SOURCE RANGE -
A FIGURE OF MERIT FOR DESIGN
LSC 3 MEETING
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Source "Range"

A Figure of Merit for Design

Finn: Use source waveforms as weighting fns to evaluate interferometer improvements

See which changes give most benefit

Noise spectrum ⟹ distance to which significant detection can be made.

inn wrote MATLAB code, cbi.m

"Range": radius of sphere whose volume, when multiplied by event abundance, yields rate of significant detections.

Coalescing N.S. binaries are fairly well understood

Suspension WG used them in White Paper design exercise.

Results of "Range" Calculations

vious :

Improve range by

a) lowering noise at minimum of spectrum

b) widening band of low noise

s obvious, except in retrospect:

Effective low freq cut-off is usually set by pendulum thermal noise

ssons :

1) LIGO II needs some more isolation will get it from multiple pendulum

2) Advanced seismic isolation should focus on control re-allocation and reduction of non-linear effects.

LIGO

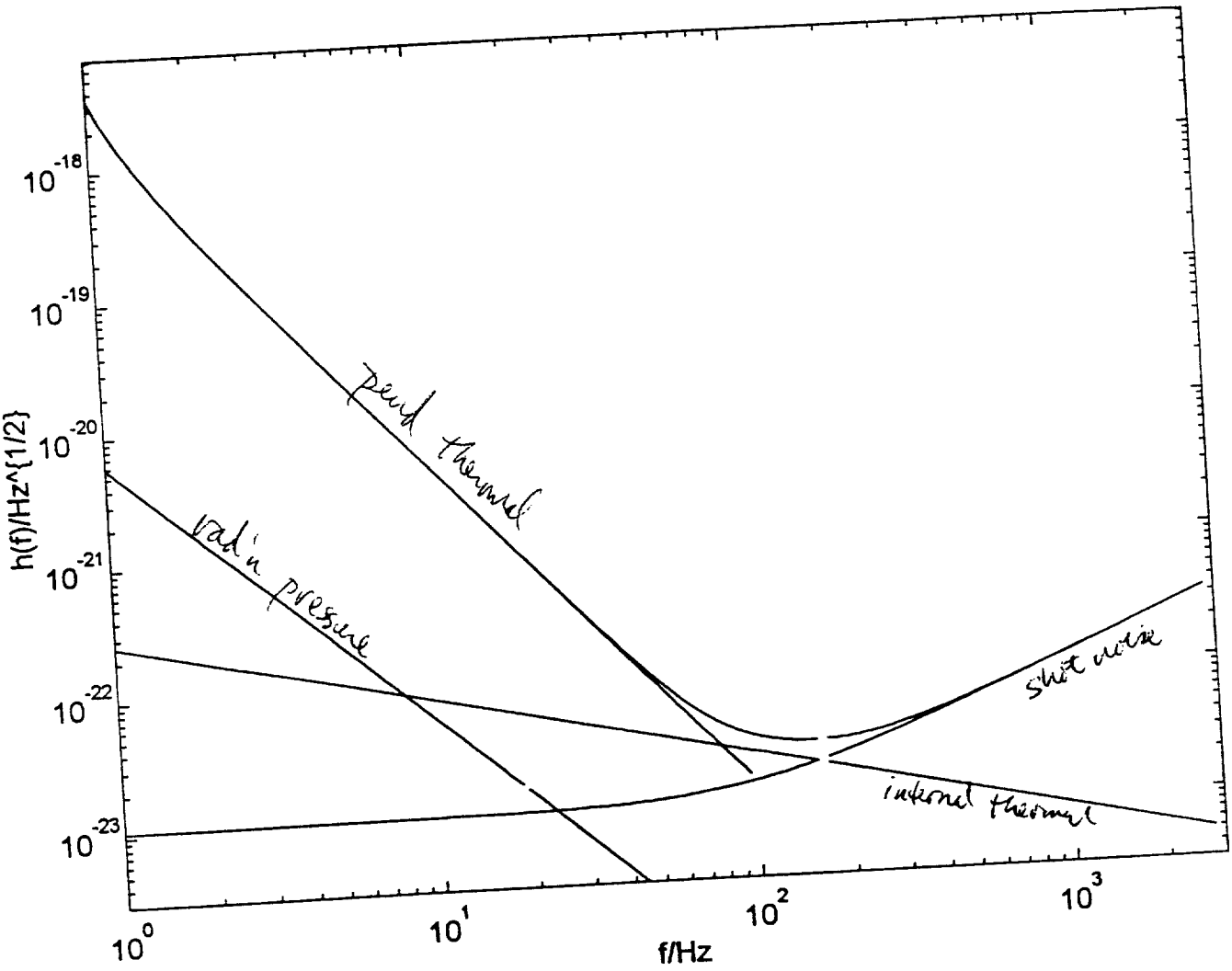
Model 1

(≈like LIGO I)

