Interface Control Document of LCGT

Subgroup Name	**Vibration Isolation System**
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Doc version	**Date**	**Description**
Rev. A-1	2009-08-25	Reviced draft

APPROVAL AUTHORITIES

Concise definition of vibration isolation system

System requirement

Displacement of the test mass mirrors must be less than $6x10^{-18}m/Hz^{1/2}$ at 5Hz where the seismic noise and the radiation pressure noise are crossed. RMS motion must be less than 0.1μm. The test mass mirrors are cooled to 20K through heat links.

SAS

Core optics are suspended by SASs. Two kinds of SASs are used in LCGT. Type-A SAS consists of an IP, three stage MGAS filters and a cryogenic mirror suspension. Type-B SAS consists of an IP, two stage MGAS filters and a mirror suspension. Type-A SASs are used for FM1, FM2, EM1 and EM2. Type-B SASs are used for BS, PRM, SEM, MC2F and MC2E.

Stack

Three stage stacks are used for BS, PRM, SEM, MC2F, MC2E, MC1F, MC1E, MMT and PD. Rubbers are enclosed by welded bellows. Some optics are placed on the stage 0.

Glossary

SAS	Seismic Attenuation System
IP	Inverted Pendulum
MGAS	Monolithic Geometric Anti Spring
PF	Platform
IM	Intermediate Mass
MB	Magnet Box
TM	Test Mass
RM	Recoil Mass
ACC	Accelerometer
LVDT	Linear Variable Differential Transformer
FM	Front Mirror
EM	End Mirror
BS	Beam Splitter
PRM	Power Recycling Mirror
SEM	Signal Extraction Mirror
MC	Mode Cleaner
MMT	Mode Matching Telescope
PD	Photo Detector

Figure: Schematic drawing of the vibration isolation system.

