In-Vacuum Detection Table with Output Mode Cleaner

LSC Meeting, March 20, 2005

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G050118-00-D

Basic Motivation

❑ **LIGO I upgrade will require a >30W laser**
  ➢ Would require between **12** and **24+** photodetectors at AS port!

❑ **Acoustic coupling**
  ➢ Close to limiting the sensitivity (jitter at detection tables)
  ➢ H1-H2 stochastic upper limit probably effected by it

❑ **Solution**
  ➢ Output mode cleaner (OMC)
  ➢ In-vacuum detection bench
  ➢ Design similar to Advanced LIGO?

# Output Mode Cleaner
~10x Power Reduction at AS port

❑ Carrier contrast defect improves by a factor of 20

➢ With OMC: carrier 2% of total power

➢ Makes it possible to reduce modulation depth

❑ ASI signal decreases by a factor of 7

➢ "ASI locking" symmetrizes RF sidebands

❑ Removes offset corresponding to 10^{-12} m

➢ Reduced AM noise coupling: factor of 60 at 3 kHz

➢ Reduced oscillator phase noise coupling: factor of 2 at 3 kHz
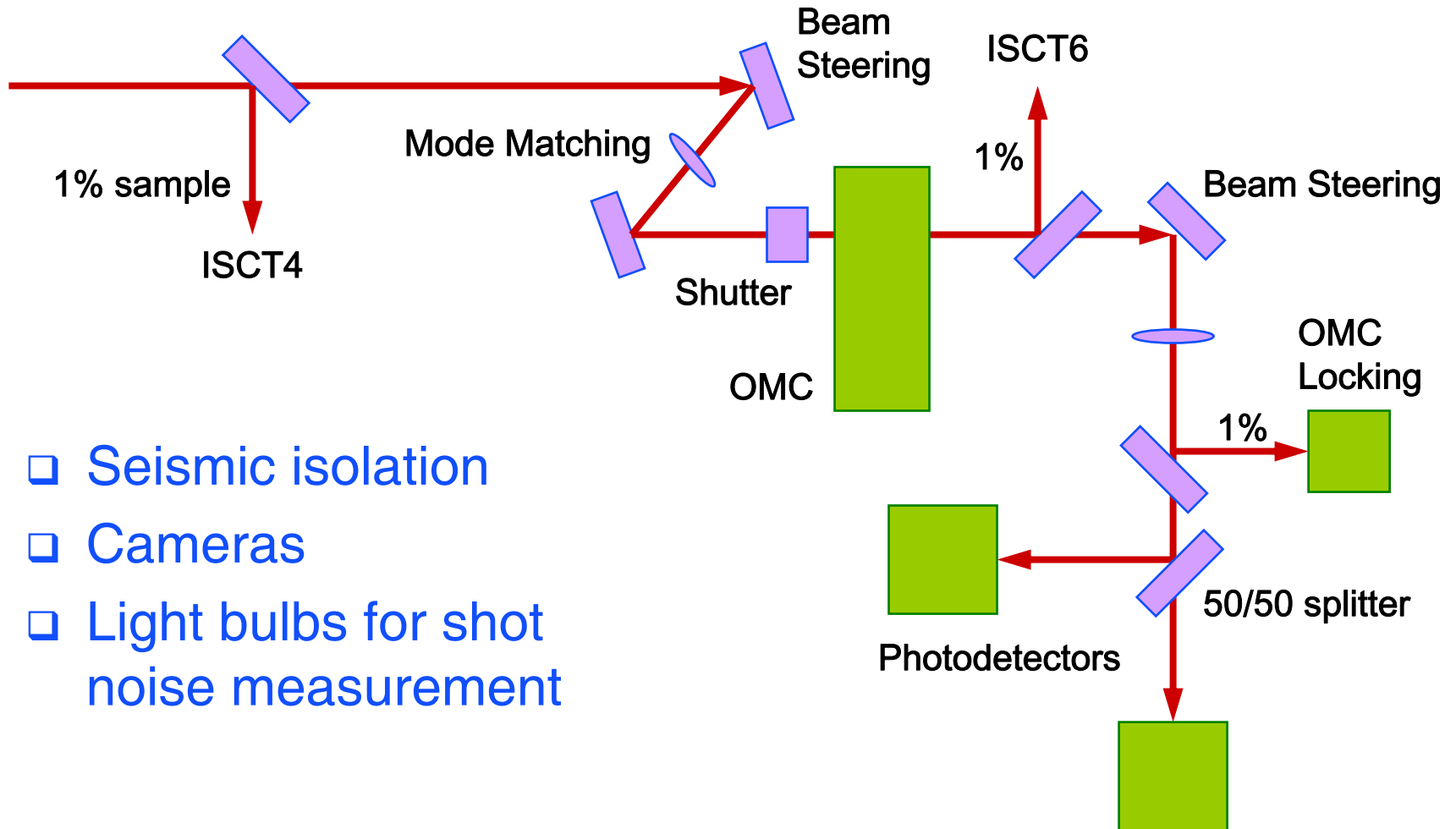
Could operate with 2 PDs at AS port & 30W input!

