Research addressing Stochastic Forces

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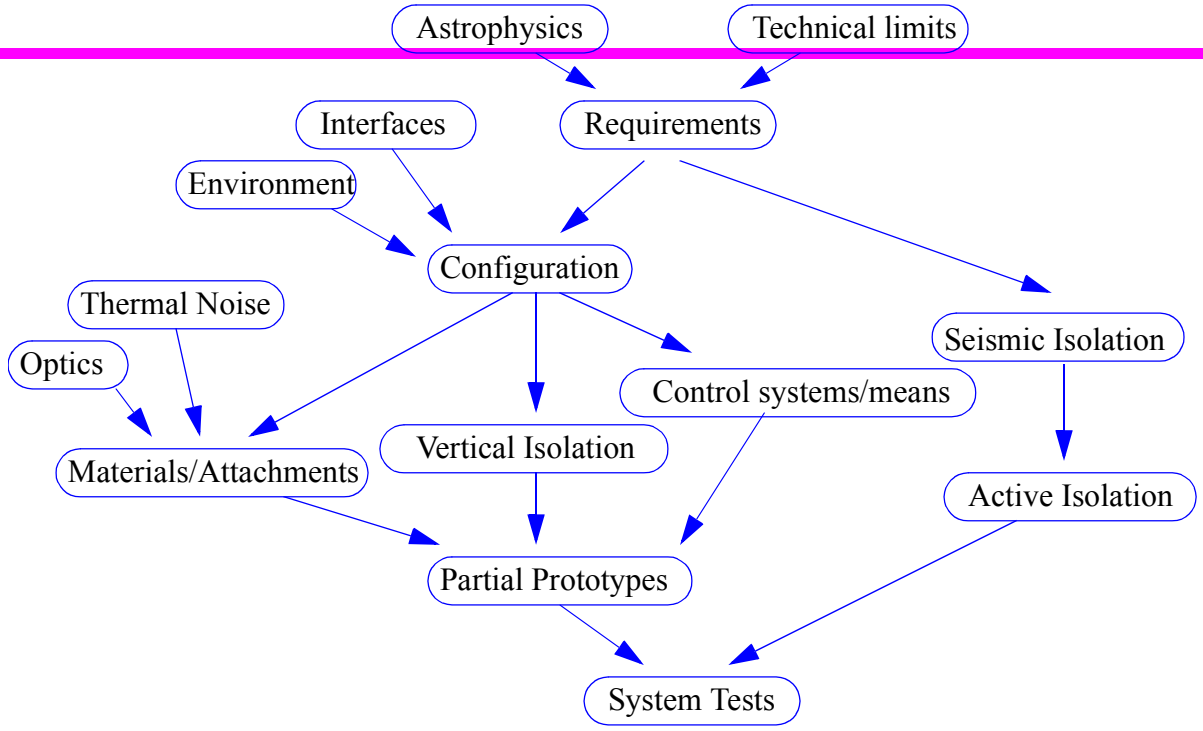
G970267- 00- D

