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Laser Interferometer Gravitational Wave Observatory (LIGO) Project

To/Mail Code: Distribution
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Phone/FAX: 395-8437
Refer to: LIGO-T950110-00-D
Date: October 19, 1995

Subject: Interface consistency between subsystems

In order to make the interfaces consistent across the subsystems, Robbie has suggested that each task leader sign-off that all interfaces listed in the task leader's subsystem has a corresponding interface listed by the corresponding subsystem task leader. Each task leader will be responsible for initialing one row of the Interface Sign-off sheet on the following page. For example, Jordan would initial the second column in the PSL row when he has established that all of the PSL/ASC interfaces are consistent with the ones that David wrote down for the ASC/PSL interfaces. If the interfaces aren't consistent, it is the job of the two task leaders to iron out the differences and then sign-off. Jordan would repeat this process with the 5 other task leaders. Absence of interfaces between subsystem should be marked as "NONE" in the table.

We also want to ensure that the requirements flowdown from SYS generated by Bob is consistent with the subsystem upper level requirements listed by each of the task leaders. Once this has been worked through with Bob, the task leader should initial the one appropriate box in the Requirements Sign-off table.

The sign-off sheets should be completed and given to Robbie by November 6.

I have included the interface and requirements documentation generated by each of the task leaders for the Detector Handbook. When we have completed the consistency check, we will update the documentation and distribute the Detector Handbook. This is also a good chance, before the Detector Handbook is widely distributed, to make additions and corrections to your interface documentation in the instance that you see a way to document your subsytem more clearly.

Distribution:
R. Spero, M. Zucker, D. Shoemaker, J. Camp, W. Kells, N. Solomonson, S. Kawamura

cc:
L. Sievers, R. Vogt, W. Althouse

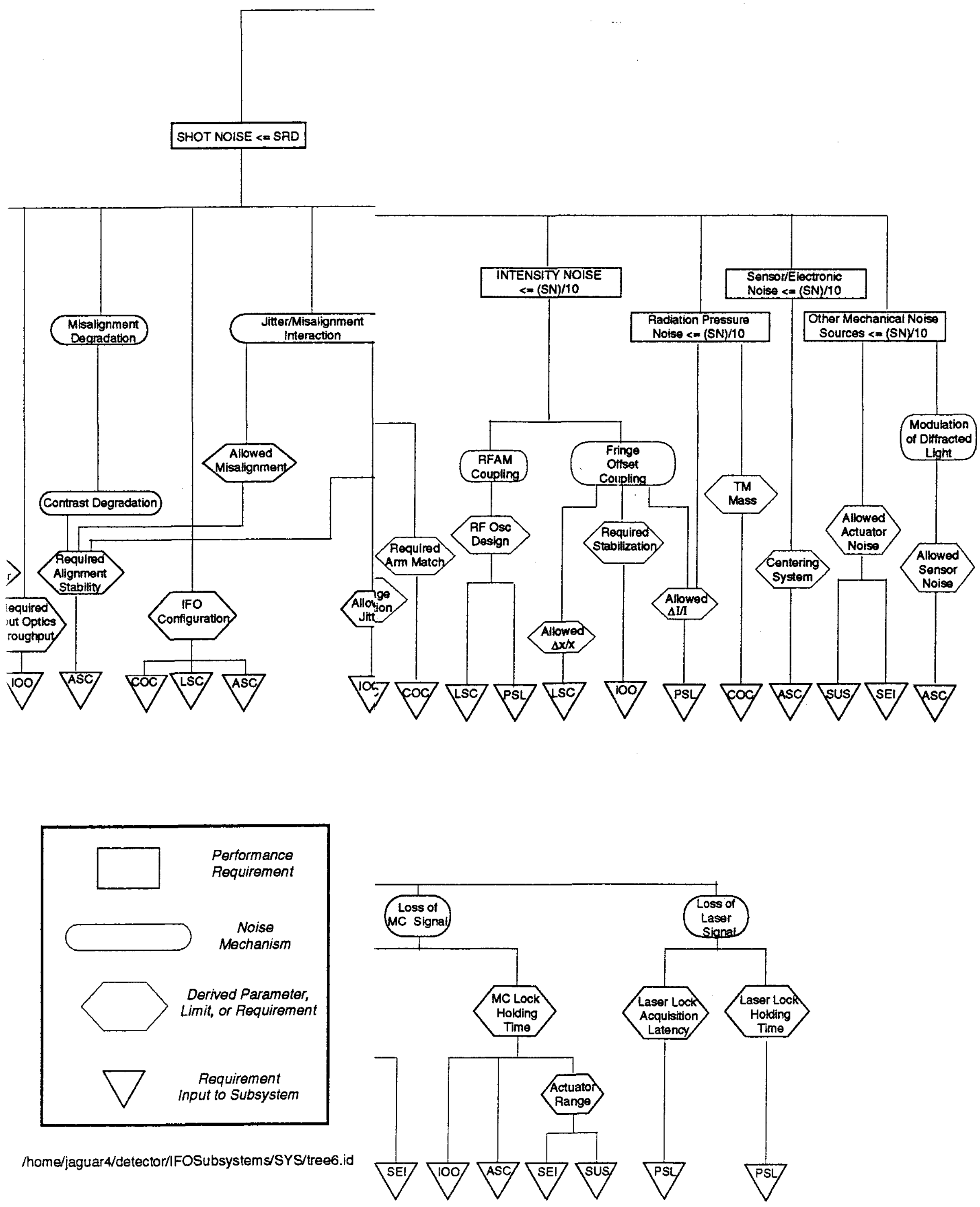
Interface Sign-Off Sheet

	LSC	ASC	COC	SEI	SUS	PSL	IOO
LSC							
ASC							
COC							
SEI							
SUS							
PSL							
IOO							

Requirements Sign-off

	LSC	ASC	COC	SEI	SUS	PSL	IOO
SYS							

7.1 Interferometer Systems Integration (SYS)



/home/jaguar4/detector/IFOSubsystems/SYS/tree6.id

7.2 Prestabilized Laser (PSL)

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Interferometer Requirement Flowdown To ASC

David Shoemaker

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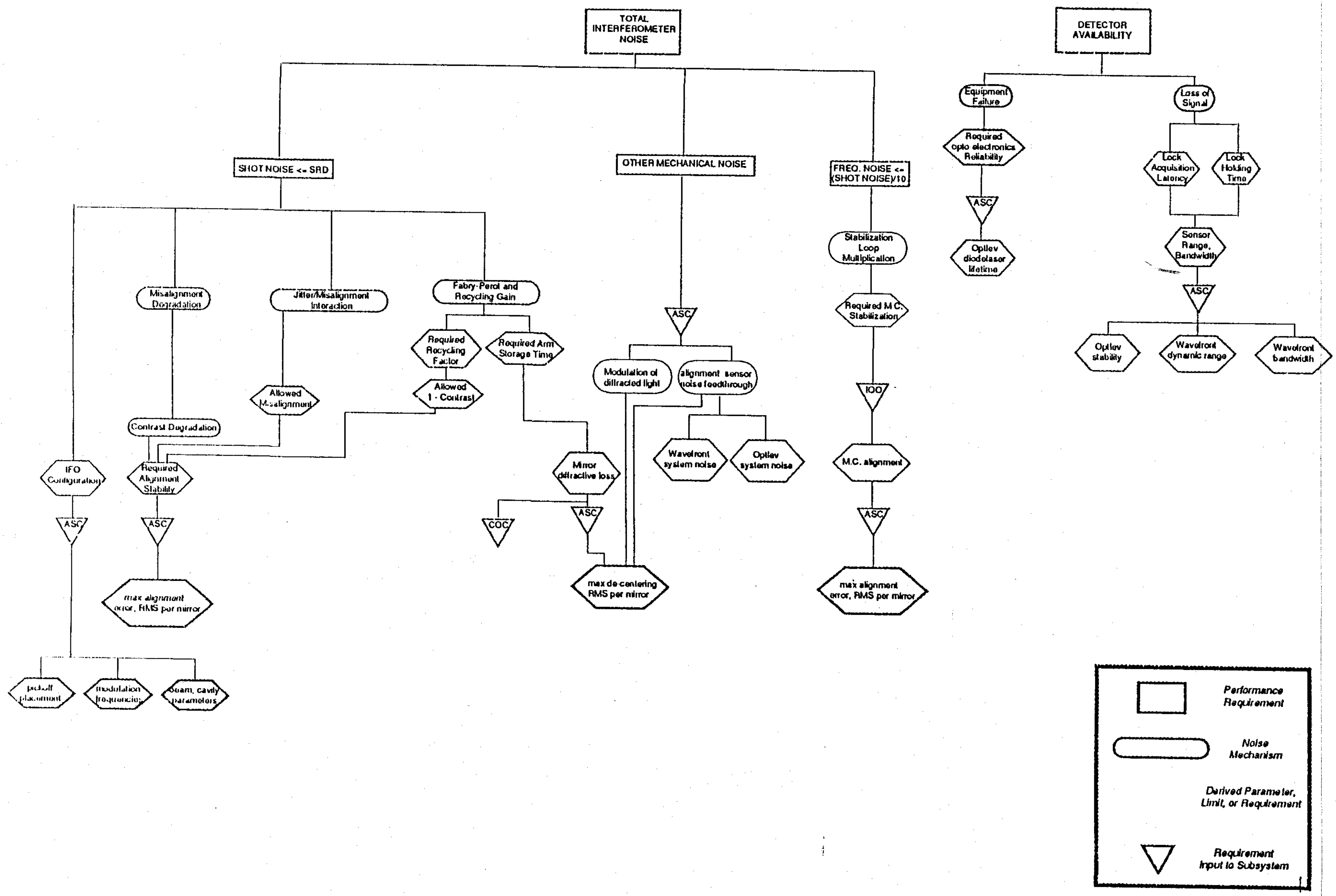

~dhs/detector/align/asc-tree ls!

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Naming and Interface Definition for ASC Initial Alignment

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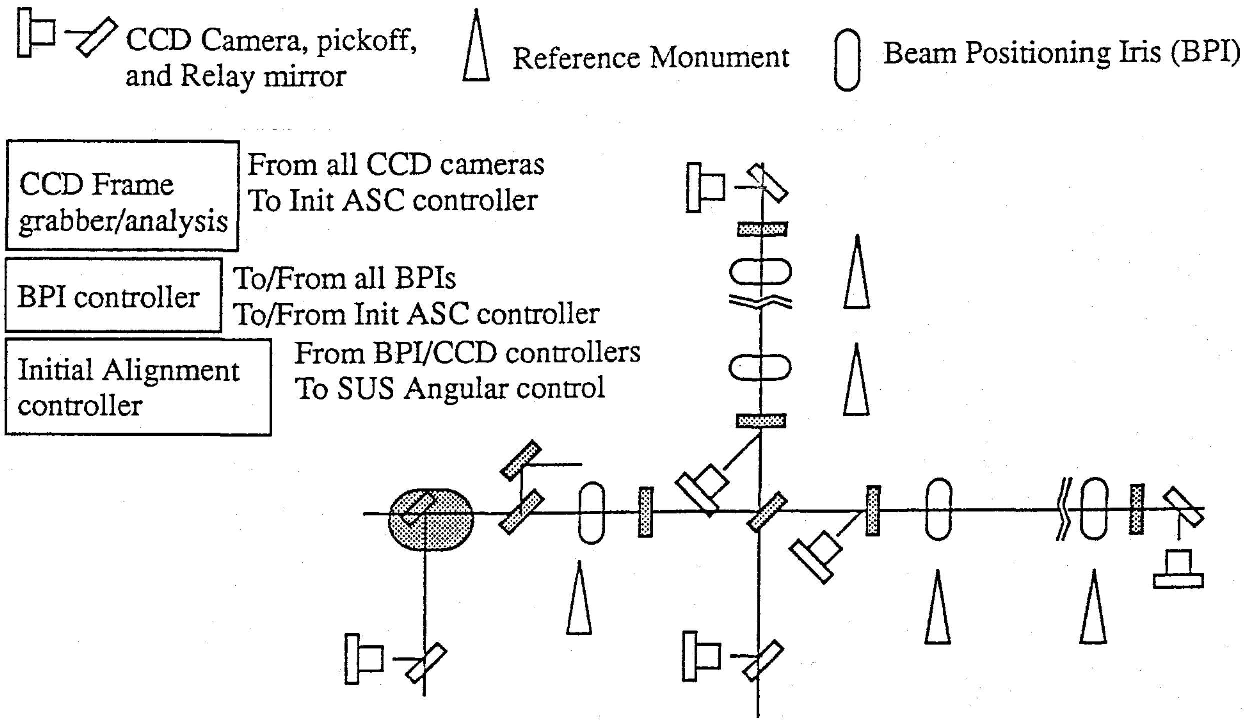
1 NAMING CONVENTION

We illustrate here the naming conventions for the ASC Initial Alignment Subsystem Components. All names in the drawing are proceeded by 'ASC Initial Alignment Subsystem'. The shaded objects are not part of the ASC Initial alignment subsystem.



Detail of Beam Positioning Iris (BPI) at manifold reducer

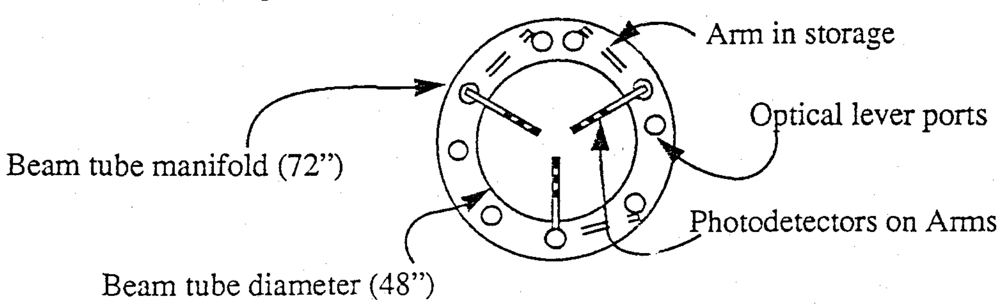


Figure 1: ASC Initial alignment subsystem

2 MECHANICAL INTERFACES

Refer to Figure 1 in Section 1: Naming Convention.

Mechanical Mounting Interfaces			*Drawing/ Doc #*
ASC Initial Alignment Mounting Surface	*Other Subsys Mounting Surface*	*Interface and its Characteristics*	
BPI Arm pivot at manifold reducer	Vac Eq manifold reducer	Bolts/screws • bolt hole pattern	
BPI Arm pivot at recycling cavity	Vac Eq TBD	Bolts/screws • bolt hole pattern	
CCD camera relay mirror mounting tab	Vac Eq or SEI	Bolts/screws • bolt hole pattern	
CCD camera	FAC (maybe ASC monument)	Bolts/screws • bolt hole pattern	
Reference Monument	FAC floor	Bolts/screws • bolt hole pattern	

Critical Dimension/Size	*Drawing/ Doc #*
Position of the Reference monument (GPS to ~1 mm) Position of the Centering Sensors w.r.t. nominal center of suspended masses (check ASC Wvfnt/Cntr for this)	
Position of CCD pickoff mirrors w.r.t. beam	
Position of CCD Cameras w.r.t. beam	
Position of BPI Arm w.r.t. Reference Monument (0.1 mm precision)	

Table 1: Mechanical interfaces between ASC Initial Alignment and other Detector subsystems

3 SIGNAL INTERFACES

Please refer to Figure 1 in Section 1.

ASC Initial Alignment Control Signals
Signal Inputs • LSC error signals • State Inputs • Acquire bootstrap • Acquire recovery • Signal Outputs • Angular control signals to suspended components • Laser intensity (low/high) State Outputs • bootstrap alignment acquired • recovery alignment acquired

Table 2: Control Signal interfaces between ASC Initial and other detector subsystems

4 OPTICAL INTERFACES

See Figure 1. We call out interfaces with the GW-sensing beam.

ASC Initial Alignment Interface	*Other Subsys Interface*	*Interface and Its Characteristics*	*Drawing/ Doc #*
CCD pick-off splitter	• transmitted light through test mass • wedge beam from input test masse • Faraday beam	• beam gaussian parameters • pickoff ratio	
Beam Positioning Iris	• beam before recycling mirror • beam at vertex manifold reducer • beam at mid/end manifold reducer	• beam gaussian parameters • power (different states)	

Table 3: Optical interfaces between ASC Initial Alignment and other Detector Subsystems

5 INTERFACES EXTERNAL TO THE DETECTOR

These fall naturally into the description of interfaces above, and therefore no separate accounting of them has been made.

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Naming Convention and Interface Definition for Optical Lever

John H. Tappan

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1 NAMING CONVENTION

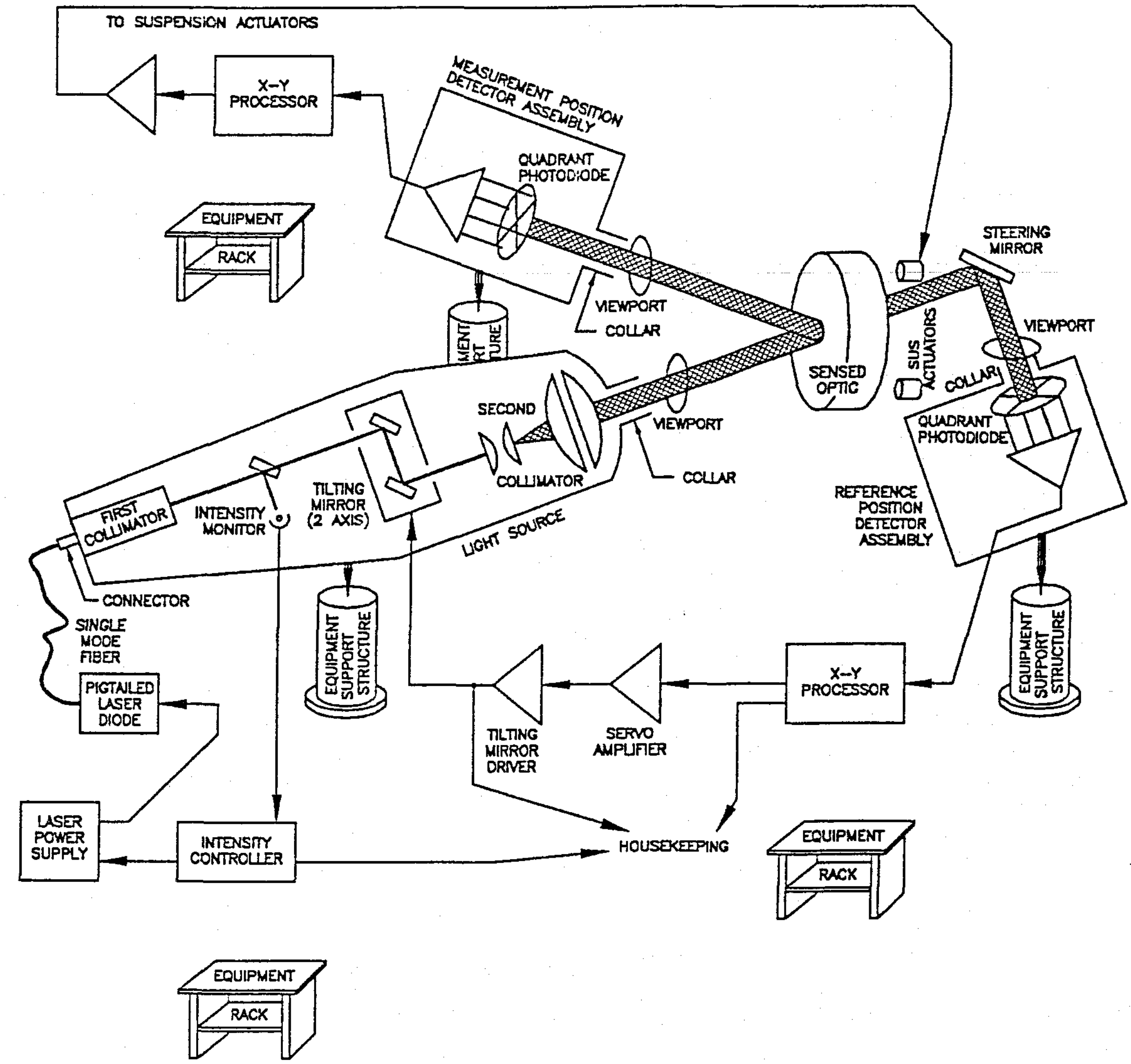

Figure 1: Naming Convention for the Optical Lever components.

