Vibration/Acoustic Isolation Techniques for spectroscopic mapping STS

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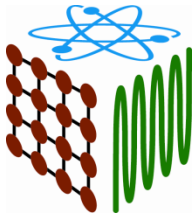


Outline

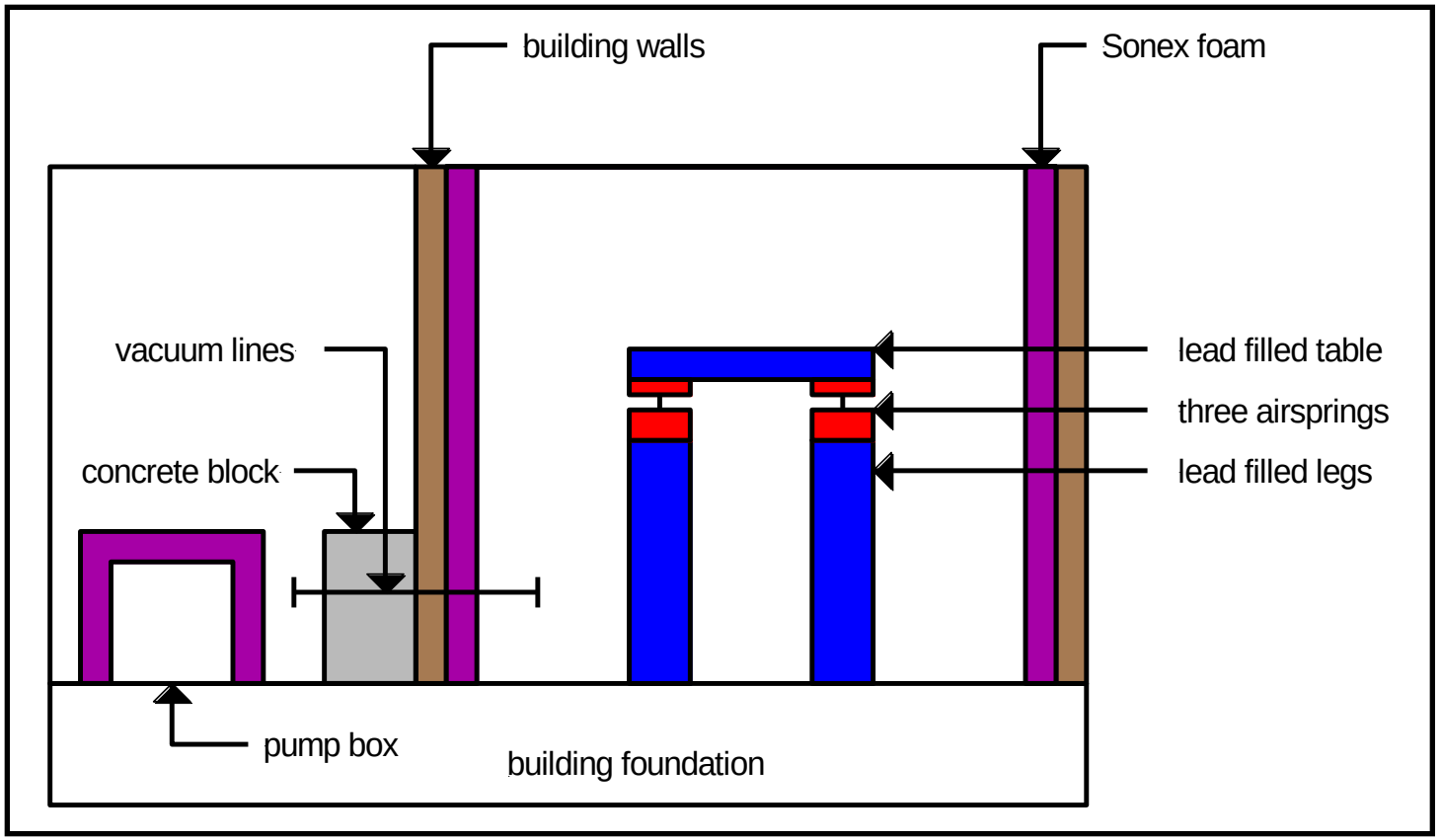
- **Motivation**
- **Previous Setup**
- **Current Setup**
- **Measurements**
- **Implications for Stability**
- **Current limitations of our system**
- **Future Improvements**

