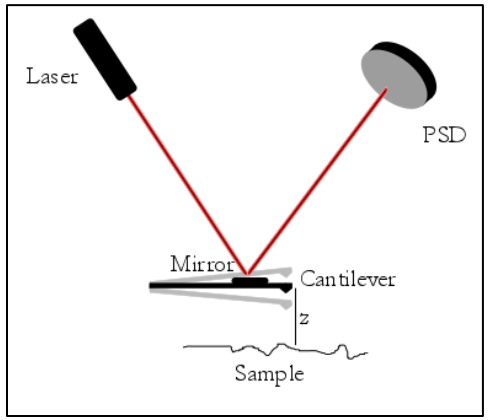
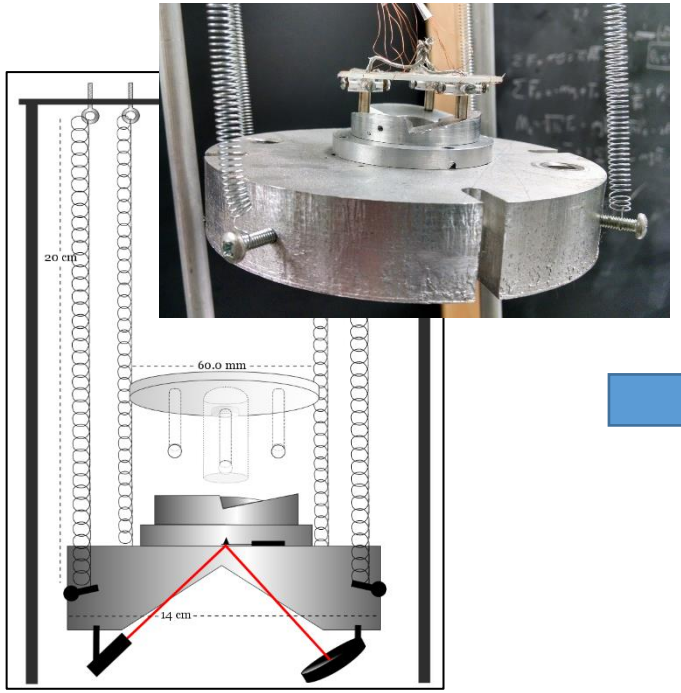
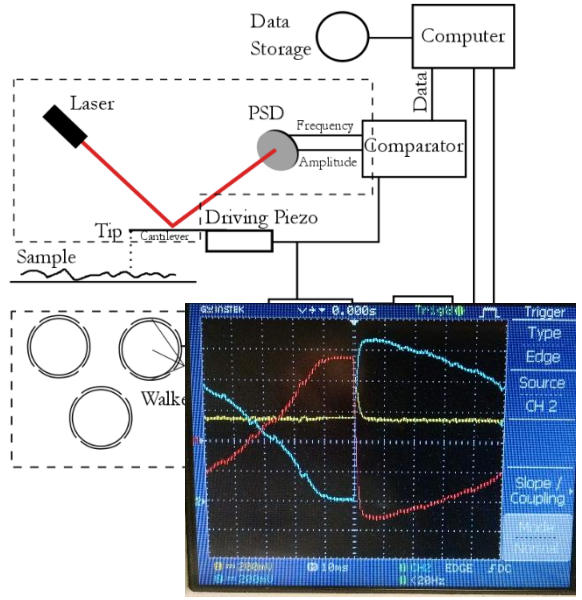
Design and Construction of An Atomic Force Microscope

Outline

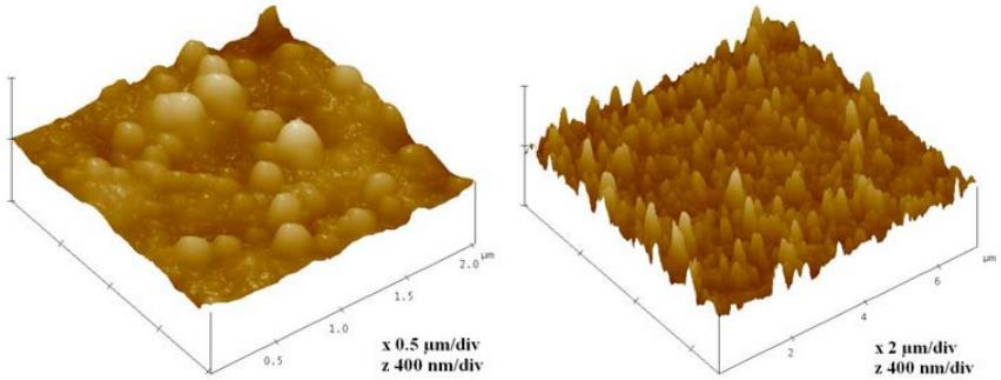

Laser
PSD
Mirror
Cantilever
z
Sample


20 cm
60.0 mm
14 cm


Data
Storage
Computer
Data
Laser
PSD
Frequency
Amplitude
Comparator
Tip
Cantilever
Driving Piezo
Sample
Trigger
Type
Edge
Source
CH 2
Slope /
Coupling

