same geometry, has been planned. The available spare substrates have been sent to the REOSC company, but they failed to polish them (all the history can be reconstructed in the detector coordinator pages, but the conclusions are summarized in the M.Punturo presentation at the DM09-06: http://wwwcascina.virgo.infn.it/collmeetings/presentations/2005/2005-09/DetectorMeeting/NewMCmirror.ppt). New and better quality substrates have been sent to an American polisher (GS-Lumonics) to be ready for a next substitution.
Experimental facts are pushing to reconsider the design of the payload asking for an heavier MC payload.

Mechanics and control issues

The current MC mirror is realized by a 80mm diameter, 31mm thickness substrate. Taking in account the density of the fused silica and the mass of all the components attached to the mirror (markers, magnets, spacers) the total MC mirror mass is about 360g. This so low mass causes many problems. First, radiation pressure effects are well visible; it has been shown (S.Hebri at the April 06 detector meeting: http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-04/DetectorMeeting/hebri_det030406.ppt) that the light circulating in the MC acts as an elastic force changing the resonant frequency of the Tx and Ty modes of the MC mirror. It is true that the control instabilities, caused by this change, have been cured tuning the control filters at the effective resonant frequency, but this tuning depends on the circulating power.
As can be noted in Figure 1, the back face of the MC is really crowded: the markers and the magnets off-centre the centre of mass by (only) one millimetre, but, mainly, the markers and the

[1] Ranging from 26% to 50%. To reduce the incertitude in this value, better measurement are scheduled as soon as the interferometer will be in better shape.

coils can bump together. For this reason the coils have been displaced by few millimetres away the ideal Helmholtz position in the assembling phase.

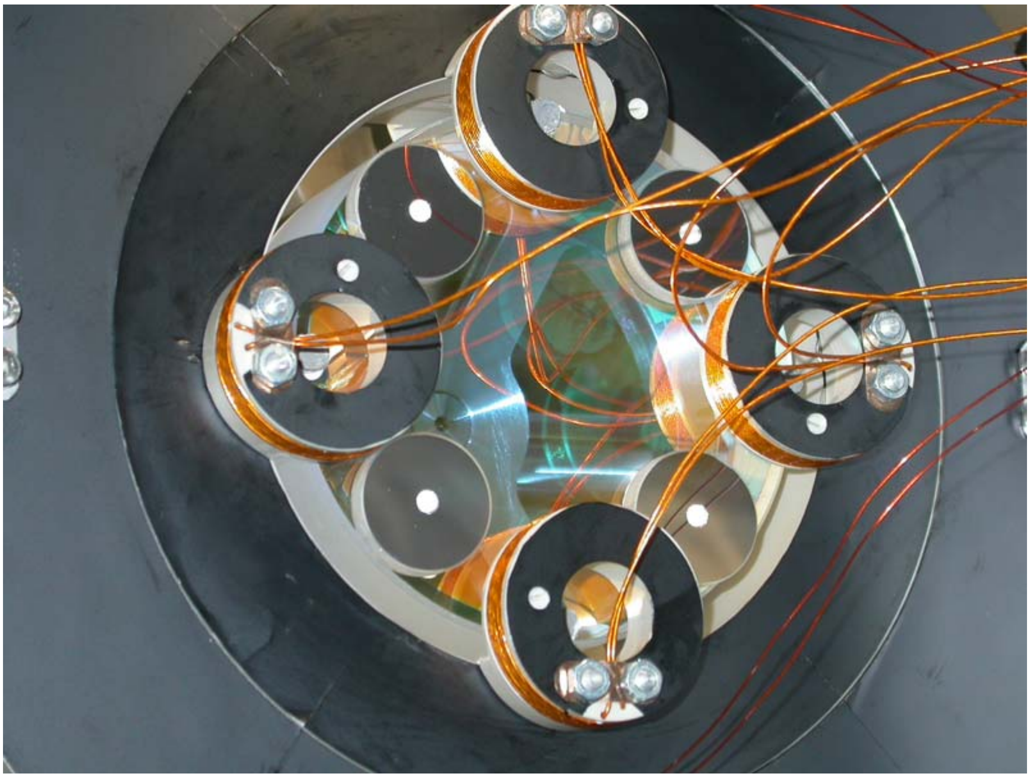

Figure 1 - back image of the MC, inserted in the reference mass.

The low mass of the MC caused a design of the payload completely different from the standard Virgo mirrors. The clamping system is different and the suspension wires are 125µm diameter CuBe[2] wires, nominally having the lower violin mode at about 81Hz (well below the 330Hz expected for the standard large payloads).

The reference mass (RM) is made by a double ring: the inner one is made by peek and the outer one in stainless steel for a total mass of about 4.196Kg. This RM is suspended by two Virgo wires (200µm diameter, two loops configuration), but, since there are 6 coils in the RM, 12 copper wires, 0.6mm diameter each (0.4 Cu + 0.2 Kapton) connect the RM to the marionette, affecting dramatically the suspension stiffness.

The control of the MC mirror seems still possible (with many problems, as shown by H.Heitmann at the 11/04/06 weekly meeting: http://wwwcascina.virgo.infn.it/commissioning/weekly/Apr2006/Heitm_060411_ISYSAAproblems.pps), but the duty cycle of the ITF seems affected[3].

Furthermore, the transfer function measurement of the MC payload don't correspond to the analytical model (i.e. the first violin mode frequency is not found where it is expected) revealing a complex behaviour of the system and a poor modelling possibility of it.

A clear example is reported in Figure 2 where the model[4] of the transfer function RM-to-MC mirror for the translational mode "z" is reported. Is well clear that the z (@0.68Hz), the Θ_y (@1.27 Hz)[5]

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[2] The usual carbon steel (C85) cannot be used because the wires pass close to the magnets in the mirror.

[3] A more precise estimate will be possible as soon as the remaining part of the ISYS will be better tuned.

[4] Obtained by fitting the real data

[5] The Θ_y mode frequency increases at 2 Hz with radiation pressure

and the Θ_x (@2.1 Hz)[6] modes are strongly coupled. A further confirmation is the same mode transfer function evaluated from the marionette, as shown in Figure 3. This could be due to the fact that it is really impossible to give a real z-excitation to the mirror with this payload, that don't behaves as a simple double pendulum system; the contribution to the stiffness due to the coil wires surely affects the pendulum motion.