Scope

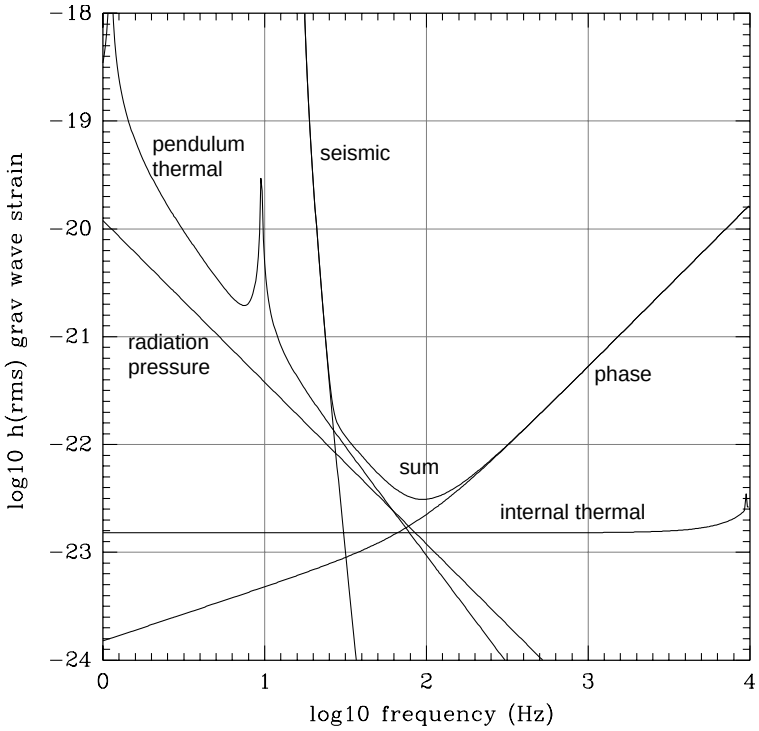
- thermal noise
- excesses beyond thermal noise
- seismic noise
- control systems

LIGO-G970267-00-R

Focus: development of a double suspension system for 2004



Top-level design questions



Requirements

- point of departure: Advanced LIGO sensitivity curve
- individual technical noise sources to be re-estimated

Environment

- site seismic noise: correlations, extrema, stationarity, drifts
- acoustic noise, other couplings found to be important

Interfaces and inter-subsystem trades

- present passive stack; coarse actuators; optics; acquisition

Hardware Isolation/Suspension R&D

Seismic Isolation

- plan to re-use the bulk of present passive isolation system
- development of moderate-bandwidth external system, with possible sensors on stack to allow damping of modes

Control systems and actuators/sensors

- attempt to eliminate actuators on test mass through acquisition cleverness and trades between isolation/suspension system
- if needed, develop electrostatic actuators for test mass

Vertical isolation

- development of moderately-high Q vertical compliant stage for upper of double pendulums