2 MECHANICAL INTERFACES

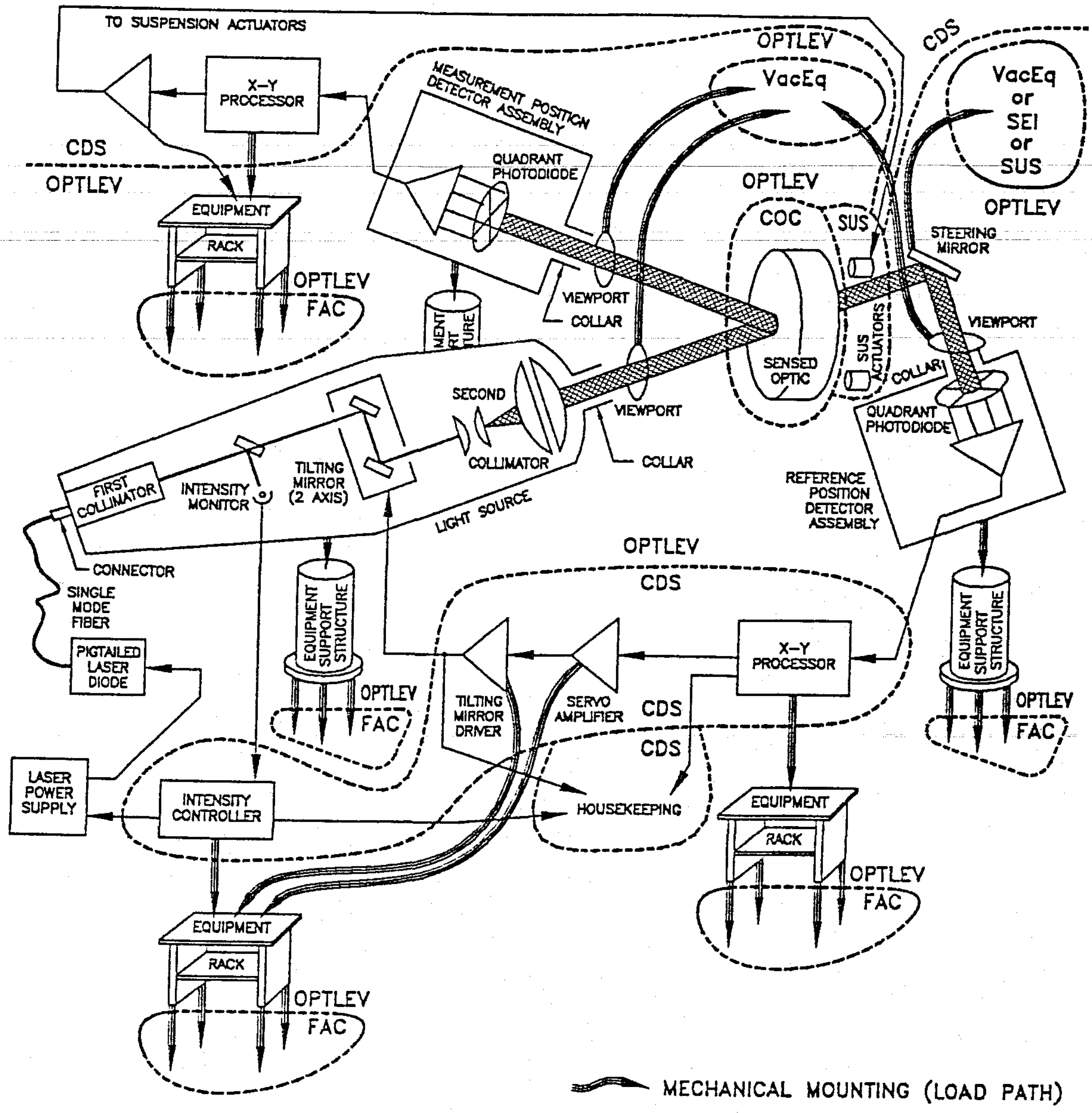

Figure 2: Mechanical Interfaces between OptLev and other Detector Subsystems.

Mechanical Mounting Interfaces			*Drawing/ Doc #*
OPTLEV Mounting Surface	*Other Subsys Mounting Surface*	*Interface and its Characteristics*	
Base of Equipment Rack	Floor (FAC)	Table legs that are not bolted to the floor	
Shelves on or slots in Equipment Rack	CDS components • Intensity Cont. • Tilt Mirror Drive • Servo Amp (2) • X-Y Proc. (2)	TBD	
Base of Equipment Support Structures	Floor (FAC)	Kinematic Base w/ clamp	
Viewports	VacEq surface to depend on Sensed Optic location	High Vacuum Flange, Style, Bolt Circle or Clamps, and Seal TBD	
Steering Mirror Support	VacEq, SEI, or SUS depending on Sensed Optic location	TBD	
Cables (CDS)	On Floor? (FAC) or in cable trays (FAC or OptlLev?)	TBD	

Critical Dimension/Size	*Drawing/ Doc #*
• Placement of Light Source with respect to its Viewport. • Placement of Steering Mirror(s) with respect to Light Source Viewport and Reference Position Detector Viewport • Placement of Reference Position Detector w.r.t. its Viewport. • Placement of Measurement Position Detector Viewport w.r.t. OptLev reflected beam. • Placement of Measurement Position Detector w.r.t. its Viewport.	

Table 1: Mechanical Interfaces between OptLev and other Detector Subsystems

3 SIGNAL INTERFACES

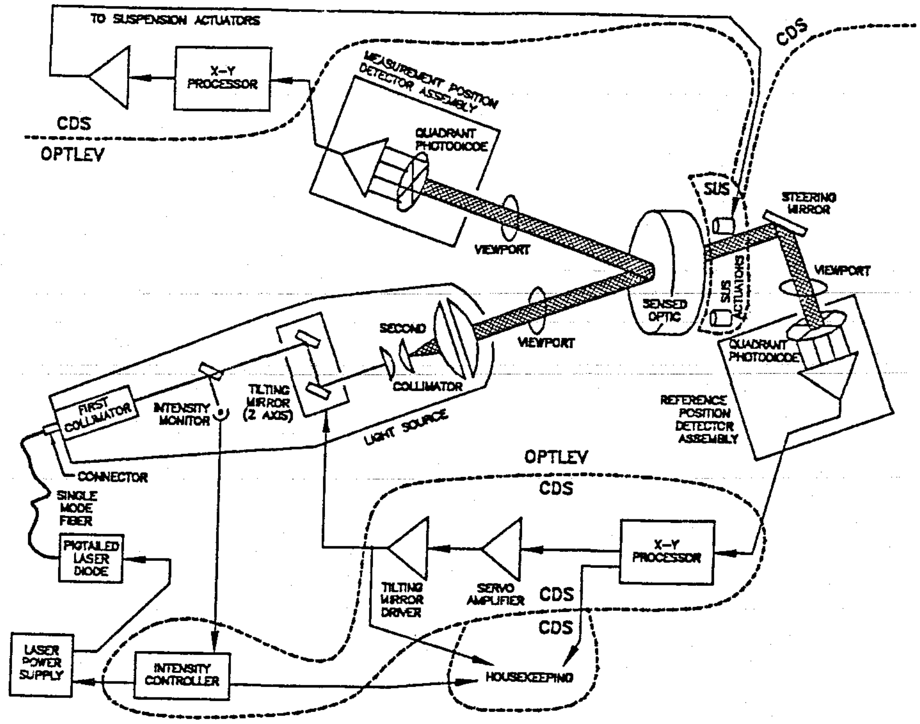

Figure 3: Signal Interfaces between OptLev and other Detector Subsystems.

OPTLEV Control Signals
Inputs • Laser Diode Intensity Control (CDS) • Tilting Mirror Drive (CDS) Outputs • Laser Diode Intensity Monitor (CDS) • Reference Position (CDS) • Measurement Position (CDS)
OPTLEV Monitor Signals
Outputs • Reference Position (CDS) • Tilting Mirror Drive (CDS) • Laser Diode Intensity (CDS)

Table 2: Signal Interfaces between Optlev and other Detector Subsystems

4 OPTICAL INTERFACES

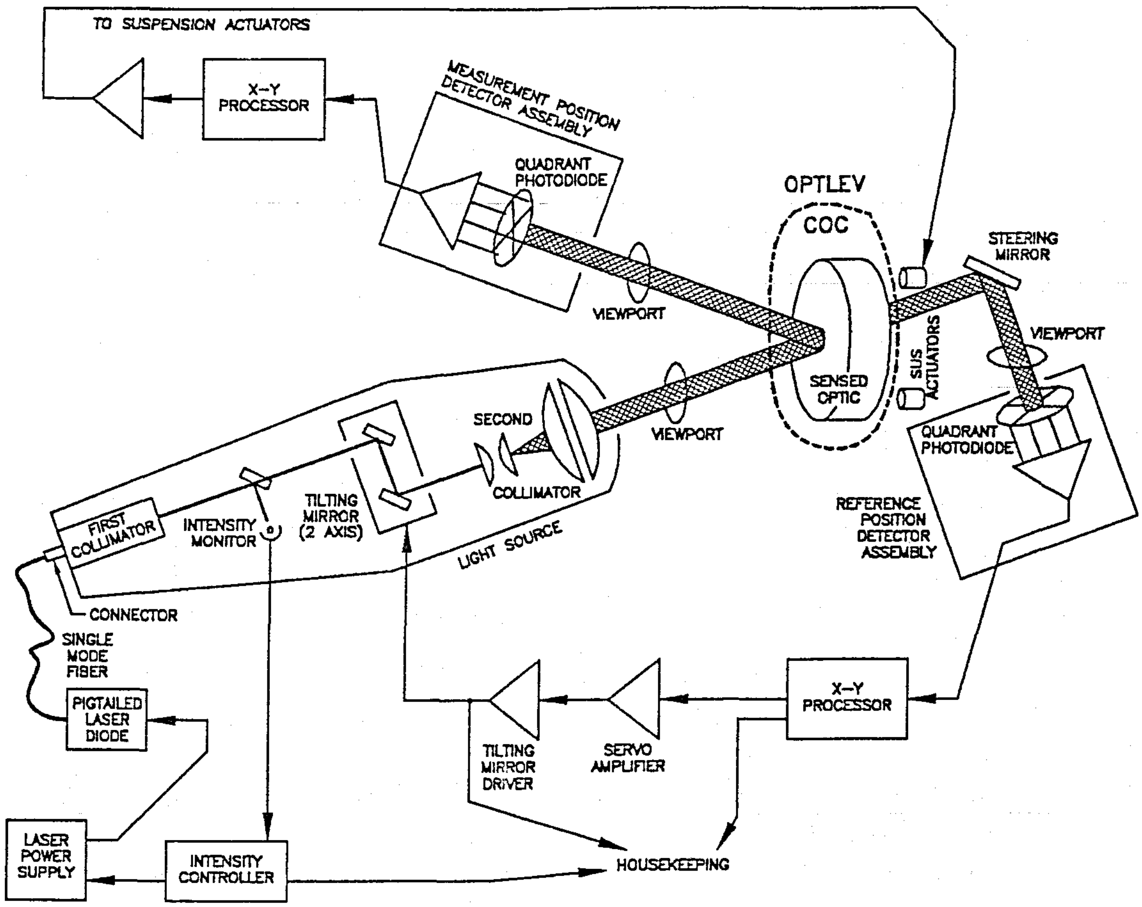

Figure 4: Optical Interfaces between OptLev and other Detector Subsystems.

OptLev Interface	*Other Subsys Interface*	*Interface and Its Characteristics*	*Drawing/ Doc #*
Optlev Beam	Sensed Optic (COC)	• wavelength • beam size • power • optic reflectance and transmittance at the Laser Diode wave-length	

Table 3: Optical Interfaces between OptLev and other Detector Subsystems

5 INTERFACES EXTERNAL TO THE DETECTOR

These fall naturally into the description of interfaces above, and therefore no separate accounting of them has been made.

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Naming and Interface Definition for ASC Wavefront/Centering

David Shoemaker

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1 NAMING CONVENTION

We describe here the naming conventions for the ASC Wavefront and Centering Subsystem Components. These two ASC subsystems are closely linked, and will be documented together. Figure 1, below, gives the significant items and their names. All names in the drawing are proceeded by 'ASC Wavefront/Centering Subsystem'; those in the optical table are additionally prefixed by 'Antisymmetric Wavefront Sensing Installation' or 'Symmetric...' according to the actual application. The objects in shaded boxes are not part of the ASC.

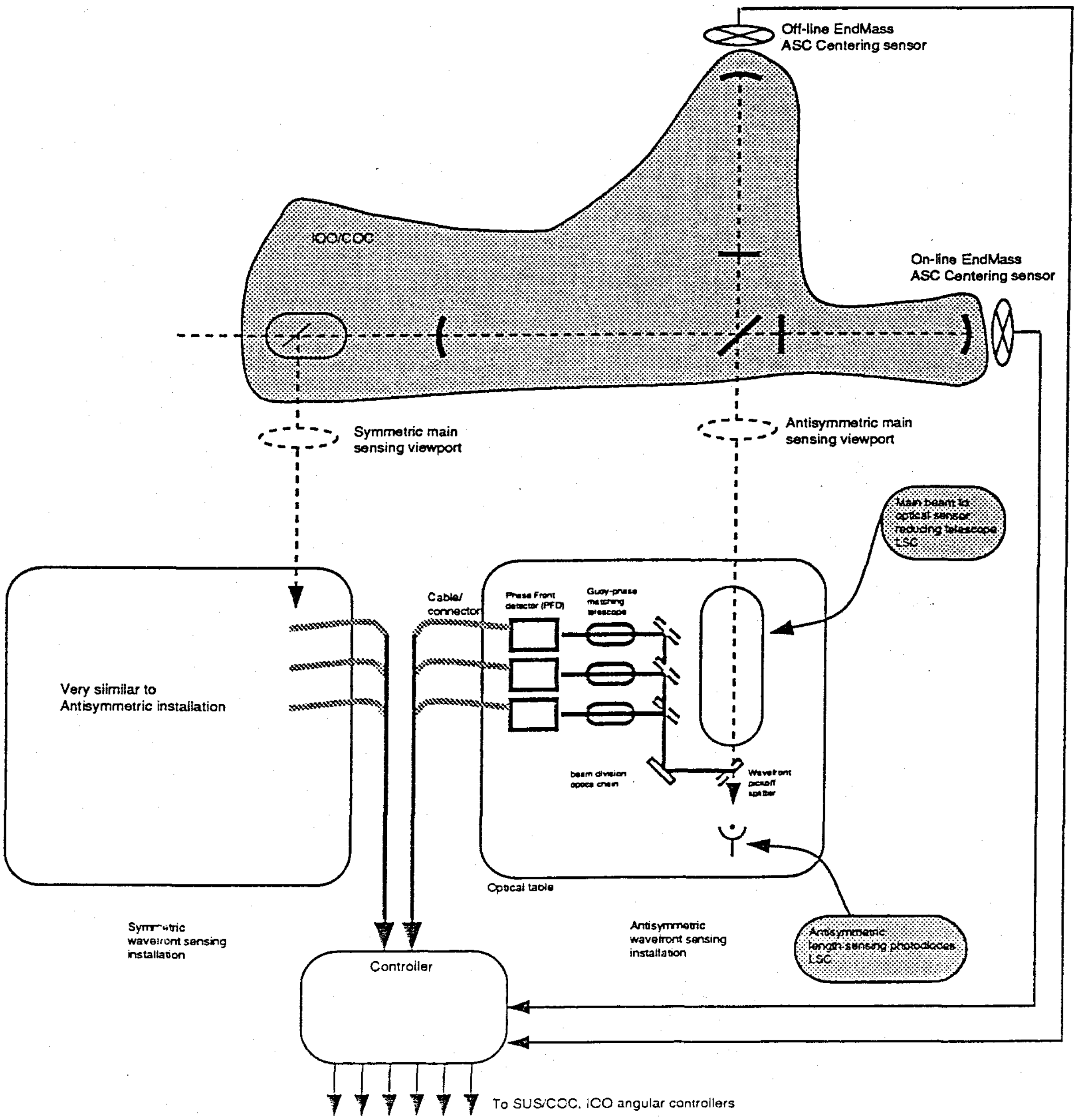

Figure 1: ASC Wavefront/Centering subsystem

2 MECHANICAL INTERFACES

Refer to Figure 1 in Section 1: Naming Convention.

Mechanical Mounting Interfaces			**Drawing/ Doc #**
ASC Wavefront and Centering Mounting Surface	***Other Subsys Mounting Surface***	***Interface and its Characteristics***	
Bottom of kinematic mounting feet of optical table	FAC Floor of LVEA	Bolts/screws • bolt hole pattern	
Optical table surface	IOO Reducing telescope	Bolts/screws • bolt hole pattern	
Optical table surface	LSC Length sensing photodiode	Bolts/screws • bolt hole pattern	
Viewports	VacEq HAM body	Bolts/screws • bolt hole pattern	
Centering sensor mounting tab	SEI Stack optical table	Bolts/screws • bolt hole pattern	

Critical Dimension/Size	**Drawing/ Doc #**
d_1: Height of the beam centers on the optical table relative to the beam center of the LSC Reducing Telescope output (small) beam d_2: Height of the Optical Table to bring the IOO Reducing Telescope to the correct height to intercept the IOO output beams	

Table 1: Mechanical interfaces between ASC Wavefront/Centering and other Detector subsystems

3 SIGNAL INTERFACES

Please refer to Figure 1 in Section 1.

ASC Wavefront/Centering Control Signals
Signal Inputs • Length error and control signals (LSC) • RF modulation references (IOO) • Calibrated misalignment/de-centering/diagnostic offset • Intensity monitor photodiodes • Laser power State Inputs • Length servos locked, all other LSC state information • Gains • Instructions to Wavefront/centering state (acquire, release, Initial alignment) Signal Outputs • angular control signals to suspended masses (including initial beam injection angle) • Diagnostics (error, control signals) State Outputs • Operational alignment achieved • Control signals approaching saturation • Wavefront/centering state (acquired, errors, overloads)

Table 2: Control Signal interfaces between ASC Wavefront and other detector subsystems

4 OPTICAL INTERFACES

See Figure 1. We call out interfaces with the GW-sensing beam.

ASC Wavefront/ centering Interface	*Other Subsys Interface*	*Interface and Its Characteristics*	*Drawing/ Doc #*
Wavefront pick-off splitter	IOO Main beam to optical sensor reducing telescope	• beam gaussian parameters • phase flatness • power	
Centering sensor	COC end test mass (transmitted light)	• beam gaussian parameters • phase flatness • power	

Table 3: Optical interfaces between ASC Wavefront/Centering and other Detector Subsystems

5 INTERFACES EXTERNAL TO THE DETECTOR

These fall naturally into the description of interfaces above, and therefore no separate accounting of them has been made.