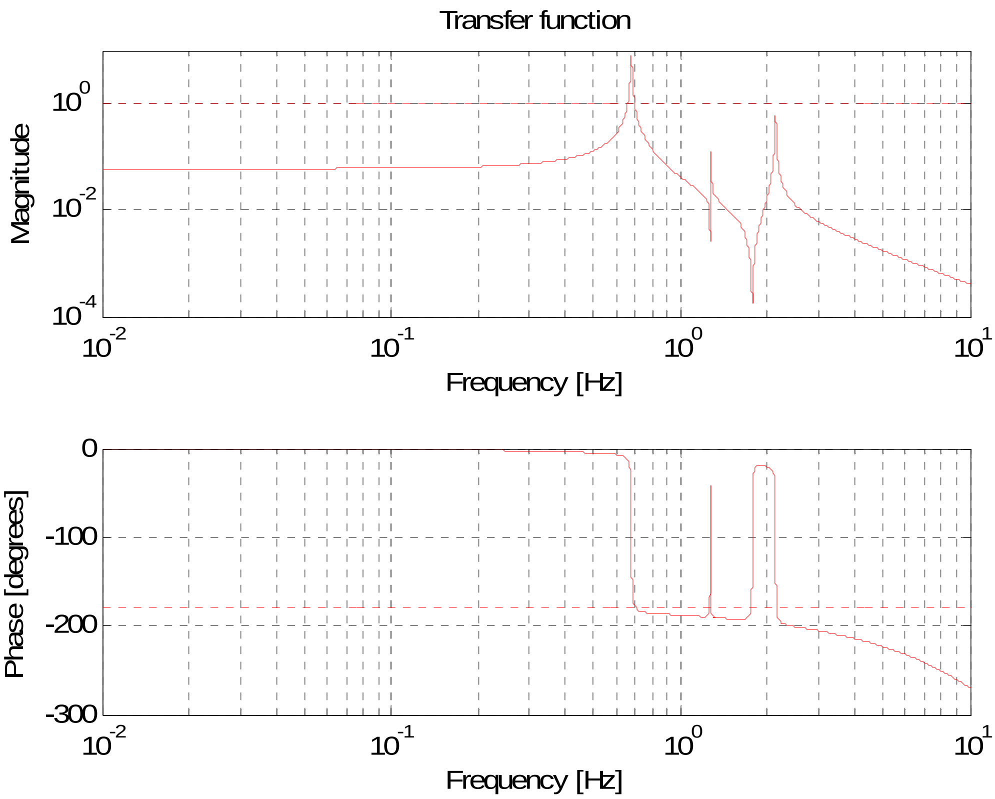


Figure 2 - Reference Mass-to-Mirror transfer function for the pendulum mode (z-mode) in the mode cleaner mirror

[6] The Θ_x mode frequency decreases at 1.93 Hz with the radiation pressure.

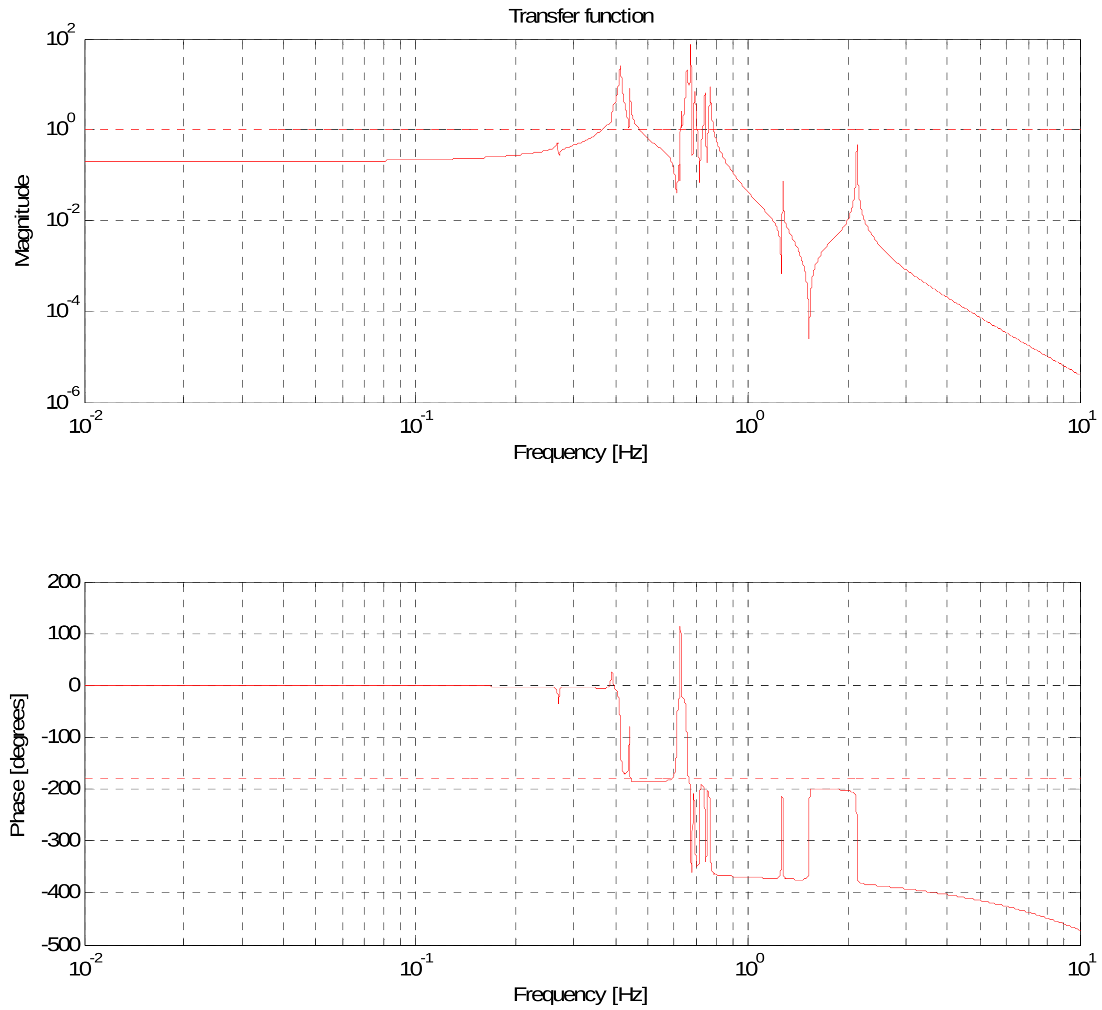


Figure 3 Marionette-to-mirror transfer function for the z mode in the mode cleaner mirror

Technical description

The two scenarios (small mirror and large mirror) will be identified here with two indices: a,b.