Motivation

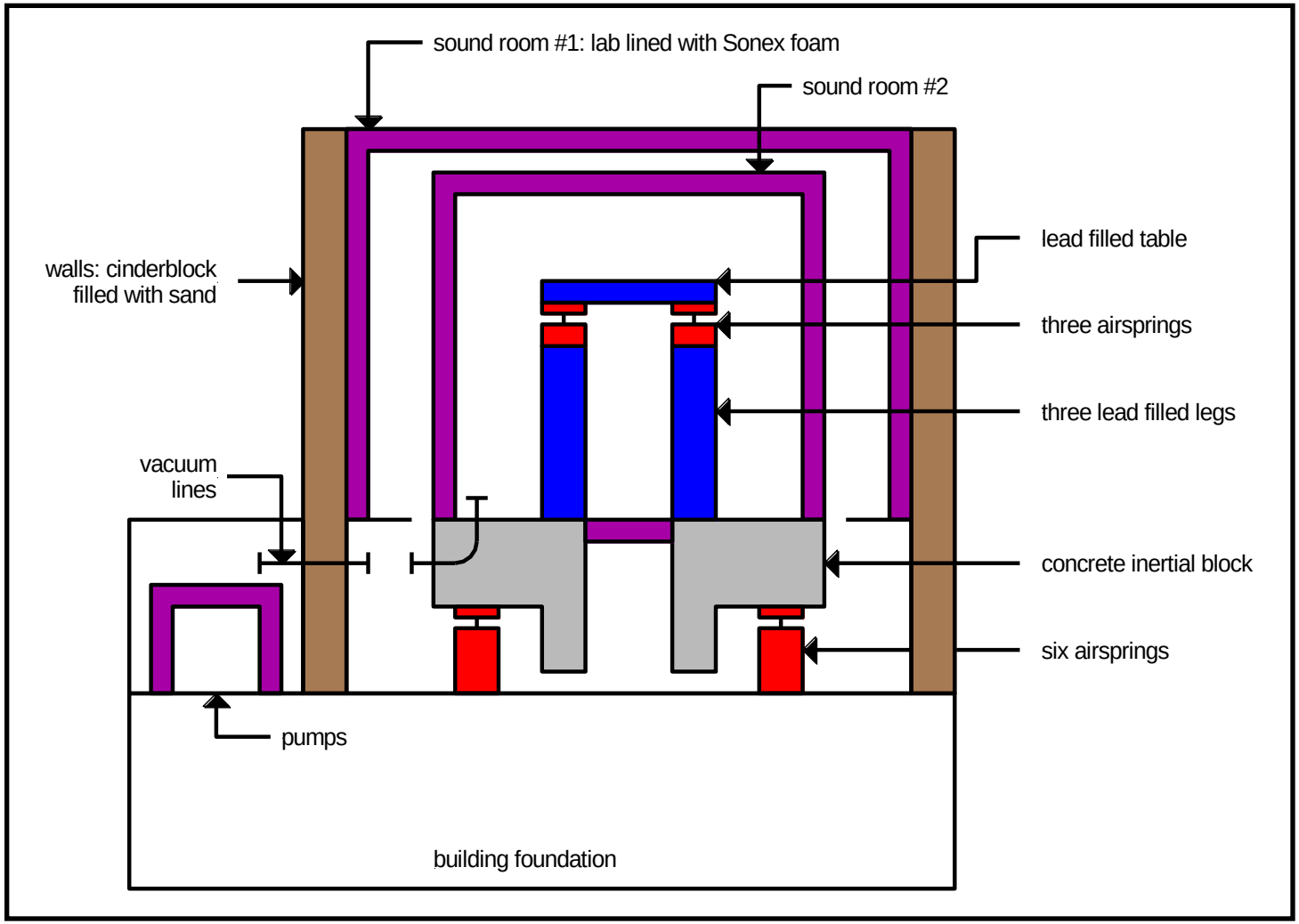
- **To decouple experiments from building, (pipes, air-conditioning) and human noise (feet, mouths)**