Motivation

- Directly observe structures on atomic scale

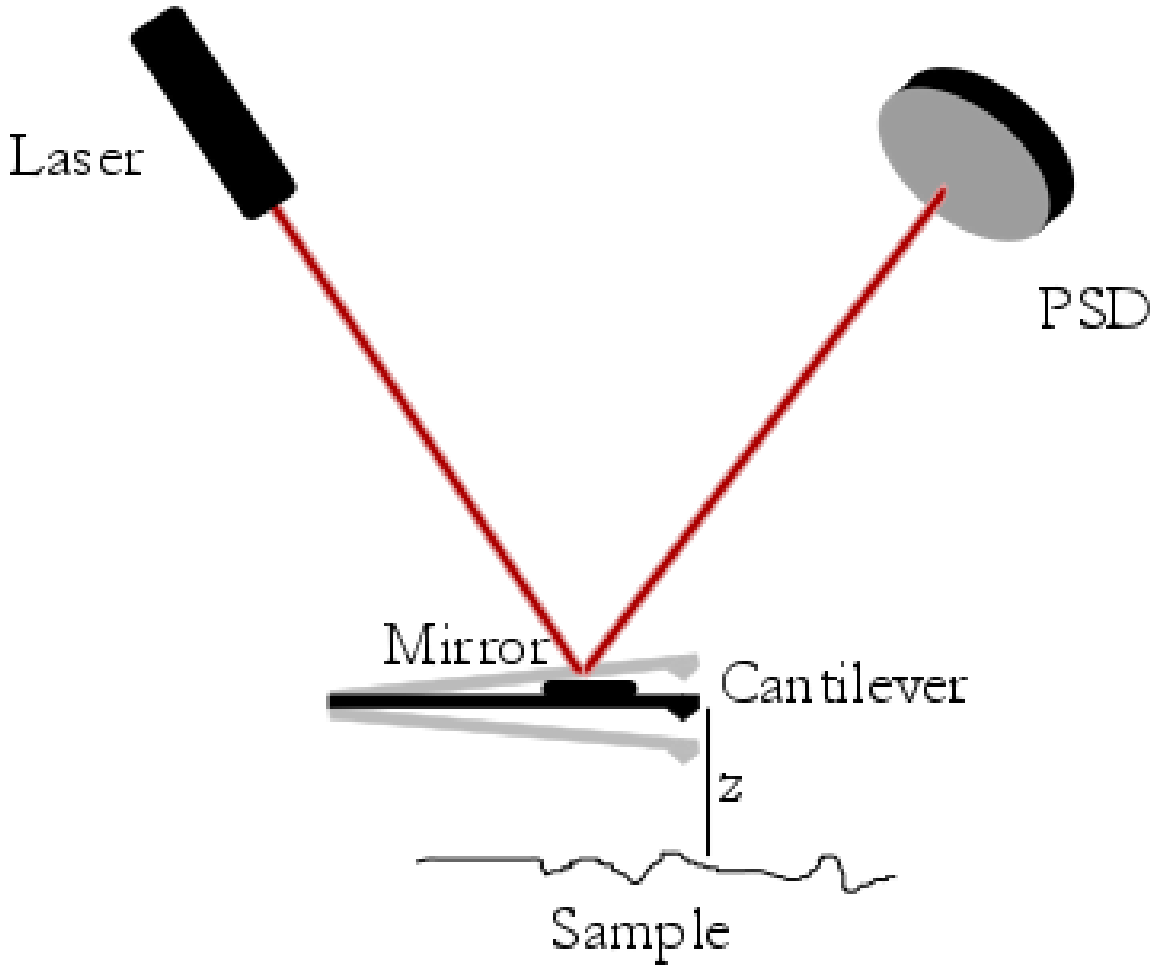


Burducea, I., Ionescu, C., Straticiuc, M., Craciun, L. S., Racolta, P. M., & Jipa, A. (2013). CHARACTERIZATION OF INDIUM NITRIDE AND ZINC OXIDE THIN FILMS BY AFM AND RBS. ROMANIAN JOURNAL OF PHYSICS, 58(3-4), 345-353.

- Characterize thin films

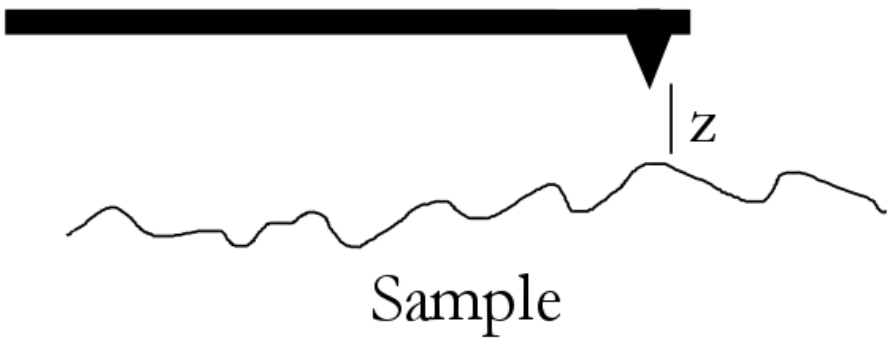
http://www.karbosguide.com/books/pcarchitecture/chapter44.htm

