PHY324 LAB REPORT

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Franck Hertz Experiment

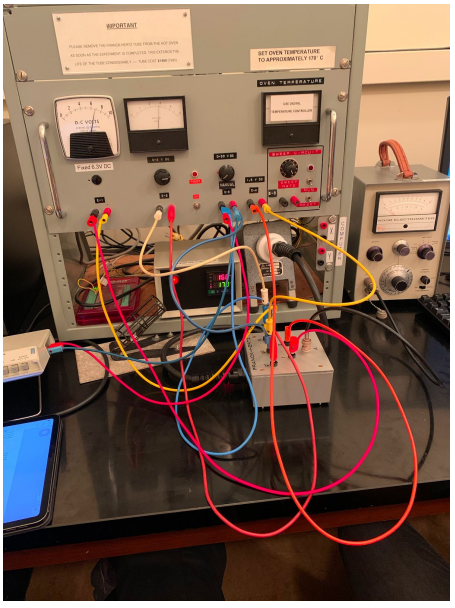
Purpose

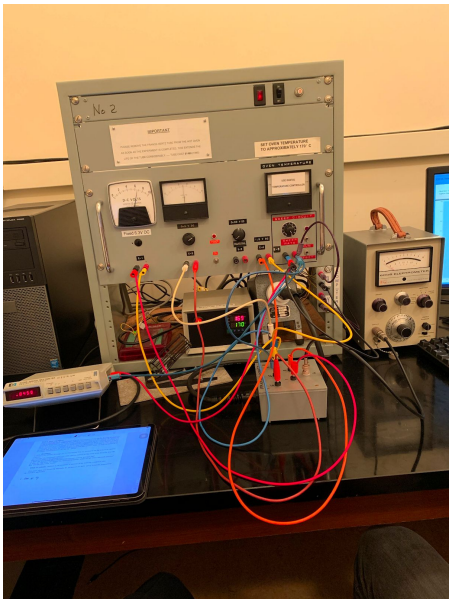
The purpose of this experiment is to show that the electrons lost discrete amounts of energy as they interacted by colliding with larger atoms.

In our experiment, we are going to measure the anode current at specific value of E3. By doing that, we will use an electron emitting filament and computer program to plot the E3 vs. current graph.

Procedures

1. Turn on the power and start heating Hg up, it took 20 minutes to reach about 170 degrees. This step can vaporize Hg in order to have higher probability to collide with electrons.
2. Plug in the wires as the plot down left shows. Now E3 is connected to the manual panel ports to verify the set up. By sweeping the accelerating voltage, we saw smooth and space raises and decrease of the electrometer reading, so our set up was good.

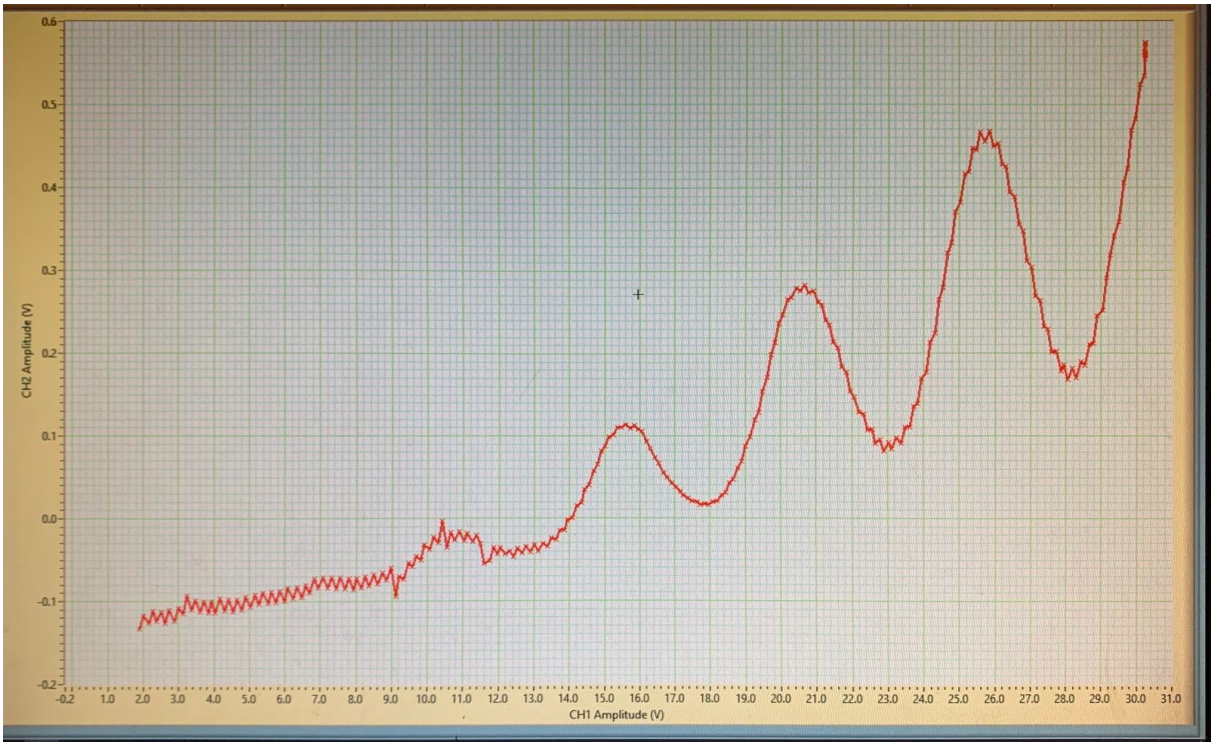




3. Switch E3 to connect with the computer ports as the plot above right shows. Switch on the reset button and the run button, then click start collecting data.

4. We adjusted the sweep rate to see if there any difference between large sweep rate and low sweep rate. We found out that low sweep rate create smoother curve, but it also shows many errors. Finally we took the data with large sweep rate since the graph looks better.
5. After finished collecting data, turn off the power and clean the wires.

Data & Plot



Discussion

Q1

By analysing the difference on x-axis between two peaks, we can see that the difference is around 5V as a constant. Then we can calculate that the discrete amount of energy transferred to the Hg atom is 5 eV for each electron in an inelastic collision.

Q2

By the equation,

$$E = hf = h/lambda$$

we have the wavelength 247 nm, which is in the range of ultraviolet light.

Q3

We want the collision to be an inelastic collision. The relative atomic mass of Mercury is very large compared to Hydrogen, so the Mercury atom is unaffected by the collision (will not absorb a lot of energy), and the Mercury electrons cannot accept energy until it reaches the

threshold to elevate them to an excited state. However, Hydrogen gas cannot satisfy this condition.

Q4

The dips from the graph are not sharp sawtooth patterns because the collision is not fully inelastic collision, which means there were still energy absorbed by the atom like the electrons were experiencing an acceleration, and it cannot be avoided. If it is completely an inelastic collision, it will show sharp sawtooth patterns.

Conclusion

After the experiment, we plot the E3 voltage vs. current graph which shows dips pattern. So we can conclude that the electrons lost discrete amounts of energy as they interacted by colliding with larger atoms. Also we can see that the dips pattern is periodic as we increase the voltage on the accelerating part of the setup.