The 22nd Advanced ICFA Beam Dynamics Workshop on Ground Motion in Future Accelerators

Slow Ground Motion Observed by Preliminary Results

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Goal:

\[ h \sim 10^{-22} / \sqrt{\text{Hz}} \; @ \; 150 \; \text{Hz} \; \text{or} \]
\[ h \sim 10^{-21} \; \text{RMS} \; @ \; 150 \; \text{Hz}, \; \text{BW} \; 100 \; \text{Hz} \]

Recycled Michelson with
2km/4km Arm Fabry-Perot

Photodetector

Laser
April 2000: 2km X-arm
⇒ control signal monitored for 22 hours

Experimental Setup:

Locking technique:
Pound-Drever-Hall ⇒ phase modulated beam
What are we measuring?

- Phase $\propto k \times L$

$\Rightarrow$ necessary to stabilize laser frequency

**Goal:** $3 \times 10^{-7} \text{Hz}/\sqrt{\text{Hz}}$ @ 150 Hz

More than one stabilization stage:

@ low frequencies, the laser follows the reference cavity

$\Rightarrow$ to study the ground motion, the behavior of the reference cavity must be taken into account
E. Morganson: model for tidal strain at LIGO sites (P. Melchior)

- induced by Moon and Sun
- but never compared to experimental data

![Graph showing estimated tide (blue) and corrected arm data (red).](image)

- offset of 150 min
- qualitative agreement
- slow drift of the cavity length observed?
Conclusions:

• correction signal $\Rightarrow$ cavity length drifted by $\sim 100 \, \mu m$;

• observable period of 12 hrs;

• temperature drift of reference cavity to be taken into account;

• qualitative agreement between model and data;

• 150 min offset?

• cavity slow drift?