Scenario a: small MC end mirror

In this case the mirror is replaced with one having a similar geometry. A blank, having a thickness of about 31.14 mm has been selected (it was the most similar to the current one). After polishing a thickness of about 30mm is expected. This should cause a displacement of the reflective face of about 0.5mm, completely adjustable through the suspension.. The current suspension design is, in any case, causing control issues and can be ameliorated. This can be made changing the reference mass (RM) with one made completely in steel and reducing the number and diameter of coil wires.

Task 1a: Production of a new MC mirror

Task 1.1a: Polishing of the substrate

A substrate has been sent for polishing to GS-Lumonics. In Table 1 are reported the requirements communicated by R.Flaminio (contribution by J.M. Mackowski and M.Punturo) to the company. Please, refer to Figure 5, for the Side A,B identification.

Table 1- Requirements for the polishing of the small substrate

SUBSTRATE	**MATERIAL : FUSED SILICA**			
	Preparation : Etched			
	Identification : CMC		all on side C	
Arrow to show the	Diameter (mm) : 80		Clear Aperture :	**75 mm**
wedge direction	Thickness (mm) : 30		Wedge : < 1µrad	
at the thickness	**Requirements :**	**Side A**	**Side B**	**OD-Flat**
minimum.	Flatness (nm-RMS)	15 on ∅60 mm	8 on ∅60 mm	
	Curvature :	FLAT	**- 180+/-2m on ∅60 mm**	
	Axis edging :			
	Roughness (Å-RMS) :	< 1	< 0,5	Polished
	Bevel (mm) :	1,5 @ 45°	1,5 @ 45°	
OD FLAT				
Number	**on each side**			**1**
Wideness (mm)				**30**
Clear Area (mm)	**X = +15/-15 & Y = +5/-5**			**30 x 10**
Flatness (PV)				**λ/10 wave**
Roughness				**For Optical Contact**

Task 1.2a Coating of the substrate

The coating characteristics must be compliant with the requirements described in the document: http://wwwcascina.virgo.infn.it/IBupgrade/StacPresOct2004/C03004-New-Concave-Mirror-MC.pdf.

Task 1.3a Assembling of the mirror

The procedure to assemble the mirror is a repetition of what has been already done. The assembling box is the old one, with some small modification. In fact, since nobody is using the coils located on the lateral sides of the RM, it is better to avoid to implement these coils and to attach to the mirror the lateral magnets. The procedure to attach the spacers and the magnets on the lateral surface of the mirror is really complicated and it can causes some mirror pollution. In this case a simpler unique lateral space (per side), made in aluminium can be used instead of the two small spacers.

Task 2a: Payload production

The payload design will be similar to the current one: the same marionette and a RM having a geometry equal to the present one, but fully made in stainless steeel.

Task 2.1a The new reaction mass design

The current reference mass (RM) is made by two rings, the inner on in peek and the outer one in stainless steel. A simpler realization, made by a single ring in stainless steel is foreseen. In this case the RM mass will increase from the current 4.2kg up to about 4.5kg. The lateral coil will be removed while it is possible to reduce the coil wire diameter. To simplify the intervention is also possible to leave untouched the diameter of the wire in the coil, reducing only the diameter of the copper wire connecting the coil to the RM. In this way the stiffness is reduced without affecting the force/Ampere coupling factor. For example, reducing the diameter of these connection wires to 0.20 mm it is possible to attain an overall pendulum stiffness decrease of a factor 6, simplifying the suspension control. Obviously the power dissipated in the connection wire will increase because its resistance is quadruplicated, but it must be remembered that currently a 47 Ω current-limiting resistor is inserted in series to the coils. Hence the maximum flowing current is 20V/(Rcoil+Rwire+47Ω)=0.416A. In Figure 4 is reported the temperature of a 1m long copper wire, in vacuum[7], when 0.42 (red, continuous line) or 1 (blue, dotted line) or 1.5 (green, dashed line) amperes are flowing in it. The Kapton cladding can resists up to 240C and, hence, the present limiting resistor can be left unchanged. This reduces any effect on the control capabilities of the local control system..

[7] The thermal radiation is taken in account, but not the conduction. The resistance has been model constant in temperature