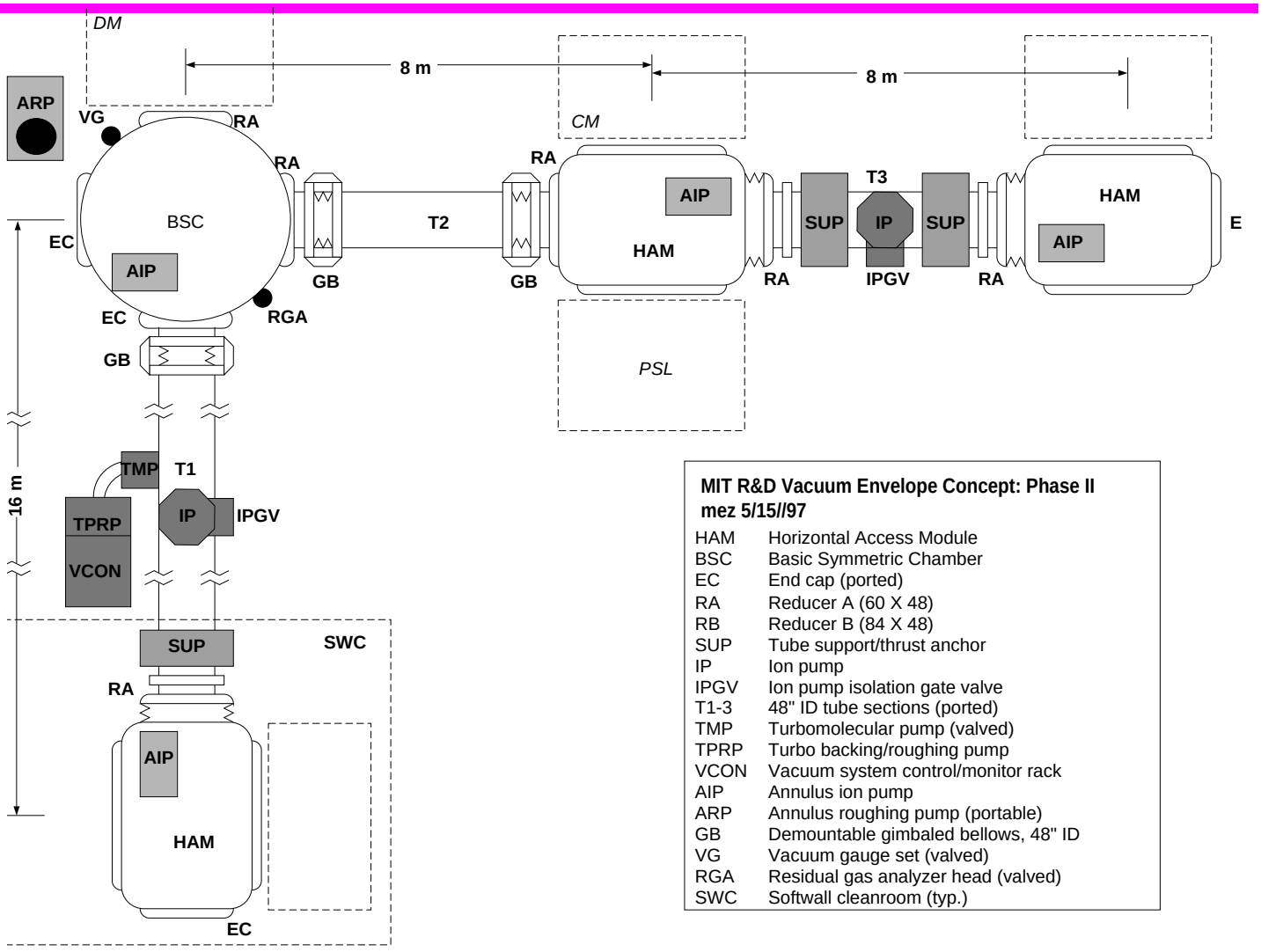
Characterization of LIGO I suspensions

- understand what we wish to do differently
- understand realities of cross-couplings, interaction with other systems

Configuration: Spring '99

- prototype test output plus modeling as input
- input from all LSC partners crucial

System tests



MIT R&D Vacuum Envelope Concept: Phase II
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HAM	Horizontal Access Module
BSC	Basic Symmetric Chamber
EC	End cap (ported)
RA	Reducer A (60 X 48)
RB	Reducer B (84 X 48)
SUP	Tube support/thrust anchor
IP	Ion pump
IPGV	Ion pump isolation gate valve
T1-3	48" ID tube sections (ported)
TMP	Turbomolecular pump (valved)
TPRP	Turbo backing/roughing pump
VCON	Vacuum system control/monitor rack
AIP	Annulus ion pump
ARP	Annulus roughing pump (portable)
GB	Demountable gimbaled bellows, 48" ID
VG	Vacuum gauge set (valved)
RGA	Residual gas analyzer head (valved)
SWC	Softwall cleanroom (typ.)

LIGO/Community facility for end-to-end full-scale testing

- tests of isolation/suspension systems, thermal noise strategies
- final qualification of such systems prior to LIGO site installation
- flexible envelope, also for optics studies
- fully operational in ‘99, for testing of double suspension system