- **By doing so achieve high signal to noise**

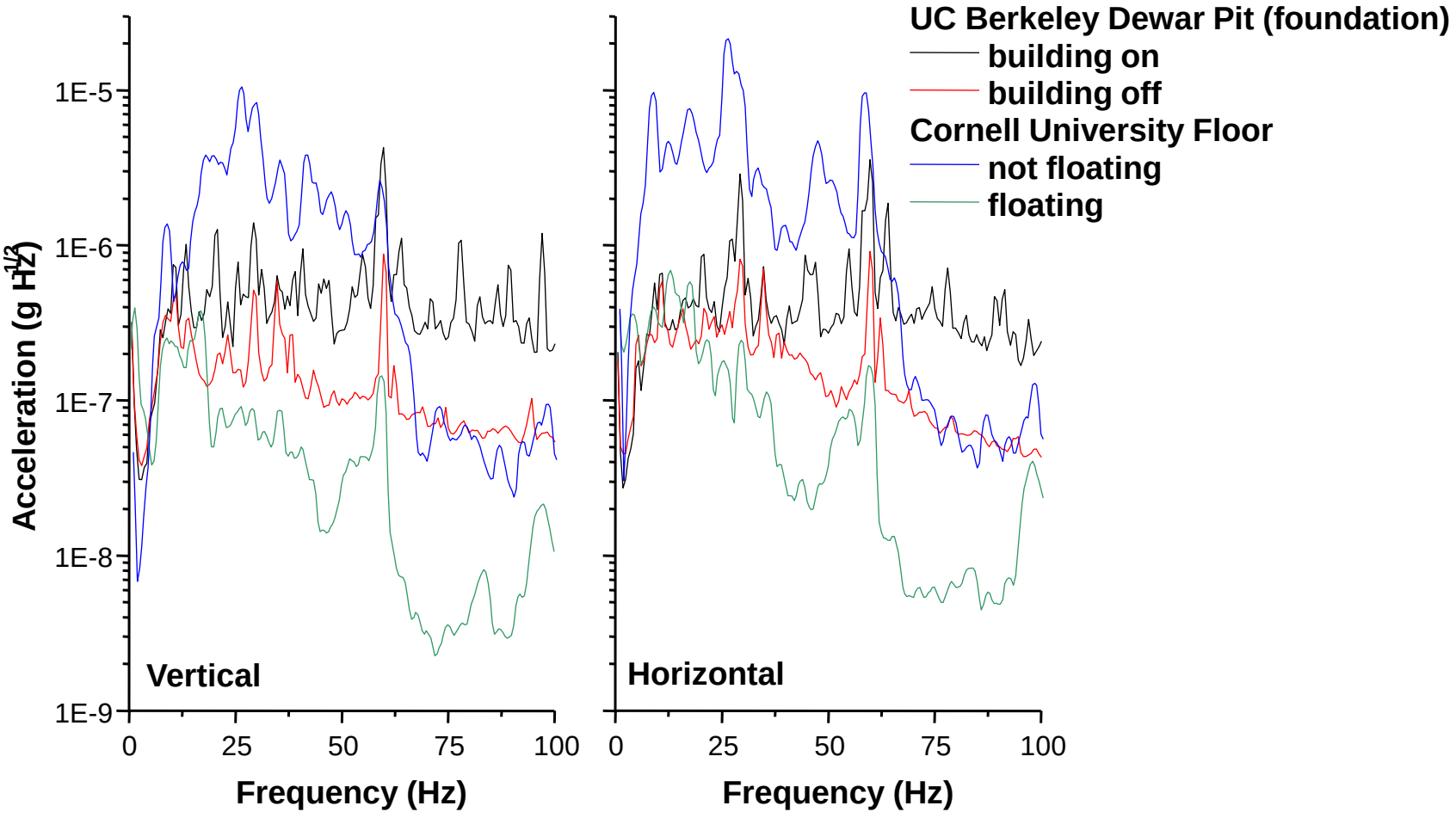
UC Berkeley Labs



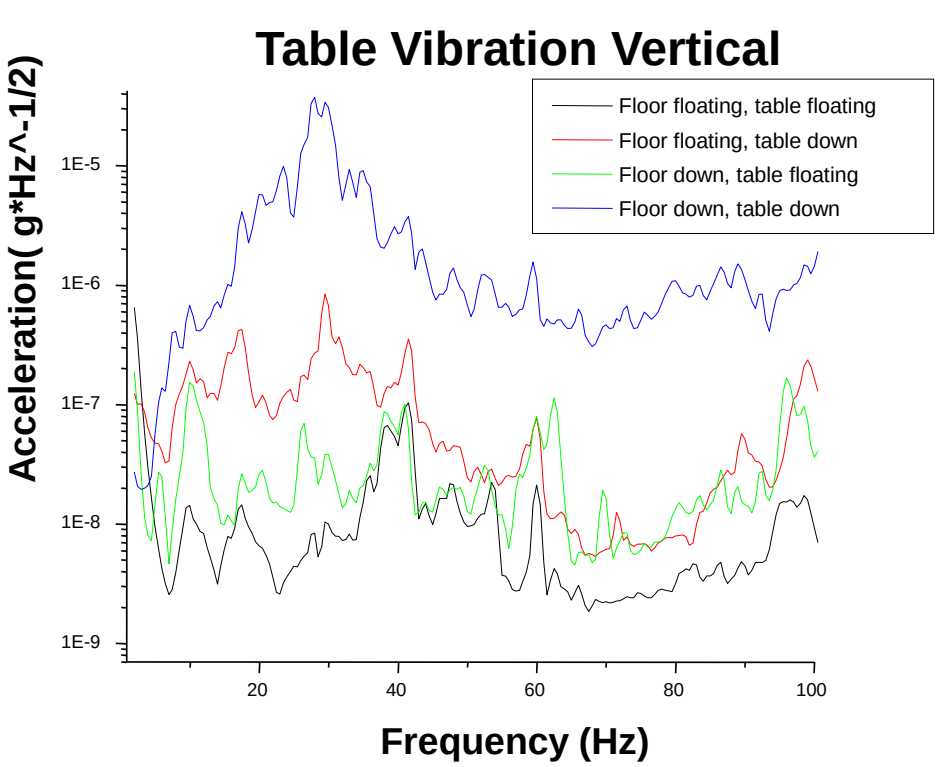
Cornell Lab

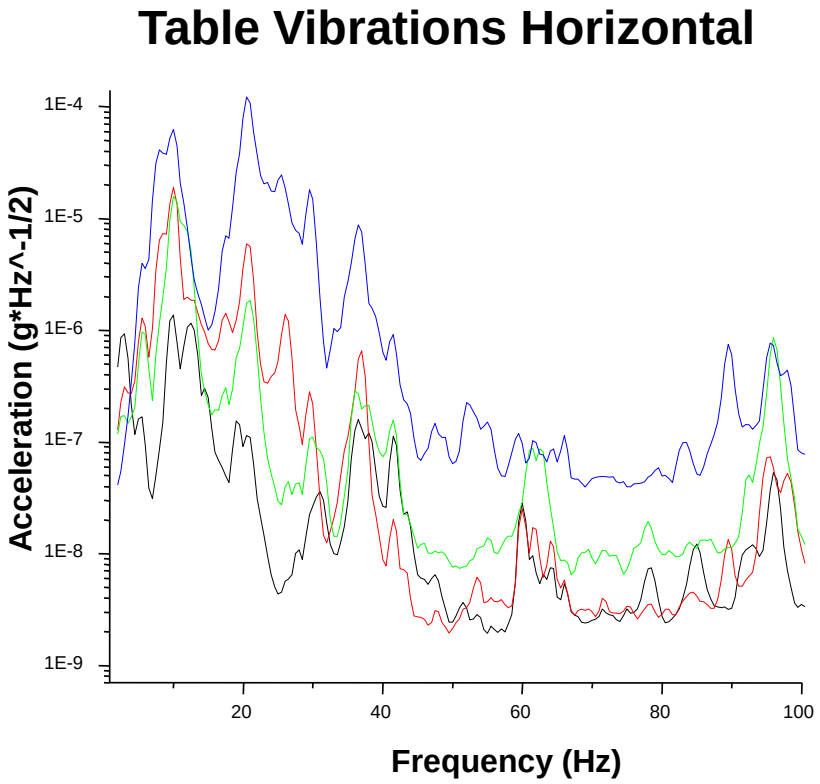

sound room #1: lab lined with Sonex foam
sound room #2
walls: cinderblock filled with sand
lead filled table
three airsprings
three lead filled legs
vacuum lines
concrete inertial block
six airsprings
pumps
building foundation

Measurements of the Floor



On Board Measurements





Benefits

- **Isolation from external events**
- **Low Background noise coupling to experiment**
- **Flexibility in vacuum system and control system setup**

Implications

These vibrations will be translated into current noise by

$$\frac{\delta I}{I} = 2x_0 < x >$$

I is the tunneling current

$x_0 = (2\ Me\ ☠)^{1/2}/ħ$

<x> is the average displacement found from <a>/❄²=<x>

Wiesendanger *Scanning Probe Microscopy and Spectroscopy* 1994

Results

Using a work function of 4eV

Acceleration average of 5×10^{-9} $m/s^2 * Hz^{1/2}$

For a frequency of 100Hz this gives us

0.5% ⊠I/(I*$Hz^{1/2}$) as an upper limit.

Current Limitations

Our measured integrated noise from 1Hz to 1kHz of our system is 5pA

If we assume a continued exponential decrease in the vibration level

We get a integrated ⌧I/I of 6.5E-4 from 1Hz to 1kHz

So if we set I to 7.8nA we get noise of the same magnitude

Improvements/Future Projects

- **In order to improve our SN ratio at low currents we need to improve our preamps**
- **This could be accomplished by the implantation of cold preamps outlined by Tessmer *et al*, RSI 73 310**
- **We can also reduce the stiffness of our STM heads and add more functionality**