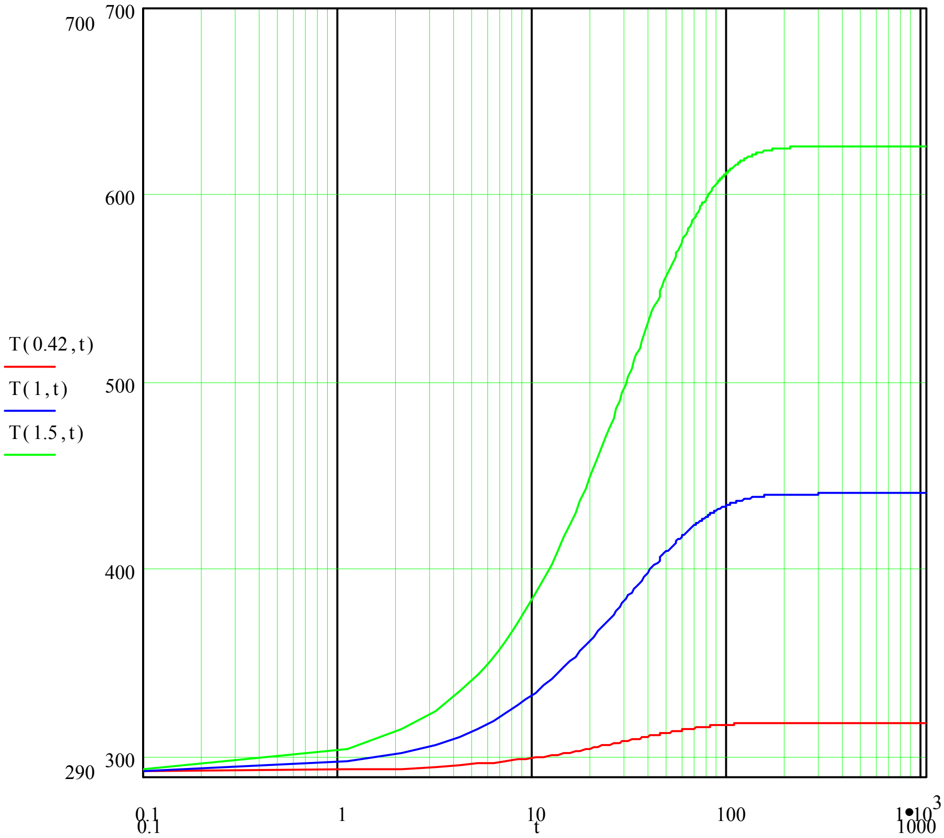


Figure 4 Temperature [K] of the connection wire versus time [s]. The wire is 1m long, 0.2mm of diameter. The red-continuous curve is obtained with 0.42A flowing in the wire, the blue-dotted one with 1A, the green-dashed one with 1.5A.

Task 2.2a Reaction mass production

The company that will produce the RM is…. Because of ….

Task 3a Payload assembling

The assembling procedure is similar to the one adopted for the current MC mirror.

Scenario b: large MC end mirror

The request to have a better substrate, and heavier MC mirror and RM pushes the design and the realization of a completely new MC payload more similar to the standard Virgo payload. The availability of many Herasil substrates and blanks originally devoted to the role of Virgo end mirror spares (see Daniel Enard presentation at the DM09-04: http://wwwcascina.virgo.infn.it/collmeetings/presentations/2004/Nov2004/DetectorMeeting/SpareOpticsStatusOctober04.doc) pushes to realize the new MC mirror using these substrates. In fact, no thermal noise or substrate absorption issues are present in the MC design and this kind of fused silica can be used. The size is a standard Virgo (ϕ=350mm, h≈96mm, M≈20.4kg) mirror. The marionette is instead different for two reasons:

- The MC is a short tower and hence the standard marionette shows a disk shape
- The MC curved mirror needs to be displaced along the MC axis to tune the cavity length to the modulation frequency

The last requirement has been defined through two detector meetings. The current payload have a displacement range of about 11cm. A first attempt to design an heavy payload having a similar displacement range has been presented by P.Puppo at the DM02-06 (http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-02/DetectorMeeting/puppo_8Feb_DM.ppt); then the displacement requirements have been stated by M.Punturo at the DM03-06, after a series of contacts with A.Brillet and E.Tournefier (http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-03/DetectorMeeting/MCrequirements.ppt). It must be noted that the same modulation frequency is used both for the longitudinal locking and for the alignment; this f_{mod} must be resonant in the recycling and in the mode cleaner cavities:

$$f_{\mathrm{mod}}^{optimal} = k \cdot FSR_{IMC}$$

Eq 1

where FSR_{IMC} is the free spectral range of the input mode cleaner. A similar equation should be writer for the power recycling cavity, but taking in account the phase shift due to the Fabry-Perot cavities.

The use of the Anderson technique for the Angular alignment requires that the TEM01 mode of the upper sideband is distant from the carrier by an exact number of free spectral range:

$$f_{\mathrm{mod}}^{optimal} = f_{And} + n \cdot FSR_{FP}$$

Eq 2

The Anderson frequency f_{And} is the difference between the resonance frequencies of the TEM00 (ν_{00}) and TEM01 (ν_{01}) modes and it is univocally defined by the cavity geometry:

$$f_{And} \equiv \nu_{01} - \nu_{00} = \frac{c}{2\pi L_{FP}} \operatorname{acos}\sqrt{1 - \frac{L_{FP}}{R_{eff}}}$$

Eq 3

where $R_{eff} \approx R_{end}$ mirror and L_{FP} is about 3km. Because of the Eq 2 and Eq 3 the modulation frequency, in principle, cannot be freely adjusted and are the power recycling cavities and the mode cleaner cavity that must be matched with the f_{mod}. The Anderson frequency is defined with an error of about 300Hz and consequently the mode cleaner length must be adjustable to match this incertitude. Furthermore, the cavity linewidth is about 500Hz, and this dictates the matching length for the mode cleaner and power recycling length:

$$\frac{\Delta L}{L} \approx \frac{\Delta f}{f_{\mathrm{mod}}} \approx \frac{500}{6.26 \cdot 10^{6}} \approx 8 \cdot 10^{-5} \quad \rightarrow \quad \left[\begin{array}{l} \Delta L_{IMC} = 144 \cdot 8 \cdot 10^{-5}\, m \approx 1.2\, cm \\ \Delta L_{RC} = 12 \cdot 8 \cdot 10^{-5}\, m \approx 1.0\, mm \end{array} \right.$$

Hence, the minimal requirement for the displacement range of the MC mirror is 12mm, but taking in account a wide safety margin, **about ±30 mm** of **displacement range** are required. It must be

Eq 4

underlined that the standard Virgo mirrors are 96 mm thick, while the current MC mirror is about 31mm. This means that the reflecting face of the new mirror will be displaced (96-31)/2=32.5mm toward the dihedron and to keep the same cavity length **the new mode cleaner curved mirror must be suspended off-centred (in the direction opposite to the dihedron) by 32.5mm**.

Task 1b: Production of a new MC mirror

Task 1.1b: Polishing of the substrate

One of the available Herasil substrate must be polished to realize a new MC mirror. Since the beam on the MC is small (waist≈11mm) the region where the curvature radius and the polishing quality are guarantee can be limited in a centred area of about ϕ=150mm. In Figure 5 is reported the scheme of the MC substrate and in Table 2 the requirements.