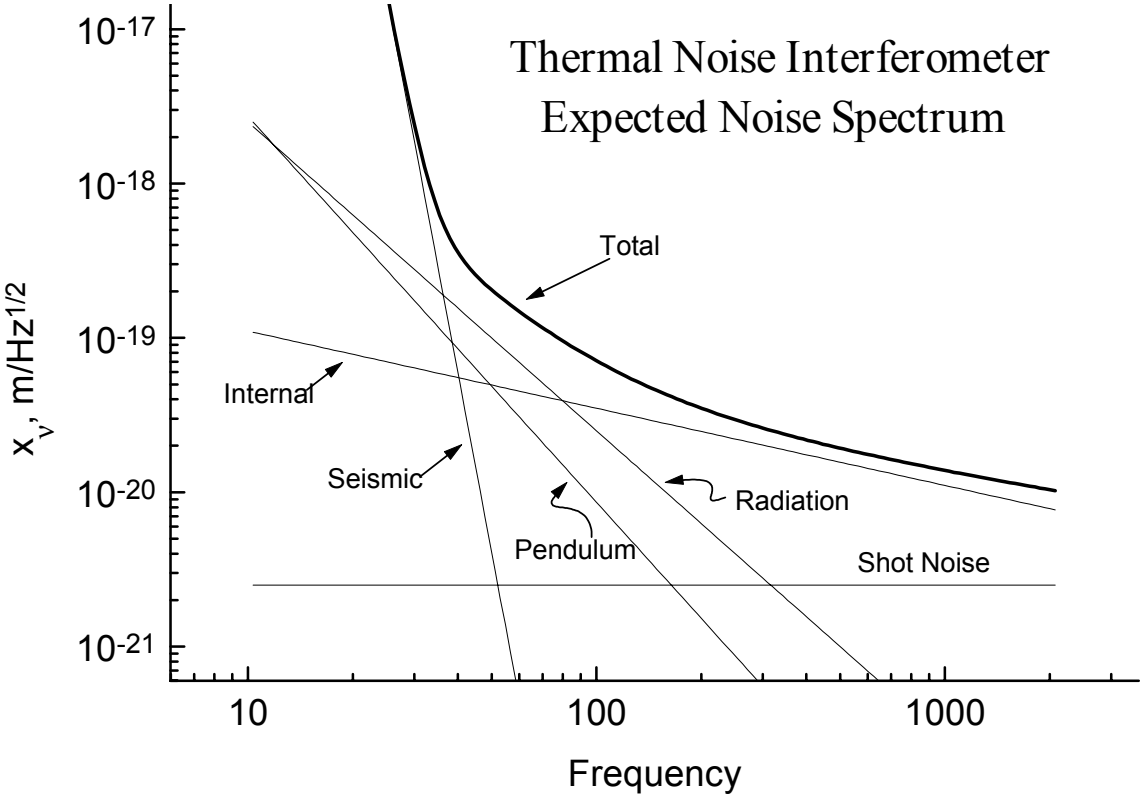
Thermal Noise research

Development of fused-silica-fiber pulling technology

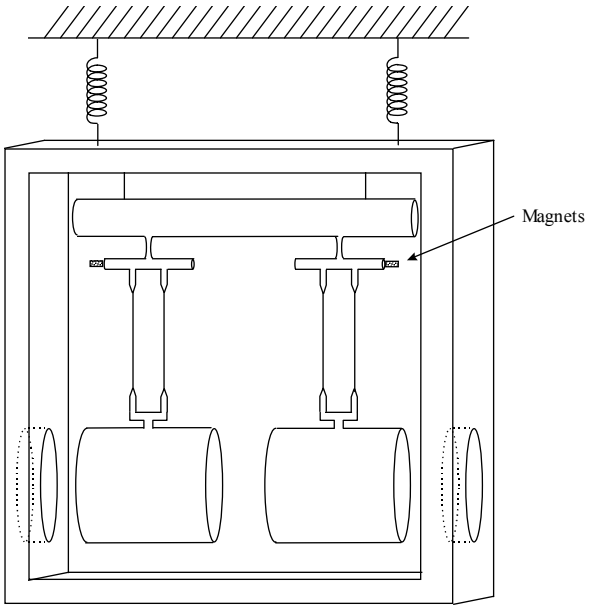
- acquisition and 'tuning' of commercial system
- tests of Q and strength

Direct measurement of thermal/excess noise

- special-purpose Thermal Noise Interferometer
- focussed on internal thermal noise of substrates



Thermal Noise Interferometer



Configuration

- short measurement cavity, long reference cavity
- LIGO passive stack
- common-mode mounting of test masses

Timeline

- in construction; to use parts of present MIT envelope, isolation
- operational early-summer 98, sensitive measurements mid-99