$P = 6\,W$, recycling gain $= 30$

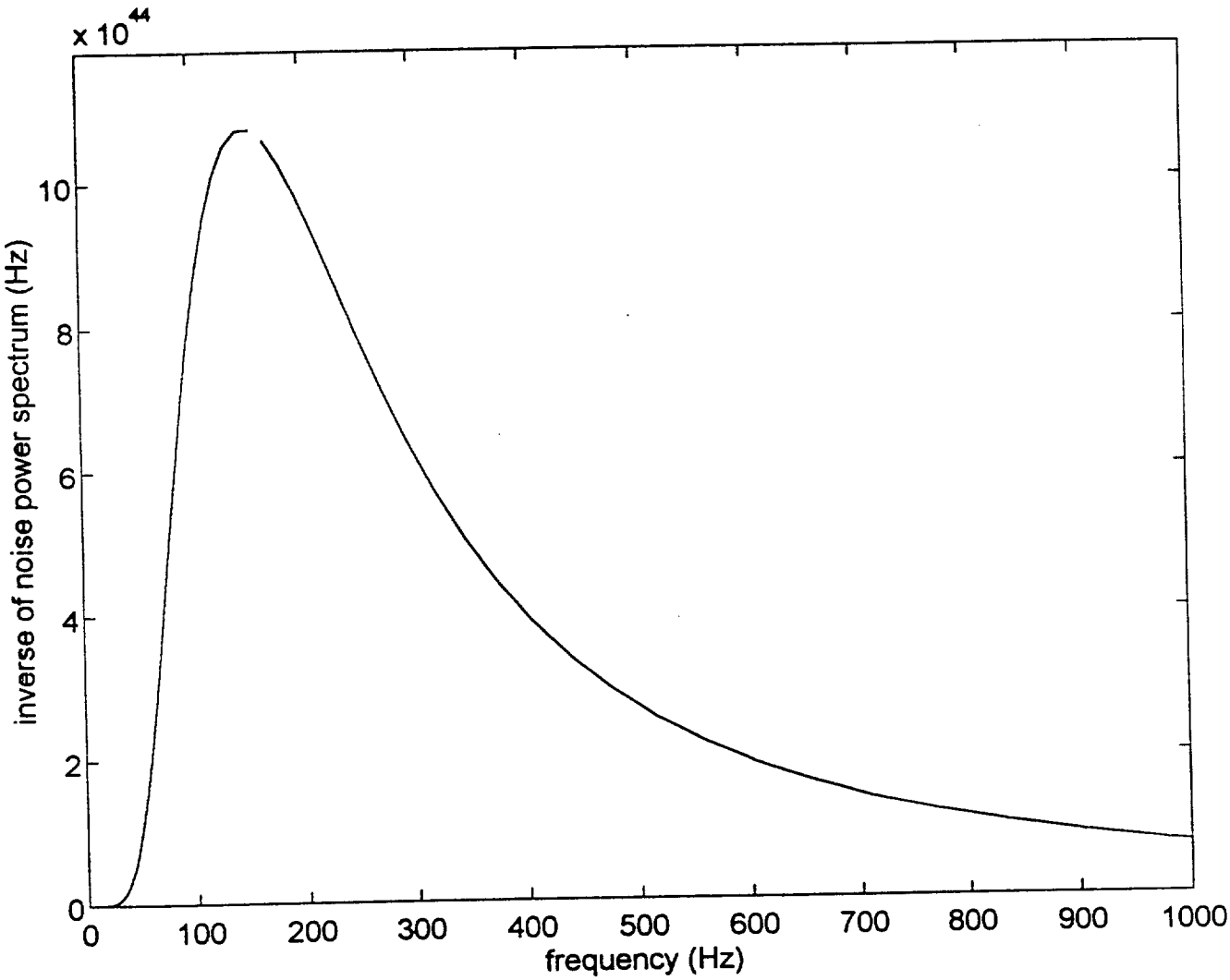
$m = 10.8\,kg$, $Q_{pend} = 3.33\times10^5$, $Q_{int} = 1\times10^6$, $T = 300K$

