

# LIGO ADVANCED SYSTEM TEST INTERFEROMETER

## Program Status Report

Mike Zucker

LIGO Science Collaboration Meeting

LIGO Livingston Observatory

20-23 March, 2002



# LASTI Mission

- Test LIGO components & systems at **full mechanical scale**
- Practice installation & commissioning
- Minimize delays & downtime for advanced LIGO upgrades
- *Qualify design mods & retrofits for initial LIGO*

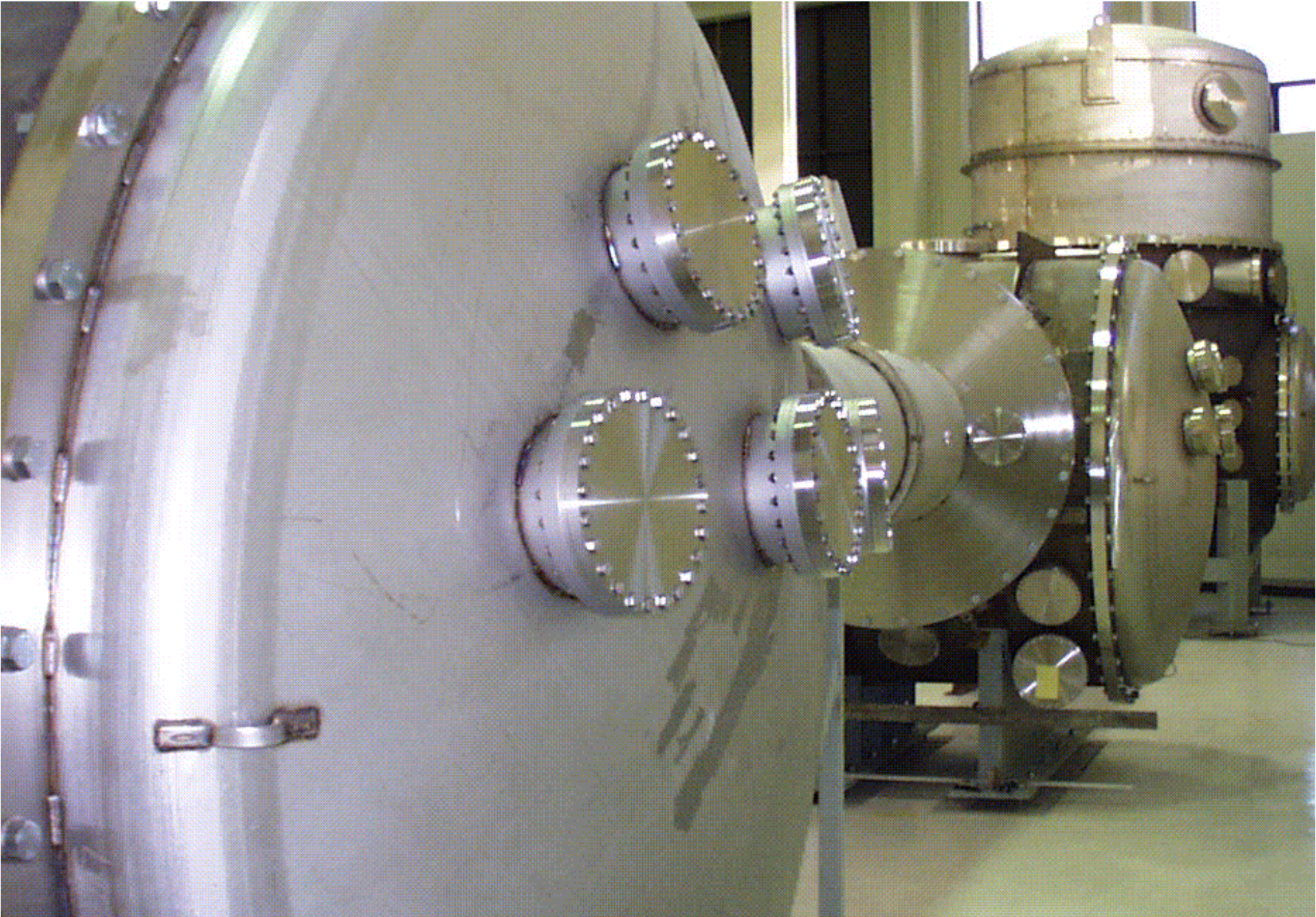
Specific Advanced LIGO Program Tasks ('01 - '06+):