Table 2 MC curved mirror requirements

Property		**Virgo Requirement**
Substrate		One of the substrate available in Lyon
Diameter		350±1 mm
Thickness		96±1 mm
Curvature	Side A	Flat
	Side B	R=180±2m ϕ150 mm (TBV)
Flatness R.M.S.	Side A	<40 nm ϕ325 [8] mm
	Side B	<8 nm ϕ150 mm <2 nm ϕ60 mm
Coating Nature	Side A	Antireflective Coating @1064 nm ϕ150 mm Reflectivity R=70% @633 nm ϕ150 mm
	Side B	HR Coating @1064 nm ϕ150 mm
Average Scattering	Side B	30 ppm ϕ150 mm (TBV ????)
Roughness (RMS)	Side A	<0.1 nm
	Side B	<0.05 nm ϕ150 mm
Absorption HR	Side B	1 ppm ϕ150 mm
Transmission (1° incidence)		<10 ppm
Scratch/Dig[9]	Side B	5/5 (TBV)
OD FLAT (one on each side)		
Clean Area (mm)		X=+50/-50 & Y=+20/-20
Flatness (PV)		λ/10 wave
Roughness		For optical contacting

[8] This is due to the necessity to attach, through silicate bonding the markers and the magnets on the side A of the mirror. The silicate bonding require at least a flatness of λ/10 and the markers are usually attached in a diameter of 310mm.
[9] Specifications MIL-O-13830 . See http://www.prhoffman.com/technical/scratch-dig.htm as reference.

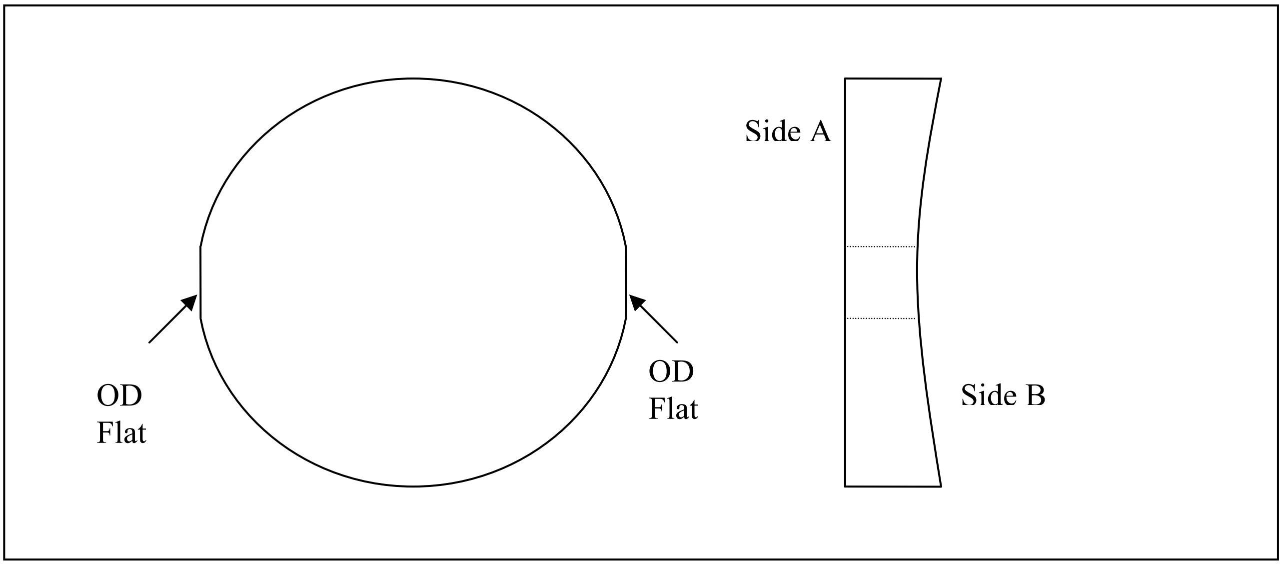


Figure 5 Mode cleaner curved mirror substrate

Task 1.2b Coating of the substrate

The characteristics of the coating are reported in Table 2. It is important that the coatings diameter is smaller than 155mm, where the markers and the magnets are attached through silicate bonding.

Task 1.3b Assembling of the mirror

The mirror must be assembled in the clean room (bench class 1), attaching the markers, the magnets and the spacers. The procedure is described in the document VIR-TRE-PER-4700-107. As can be noted in Figure 1, the in the current MC the markers and the magnets are attached in the same (back) face of the mirror, instead, in the Virgo mirrors usually the magnets are located in the back face and the markers in the front face. If we want to use a standard reference mass, it is necessary to attach the markers in the front face, changing the local control camera position (TBV). Otherwise, keeping the markers in the back face of the mirror, an higher cleanliness of the HR coated face can be guarantee, but with a more complex reference mass design. In this case the preparation time can be shortened (if Silicate bonding is used) by one week. This item must be still discussed.

Task 2b: Payload production

The new last stage suspension will be set up: a bench-like marionette and a reaction mass similar to the one of test masses.

Task 2.1b The new marionette design

The marionette design must follow the requirements given in the sections above. Below you will find a summary of them focusing on the mechanical details.
The mirror suspension point must be 32.5 mm off-centered with respect to the suspension axis of the marionette, in order to take into account the thickness of the new MC mirror.
The MC mirror and its reaction mass must be displaced along the optical axis of about ±30 mm at least. This allows to adjust mode cleaner cavity length.
The marionette hosts a counterweight designed to keep the center of mass of the system on the suspension axis. The counterweight must be displaced in the opposite direction of the mirror along the baricentric plane of the marionette so that its center of mass coincides with the suspension point.
The marionette will host the gear to displace both the mirror and the counterweight;

The counterweight is made of a W-Co alloy having a density of 15g/cm^3 sized in such a way have a mass of about 70 kg (mirror+reaction mass). The mirror and the counterweight are displaced by motorised gears, which are hosted in the marionette as well.
The marionette mass will be of about 170 kg (marionette+counterweight), so that an intervention on the superattenuator chain will be requested.

Task 2.2b Marionette production

The company that will produce the marionette is…. Because of ….