$f_{pend} = 0.74\,Hz$, $f_{int} = 10kHz$

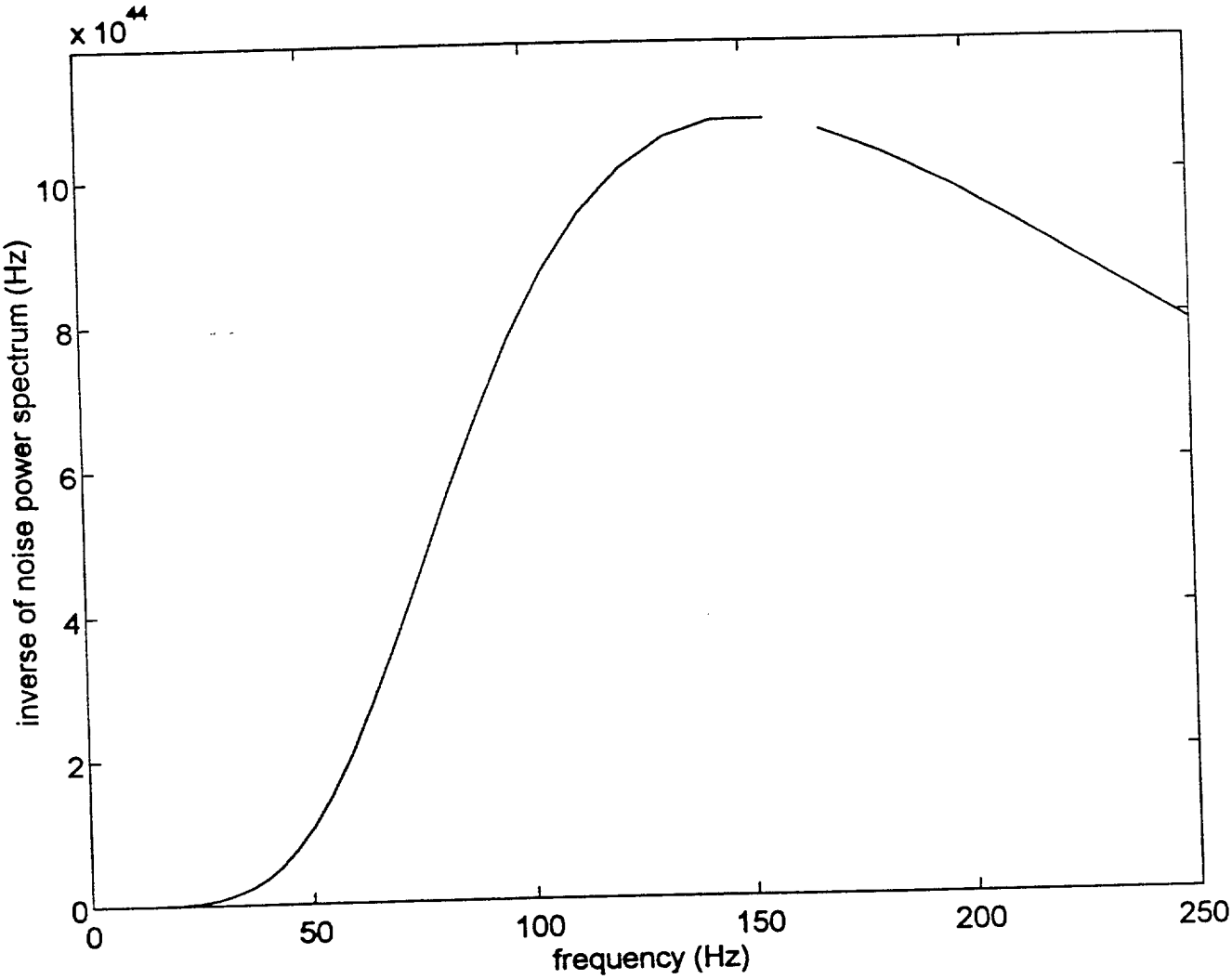


Seismic cutoff	"range"
1 Hz	14.41 Mpc
30	14.32
50	13.89
100	10.75

The idea of large interferometers


x 10^44
inverse of noise power spectrum (Hz)
0
2
4
6
8
10
0
100
200
300
400
500
600
700
800
900
1000
frequency (Hz)

model 1


x 10^44
10
8
6
4
2
0
inverse of noise power spectrum (Hz)
0
50
100
150
200
250
frequency (Hz)