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Interferometer Requirements Flowdown to LSC

Mike Zucker and Lisa Sievers

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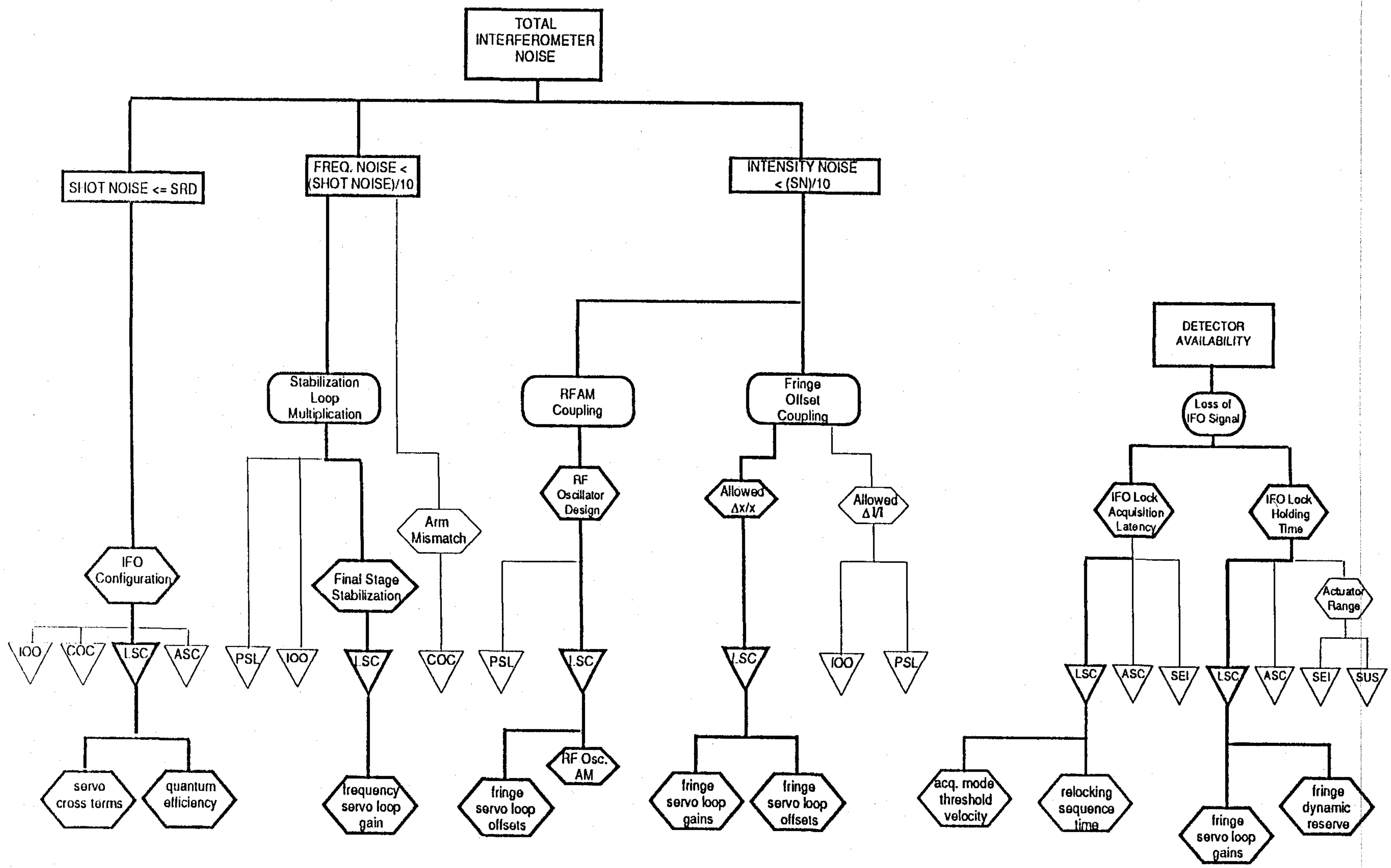

/home/jaguar4/detector/IFOSubsystems/LSC/treeLSCmike.id

Figure 1: IFO Requirements Flowdown to LSC

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Naming Convention and Interface Definition for LSC

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1 NAMING CONVENTION FOR LENGTH SENSING AND CONTROL COMPONENTS

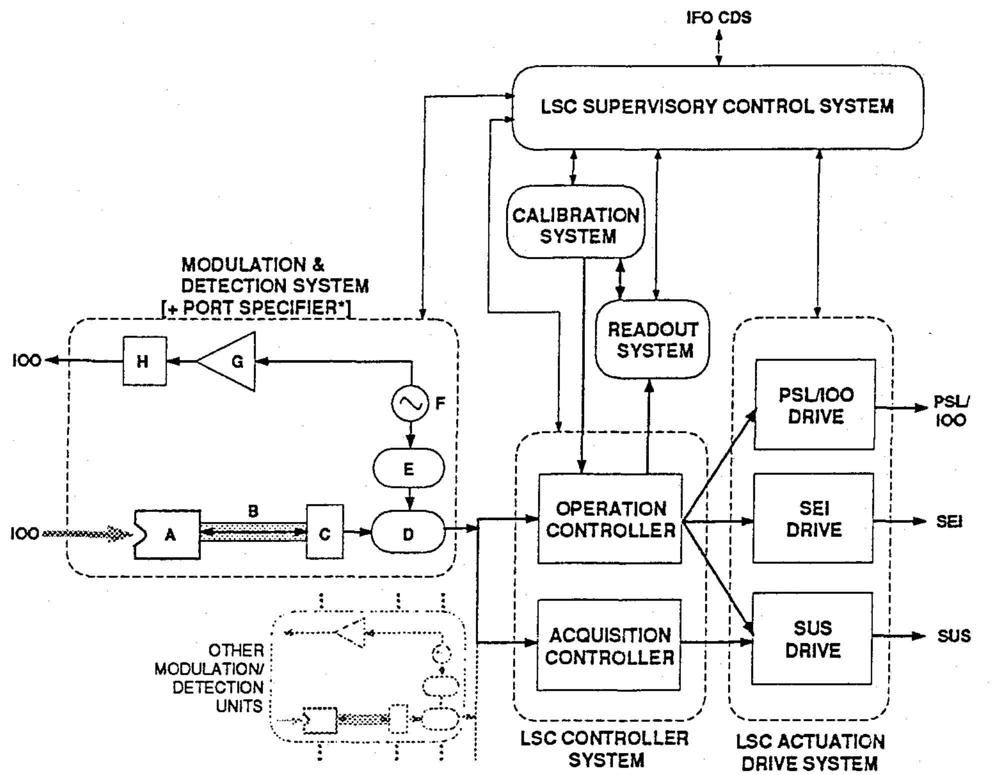

Figure 1: Naming Convention for Length Sensing and Control Components.

2 MECHANICAL INTERFACES

Mechanical Mounting Interfaces			*Drawing/ Doc #*
LSC Mounting Surface	*Other Subsys Mounting Surface*	*Interface and its Characteristics*	
Base of photodetector mount	ASC External Optics Platform	• bolt hole pattern • stay-clear • beam path	TBD
Critical Dimension/Size			*Drawing/ Doc #*
Height of output beam(s) above ASC External Optics Platform			TBD

Table 1: Mechanical interfaces between LSC and other Detector subsystems

3 SIGNAL INTERFACES

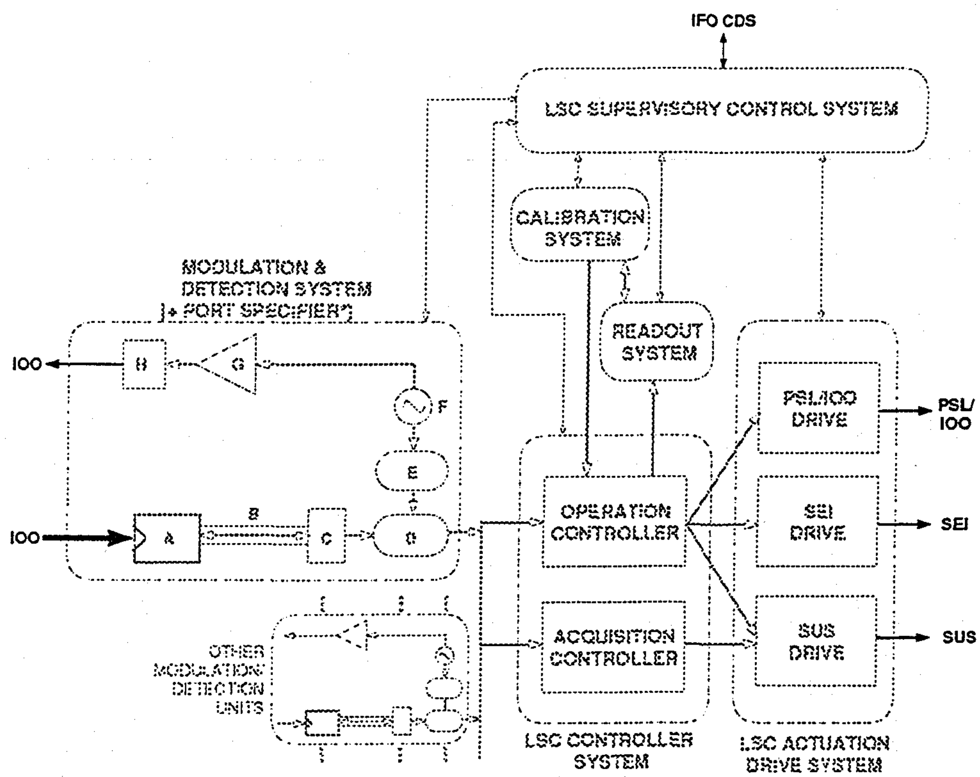

Figure 2: Diagram showing signal interfaces between LSC and other detector systems

Signal Interfaces			*Drawing/ Doc #*
LSC Funtion	*Source or*	*Interface and its Characteristics*	
TBD	TBD	• TBD	TBD

Table 2: Signal interfaces between LSC and other Detector subsystems

4 OPTICAL INTERFACES

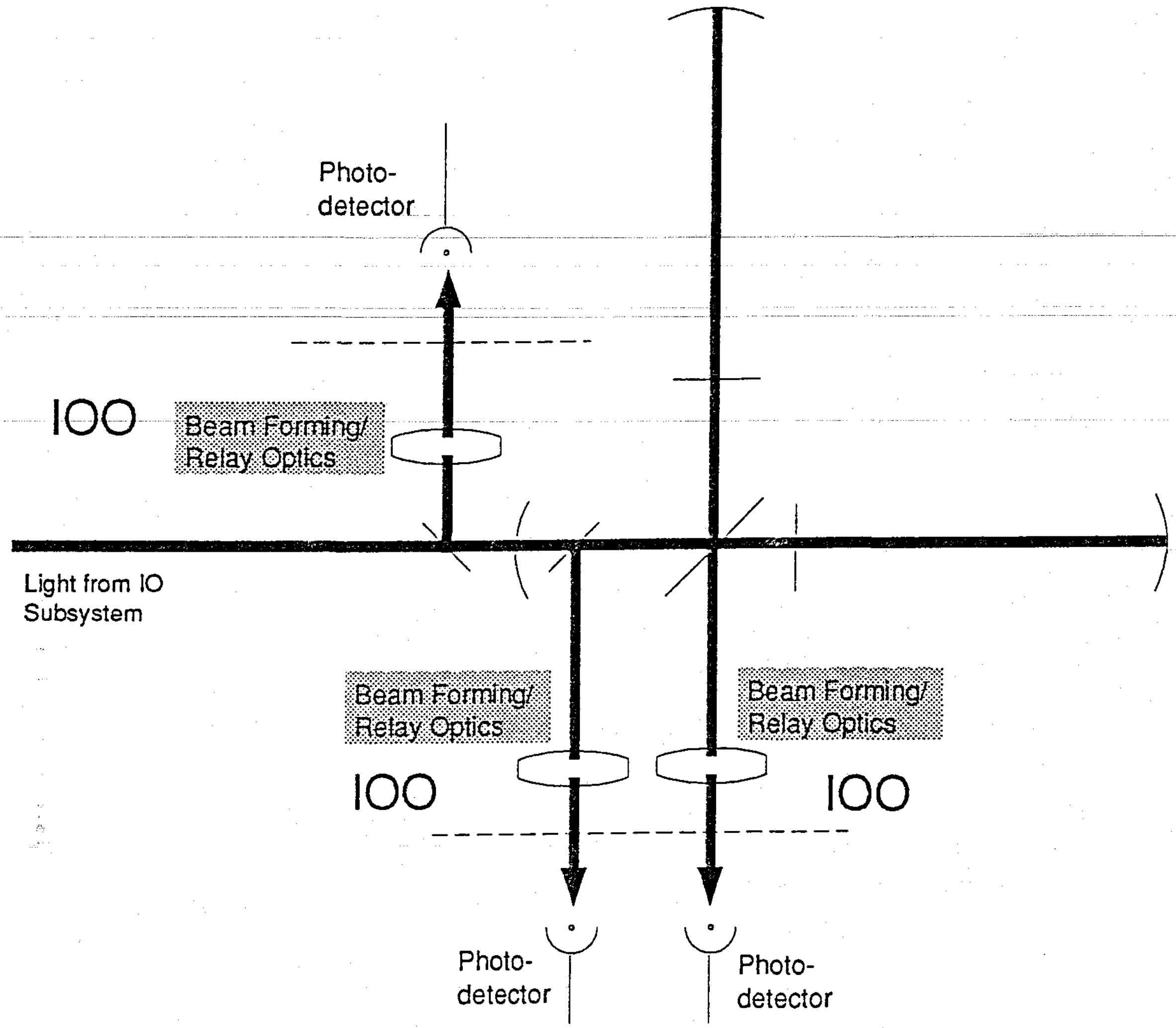

Figure 3: Diagram Showing Optical Interfaces between LSC and other Subsystems.

LSC Interface	*Other Subsys Interface*	*Interface and Its Characteristics*	*Drawing/ Doc #*
Photodetector	IOO output beam forming & relay optics	• beam size • beam ellipticity • power (min, max) • mode quality	TBD

Table 3: Optical interfaces between LSC and other Detector Subsystems

5 INTERFACES TO CIVIL FACILITIES AND VACUUM EQUIPMENT

No direct detector-external interfaces apply. Significant dependencies on properties of the facilities and vacuum equipment are mediated by SEI, ASC and IOO subsystems.

7.7 Suspensions (SUS)

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Interferometer Requirements Flowdown for PSL

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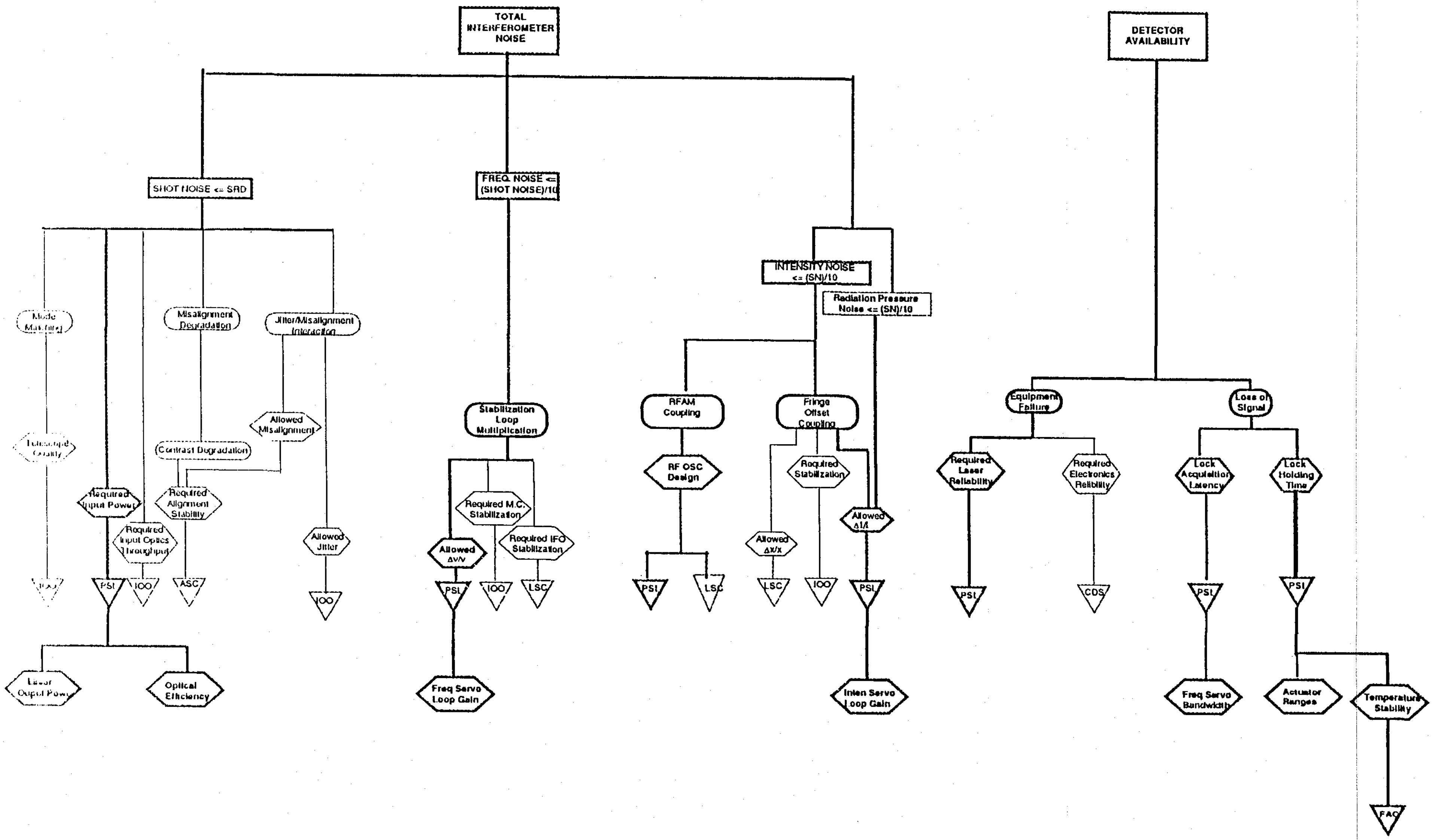
TOTAL INTERFEROMETER NOISE
DETECTOR AVAILABILITY
SHOT NOISE <= SRD
FREQ. NOISE <= (SHOT NOISE)/10
INTENSITY NOISE <= (SN)/10
Radiation Pressure Noise <= (SN)/10
Mode Matching
Misalignment Degradation
Jitter/Misalignment Interaction
Telescope Quality
Contrast Degradation
Allowed Misalignment
Required Input Power
Required Input Optics Throughput
Required Alignment Stability
Allowed Jitter
IOO
PSL
IOO
ASC
IOO
Laser Output Power
Optical Efficiency
Stabilization Loop Multiplication
Required M.C. Stabilization
Allowed Δν/ν
Required IFO Stabilization
PSL
IOO
LSC
Freq Servo Loop Gain
RFAM Coupling
Fringe Offset Coupling
RF OSC Design
Required Stabilization
Allowed Δx/x
Allowed ΔI/I
PSL
LSC
LSC
IOO
PSL
Inten Servo Loop Gain
Equipment Failure
Loss of Signal
Required Laser Reliability
Required Electronics Relibility
Lock Acquisition Latency
Lock Holding Time
PSL
CDS
PSL
PSL
Freq Servo Bandwidth
Actuator Ranges
Temperature Stability
FAC

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Naming Convention and Interface Definition for PSL

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1 NAMING CONVENTION FOR THE PSL COMPONENTS