- Qualify advanced **seismic isolation & suspension** systems and associated controls at full scale
- Develop detailed SEI/SUS **installation & commissioning** handbook
- Look for unforeseen interactions & excess **displacement noise**
- Test **LASER** and **Input Mode Cleaner** together at *full power*





Vacuum envelope, left (S) arm





# People

## •Locals

Grad - Jamie Rollins, Keisuke Goda

Engineering - Ken Mason, Ralph Burgess

Tech support - Myron MacInnis, Fred Miller, Bob LaLiberte

Scientists - Rich Mittleman, Gregg Harry, Dave Ottaway

Lunch - David Shoemaker, Mike Zucker

## •Visitors

LIGO I SEI - Corey Gray, Hugh Radkins, Gary Traylor, Harry Overmier

AdLIGO SEI - Joe Giaime, Giles Hammond, Brian Lantz, Wensheng Hua, Tuck Stebbins

AdLIGO SUS - Norna Robertson, Calum Torrie, Janeen Romie, Phil Willems, Mark Barton

CDS/DAQ/PSL/Initial SUS - Jay Heefner, Rus Wooley, Rick Karwoski, Paul Russel

## •TODAY'S TOPICS

PSL & Suspended Initial Test Cavity Progress

Vacuum System Performance Update

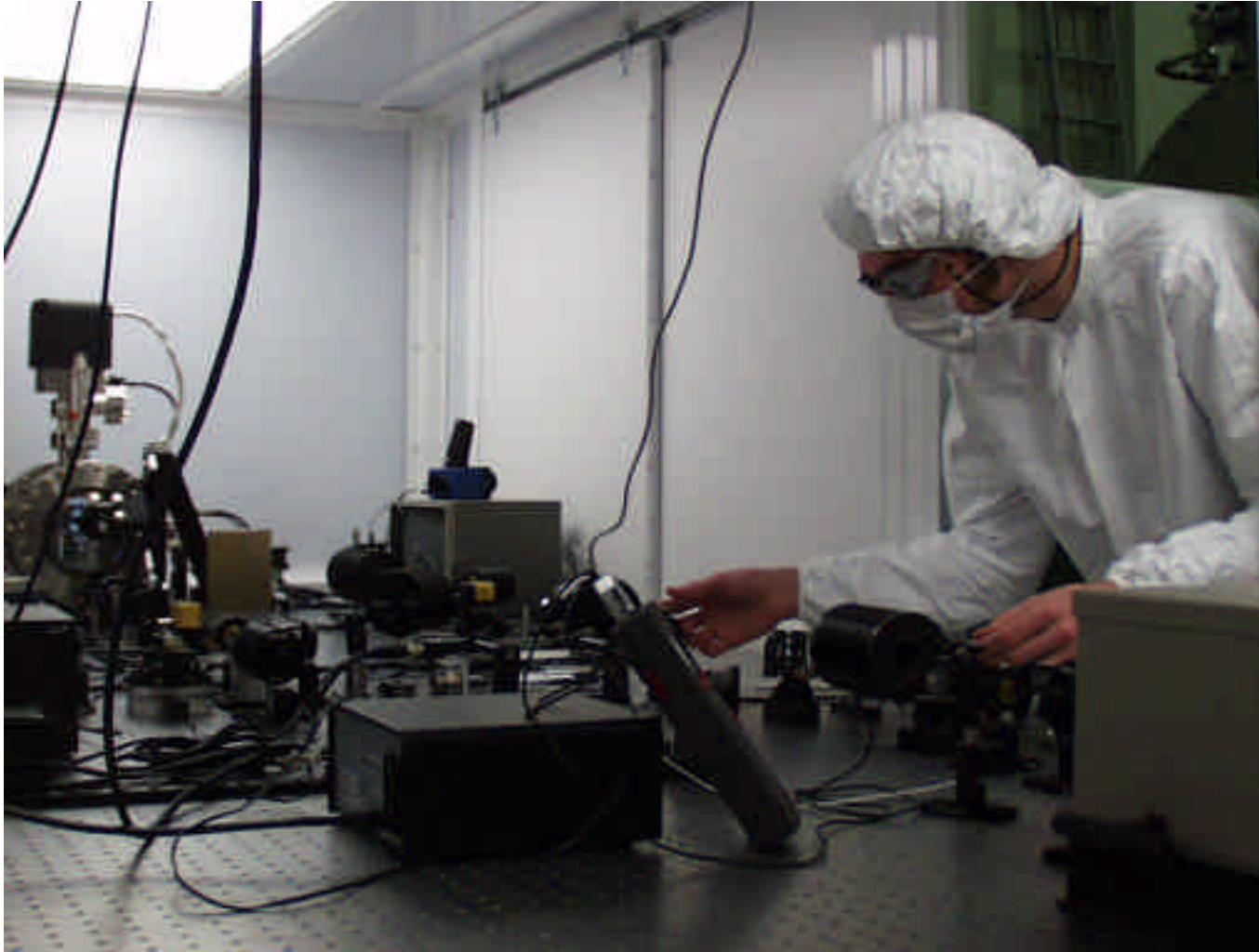
PSL & Suspended Test Cavity Progress

LIGO I External Pre-Isolator Program

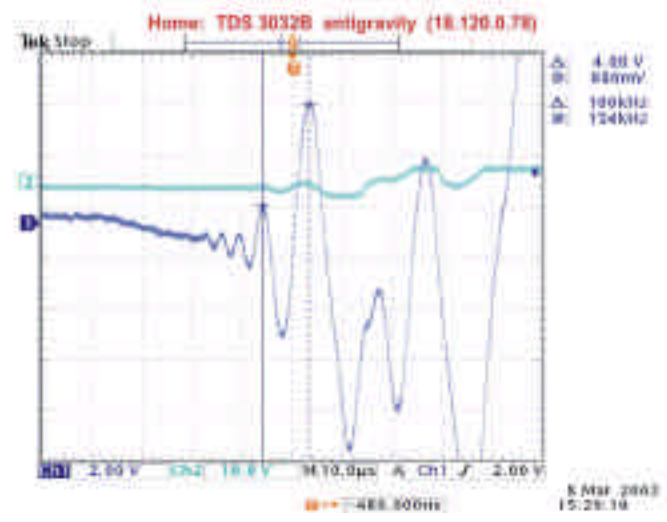
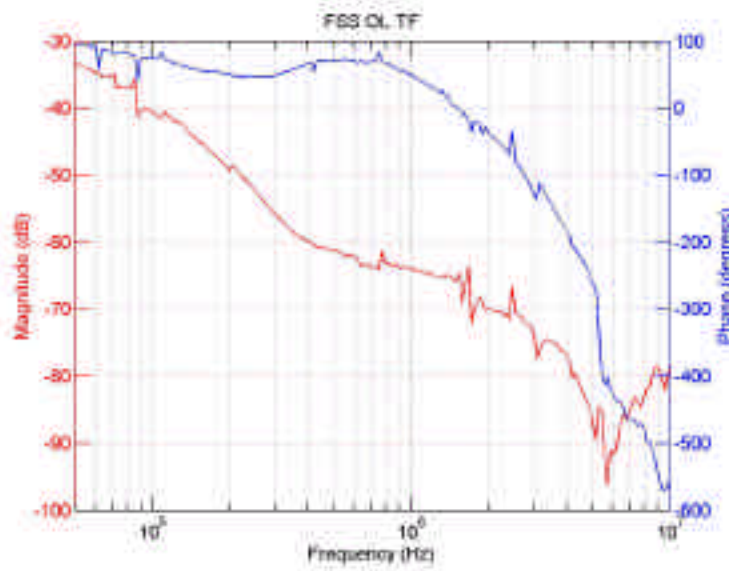
Schedule: Impact on AdLIGO Test Program