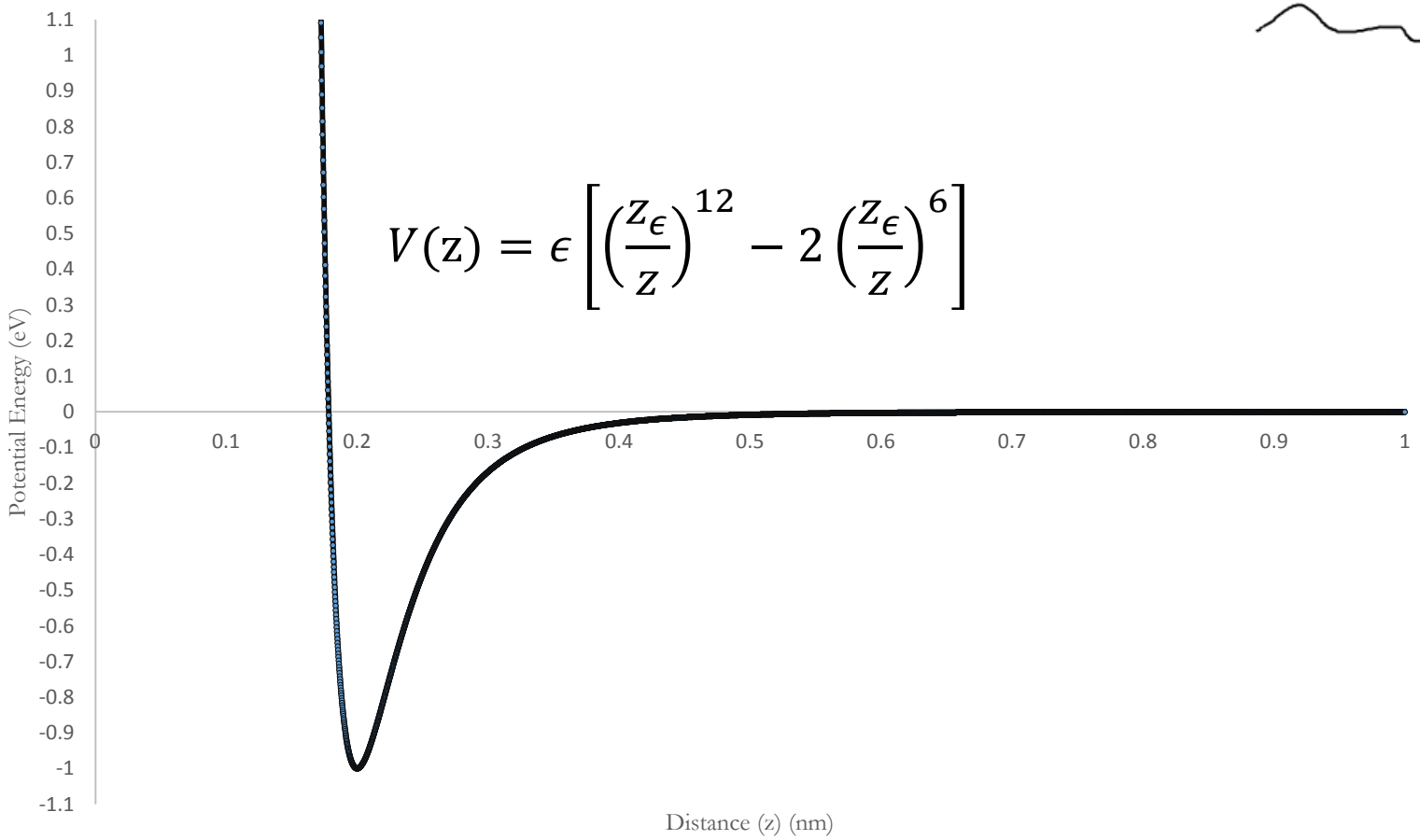
Operation



- Static Mode
- Dynamic (Tapping) Mode

Tip-Sample Interaction



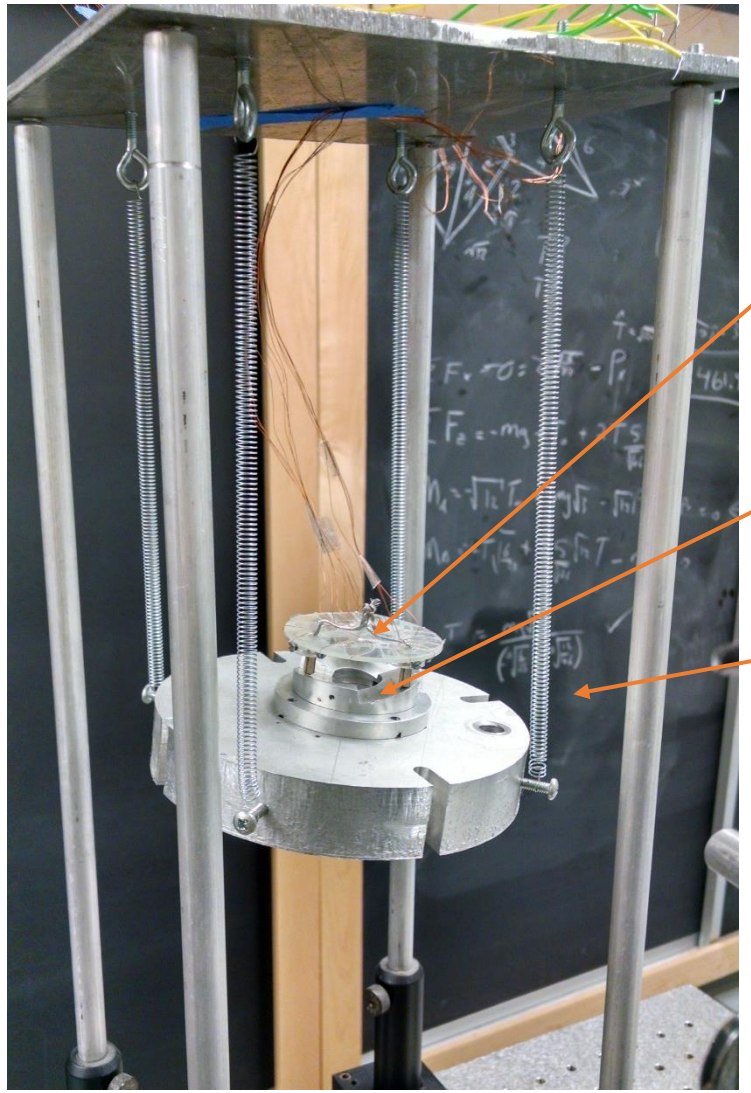


$$V(\mathrm{z}) = \epsilon\left[\left(\frac{z_\epsilon}{z}\right)^{12} - 2\left(\frac{z_\epsilon}{z}\right)^{6}\right]$$

$$\ddot{z} + \frac{\omega_0}{Q}\dot{z} + \omega_0^2 z = A\omega_0^2 \cos\omega t$$

$$\frac{\Delta\omega}{\omega_0} \approx -\frac{1}{2k}\frac{\partial F}{\partial z}$$