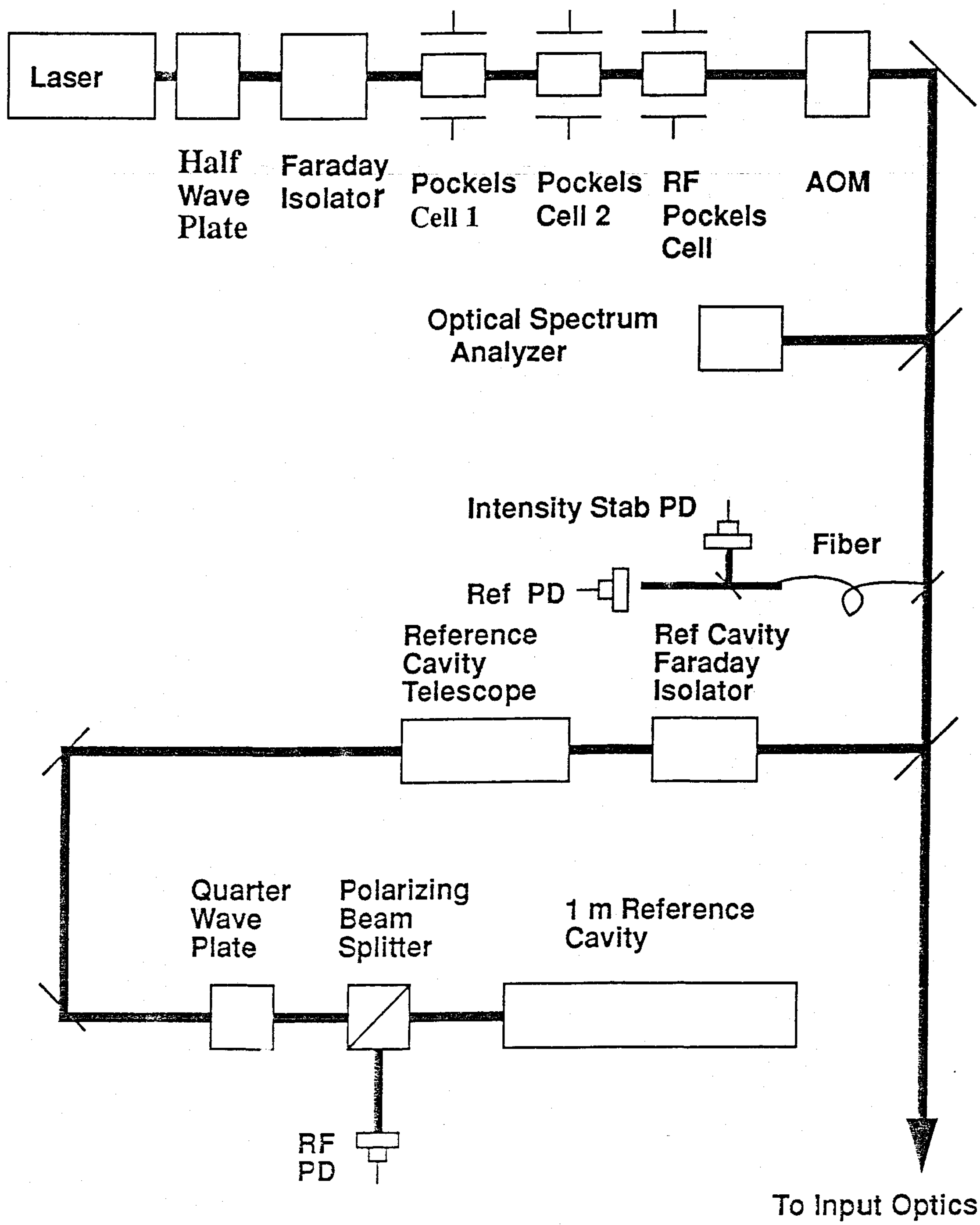

Figure 1: Naming convention for the PSL components

2 MECHANICAL INTERFACES TO OTHER SUB-SYSTEMS

The PSL has no mechanical interfaces to other detector subsystems.

3 SIGNAL INTERFACES

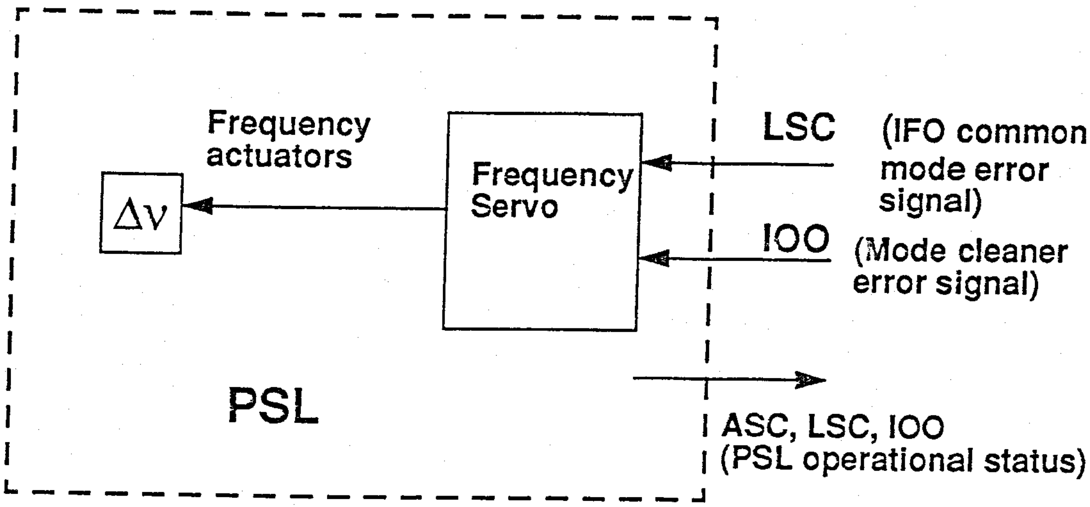

Figure 2: Signal Interfaces between the PSL and other Detector subsytems

PSL Control Signals
Inputs • IFO common mode error signal (LSC) • Mode cleaner error signal (IOO)
PSL Monitor Signals
Outputs • PSL operational status: locked, ulocked, diagnostic (IOO,LSC,ASC)

Table 1: Signal Interfaces between PSL and other Subsytems

4 PSL Optical Interfaces

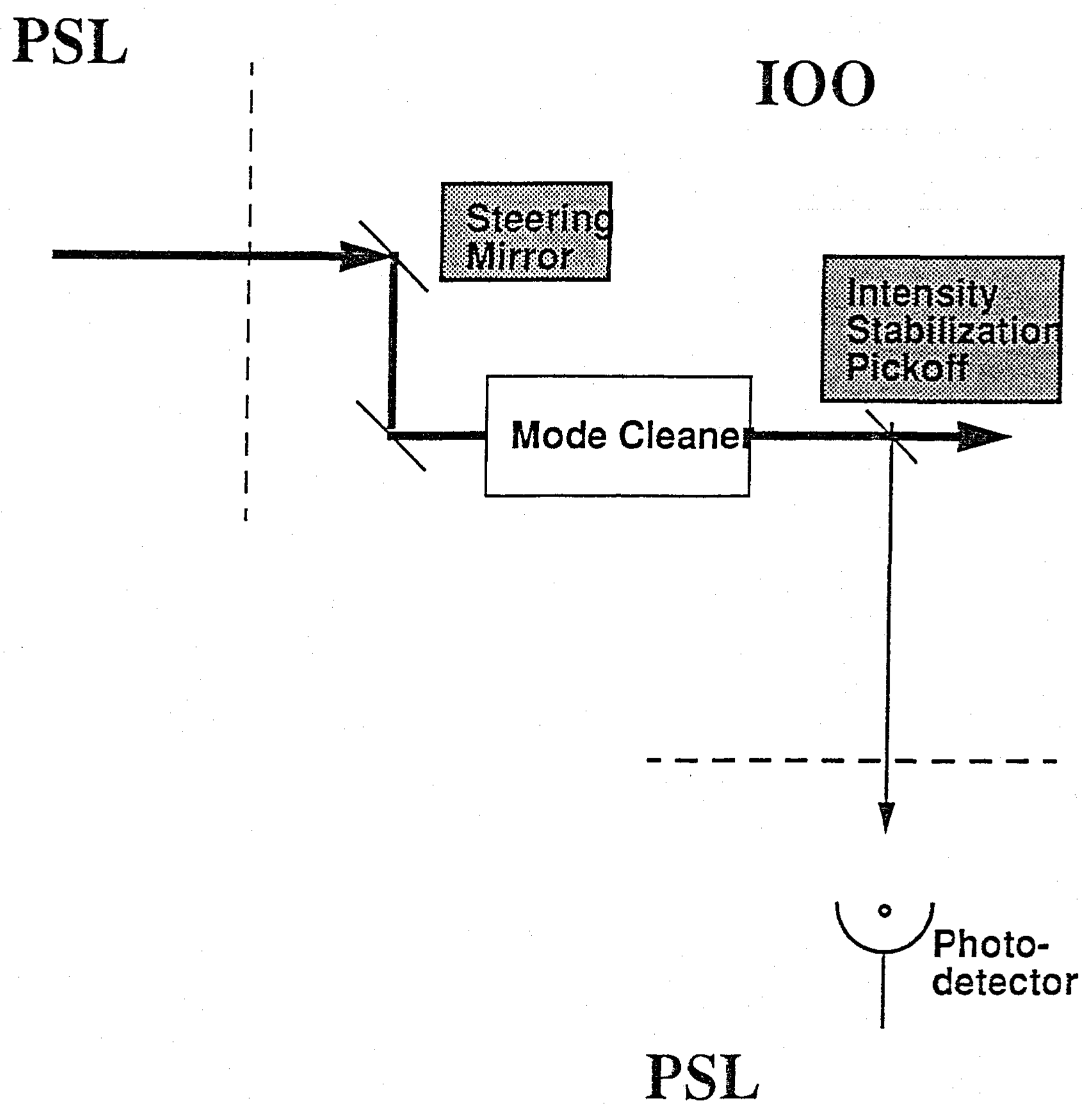

Figure 3: Optical interfaces between the PSL and other Detector subsystems

PSL Interface	*Other Subsys Interface*	*Interface and Its Characteristics*	*Drawing/ Doc #*
Output beam	Input steering mirror (IOO)	• beam size • power	
Photodetector	Intensity stabilization pickoff (IOO)	pickoff fraction	

Table 2: Optical Interfaces for the PSL Subsystem

5 INTERFACES BETWEEN PSL AND SYSTEMS EXTERNAL TO THE DETECTOR

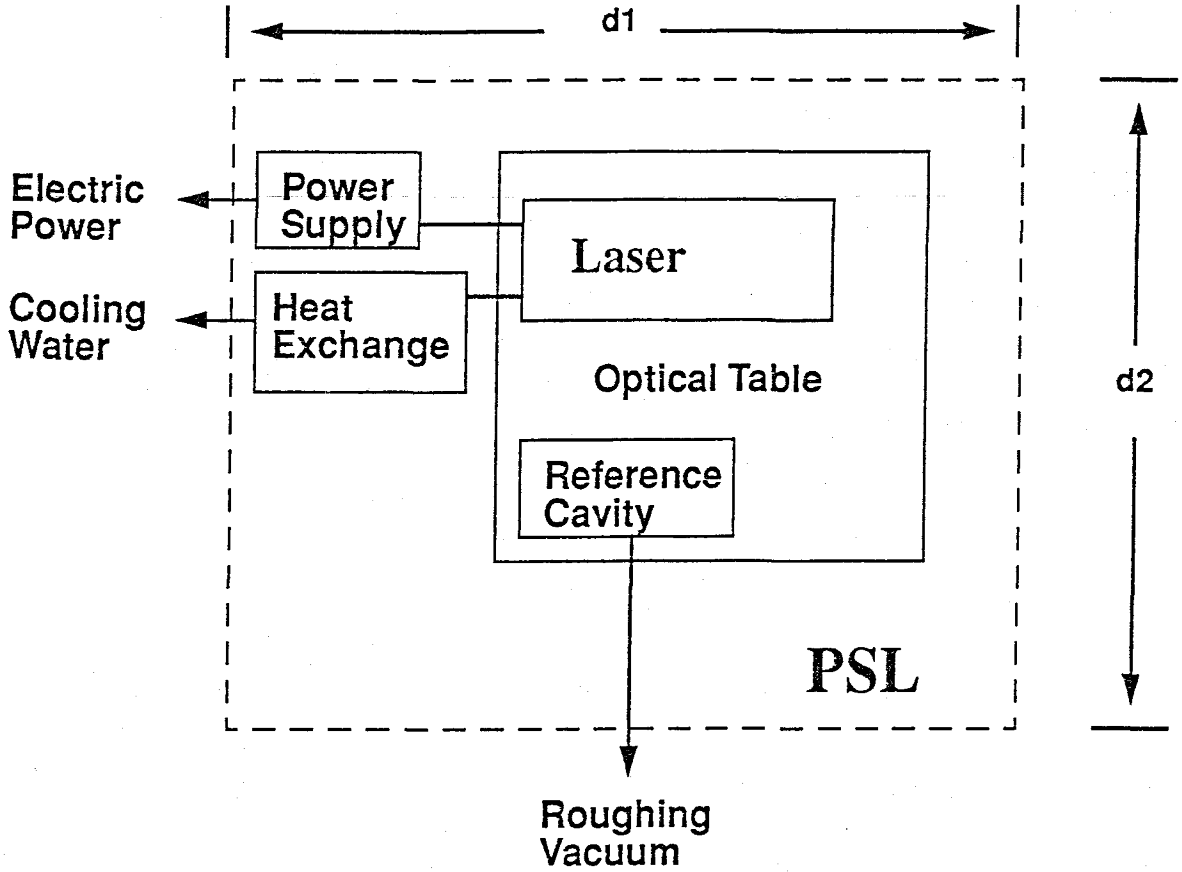

Figure 4: Interfaces between the PSL and systems external to the Detector

PSL component interface	*External System*	*Critical Dimensions*	*Drawing/ Doc #*
Reference Cavity roughing vacuum line	VE		
Optical table, utilities	FAC	d1, d2 = footprint of PSL subsystem	

Table 3: Mechanical Interfaces between PSL and Systems External to the Detector

PSL Component Interface	*PSL Utility Interface*	*Characteristic*	*Drawing/ Doc#*
Laser	Electric power	voltage, current	
Laser	Cooling water	temperature, flow rate	

Table 4: Utility Interfaces Between PSL and Facility

7.3 Input/Output Optics (IOO)

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Interferometer Requirements Flowdown for IOO

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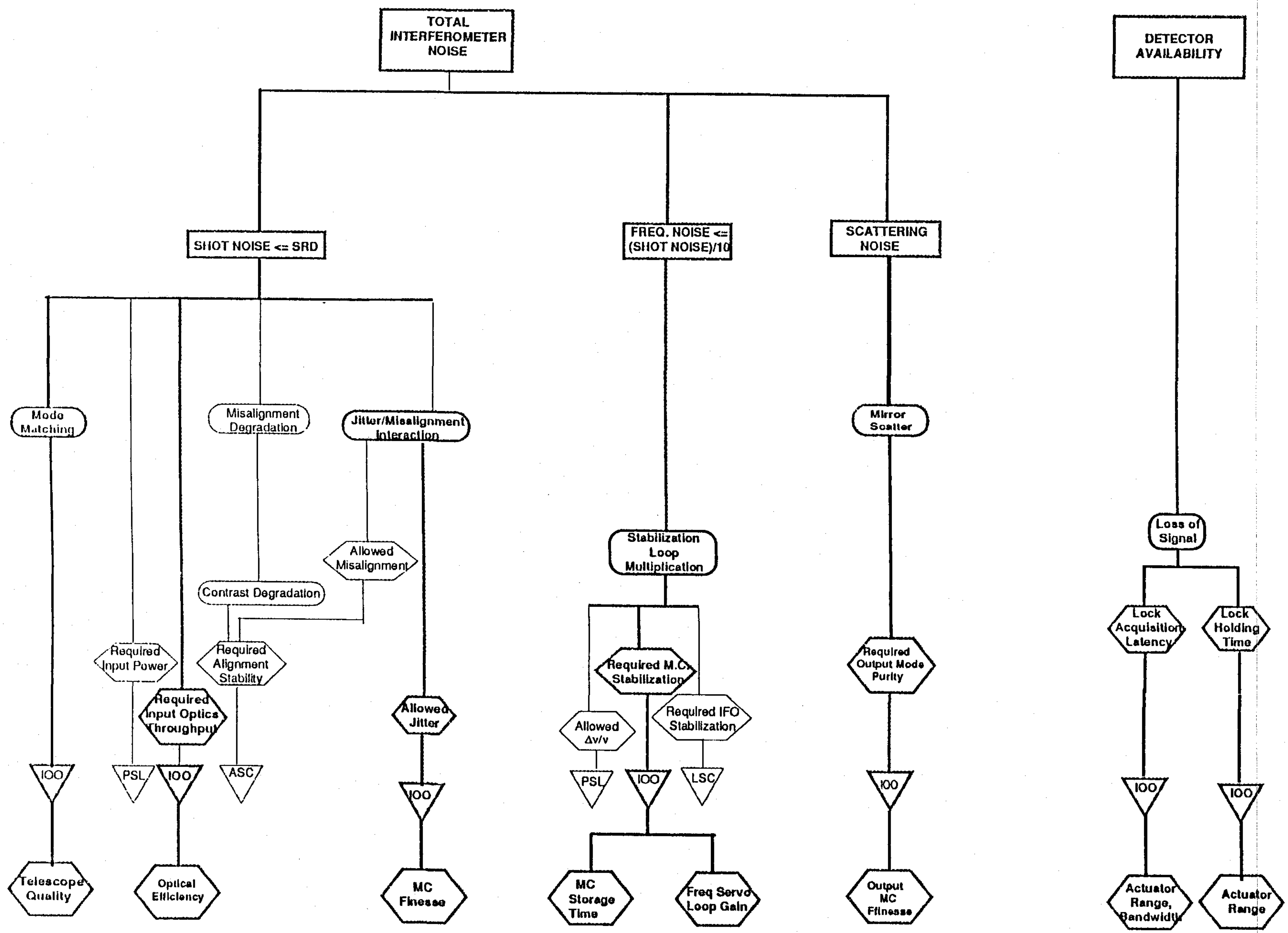
TOTAL INTERFEROMETER NOISE
DETECTOR AVAILABILITY
SHOT NOISE <= SRD
FREQ. NOISE <= (SHOT NOISE)/10
SCATTERING NOISE
Mode Matching
Misalignment Degradation
Jitter/Misalignment Interaction
Mirror Scatter
Allowed Misalignment
Stabilization Loop Multiplication
Loss of Signal
Contrast Degradation
Lock Acquisition Latency
Lock Holding Time
Required Input Power
Required Alignment Stability
Required Input Optics Throughput
Required M.C. Stabilization
Required Output Mode Purity
Allowed Jitter
Allowed Δν/ν
Required IFO Stabilization
IOO
PSL
IOO
ASC
IOO
PSL
IOO
LSC
IOO
IOO
IOO
Telescope Quality
Optical Efficiency
MC Finesse
MC Storage Time
Freq Servo Loop Gain
Output MC Finesse
Actuator Range, Bandwidth
Actuator Range

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Naming Convention and Interface Definition for Input / Output Optics

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Bolted component	Optics platform (SEI)		
Critical Dimentsion/Size			*Drawing/ Doc #*
d1: diameter of suspended component (or adapter) d2: depth of suspended component			