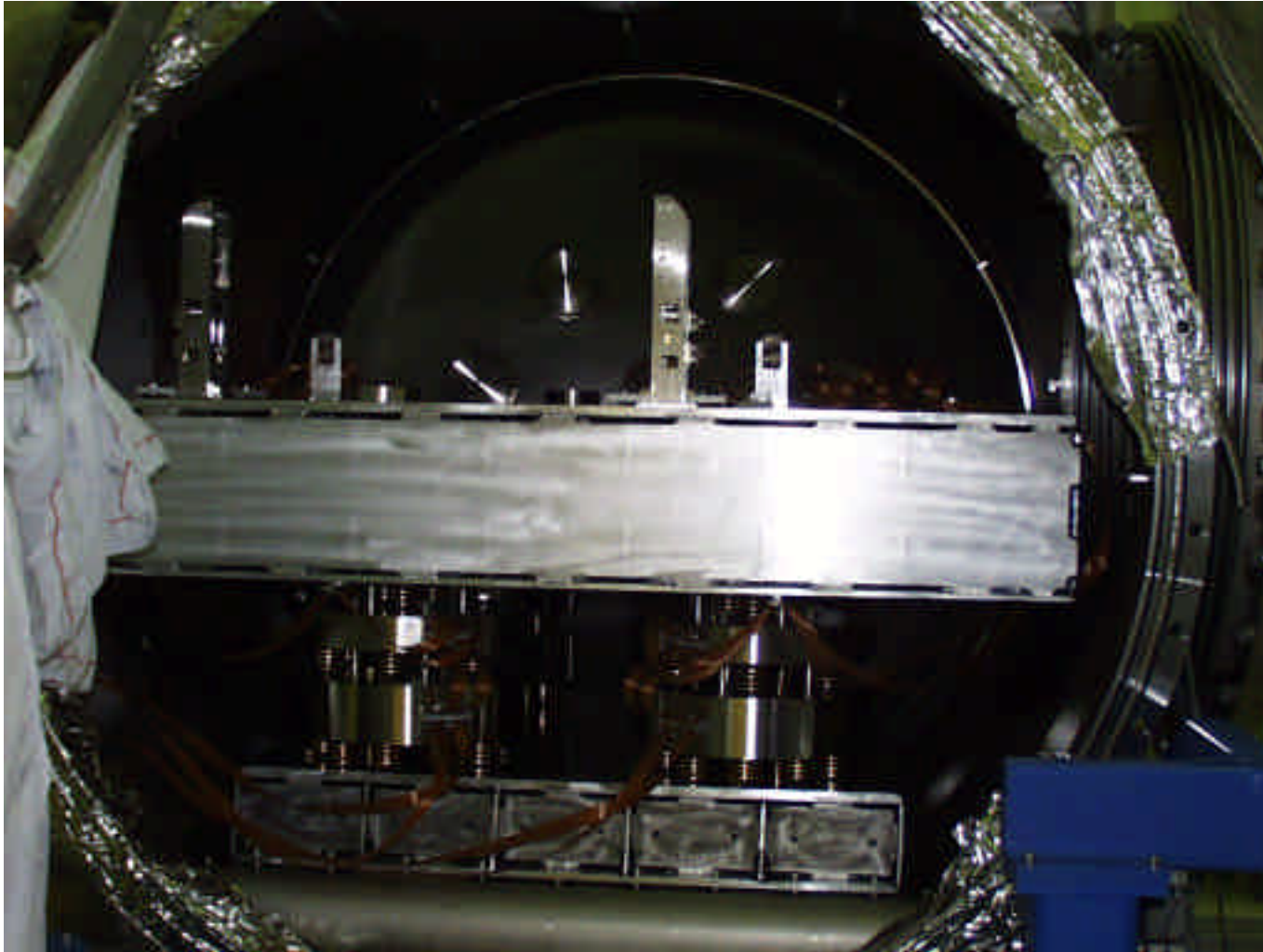
# PSL Enclosure & Optics



# PSL Locks! (but some work to do)