Task 2.3b The reaction mass design

The MC mirror is suspended with a (C85) steel wire with a diameter of 0.2 mm and a length of 555 mm. If the old MC mirror design is adopted, four markers with a diameter of 20mm are to be placed on the rear side and will be used for the MC local position monitor. The local control correction signal in sent to the four coils hosted in the reaction mass on the rear side. The use of lateral actuators could be taken into account.
The reaction mass will be in Al6063 aluminium alloy, its design will allow to place markers and coils in the same side.
If, instead, the markers are attached in the front side of the mirror, a standard design RM can be adopted.
The drawings of the MC payload system is sketched in Figure 6 and Figure 7.

Task 2.4b The reaction mass production

The company that will produce the reaction mass is…. Because of ….

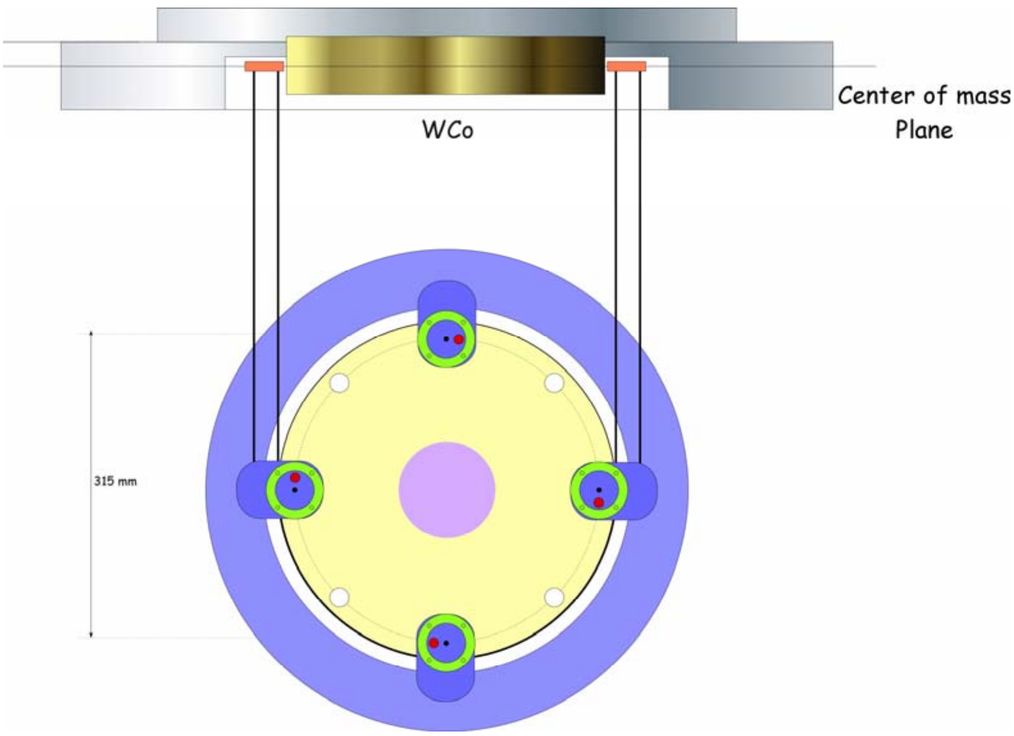


Figure 6 Rear Side view of the MC payload, if markers and magnets are attached in the same face.

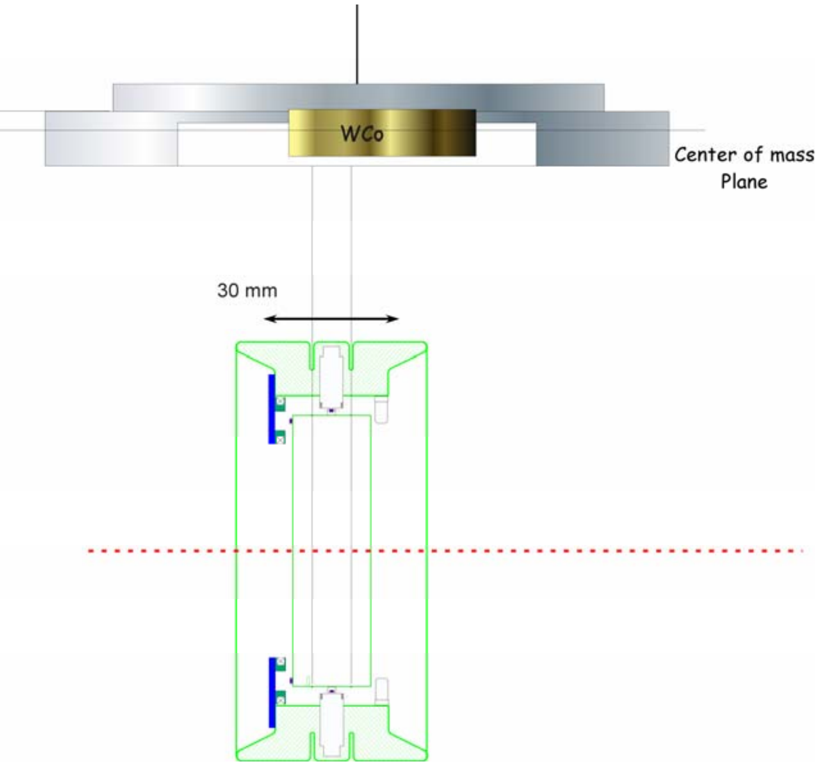


Figure 7 Section view of the MC payload

Task 3b Payload assembling

Thanks to the standard size of the mirror and reference mass the assembling procedure is similar to the one adopted for the Virgo main mirrors (see the picture sequences at the URL http://virgo-bwulf.pg.infn.it/~punturo/ to make a comparison between the tools and procedures adopted in the MC mirror and in the large mirror payload assembling)

Task 3.1b Assembling frame design.

Since the marionette is completely different from the one used in the large Virgo mirror, a special assembling frame must be realized.

Task 3.2b Assembling frame production

The assembling frame will be produce by … (or we will modify the existing one).

Task 3.3b Assembling frame activity

The assembling frame procedures are described here …

Task 4 Commissioning issues

Describe here the commissioning issues

Deliverable 1
Mirror substrate polished and coated according to the specification described in the text.

Deliverable 2
Assembling of the mirror with magnets, markers and spacers

Deliverable 3b
Marionette

Deliverable 4
Reference mass

Deliverable 5b
Payload assembling frame

Deliverable 6
Assembled payload

Involved Virgo sub-systems

Please, describe in the next table the subsystems that are involved in this change. Make the effort to put the sub-system in order of decreasing involvement (1 is the sub-system you want to modify) describing the type of consequence on each subsystem.