Table 1: Mechanical Interfaces between IOO and other Detector Subsystems

3 SIGNAL INTERFACES

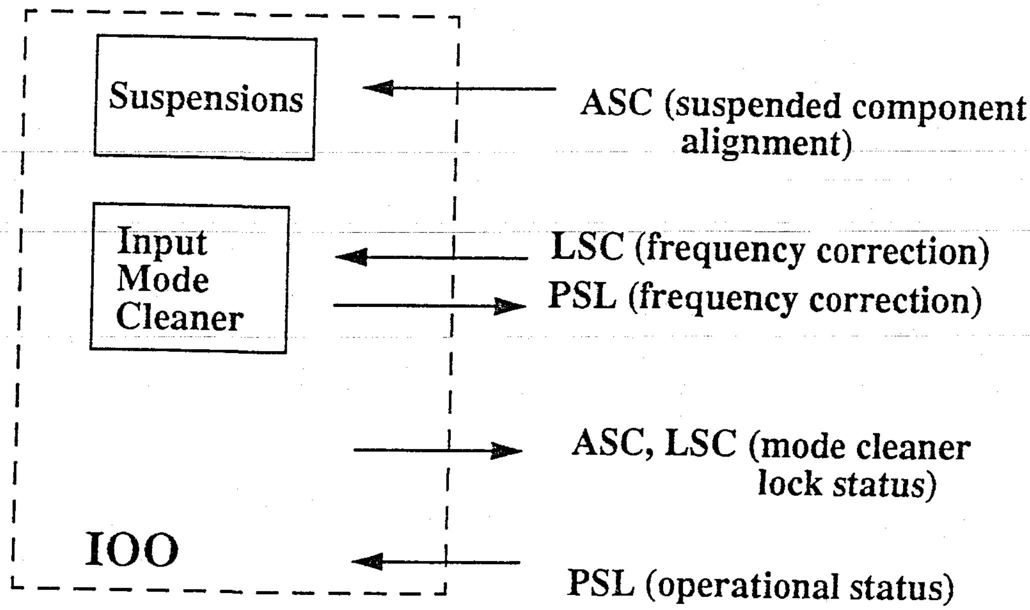

Figure 3: Signal Interfaces between IOO and other Detector subsystems

IOO Control Signals
Inputs • Suspended component alignment control (ASC) • Input mode cleaner frequency correction (LSC) Outputs • Input mode cleaner error signal (PSL)
IOO Monitor Signals
Inputs • PSL operational status (PSL) Outputs • Mode cleaner operational status (LSC,ASC)

Table 2: Signal Interfaces between IOO and other Subsystems

4 OPTICAL INTERFACES

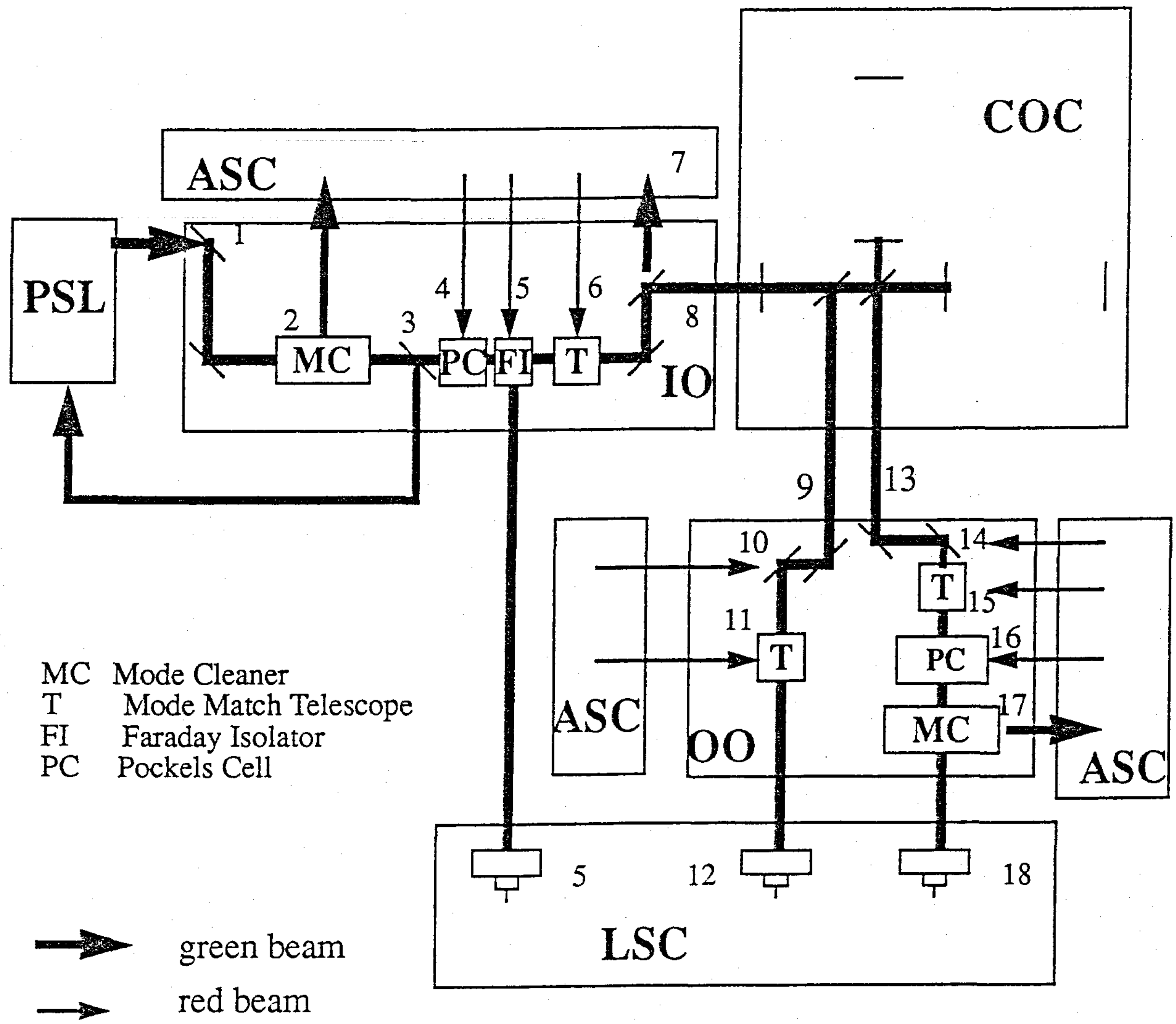

Figure 4: Optical Interfaces between the IOO and other Detector subsytems

IOO Interface	*Other Subsys Interface*	*Interface and Its Characteristics*	*Drawing/ Doc #*
1)IO input steering mirror	Output beam (PSL)	beam size, power at mirror	
2) IO Mode Cleaner mirror pickoff	Wavefront sensing photodetector (ASC)	pickoff fraction	
3)IO intensity stabilization pickoff	photodetector (PSL)	pickoff fraction	
4) IO Pockel cell, Faraday Isolator	Optical lever photodetector (ASC)	lever length	
5) IO Faraday Isolator	length sensing photodetector (LSC)		
6) IO output telescope	Optical lever photodetector (ASC)	lever length	
7) IO output steering mirror pickoff	wavefront sensing photodetector (ASC)	pickoff fraction	
8) IO output steering mirror	recycling mirror (COC)	beam size, power at recycling mirror	
9) OO length control signal input steering mirror	length control pickoff (COS)	pickoff fraction	
10) OO length control signal input steering mirror	optical lever photodetector (ASC)	lever length	
11) OO length control signal telescope	optical lever photdetector (ASC)	lever length	
12) OO length control signal output beam	length control signal photdetector (LSC)	beam size, power at photodetector	

Table 3: IOO Optical Interfaces

13) OO GW signal input steering mirror	beam splitter (COC)	beam size, power at steering mirror	
14) OO GW signal input steering mirror	optical lever photodetector (ASC)	lever length	
15) OO GW signal telescope	optical lever photodetector (ASC)	lever length	
16) OO Pockels cell	optical lever photodetectror (ASC)	lever length	
17) OO mode cleaner mirror	wavefront sensing photodetector (ASC)	pickoff fraction	
18) OO GW signal output beam	GW signal photdetector (LSC)	beam power, size at photodetector	

Table 3: IOO Optical Interfaces

5 INTERFACES BETWEEN IOO AND SYSTEMS EXTERNAL TO THE DETECTOR

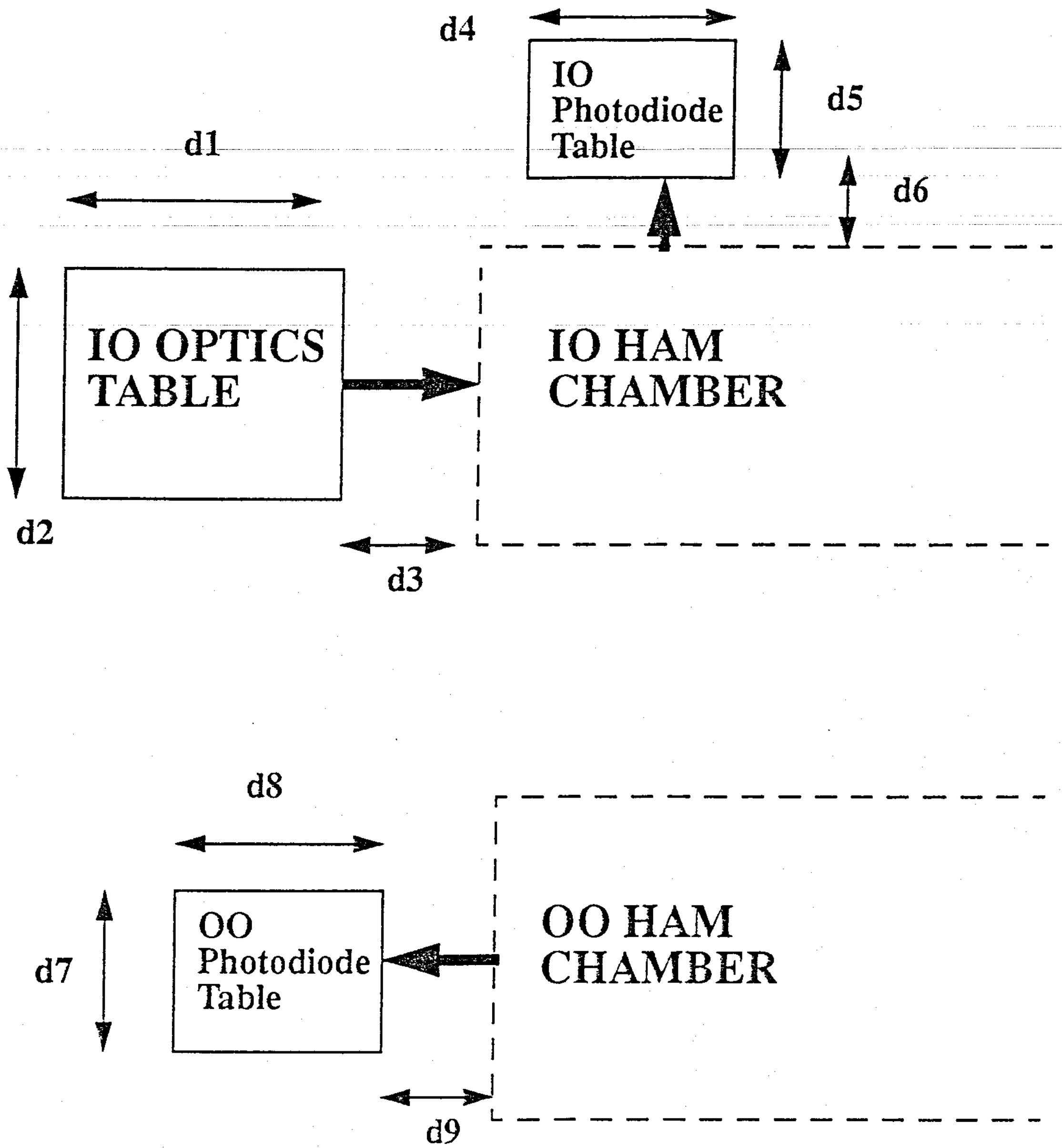

Figure 5: Interfaces between IOO and systems external to the Detector

Dimensions	*Drawing / Doc #*
d1, d2 = IO optics table footprint	
d3, d4 = IO photodiode table footprint	
d5, d6 = OO photodiode table footprint	
Stay Clear Zones	
d3 , d6 = IO HAM chamber stay clear	
d9 = OO HAM chamber stay clear	

Table 4: Mechanical Interfaces Between IOO and Systems External to Detector

7.4 Core Optics Components (COC)

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Naming Convention and Interface Definition for SEI

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1 NAMING CONVENTION FOR THE SEI COMPONENTS