Overall Design

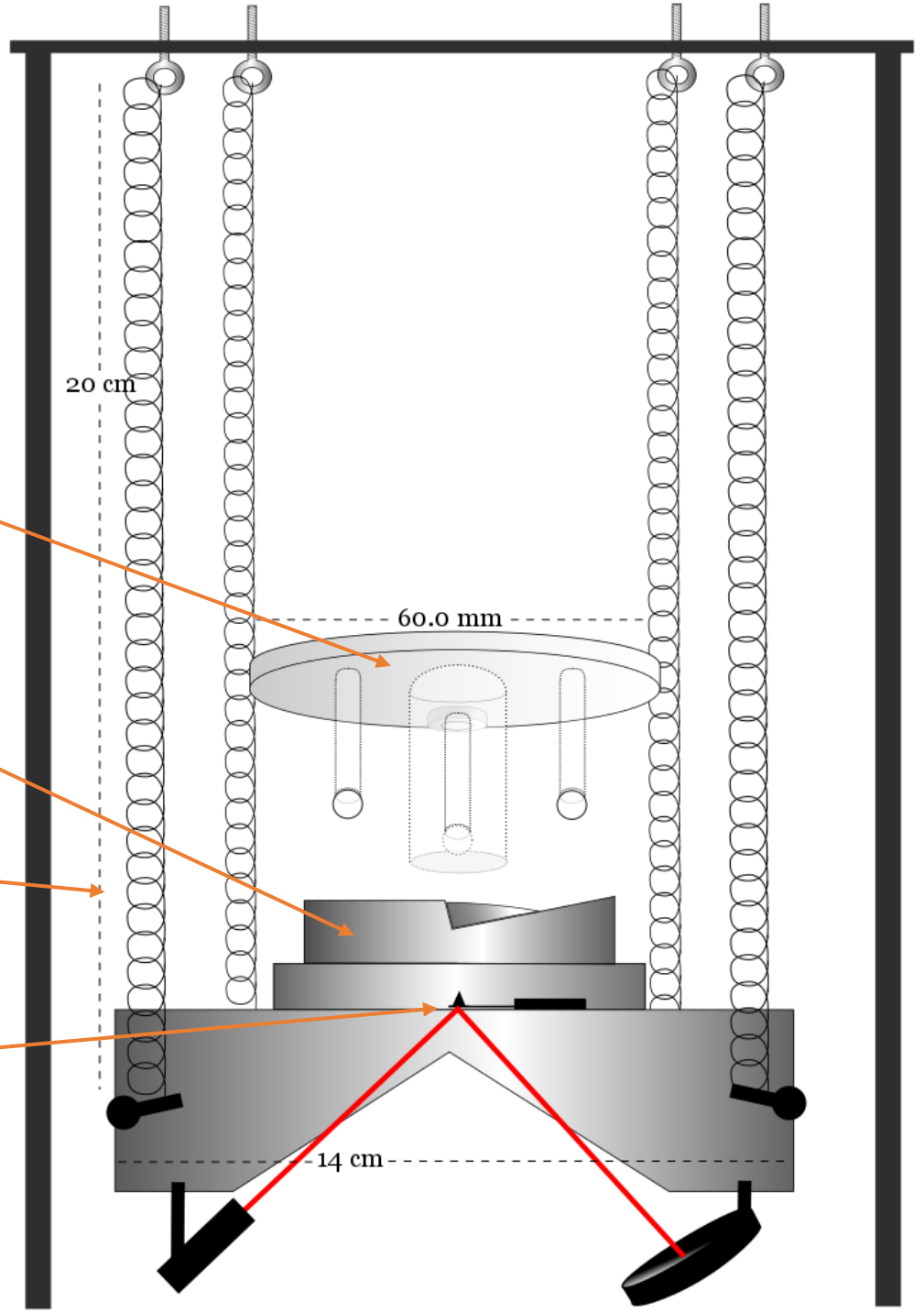


“Johnny Walker”