Power spectrum

*T0=01/05/2004 07:31:45   LIGOAvg=20/Bin=5L   *BW=0.187493   4
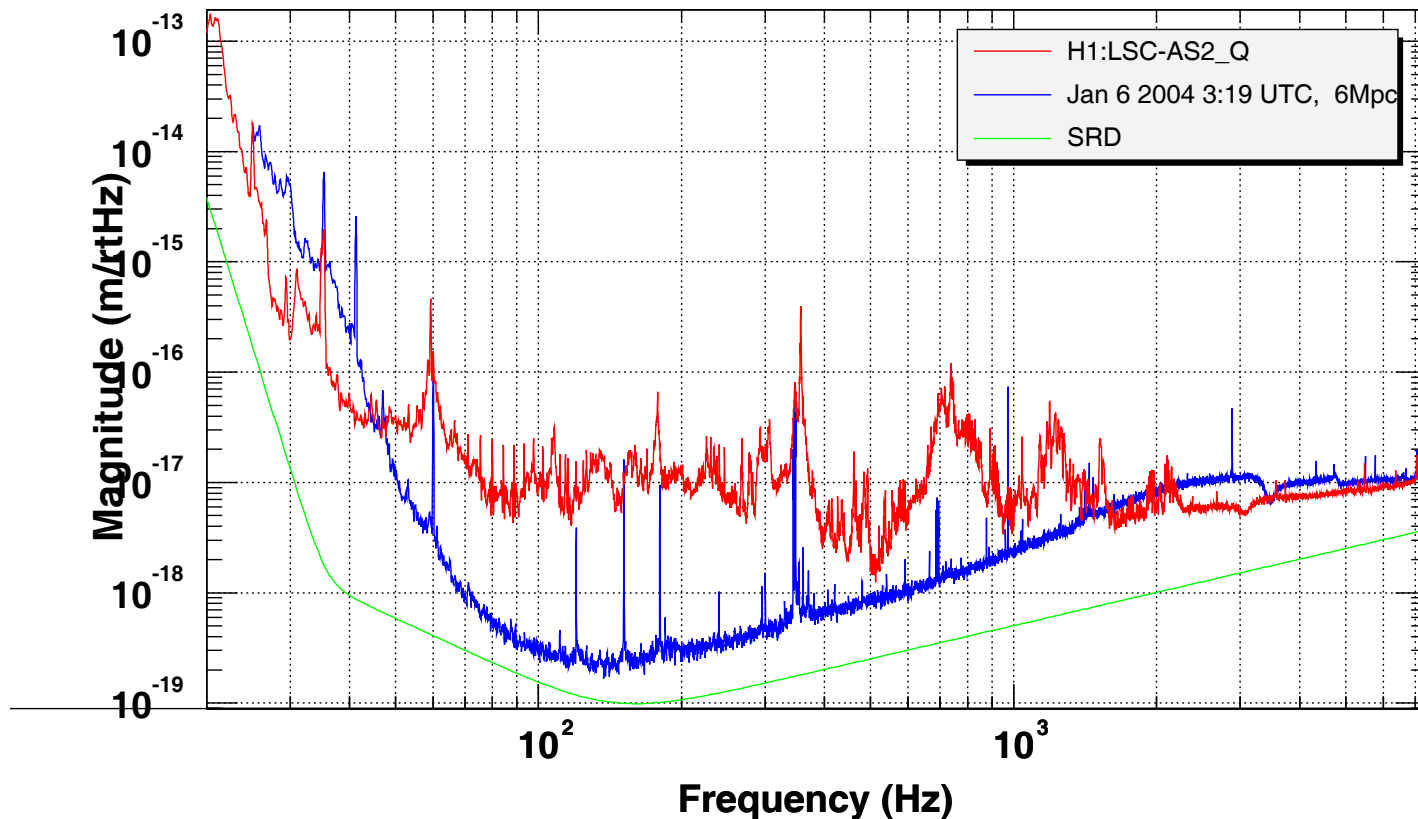
Optical Layout (Conceptual)