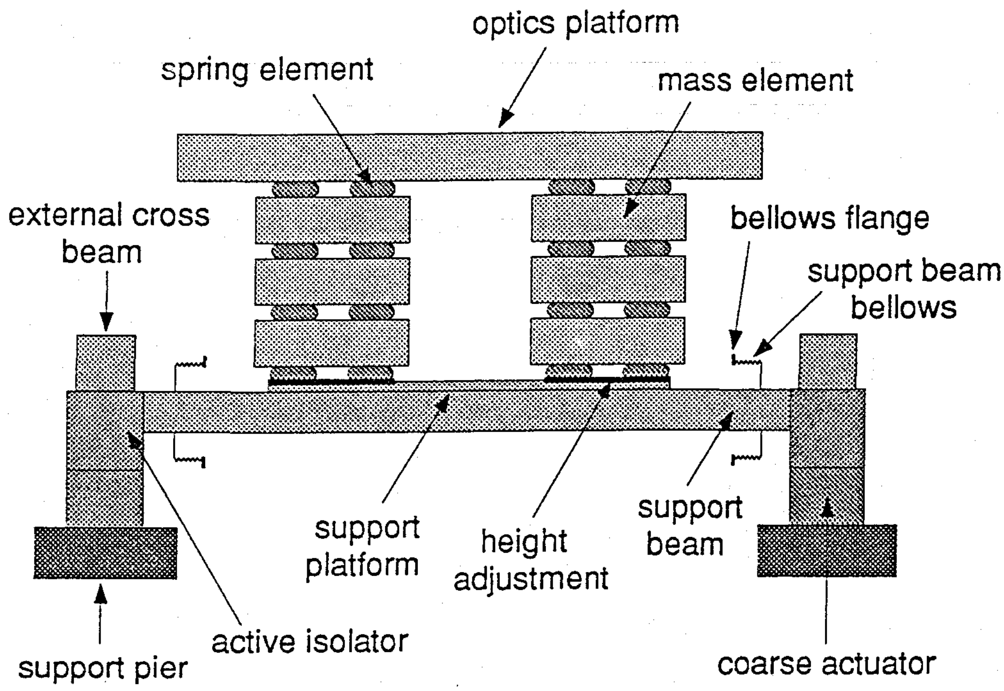

Figure 1: Naming convention for HAM-SEI parts

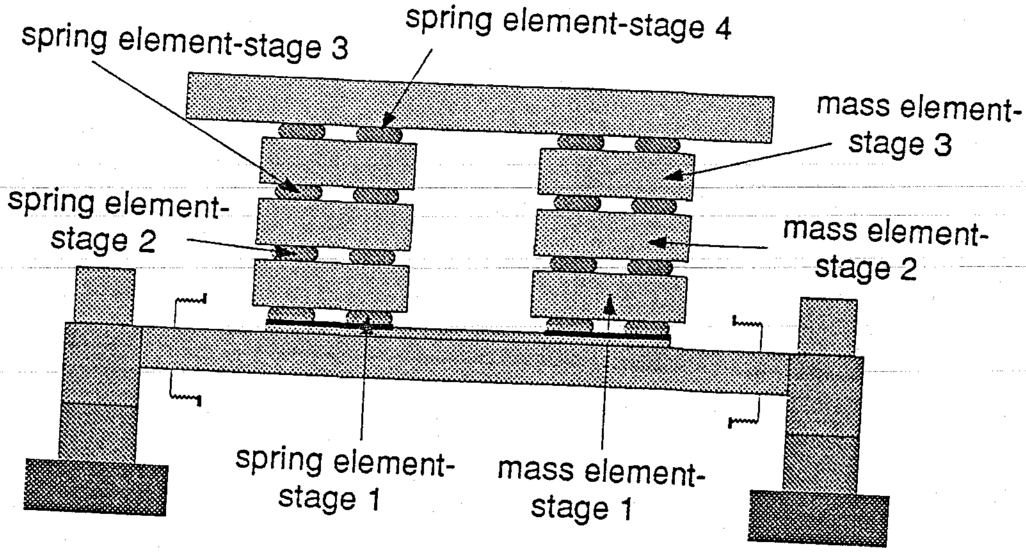

Figure 2: Naming convention for HAM-SEI parts

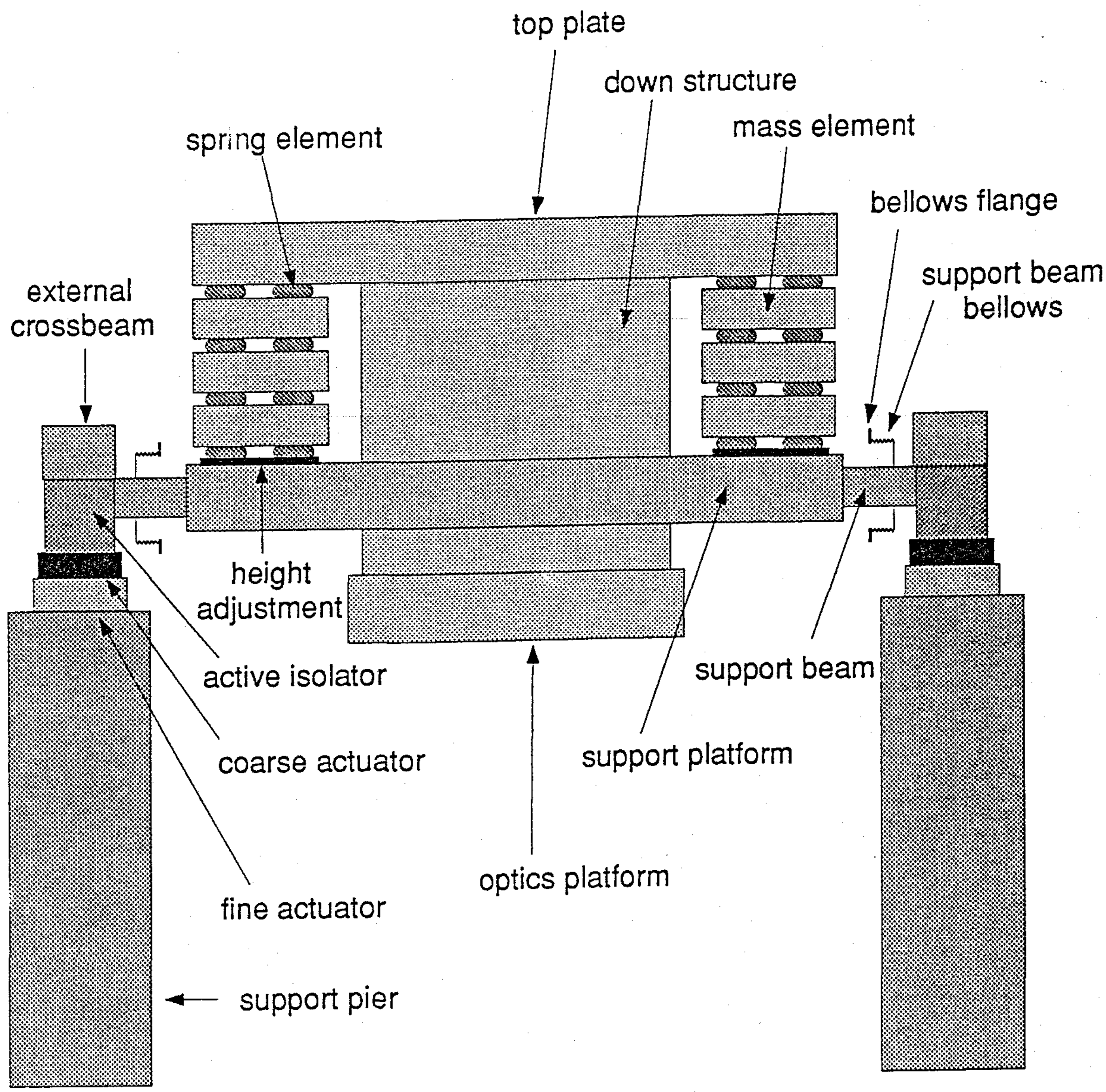

Figure 3: Naming convention for BSC-SEI parts

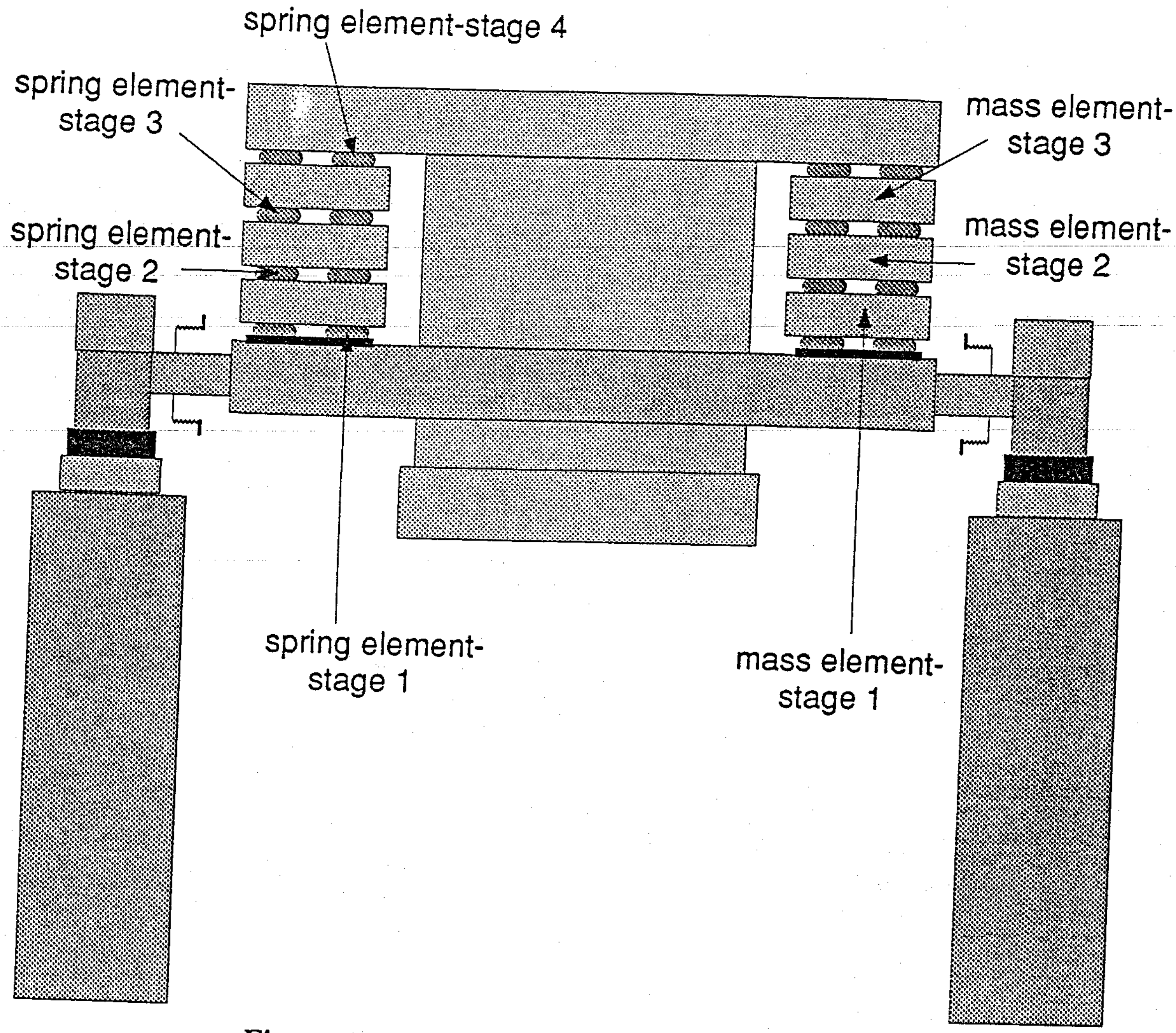

Figure 4: Naming convention for BSC-SEI parts

2 MECHANICAL INTERFACES

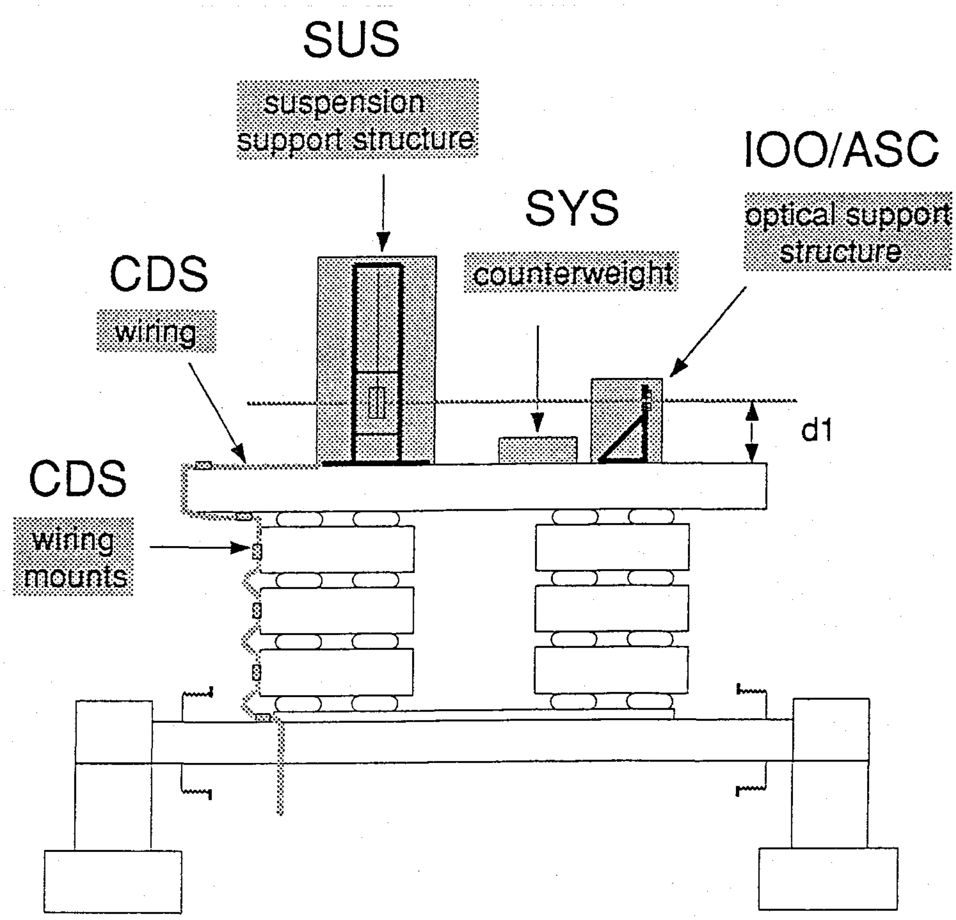

Figure 5: Mechanical interfaces between HAM-SEI and other Detector subsystems

Mechanical Mounting Interfaces			*Drawing/ Doc #*
SEI Mounting Surface	*Other Subsystem Mounting Surface*	*Interface and its Characteristics*	
Ham optics platform	Bottom plate of suspension support structure (SUS)	Bolts/screws • bolt hole pattern • bolt hole thread size	
HAM optics platform	Optical support structures (IOO/ASC)	Bolts/screws • bolt hole pattern • bolt hole thread size	
HAM optics platform	Counter weight (SYS)	Bolts/screws • bolt hole pattern • bolt hole thread size	
HAM support platform, mass elements and optics platform	Wiring mounts (CDS)	Bolts/screws • bolt hole pattern • bolt hole thread size • location and number of wiring mounts	

Critical Dimensions/Size	*Drawing/ Doc #*
d1= 20 cm: Height of main laser beam above optics platform	
Total mass load on optics platform	
Moments of inertia about center of optics platform surface	
Wiring mass and stiffness	

Table 1: Mechanical interfaces between HAM-SEI and other Detector subsystems

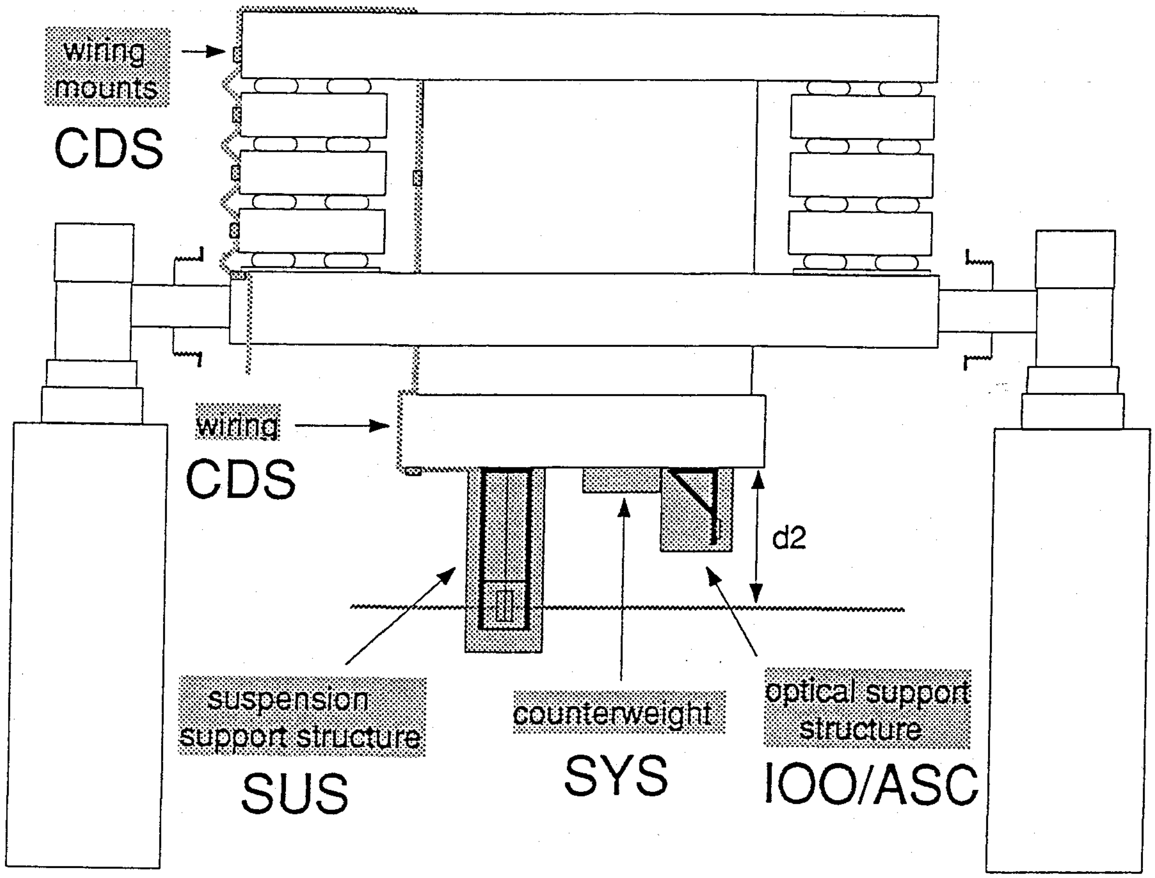

Figure 6: Mechanical interfaces between BSC-SEI and other Detector subsystems

Mechanical Mounting Interfaces			*Drawing/ Doc #*
SEI Mounting Surface	*Other Subsystem Mounting Surface*	*Interface and its Characteristics*	
BSC optics platform	Top Plate of suspension support structure (SUS)	Bolts/screws • bolt hole pattern • bolt hole thread size	
BSC optics platform	Optical support structures (IOO/ASC)	Bolts/screws • bolt hole pattern • bolt hole thread size	
BSC optics platform	Counter weight (SYS)	Bolts/screws • bolt hole pattern • bolt hole thread size	
BSC support platform, mass elements, down structure and top plate	Wiring mounts (CDS)	Bolts/screws • screw hole pattern • screw hole thread size • location and number of wiring mounts	

Critical Dimensions/Size	*Drawing/ Doc #*
d2= 60 cm: Distance of main laser beam below optics platform	
Total mass load on optics platform	
Moments of inertia about cen..er of optics platform surface	
Wiring mass and stiffness	

Table 2: Mechanical interfaces between BSC-SEI and other Detector subsystems

3 SIGNAL INTERFACES

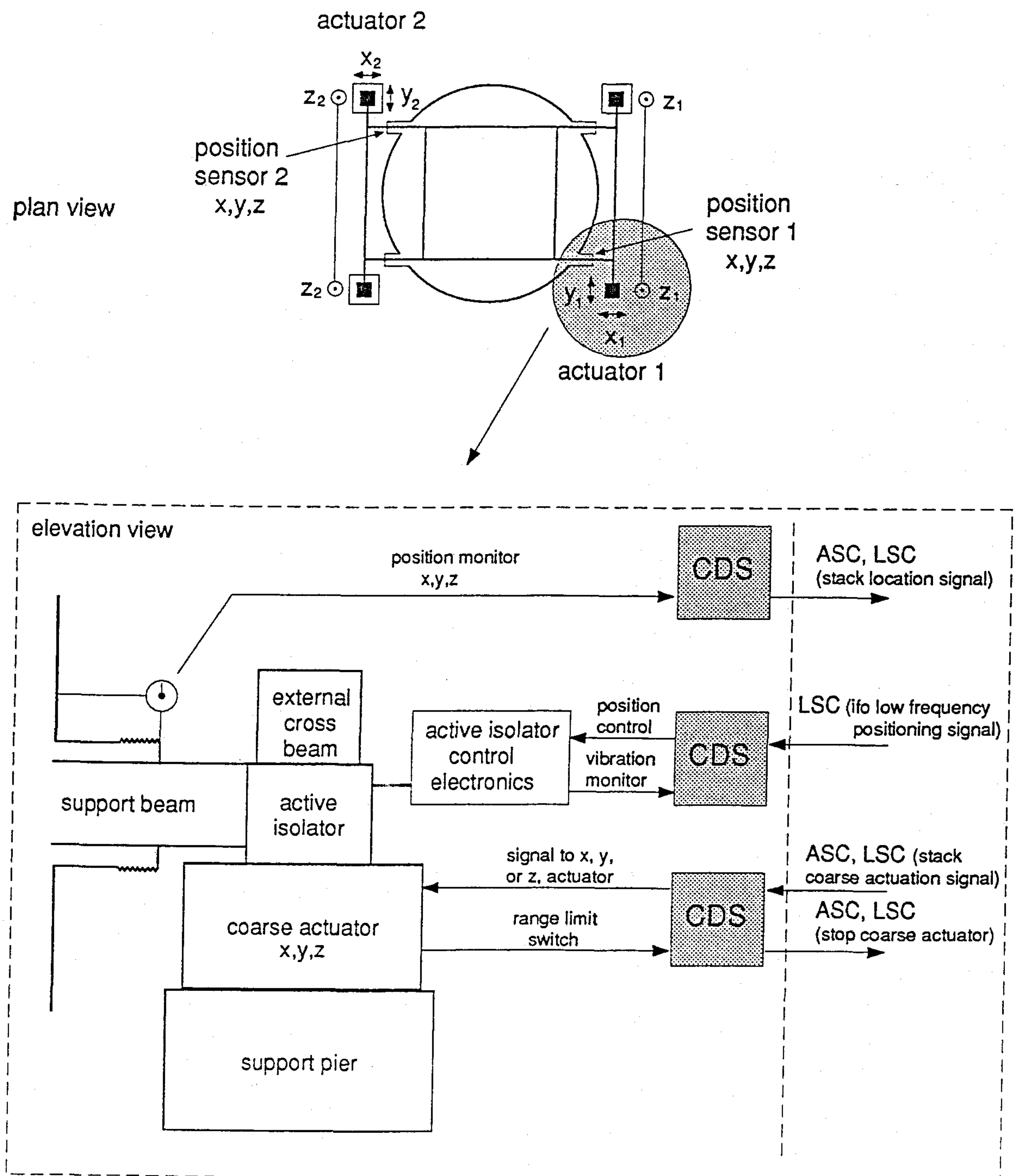

Figure 7: Diagram showing signal interfaces between HAM-SEI and other Detector subsystems

HAM-SEI Control Signals
Inputs • Interferometer low frequency positioning position (LSC) • Stack coarse actuation signal (ASC, LSC) Outputs • Stop coarse actuator (ASC, LSC)
HAM-SEI Monitor Signals
Outputs • Stack location signal (ASC, LSC)

Table 3: Control Signal interfaces between HAM-SEI and other detector subsystems

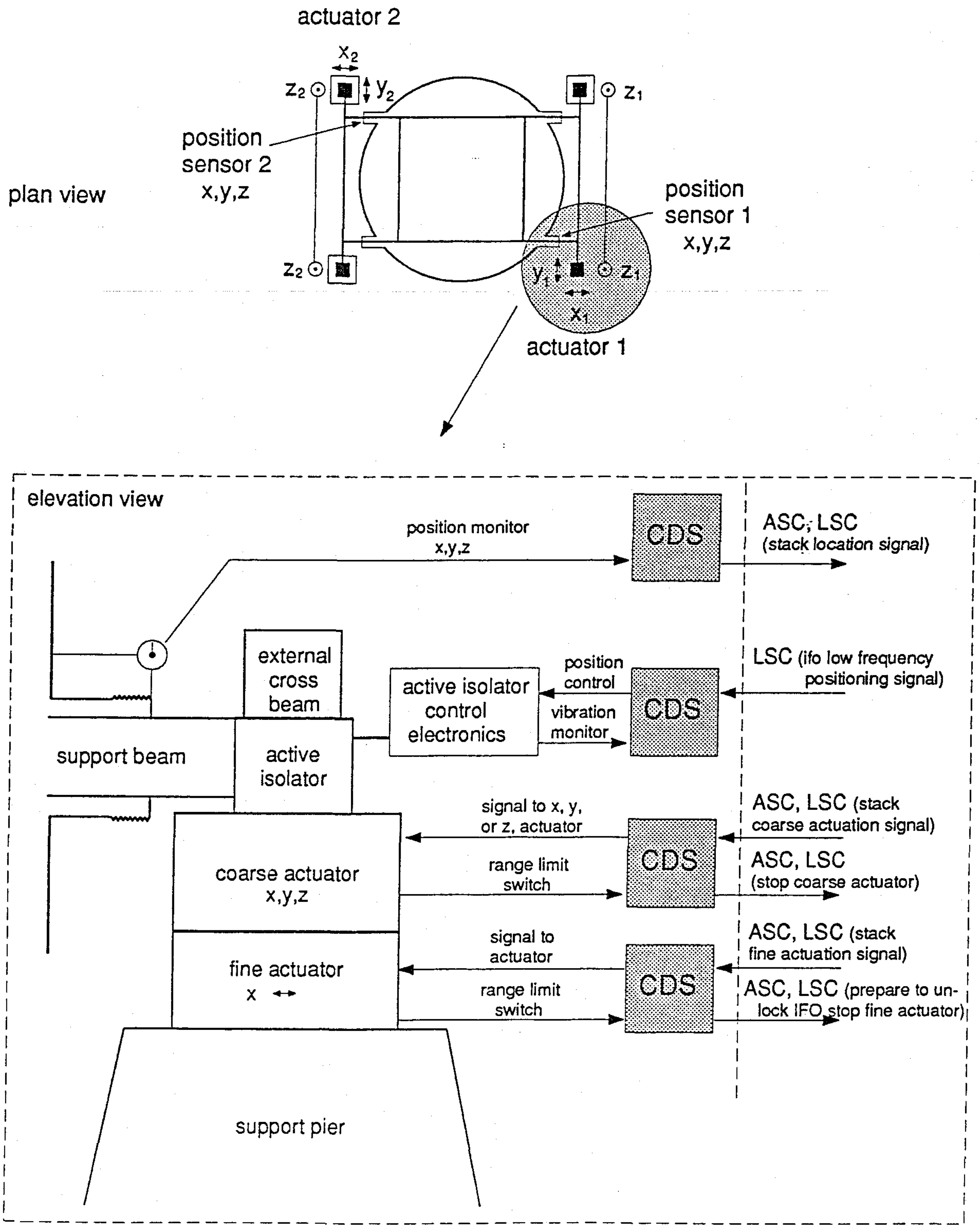

Figure 8: Diagram showing signal interfaces between BSC-SEI and other Detector subsystems

BSC-SEI Control Signals
Inputs • Interferometer low frequency positioning signal (LSC) • Stack coarse actuation signal (ASC, LSC) • Stack fine actuation signal (ASC, LSC)
Outputs • Stop coarse actuator (ASC, LSC) • Stop fine actuator (ASC, LSC)
HAM-SEI Monitor Signals
Outputs • Stack location signal (ASC, LSC)

Table 4: Control Signal interfaces between HAM-SEI and other Detector subsystems

4 OPTICAL INTERFACES

There are no optical interfaces.