i: model 1

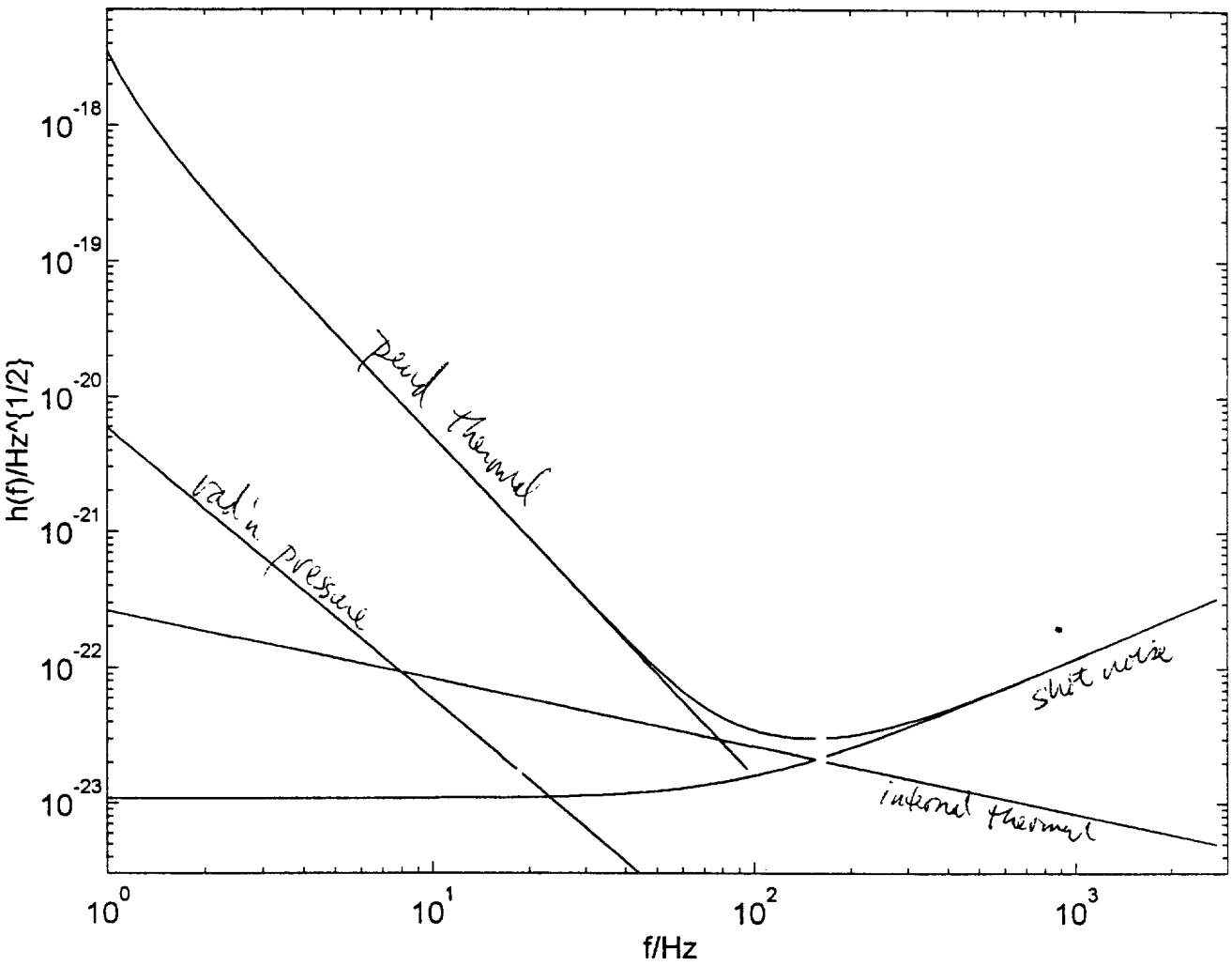
(≈like LIGO I)

Model 1

$P = 6\ W$, recycling gain $= 30$

$m = 10.8\ kg$, $Q_{pend} = 3.33 \times 10^5$, $Q_{int} = 1 \times 10^6$, $T = 300K$

$f_{pend} = 0.74\ Hz$, $f_{int} = 10\ kHz$



Seismic cutoff	"range"
1 Hz	14.41 Mpc
30	14.32
50	13.84
100	10.75

"Ranges"

LIGO II will make a dramatic improvement in sensitivity

LIGO I range ~ Virgo Cluster

LIGO II range ~ 5-10x Virgo distance

A very respectable chance of detection, but no guarantees.

For high confidence of success, need to do substantially better.

We need to start thinking about LIGO III.

Note 1, Linda Turner, 08/20/98 11:21:34 AM
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