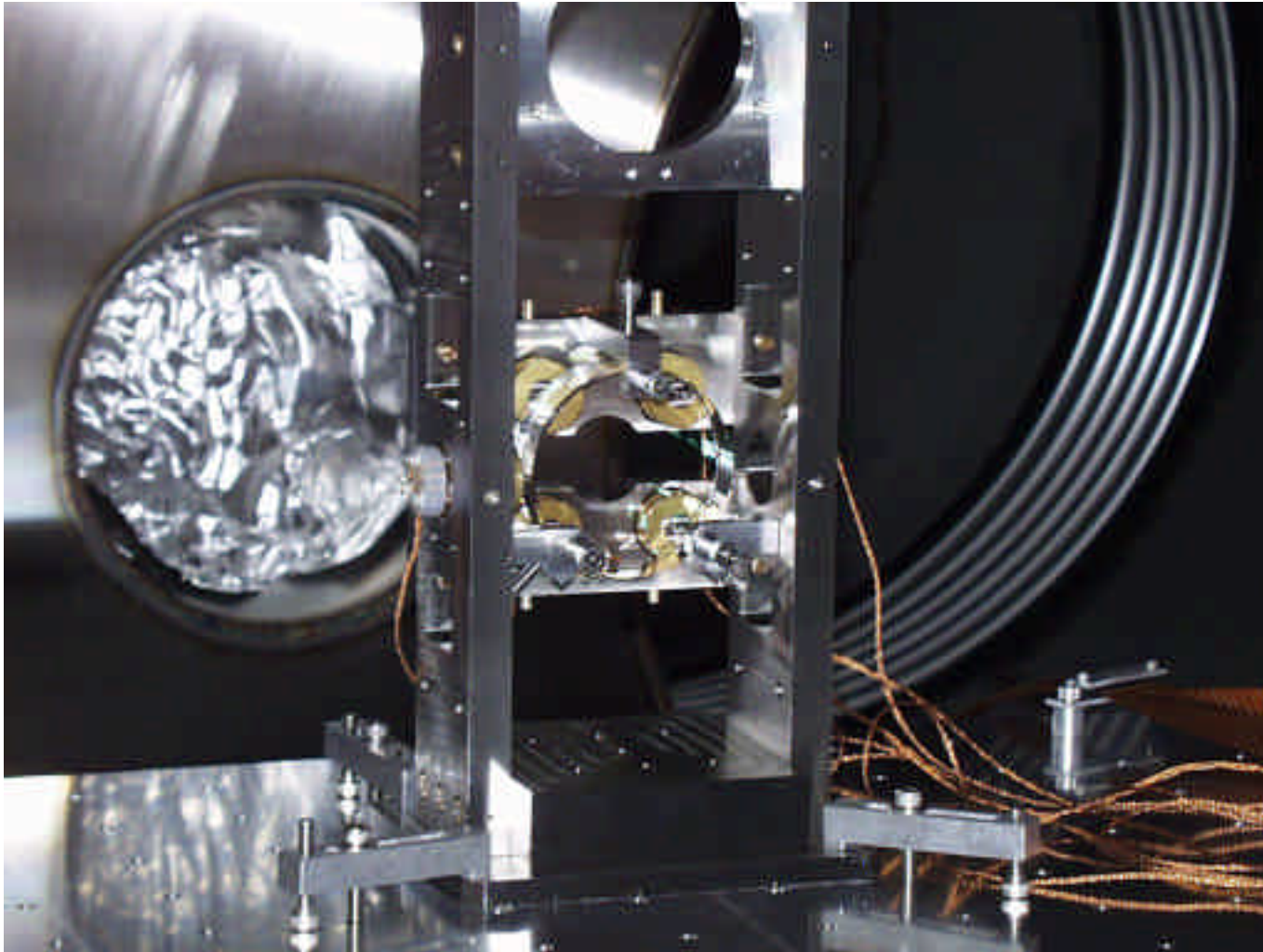


# Suspended 1m Test Cavity





# Suspended 1m Test Cavity





