Measurement of Universal Gravitational Constant Using a Cavendish Balance
PHYS 451

Cameron Kimber

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Instructor: Dr. Minschwaner

Abstract

Ever important in the history of physics and in making accurate measurements of masses in the universe is the universal gravitational constant, G. Using a boom arm suppprting two small masses, supended by a thin tungsten wire, I have made a measurement of this value. The system was set to oscillate, changing the capacitance of a parallel plate capacitor beneath the boom. When the oscillations became small enough, I began to drive them using a larger boom supporting two larger masses, mounted beneath the system. The force of gravity between the masses drives the wire-supported boom back and forth. By finding the torsional coefficient of the wire, the angular displacement of the boom in the forced regime, the distance between the masses, and the masses themselves, I have determined the value of G to be $5.49 \times 10^{-11}\ kg\ m^3\ s^{-2} \pm\ 7.14 \times 10^{-12}\ kg\ m^3\ s^{-2}$. The accepted value for this constant is $6.67 \times 10^{-11}\ kg\ m^3\ s^{-2}$, which lies at σ of 1.66 given my measurement. I feel, given these results, that the measurement is accurate; there are, however, ways the accuracy of my value could be improved. I had not properly calibrated the voltmeter reading out the values, so they did not oscillate over 0 V. Additionally, a laser reflecting off the balance arm, projected on a ruler $1\ m$ away was supposed to be centered at 60 cm on the ruler, but this too was off by a small fraction. In my data reduction, I did use 0 V and 60 cm as these values, which may have led to small discrepancies. Additonally, it would be worthwhile taking more data to ensure the accuracy and drive down the uncertainty in the results.