Table 3 Involved subsystem in the small payload scenario (a)

#	Subsystem Name	Description of the involvement
1	MC payload	Replacement of the mirror and RM
2	MC SA	Slight change of the weight; easy retuning of the suspension
3	ITF	Variation of the power transmitted by the ISYS

Table 4 - Involved subsystem in the large payload scenario (b)

#	Subsystem Name	Description of the involvement
1	MC payload	Complete replacement
2	MC SA	Large change of the weight; retuning of the suspension through the insertion of new and larger blades in the SA
3	MC local control	Change of the geometry, displacement of the reflecting surface, of the markers seen by the camera; possible displacement of the camera; change of the control filters
4	IMC auto-alignment	Change of the light seen by the quadrant, change of the filters.
5	ITF	Variation of the power transmitted by the ISYS

Involved EGO infrastructures

Please, describe the infrastructures of EGO you need (Clean rooms, workshop, Electronic support,…)

Table 5 EGO infrastructures involved in the case of small payload (a)

#	Infrastructure	Description of the involvement
1	Class 1 clean bench	Assembling of the MC mirror (markers, spacers and magnets)
2	Crane in the CB	Transport of the Payload

Table 6 EGO infrastructures involved in the case of large payload (b)

#	Infrastructure	Description of the involvement
1	Class 1 clean bench	Assembling of the MC mirror (markers, spacers and magnets)
2	Class 10 clean room	Assembling of the new MC payload
3	Mechanical workshop	Preparation of small components
4	Crane in the CB	Transport of the Payload

Planning

Describe the planning of the change. Define relative time needed and specify the milestones

Figure 8 Planning in the case of the small payload scenario (a)

ID	Task Name	Duration
1	**Mirror Production**	**160 days?**
2	Substrate Polishing	120 days
3	Substrate Coating	20 days
4	Mirror Assembling	20 days?
5	**Payload production**	**55 days**
6	RM Design	15 days
7	RM production	40 days
8		
9	**ITF shutdown**	**23 days**
10	**MC Tower installation**	**23 days**
11	Old MC dismount	3 days
12	SA pre-tuning	5 days
13	New MC installation	3 days
14	SA post-tuning	5 days
15	Tower Closing	2 days
16	**Payload assembling**	**10 days**
17	Payload assembling	10 days
18	MC commissioning	29 days

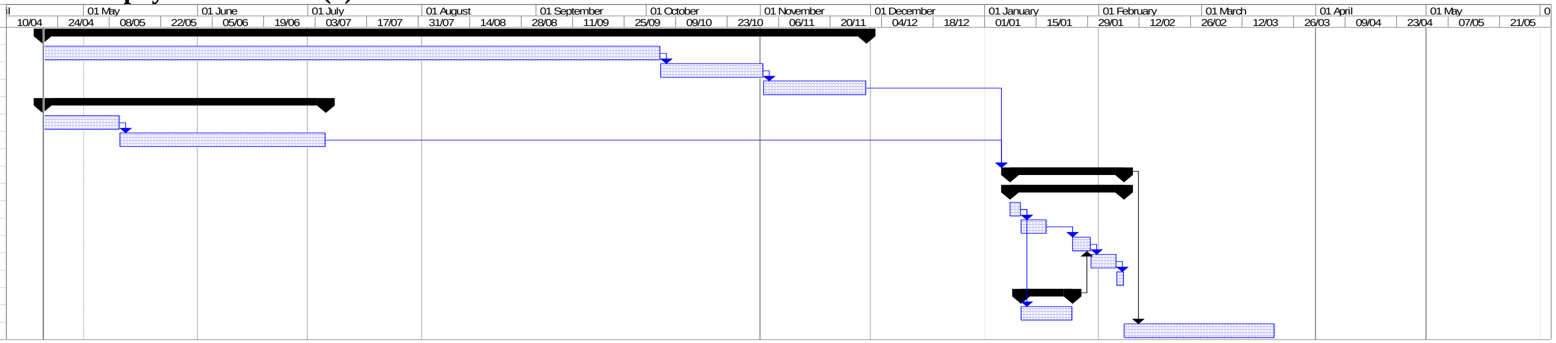
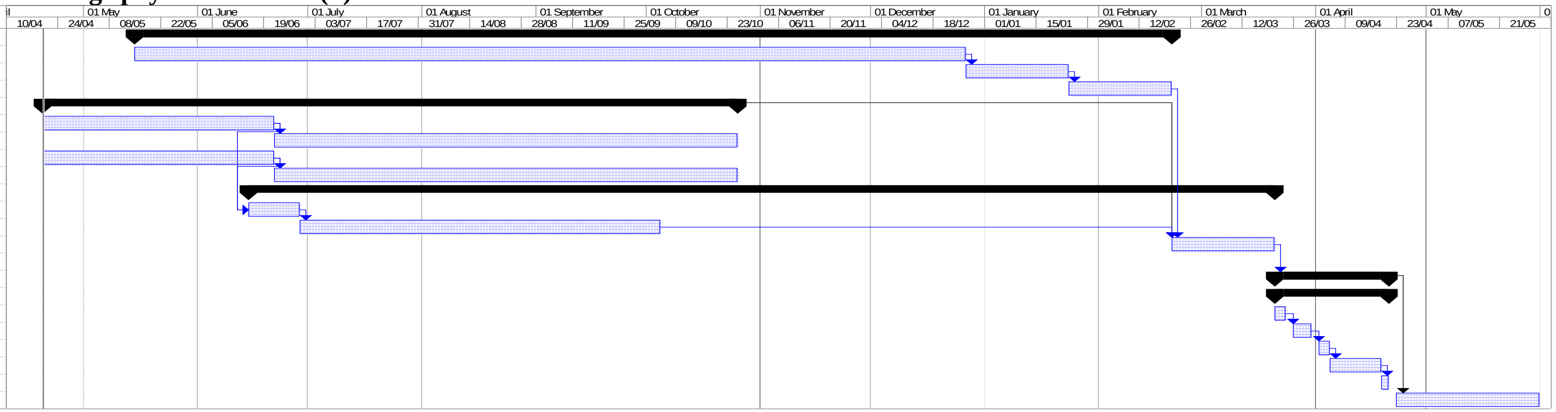