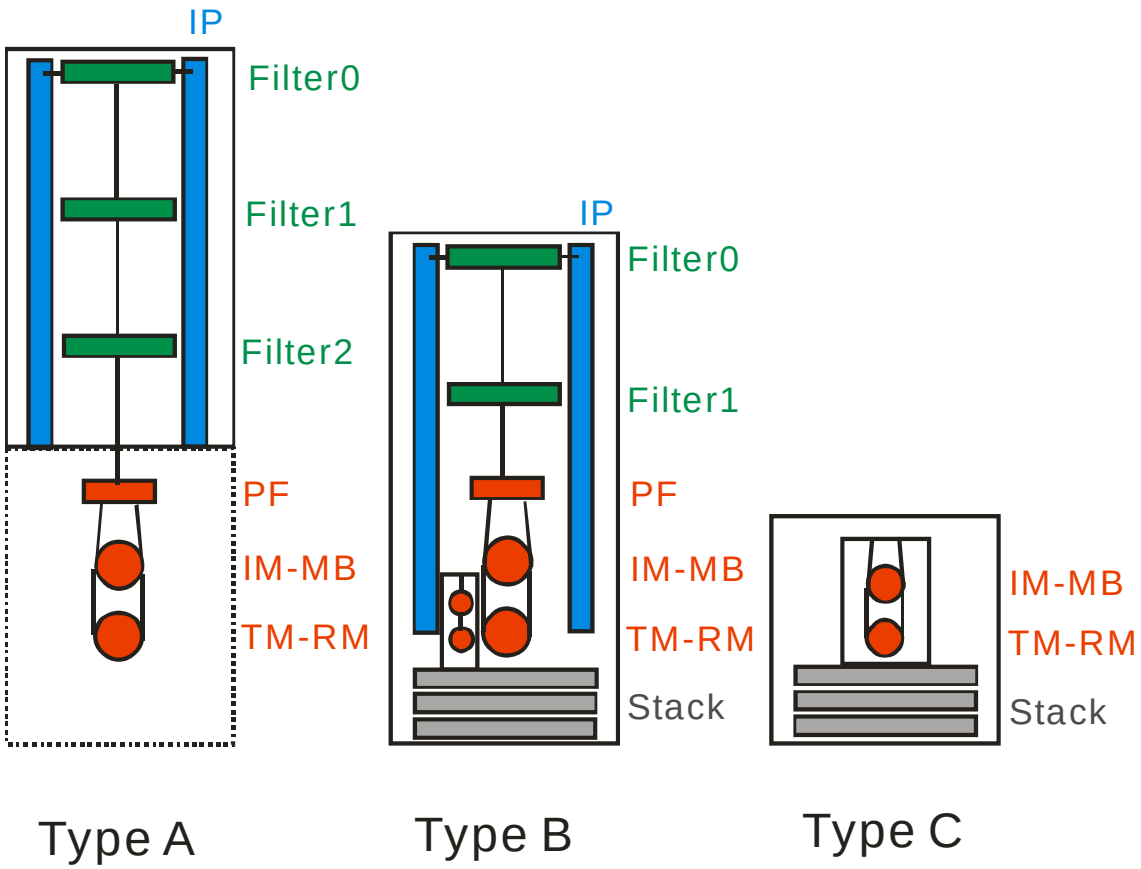

Table: Specification of the vibration isolation system

		#	Electric	Interface
Type-A SAS		4		Vacuum
Inverted pendulum (IP)				
Leg	30mHz	3		
ACC	$<10^{-10}$m/Hz$^{1/2}$@1Hz	3	DC15V	Control
LVDT	$<10^{-8}$m/Hz$^{1/2}$@1Hz	3	DC15V	Control
Actuator	10mm/V	3	DC15V	Control
Moter slider	?	3	?	Control
Filter0	120kg			
MGAS	H: 0.55Hz, V: 0.2Hz	1		
Picomoter	?	1	AC100V	Control
Filter1	120kg			
MGAS	H: 0.55Hz, V: 0.2Hz	1		
Filter2	120kg			
MGAS	H: 0.5Hz, V: 0.2Hz	1		
Platform (PF)	120kg, 14K			
mini-GAS	V: 0.7Hz	4		
Picomoter	?	4	AC100V	Control
Actuator	1mm/V	8	DC15V	Control
Heat link	H: 14mHz, V: 8mHz, 1W			Cryostat
Intermediate mass (IM)	60kg, 15K			
Heat link	1W			Cryostat
Magnet block (MB)	60kg, 14K			
Magnet	?	?		
Test mass (TM)	30kg, 20K			Optics
Recoil mass (RM)	30kg, 15K			
Actuator	?	4	DC15V	Control

		#	Electric	Interface
Type-B SAS		5		Vacuum
Inverted pendulum (IP)				
Leg	30mHz	3		
ACC	$<10^{-10}$m/Hz$^{1/2}$@1Hz	3	DC15V	Control
LVDT	$<10^{-8}$m/Hz$^{1/2}$@1Hz	3	DC15V	Control
Actuator	10mm/V	3	DC15V	Control
Moter slider	?	3	?	Control
Filter0	120kg			
MGAS	H: 0.55Hz, V: 0.2Hz	1		
Picomoter	?	1	AC100V	Control
Filter1	120kg			
MGAS	H: 0.55Hz, V: 0.2Hz	1		
Platform (PF)	120kg			
mini-GAS	V: 2Hz	4		
Picomoter	?	4	AC100V	Control
Actuator	1mm/V	8	DC15V	Control
Intermediate mass (IM)	60kg			
Magnet block (MB)	60kg			
Magnet	?	?		
Test mass (TM)	30kg			Optics
Recoil mass (RM)	30kg			
Actuator	?	4	DC15V	Control

Stack	H: 2Hz	9	Vacuum
Stage 0			
Breadboard		1	
Bellows		3	
Rubber		3	
Stage 1			
Block		3	
Bellows		9	
Rubber		9	
Stage 2			
Block		3	
Bellows		9	
Rubber		9	

General requirement		Band	Interface
PSD displacement	$6x10^{-18}m/Hz^{1/2}$	5Hz	
RMS displacement	0.1μm	0.1-4Hz	Control
RMS velocity	0.1μm/s	DC-4Hz	Control
RMS pitch	10nrad?	1-10Hz	Control
RMS pitch	1μrad?	0.1-1Hz	Control
RMS yaw	10nrad?	1-10HZ	Control
RMS yaw	1μrad?	0.1-1Hz	Control