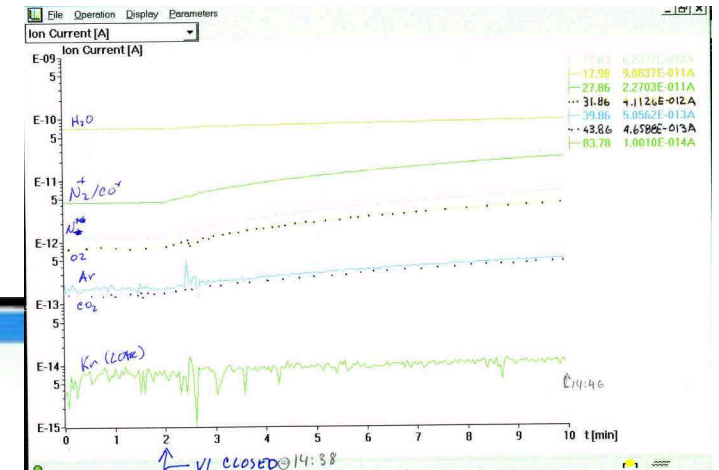
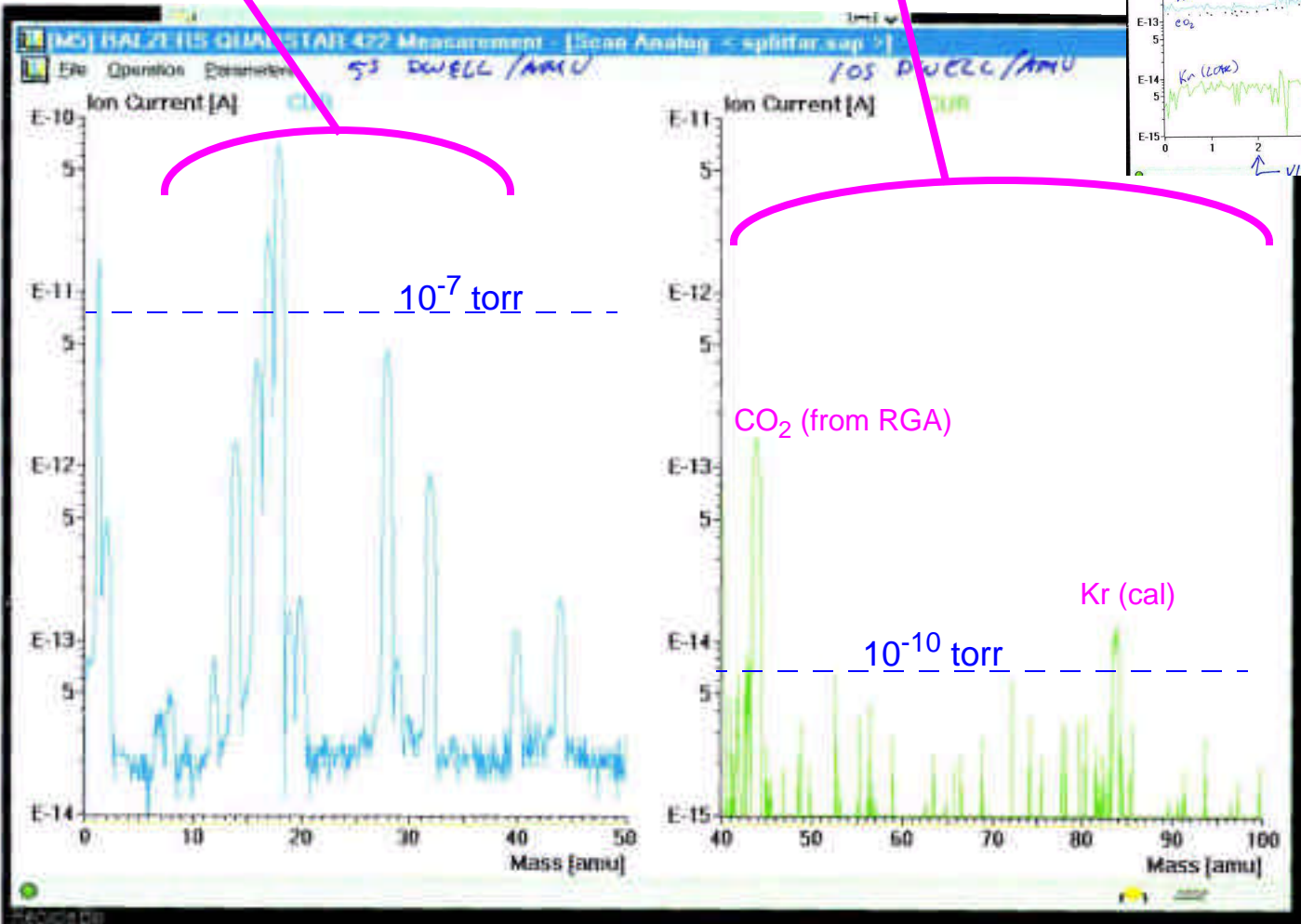
# 600 h Vacuum Baseline