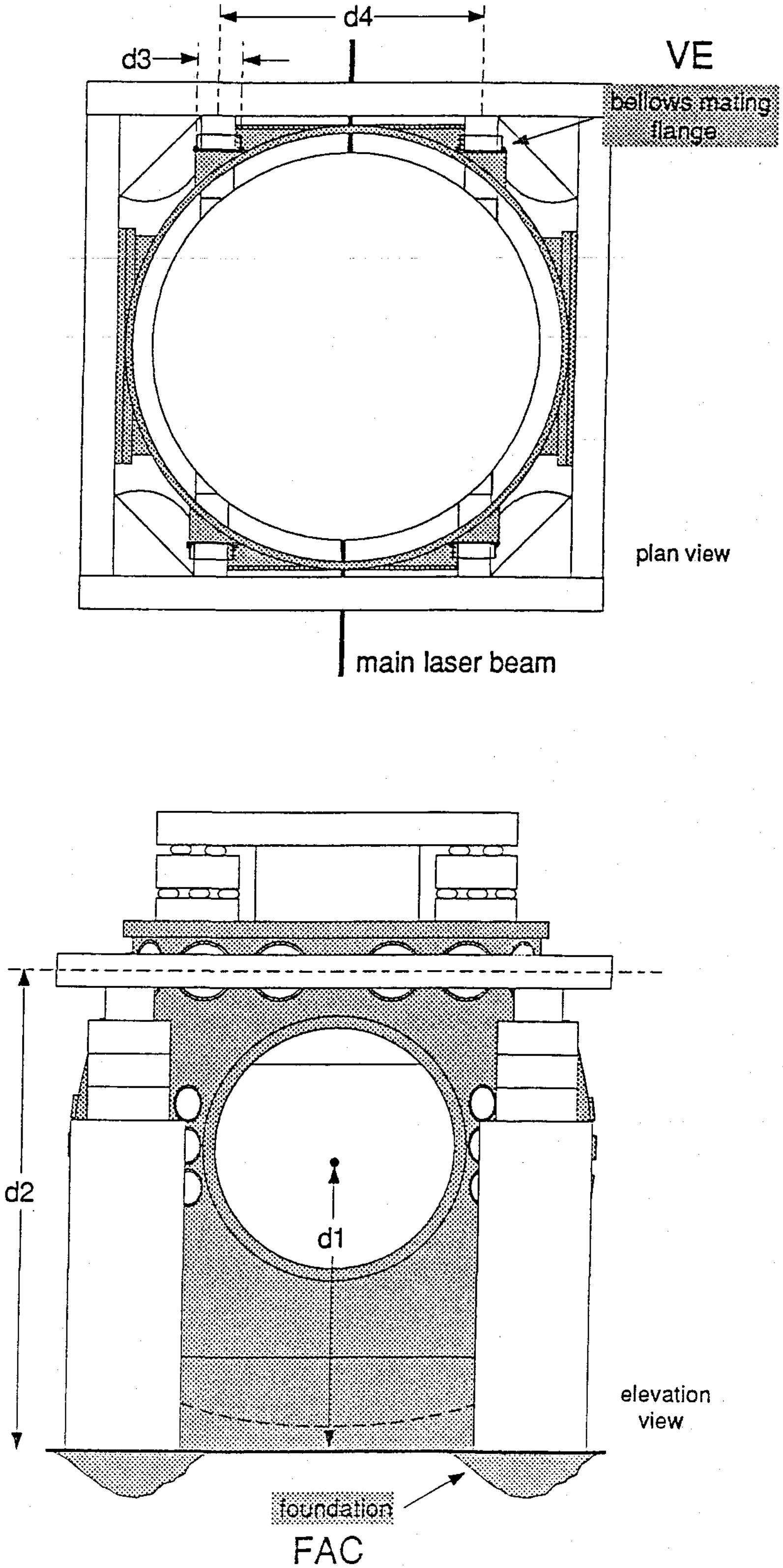

Figure 10: Mechanical interfaces between BSC-SEI and systems external to the detector

Mechanical Mounting Interfaces			*Drawing/ Doc #*
BSC-SEI Mounting Surface	*FAC/VE Mounting Surface*	*Interface and its characteristics*	
Support pier	Foundation slab (FAC)	Anchoring must secure pier to foundation rigidly so that actuator forces applied between pier and support structure do not tilt or displace piers	
Bellows flange	Bellows mating flange (VE)	Flange size and type Bolt hole pattern Bolt size	

Critical Dimensions	*Drawing/ Doc #*
d1 +/- tol. = distance from main laser beam to the facility floor d2 +/- tol. = distance from centerline of support beam port to the facility floor d3 +/- tol. = inner diameter of VE support beam port d4 +/- tol. = distance between centerlines of the 2 parallel support beam tube ports	

Stay Clear Zones	*Drawing/ Doc #*
Piers require ~ 3 ft diameter footprint on the facility floor. This must extend vertically to the height of the support beam ports. A stay clear zone for the external support structure and actuators requires a 3 ft wide ring surrounding the BSC in the plane defined by the support beam ports.	

Table 6: Mechanical interfaces between BSC-SEI and systems external to the detector

6 UTILITY INTERFACES BETWEEN SEI AND FACILITY

HAM-SEI Component Interface	*Utility Interface*	*Characteristics*	*Drawing/ Doc #*
Coarse actuators	power	voltage/power requirement	
active isolators	power	voltage/power requirement	

Table 7: Utility interfaces between HAM-SEI and facility

BSC-SEI Component Interface	*Utility Interface*	*Characteristics*	*Drawing/ Doc #*
fine actuators	power	voltage/power requirements	
Coarse actuators	power	voltage/power requirements	
active isolators	power	voltage/power requirements	

Table 8: Utility interfaces between BSC-SEI and facility

7.9 Alignment Sensing/Control (ASC)

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Naming Convention and Interface Definition for SUS

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1 NAMING CONVENTION FOR THE SUSPENSION COMPONENTS

The naming convention for the suspension components is shown in Fig. 1.

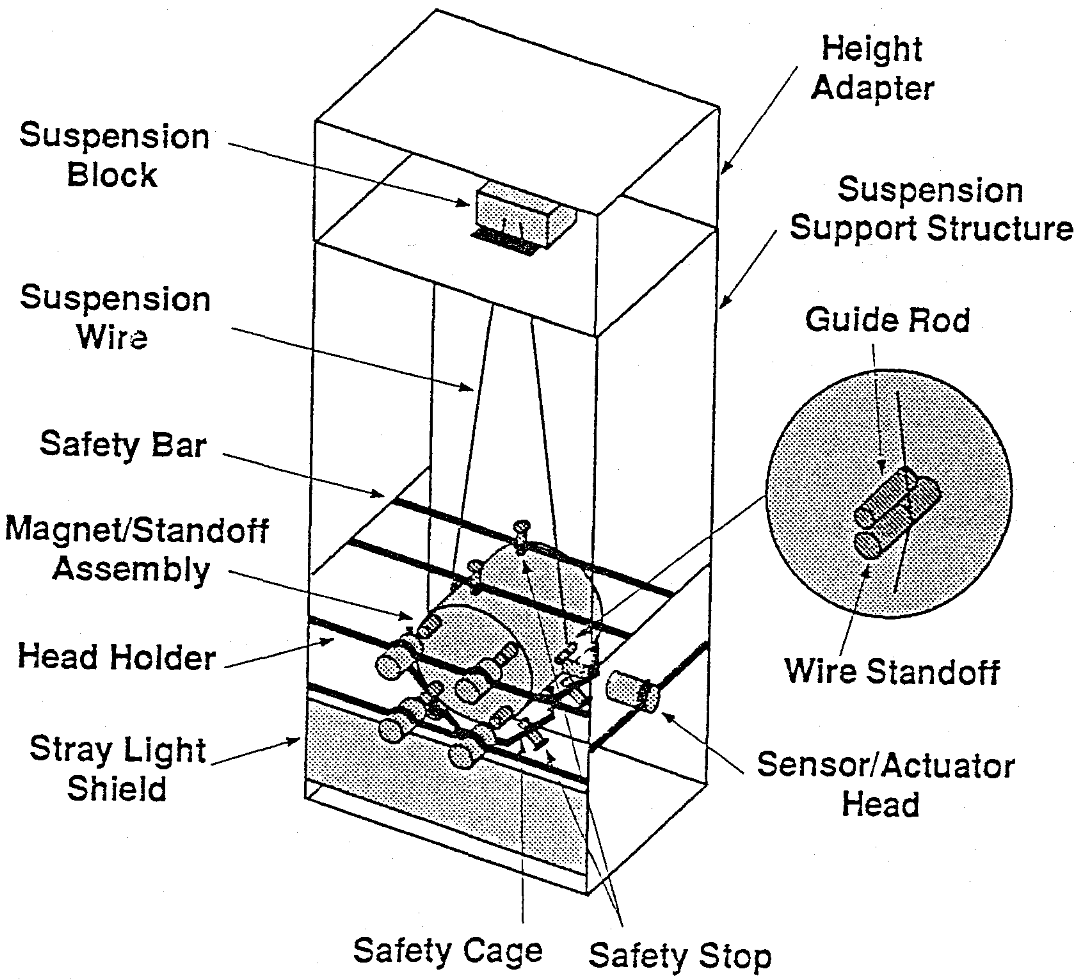

Figure 1: Naming convention for the suspension components. The height adapter exists only for the suspension for the BSC chamber, not for the HAM chamber. The whole assembly is called Suspension Assembly.

2 MECHANICAL INTERFACES

The mechanical interfaces between SUS and other detector subsystems are shown in Fig. 2 and Table 1.

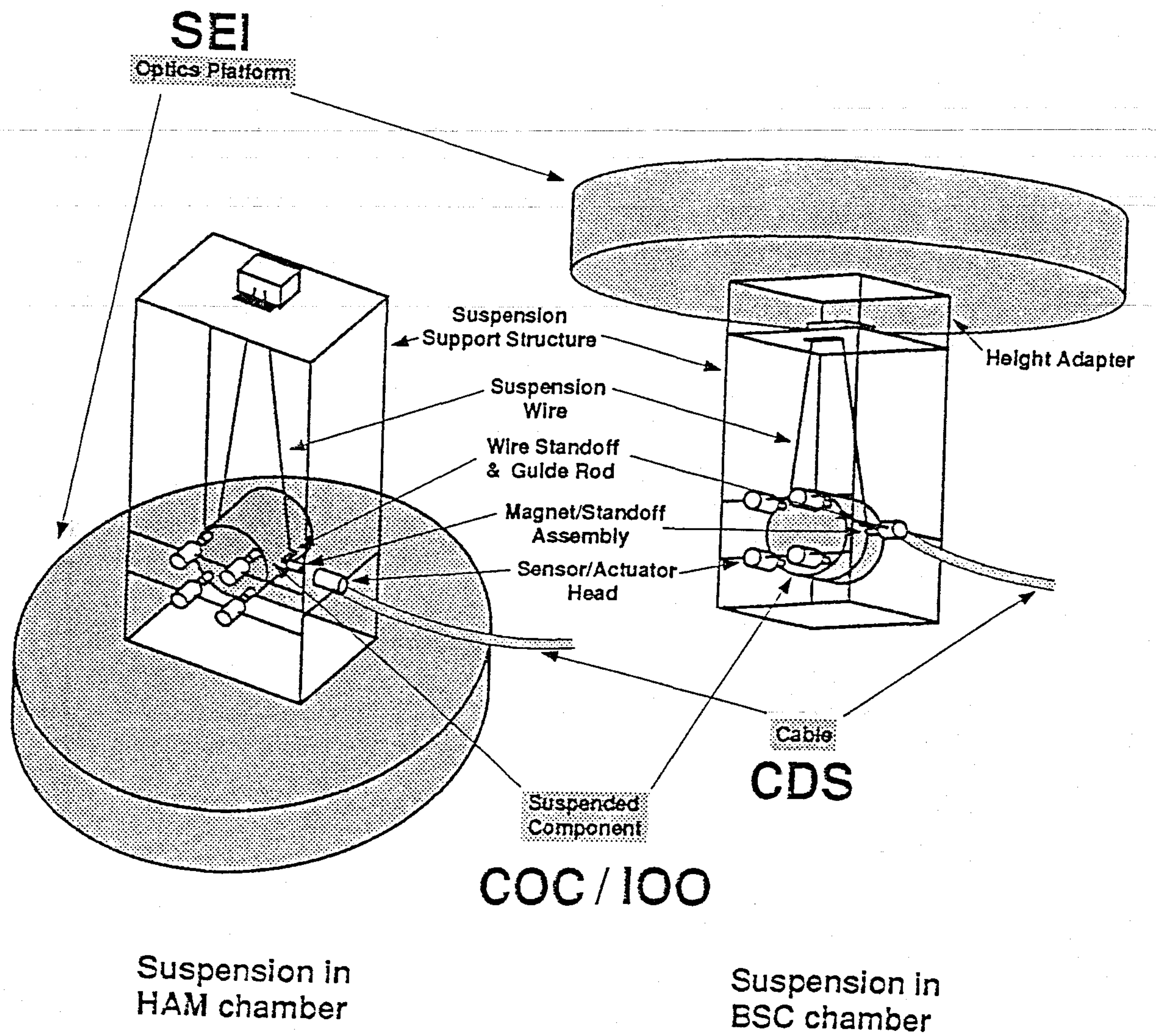

Figure 2: Mechanical interfaces between SUS and other detector subsystems (Left: the suspension system in the HAM chamber; Right: the suspension system in the BSC chamber). The objects and their names belonging to other subsystems are shaded.

Mechanical Mounting Interfaces			*Drawing/ Doc #*
SUS Mounting Surface	*Other Subsystem Mounting Surface*	*Interface and its Characteristics*	
Top Plate of Height Adapter	BSC Optics Platform (SEI)	Bolts/screws	
Bottom Plate of Suspension Support Structure	HAM Optics Platform (SEI)	Bolts/screws	
Suspension Wire	Suspended Component (COC/IOO)	Friction	
Wire Standoff and Guide Rod	Suspended Component (COC/IOO)	Glue	
Magnet/Standoff Assembly	Suspended Component (COC/IOO)	Glue	
Sensor/Actuator Head	Cable (CDS)	Clamp	

Critical Dimension/Size	*Drawing/ Doc #*
Height of the center of suspended components relative to the bottom surface of the BSC Optics Platform (SYS)	
Height of the center of suspended components relative to the top surface of the HAM Optics Platform (SYS)	
Clear aperture of the suspended components (COC, IOO)	
Maximum size of the suspension support structure (ASC)	
Maximum weight of the suspension (SEI)	

Table 1: Mechanical interfaces between SUS and other detector subsystems

3 SIGNAL INTERFACES

The signal interfaces between SUS and other detector subsystems are shown in Fig. 3 and Table 2.

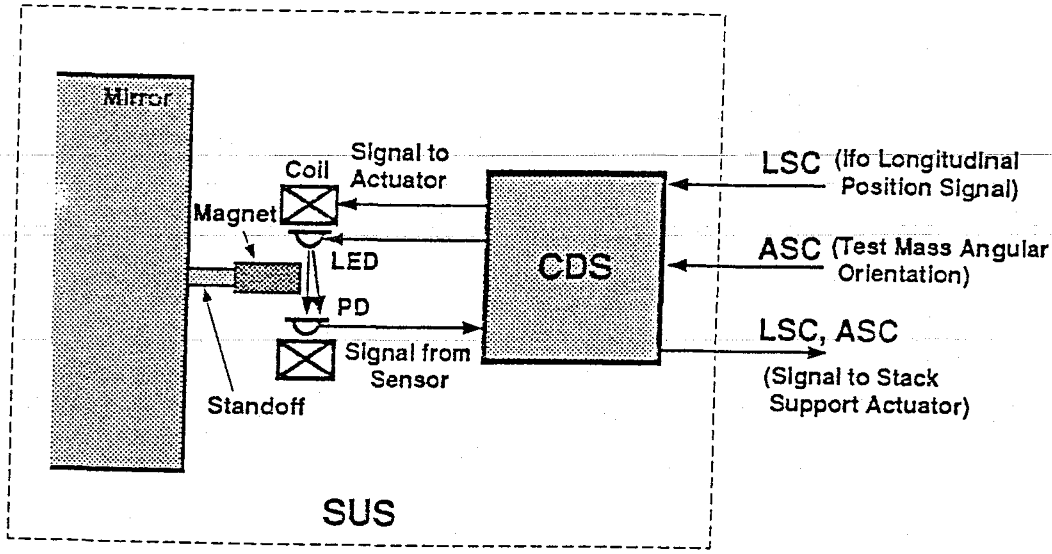

Figure 3: Diagrams showing signal interfaces between SUS and other detector subsystems

SUS Control Signals
Inputs • Interferometer longitudinal position signal (LSC) • Test mass angular orientation (ASC)
Outputs • Signal to stack support actuator (LSC,ASC)

Table 2: Signal interfaces between SUS and other detector subsystems

4 OPTICAL INTERFACES

There is no optical interfaces between *SUS* and other detector subsystems.

5 INTERFACES BETWEEN SUS AND SYSTEMS EXTERNAL TO THE DETECTOR (FAC/VE)

There is no interfaces between *SUS* and systems external to the detector.

