

# LSC Research Directions

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LSC 13 August 98  
Gustafson, Shoemaker, Strain

## **1) Are the three technical development groups a useful cut through the issues?**

- We feel so
- some interesting questions to resolve (diffractive optics? suspension point interferometers? seismic controls design?)

## **2) Are the short term incremental steps being taken too small?**

### **Constraints and inputs:**

- LIGO I observing run: 2002-2004
- length of time for an upgrade
  - > real downtime
  - > debugging/shakedown
- continued support for R&D; capital equipment for installed hardware
- how long will LIGO II data be interesting to exploit?
- incremental changes 2006-2008 (the 5 steps)?
- Advanced LIGO: should we/must we choose a date?
- magnitude of changes considered reasonable (LIGO II for now)?
- LIGO III to be limited by 'fundamental' limits?

# Baseline for 2004 'LIGO II'

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## **improvements to mechanical noise**

- triple pendulum
- fused silica suspension
- present stacks
- external pre-isolator

## **improvements in optical sensing**

- low-absorption substrates
- present polishing/coating technology

## **improvements to the configuration**

- optimization of mirror transmissions

# Technically possible by 2004

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## **additional improvements to mechanical noise**

- replacement of LIGO I stack; active/passive attenuators

## **improvements in lasers/optics**

- higher laser power (~30-100W)
- associated modulator/input optics/photodiode issues
- larger fused silica test masses
- adaptive thermal de-focussing

## **improvements to the configuration**

- output mode cleaner
- change in modulation scheme (flat frequency response, technical advantage)
- signal recycling

**With higher power and associated readout changes, we would be quantum-noise limited for the 11kg test masses**

**With a signal recycling scheme and the other changes, we would have a ~10x increase in range of detection of NS binaries over LIGO I**

# Some targets for 'LIGO III'

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## **mechanical noise**

- cryogenically cooled suspensions/test masses
- alternative materials for test masses
- large masses
- 10 Hz seismic isolation wall (mix of active and passive)
- monitoring/balancing schemes to suppress thermal noise
- possibly work on gravity gradients

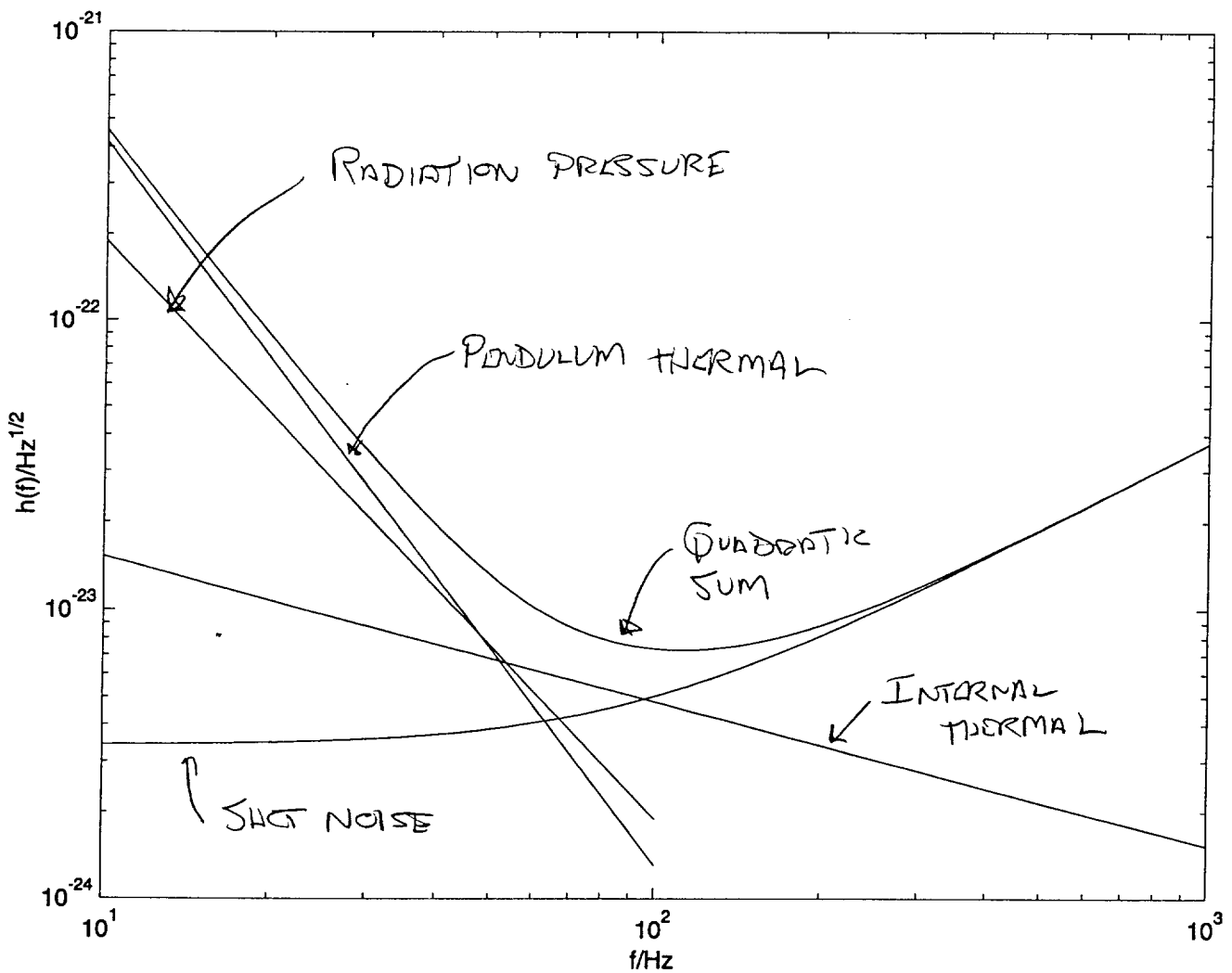
## **lasers/optics**

- significantly more stored energy
- lower absorption substrates
- lower absorption coatings
- better large scale and small scale (scatter) figure
- modulators/photodiodes to handle powers

## **configurations**

- signal-tuned systems
- adaptive systems

LIGO II BASELINE  
Q's  $3 \times 10^7$ ; 100 W; 10.7 kg



*Note 1, Linda Turner, 08/20/98 11:32:44 AM*  
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