AFM Based Experimental Study of Optical Force Modulation
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Background & Objectives
The objective of this project was to experimentally demonstrate the optical force reflected by sample materials using a probe-based atomic force microscopy system [1]. The study of this Casimir force holds applications throughout astronautics and electronics in nanoparticle repellant self-cleaning capabilities. This project sought to configure and calibrate an AFM using a tuning fork or Akiyama probe to measure the force reflected from different materials sensitive to nanoparticles (solar panels, space suits etc.) [2].

Experimental Set Up
The experiment was conducted using a home-made, probe-based force measurement system. A silicone tip probe and an Akiyama probe were placed on a tuning fork attached to the preamplifier board. This was connected to the tuning fork sensor controller to change the gain and amplitude. It was also connected to an oscilloscope to visualize the readings. A function generator was used to set the sweeping sine function. The probe was tested in an open-air environment but has the capability of being moved into different settings (i.e. a vacuum).

Discussions and Conclusions
The amplitude versus frequency graph was not an accurate measure of the force deflected off the AFM, most likely because the tuning fork and Akiyama probe tested had both been used and were damaged as a result. Further testing with a software-based controller system and newly ordered probes would allow for a high degree of accuracy; both improvements will be explored next semester during the continuation of this project. Furthermore, due to the constraints of on-campus research, the desired outcome – the optical force change of different materials – was not ultimately achieved. This is another topic to be explored more thoroughly next semester.

Methods
Using the controller, a low amplitude sensor drive was selected, and a frequency sweep was set on the sine wave generator with center frequency equal to the resonance frequency of the probe. A bandwidth of 2kHz, amplitude of 1 Vpp, and sweep of five seconds were used to record the measurements. The parasitic capacitance was finely adjusted using the function generator in conjunction with an oscilloscope.

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