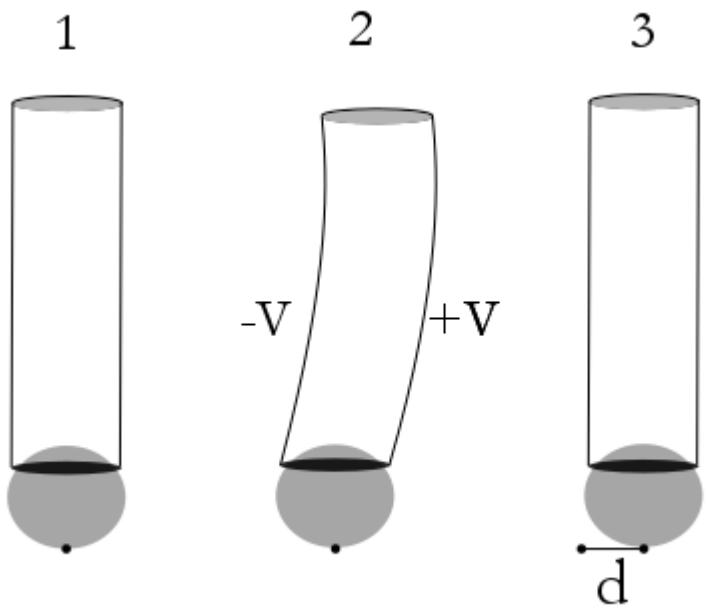
Ramp

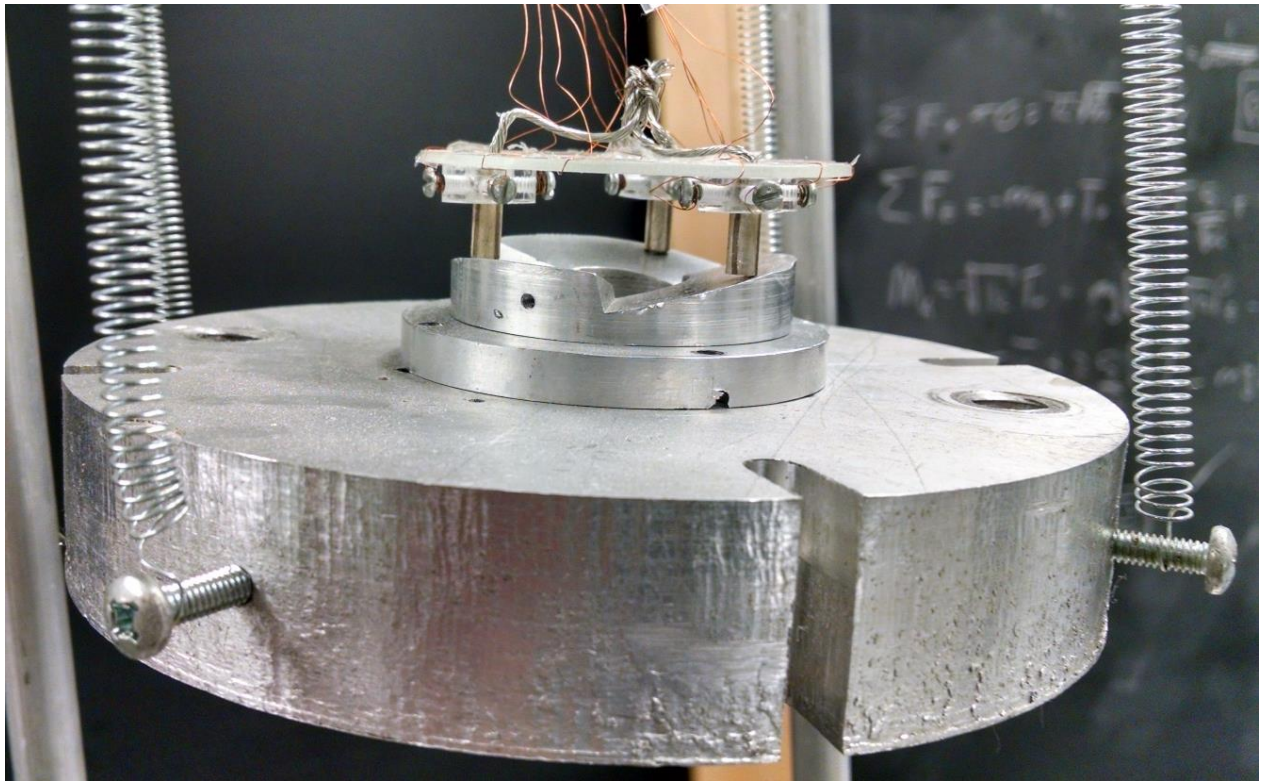
Springs

Cantilever

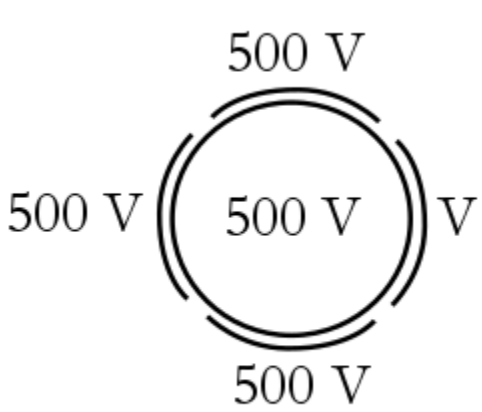


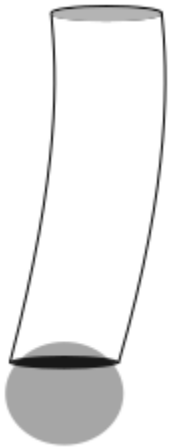
“Johnny Walker”

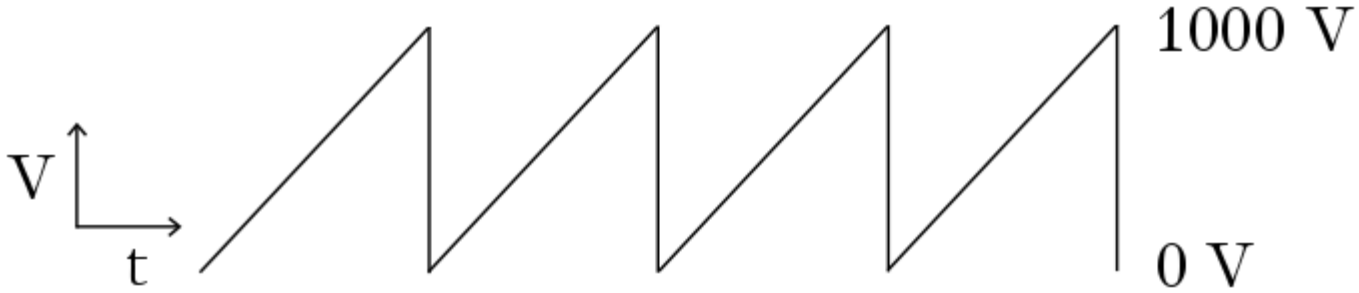


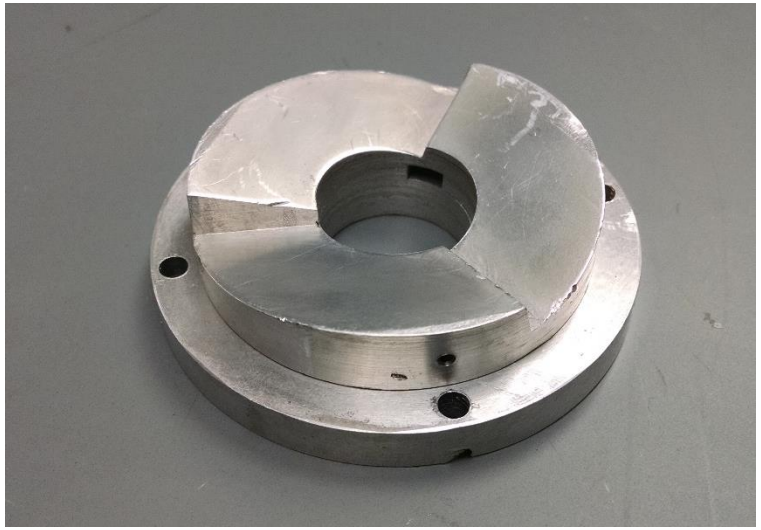


Walker Cont.