7.8 Seismic Isolation (SEI)

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Interferometer Requirements Flowdown to SEI

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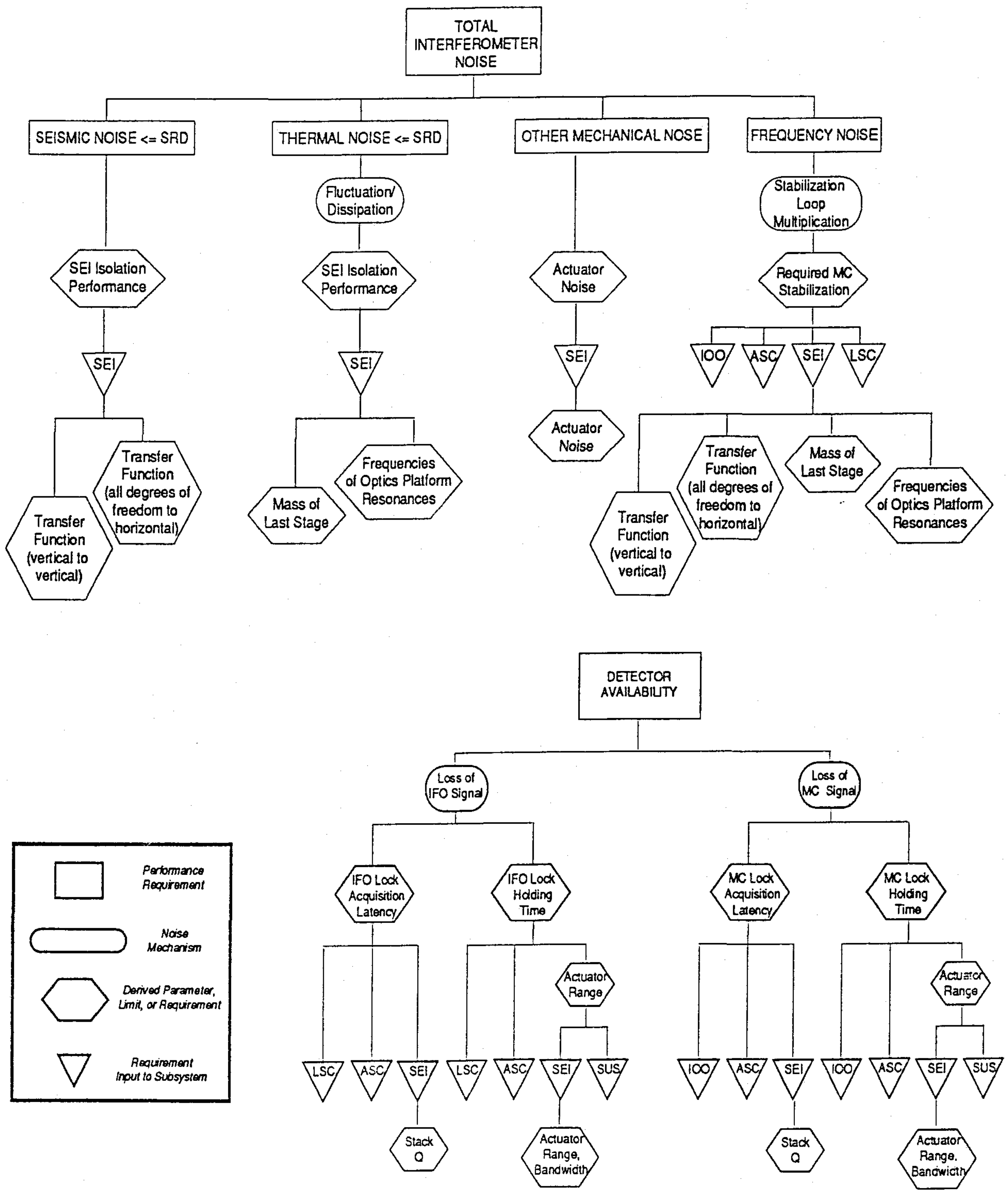

Figure 1: SEI Requirements Flowdown from SYS

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Interferometer Requirements Flowdown to SUS

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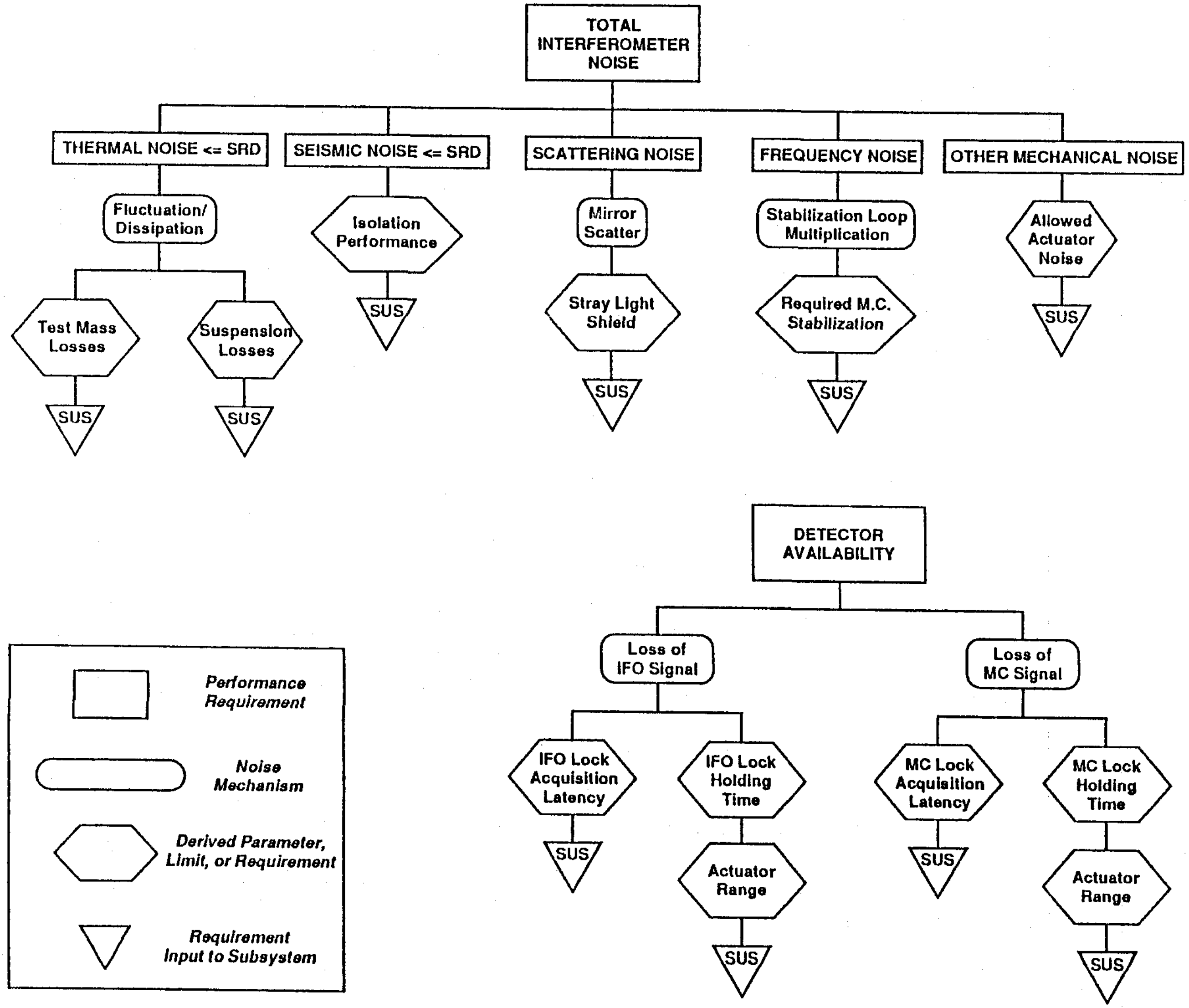

Figure 1: Interferometer Requirements Flowdown to SUS

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Interferometer Requirement Flowdow to the COC

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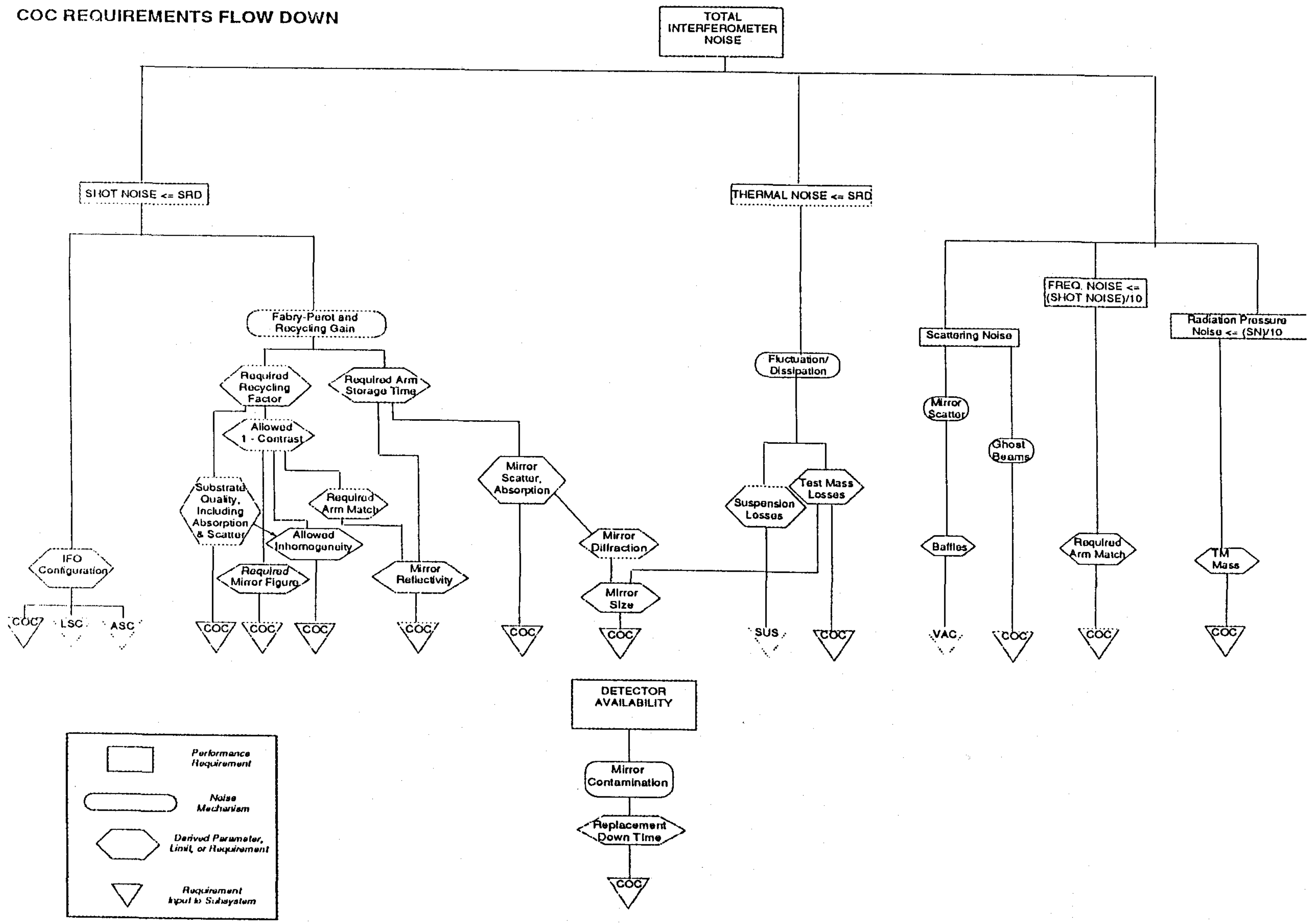
COC REQUIREMENTS FLOW DOWN



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Naming Convention and Interface Definition for the COC

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1 NAMING CONVENTION FOR THE CORE OPTICS COMPONENTS

Physically, the core optics subsystem consists of the following components as shown in Fig. 1:

- Test masses (TM) of two types: input TM (ITM) and end TM (ETM) These are fused quartz cylinders
- Beam splitter (BS) substrate: fused quartz cylinder
- Pick off mirrors (PO): Fused quartz cylinders
- Recycling mirror (RM) substrate: fused quartz cylinder.
- Fold mirror (FM)substrates: fused quartz cylinder.
- Anti reflection coating (ARxx) applied to one surface ("surface 2") of each optic: e.g. ARRM= anti-reflection coating on RM2 surface of recycling mirror
- Enhanced reflectance coating (ERxx) applied to one surface ("surface 1") of each optic, **except POs:** e.g. ERITM = reflector coating on ITM1 surface of input test mass.
- Anti-static coating on COC sides : naming TBD.

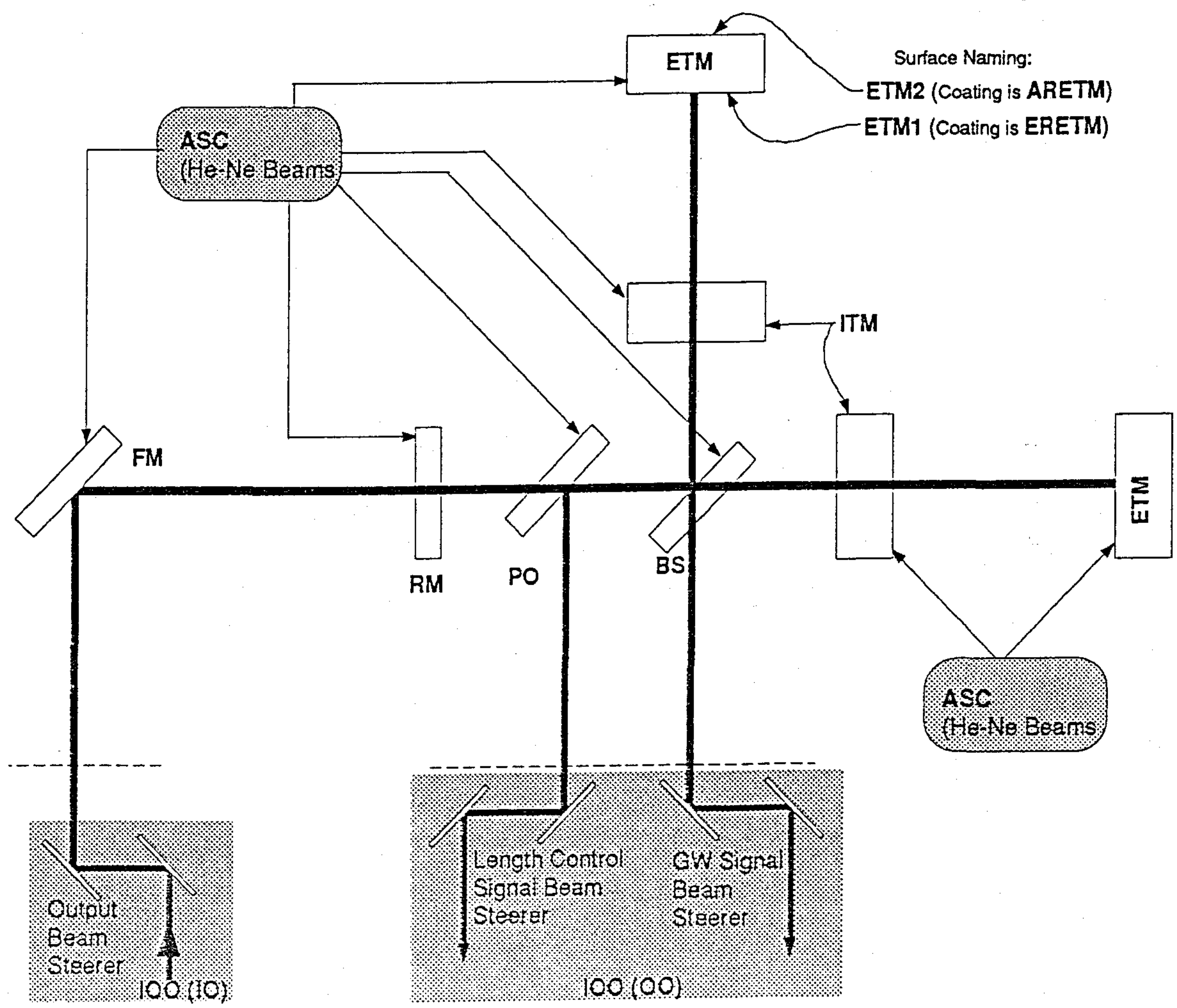

Figure 1: Naming Convention for the COC.

2 MECHANICAL INTERFACES

The Core Optics Components have mechanical interfaces with other subsystems as shown in table 1 (Ref. Fig. 2). It should be noted that with the possible exception of an electrostatic shield coating applied to the COCs and the influence of outgassing, all mechanical interfacing items belong to the SUS subsystem.

Table 1: Mechanical interfaces between COC and other Detector subsystems

Mechanical Interfacing Points			*Drawing/ Doc#*
COC Element/ Surface	*Other Subsystem Element*	*Contact/Connection method*	
All Elements/ Cylindrical side	SUS-Suspension wire	Constrained slip fit	
All Elements/ Cylindrical side	SUS-Wire standoff	Adhesive	
All Elements/ Cylindrical side & Surface 1 or 2	SUS-Magnet/Vane assembly	Adhesive	
AllElements TBD/ Cylindrical side	TBD-Electrostatic contact	Electrostatic shield coating TBD	
All Elements/All surfaces	All Subsystems Surfaces	Outgassing from all elements	
Critical Dimension/Size			*Drawing/ Doc#*
Offset of COC element optical axis relative to the top surface of the HAM Optics platform (= d_1 in SEI DRD). Offset of COC element optical axis realative to the bottom surface of the BSC Optics platform (=d_2 in SEI DRD			

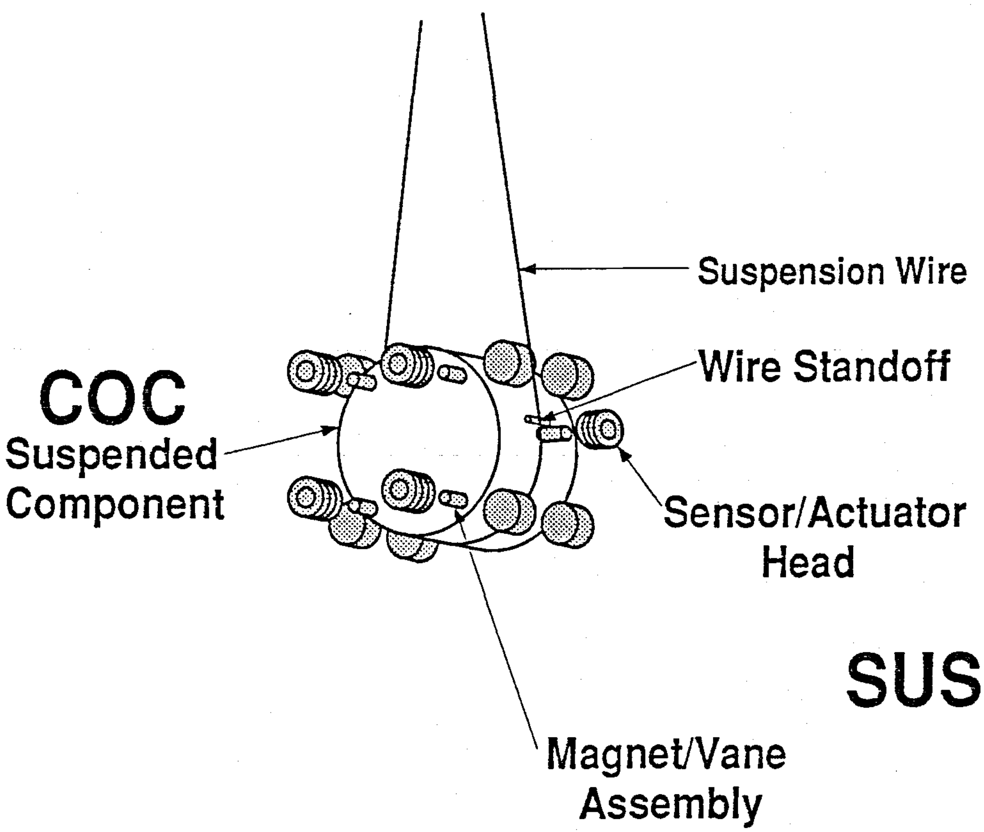

Figure 2: Mechanical interfaces of COCs

3 OPTICAL INTERFACES

Optical interfaces are represented in figure 1. The optical interfaces to the COC may be divided into two categories:

- Primary IFO beams received from(IO) and delivered to(OO) the COC subsystem from the IOO subsystem. These beams are to have vertical polarization, to within $\pm 1^{\circ}$ TBD, with respect to the plane defined by the two IFO arms.
- Diagnostic beams which interface to the ASC subsystem and are either input to COC from the ASC or derivative from the primary IFO beams (as ,e.g., ghost beams off wedged AR surfaces.

Table 2: Optical interfaces between COC and other Detector subsystems

COC Element/ Interface	*Other Subsystem*	*Interface & Characteristics*	*Drawing/ Doc.#*
Recycling mirror (RM) secondary surface	IO output steering mirror	Laser power Laser Beam size	
BS secondary surface and PO	OO GW signal input steering mirror	Beam power Beam size	
Lenght control pickoff (PO)	OO length control signal input steering mirror	pickoff light power fraction	
All COC secondary surfaces except POs TBD	ASC-Beam centering monitor	Ghost beam pickoff AR coating reflectivity	
All COC secondary surfaces TBD	ASC-Optilever beam centering	Auxillary probe laser beams	

4 EXTERNAL INTERFACES.

The COCs are directly coupled (as compared to being indirectly coupled via the SUS subsystem) to the FAC/VE systems via their vacuum environment. The vacuum system is required to be of a quality such that the integral contamination to the COC surfaces over ~year time scale does not degrade the IFO performance.

7.6 Length Sensing/Control (LSC)