BSC0 stack + 2 SOS + stack + wiring in HAM13

H<sub>2</sub>O, N<sub>2</sub>, O<sub>2</sub>, Ar: consistent with degassing of Flourel

(sensitivity S~ 85 μA/torr)

P(H<sub>x</sub>C<sub>y</sub>) < 2e-11 torr



Accumulation test on LASTI volume

(water diffusion is "interesting!")



# External Pre-Isolator

- Originally part of AdLIGO SEI plan: reduces control power req'd for internal active isolator
- **Accelerated** as retrofit to address impulsive noise at LLO due to logging (site install between S1 and S2)
- Active 6 DOF suppression w/ local geophones + position sensors
- Two **actuator** variants
  - Laminar proportional **hydraulic** piston (Stanford, LSU, LLO, MIT, Caltech)
  - Moving-coil **electromagnet** (MIT, LSU, LLO)
- Incl. 3 options for **damping** of primary modes of LIGO I stack
  - Active in-vacuo, using LVDT's and coil/magnets (Caltech)
  - Tuned-mass-damper in-vacuo passive (Caltech)
  - External sensing/actuation with narrowband gain (LSU, LLO)
- LASTI is the only place available for offline development & test



# LASTI EPI Plan

- Install LIGO I BSC stack *done*
- Characterized impedance/modes of BSC support piers *done*
- Characterize BSC stack for control allocation design *in progress*
- EM actuator standalone test *starts next week*
- Common preload/actuator support fabrications test & fit-check on HAM *~ 4 weeks out*
- EM actuator & active damper slated for HAM integration
- Hydraulic actuator slated for BSC integration
- Testing wraps up by 3Q02 to meet production schedule for LLO
- **SCHEDULE HIT DUE TO EPI:** “none” (or, “lots...”)

AdLIGO SEI deliveries slipped 6-12 months w.r.t. original LASTI baseline (partly from advancing EPI subproject out of adLIGO sequence)

Moved up adLIGO HAM SUS (triple pend) controls test (on hacked LIGO I stack)

Moved up adLIGO intensity stabilization exp't using initial PSL (MS thesis)