- ❑ Seismic isolation
- ❑ Cameras
- ❑ Light bulbs for shot noise measurement

OMC Cavity

HAM6

HAM5

HAM4

ITMX   BS   RM

ITMY

□ **Monolithic spacer cavity**

  ➢ Triangular or 4 mirror zig-zag
  ➢ Dither lock with PZT drive
  ➢ Low finesse
  ➢ Sidebands pass on same FSR
  ➢ Easier design, HAM5 or HAM6

□ **Suspended**

  ➢ Same design as input mode cleaner
  ➢ Additional modulator for locking and WFS(?)
  ➢ High finesse
  ➢ Sidebands pass on next over FSR
  ➢ More complicated design, more expensive, HAM5 and HAM6
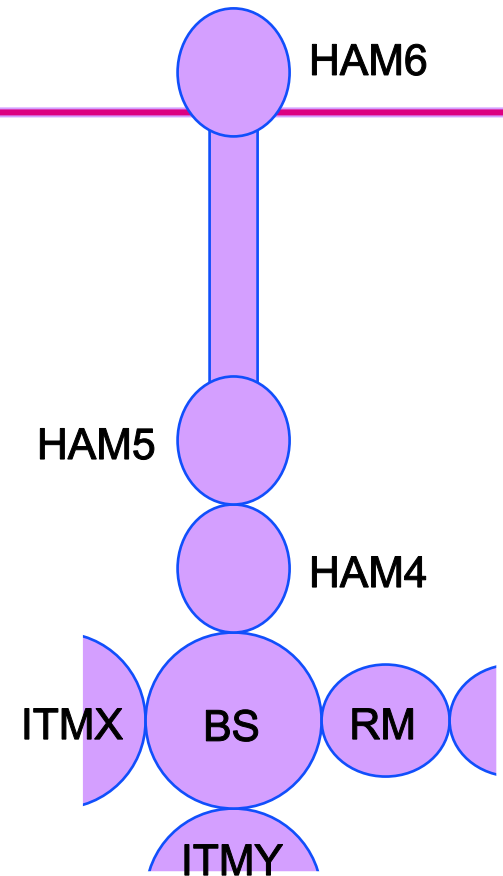
Seismic Isolation

❑ One (two) more of the ones we already have
  ➢ Straight forward & design available
  ➢ Lots of experience
  ➢ Low maintenance

❑ Advanced LIGO HAM stack
  ➢ Ricardo design?
  ➢ Could serve as an advance LIGO prototype
  ➢ May stay there for advanced LIGO

❑ HEPI needed?

❑ Vacuum window at HAM6?