Figure 9 Planning in the case of the large payload scenario (b)

ID	Task Name	Duration
1	**Mirror Production**	**202 days?**
2	Substrate Polishing	162 days
3	Substrate Coating	20 days
4	Mirror Assembling	20 days?
5	**Payload production**	**135 days?**
6	RM Design	45 days
7	RM production	90 days
8	Marionnette Design	45 days?
9	Marionnette Production	90 days?
10	**Payload assembling**	**199 days?**
11	Assembling frame design	10 days?
12	Assembling frame realization	70 days?
13	Payload assembling activity	20 days?
14		
15	**ITF shutdown**	**23 days**
16	**MC Tower installation**	**23 days**
17	Old MC dismount	3 days
18	SA pre-tuning	5 days
19	New MC installation	3 days
20	SA post-tuning	10 days
21	Tower Closing	2 days
22	MC commissioning	29 days



Budget

Short description

Please, make an introductory description of the budget requests.

Detailed description of the requested items

Table 7 Cost table in the case of small payload scenario (a)

#	Item	Contractor / supplier	Cost (€) (taxes included)	Charged to (EGO/Virgo lab)
1	Polishing of a small substrate	GS-Lumonics	????	EGO
2	Coating of the substrate	SMA-Lyon	????	SMA-Lyon
3	Reference Mass	????	???	EGO
4	Mirror Spacers	CVI	300	EGO
5	Mirror Markers	CVI	1000	EGO
6	Mirror Magnets	????	300	EGO

Total cost (€):

Request to EGO (€)

Table 8 - Cost table in the case of large payload scenario (b)

#	Item	Contractor / supplier	Cost (€) (taxes included)	Charged to (EGO/Virgo lab)
1	Polishing of a Herasil substrate	GS-Lumonics	????	EGO
2	Coating of the substrate	SMA-Lyon	????	SMA-Lyon
4	Marionette	????	15000	EGO
5	Reference Mass	????	7500	EGO
6	Assembling Frame	????	7500	EGO
7	Mirror Spacers	CVI	300	EGO
8	Mirror Markers	CVI	1000	EGO
9	Mirror Magnets	????	300	EGO

Total cost (€):

Request to EGO (€)

Document/Procedure history

Date	Event	Comment
07/12/2005	Presentation to the detector meeting	Presentation made by M.Punturo at the DM about the upgrades to do in the ITF: http://wwwcascina.virgo.infn.it/collmeetings/presentations/2005/2005-12/DetectorMeeting/DetectorActivities.ppt
08/02/2006	Presentation to the detector meeting	Presentation made by P.Puppo at the DM about the mechanics of the payload. Discussion on the effective requirements/need of the translation mechanism. http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-02/DetectorMeeting/puppo_8Feb_DM.ppt
08/03/2006	Presentation to the detector meeting	M.Punturo presentation on the mechanical requirements definition http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-03/DetectorMeeting/MCrequirements.ppt
19/04/2006	Start of the procedure	Incomplete draft version v00r10 of the document presented to the Change Request meeting
19/04/2006	Change request meeting	At the meeting has been decided to investigate the possibility to change only the mirror with one similar to the current one, replacing the RM with one made fully by stainless steel. The two options ("current payload" and "heavy payload") must be compared when a better qualification of the current MC payload will be available. Optical losses and dead time caused by control problems. One possibility is to proceed as soon as the requirements are confirmed with the production of the mirror, while the mechanics production can be postponed to the next year. This is supported by the fact that the "heavy payload" will be probably necessary in Virgo+. Another meeting will occur at the beginning of May.
20/04/2006	Creation of the two scenarios	Small and large payload parallel evaluation
03/05/2006	Insertion of the TF models	The current model of the transfer functions has been inserted in the motivations. The power dissipated in the coil connection wire has been evaluated.
11/05/2006	CRE meeting: update of the optical requirements in the large mirror scenario	In a CRE meeting (M.Punturo, B.Mours, F.Menzinger, R.Flaminio), the requirements have been updated in agreement with the document http://www.ego-gw.it/reserved/documents/codifier/download.aspx?Code=EGO-SPE-OPE-17 . It has been decided to proceed with the realization of the small payload, waiting (at least) for the ordering of the polishing of the large mirror the similar order for the Virgo+ end mirrors. The evolution of the control capabilities of the MC payload must be taken in account to decide the substitution of the current payload
01/07/2006	Paolo La Penna and Franco Frasconi reports arrived	
21/07/2006	Meeting on the referee report	

Annexes

#	Description	Hyperlink
1	First Virgo MC mirror geometrical specs sheet	http://www.virgo.infn.it/Documents/FTPvirgo/Archive/Notes/VIR-SPE-OCA-4100-150.pdf
2	MC radiation pressure effects	http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-04/DetectorMeeting/hebri_det030406.ppt
3	Minutes of the MC transport box opening	http://wwwcascina.virgo.infn.it/IBupgrade/StacPresOct2004/pv%20Mmc%20op-1.doc
4	Virgo MC concave mirror characterization	http://wwwcascina.virgo.infn.it/IBupgrade/StacPresOct2004/C03004-New-Concave-Mirror-MC.pdf
5	Large IMC curved mirror payload mechanics	http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-02/DetectorMeeting/puppo_8Feb_DM.ppt
6	Requirements for the new heavy payload of the IMC end mirror	http://wwwcascina.virgo.infn.it/collmeetings/presentations/2006/2006-03/DetectorMeeting/MCrequirements.ppt
7	Paolo La Penna referee report	http://wwwcascina.virgo.infn.it/collmeetings/DMwebpages/CRE/virchrq0032006/LaPennaReferee.pdf
8	Franco Frasconi referee report	http://wwwcascina.virgo.infn.it/collmeetings/DMwebpages/CRE/virchrq0032006/FrasconiReferee.pdf

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Description	**Value**
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Last saved time:	01/07/2006 9.27
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Automatic title	Replacement of the Virgo MC payload
Filename	ModeCleanerNewPayloadCRE.doc