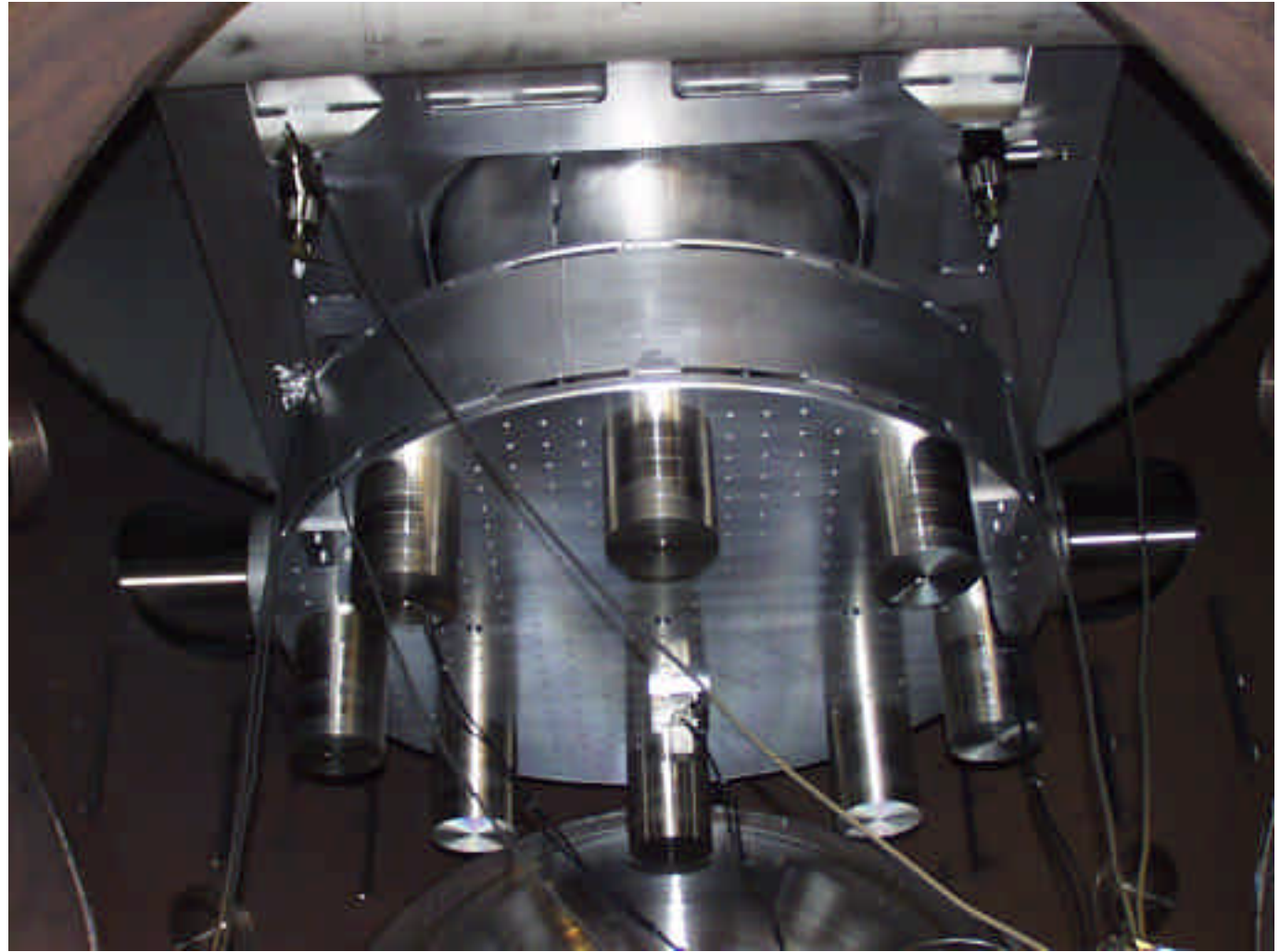


# BSC Stack Characterization Test

SEI support structure instrumented with 6 accelerometers  
Optics payload plate instrumented with 8 4 Hz geophones



PEM shakers on loan  
from LLO and LHO  
mounted to external  
seismic supports



# Updated milestones

4Q99 / 4Q99 act: LASTI vacuum envelope commissioned

1Q00sch / 3Q01 act: LASTI SEI external structures installed

2Q00sch / 4Q00 act: LASTI infrastructure design review

3Q01sch / 1Q02 act: LASTI infrastructure complete (DAQ, SEI, PSL, test cavity)

NEW 4Q01: Fit LIGO I BSC stack (from spare parts) to support EPI qualification

NEW 1Q02: External pre-isolator tests for LLO seismic retrofit **underway**

NEW 4Q02: Early HAM SUS “controls” pre-test

NEW 1Q03: PSL intensity stabilization experiment

~~4Q02: HAM SEI pathfinder installed for standalone testing *slips to 2Q03*~~

~~3Q02: BSC SEI pathfinder installed for standalone testing *slips to 3Q03*~~

2Q04: LASTI noise test SUS prototypes installed *not allowed to slip!*

1Q05: Interferometric displacement tests

2Q05: LASTI SUS/SEI test review

3Q05: Adv LIGO PSL/MC tests start