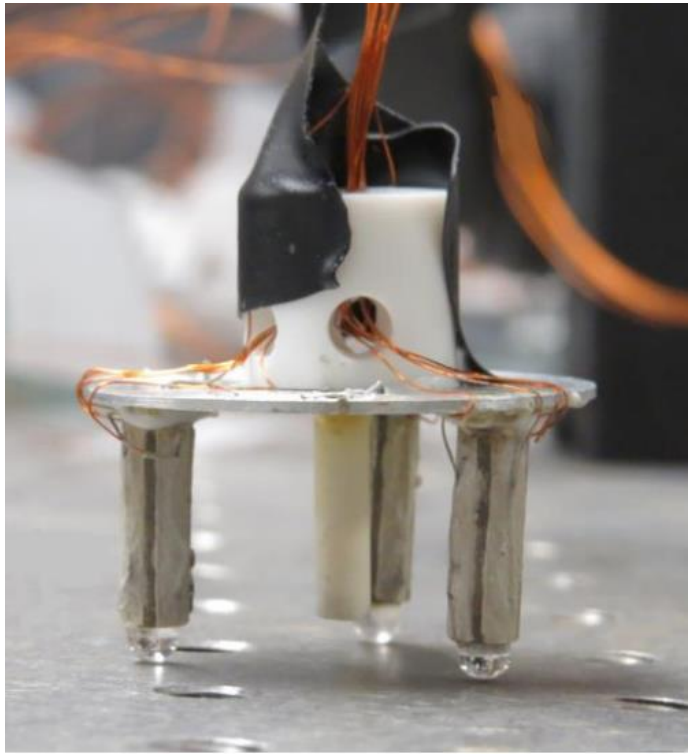




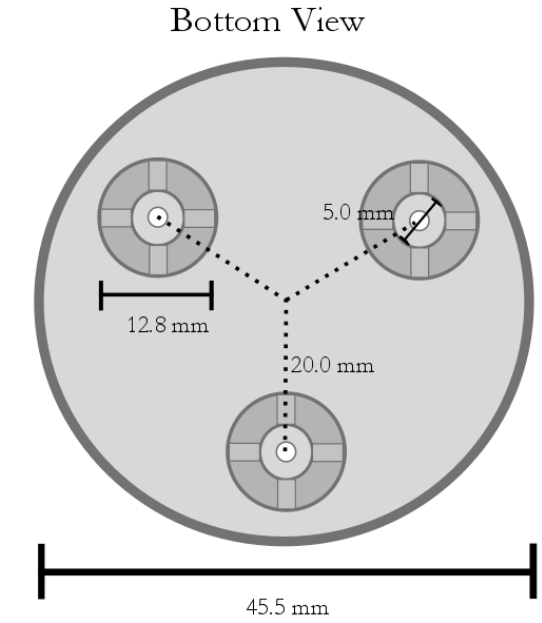


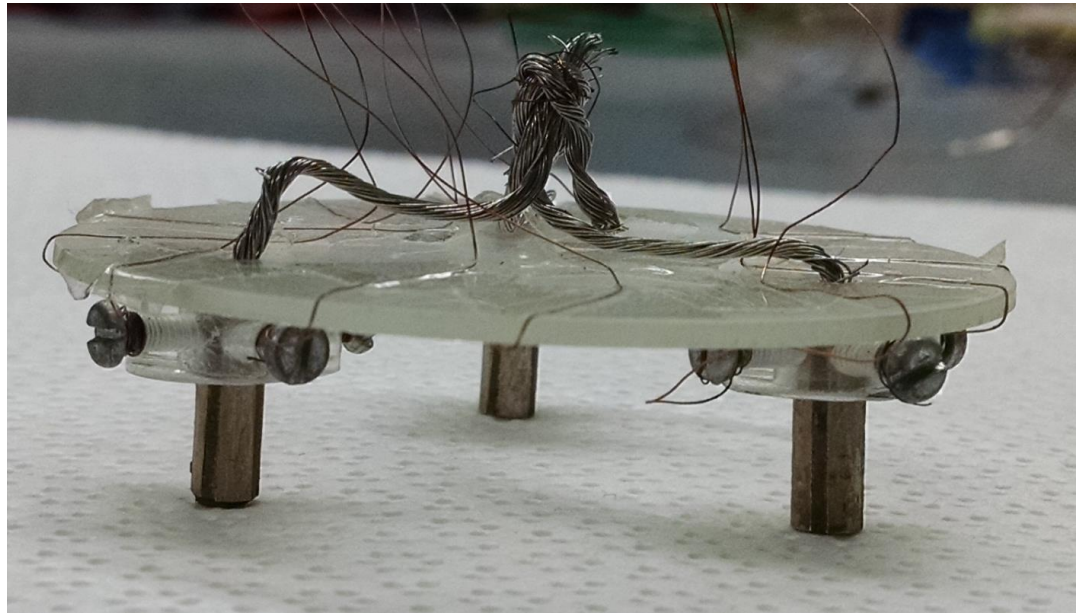
Walker Progress

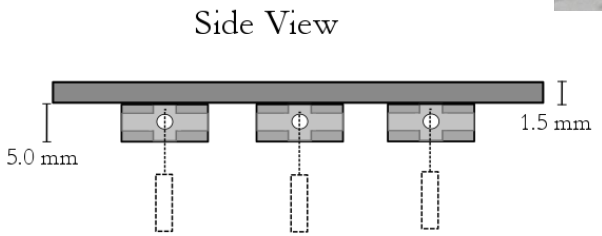
Old Design:



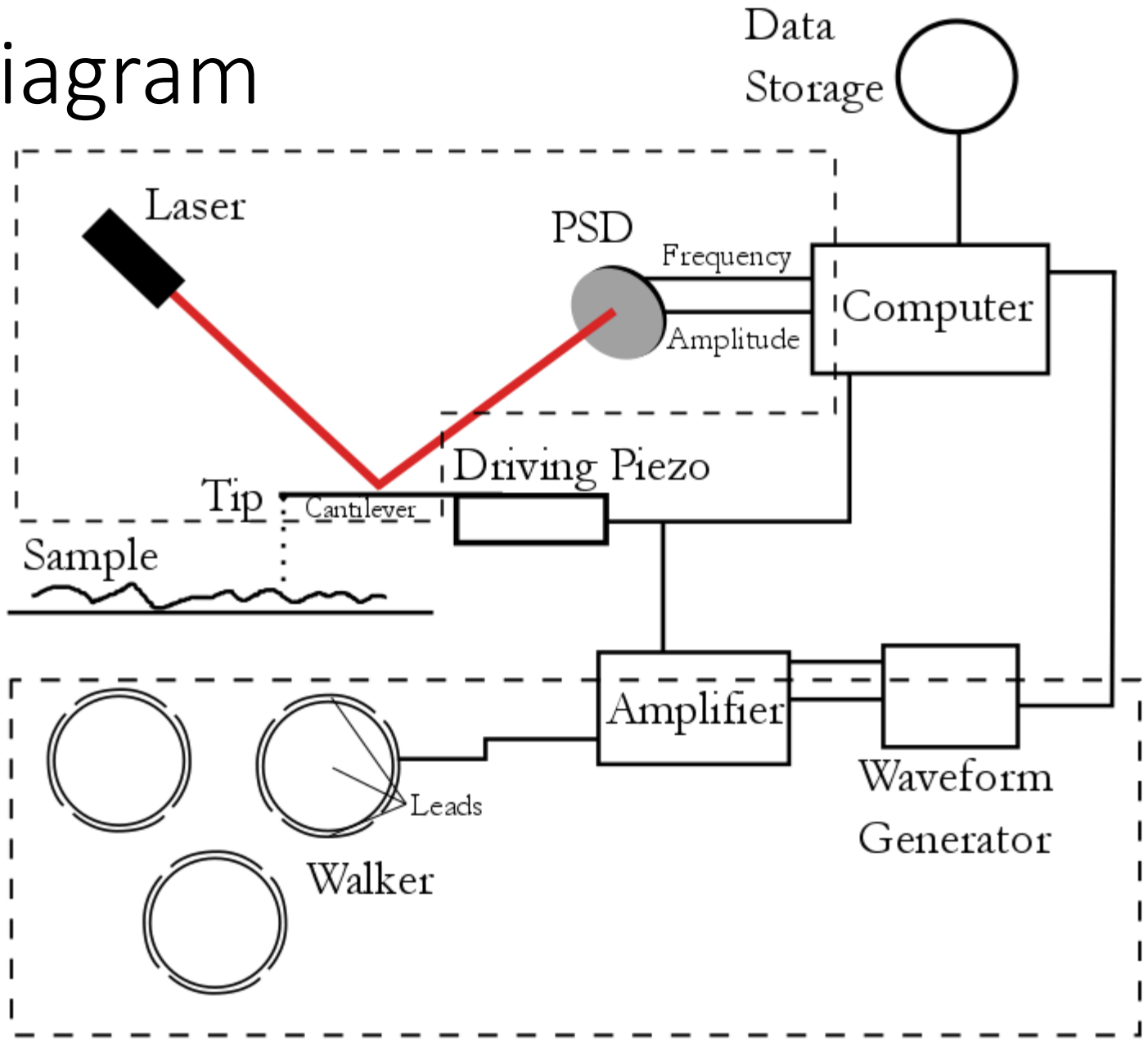
New Design:



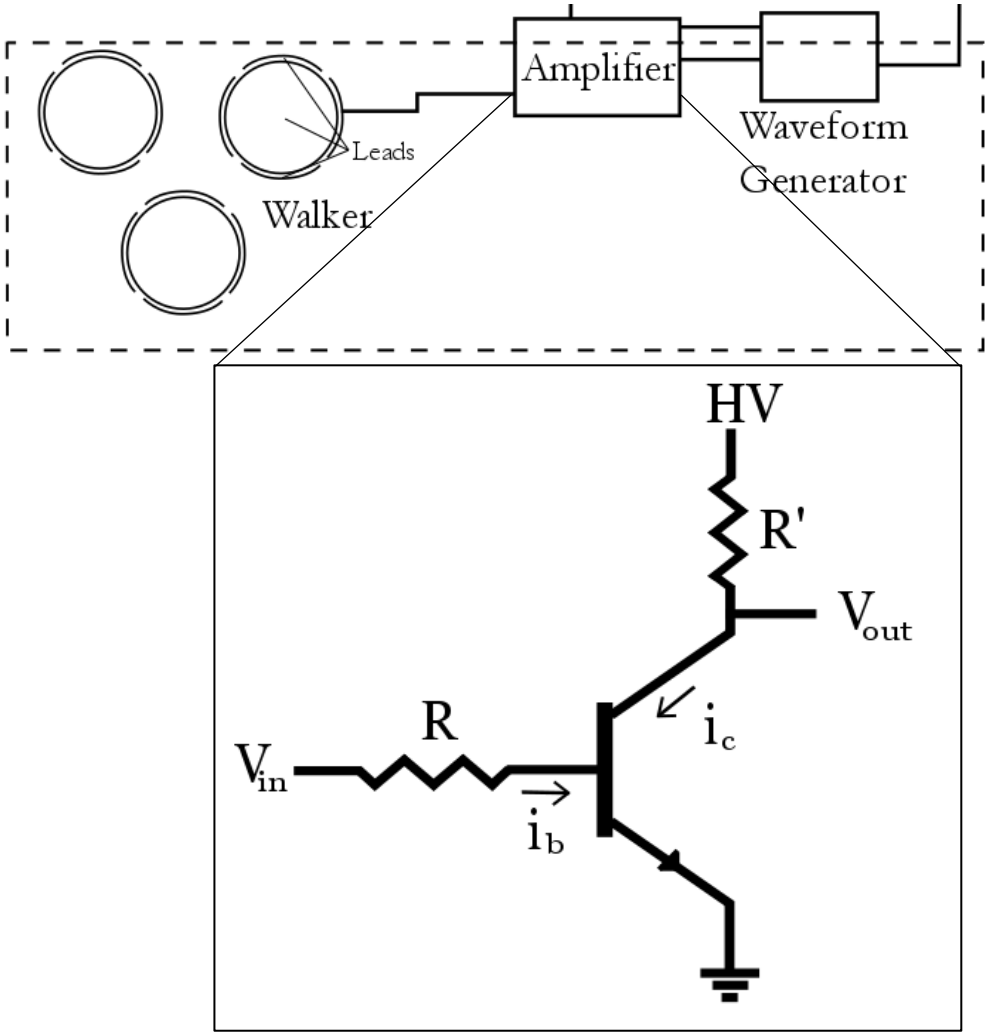


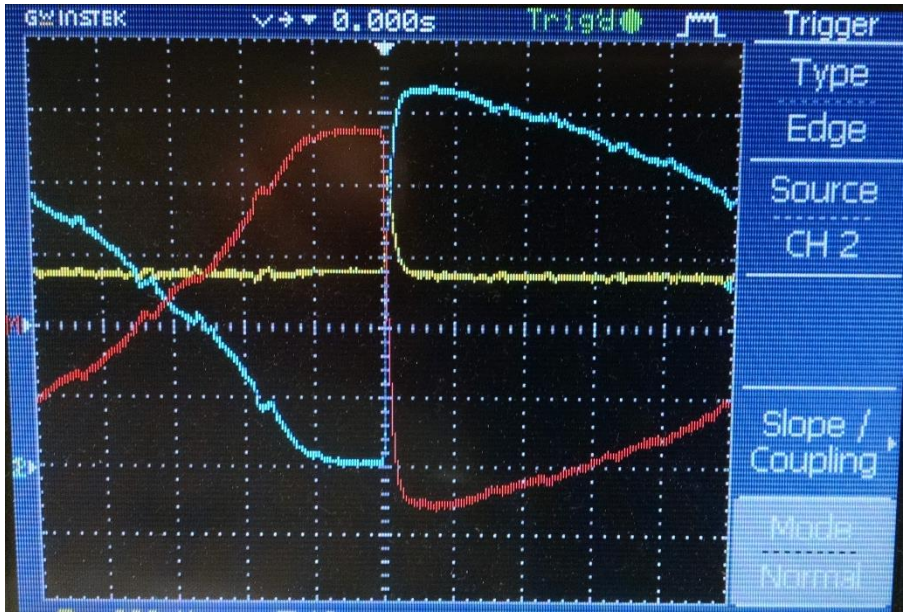


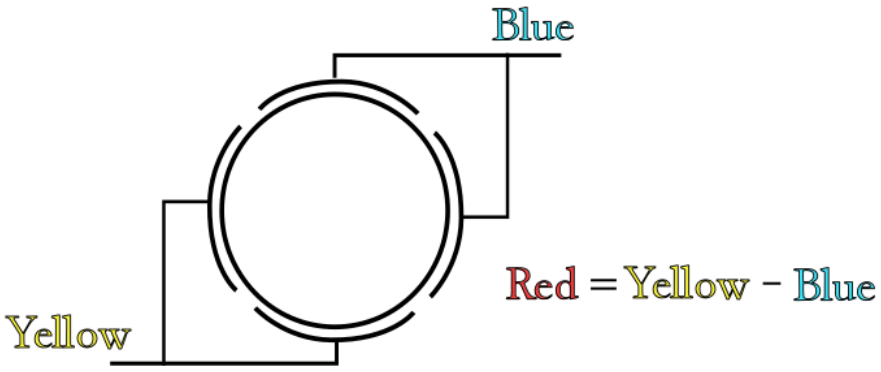
Block Diagram



Control Circuit Progress

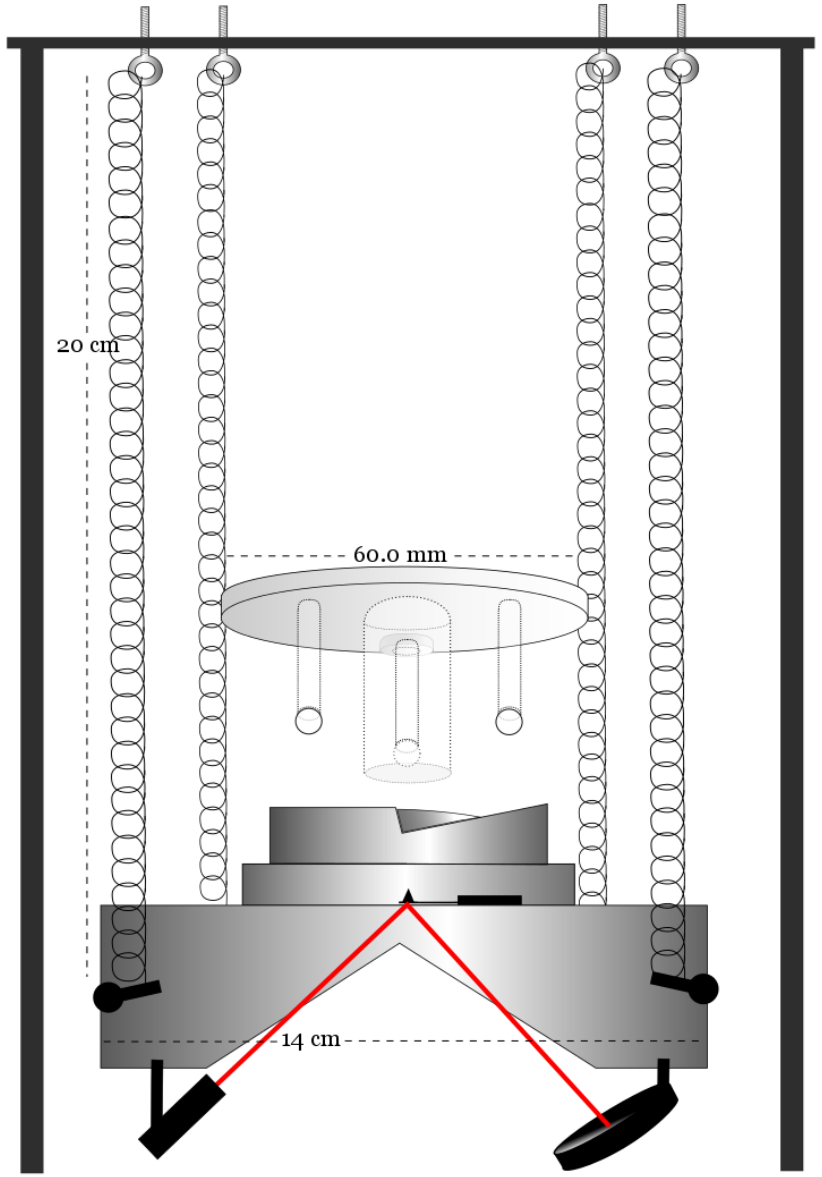






In The Future

- Improve walker design
- Drive cantilever and add feedback from PSD



18 83
HOUGHTON
COLLEGE