Outline

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Background

• Bohr Model 1913

• In 1914, James Franck and Gustav Hertz performed an experiment which demonstrated the existence of excited states in mercury atoms.

• Frank-Hertz Data shows electrons losing 4.9 eV per collision with mercury atoms.
Method

- Set Temperature of the oven (That changes the Density of the atoms).
- Mercury vapour is bombarded with electron accelerated under the potential $V$ (between the grid and the filament)
- A small potential $V_0$ between the grid and collecting plate prevents electrons having energies less than a certain minimum from contributing to the current measured by ammeter
- The data gathered by the “KeithleyIV” labview program.
Data and Analysis

- Use thermometer to take measurements at five different temp.
- Find the voltage that the peaks occur.
- Make linear graph (Voltage vs. Peaks) to find spacing between peaks and residual graph for each temp.
Effect of Temperature

Temperature 50 Degrees Celsius

Temperature 170 Degrees Celsius
Linear/Residual

170 Linear Graph

170 Residual Graph

<table>
<thead>
<tr>
<th>Value</th>
<th>Error</th>
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<tr>
<td>m1</td>
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<tr>
<td>m2</td>
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<td>R</td>
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Voltage vs Minimum

Voltage vs Minimum
Slope Vs. Temperature

Franck–Hertz

accepted value

slope (Volts/peak) vs. temperature (Celsius)
Discussion

• Residual graph followed 2/3 rule except for 150°C.

• There is uncertainty in the current and the voltage. Taking that into account are degrees of freedom was 3.

• To improve our data I could have re-calibrated all of our equipment (since it was expired) being used to measure the volts and current.

• I could have done multiple trials at the different temp. and taken an average of the results.
Conclusion

- 150°C – 5.2+/-.02 eV which is .3 eV from excepted value and a weighted Chi Squared of 1.6
- 160°C – 5.08+/-.02 eV which is .16 eV from excepted value. and a weighted Chi squared of 1.48
- 170°C – 4.94+/-.02 eV which is .06 eV from excepted value. and a weighted Chi Squared of 1.11
- 180°C – 4.84+/-.02 eV which is .06 eV from excepted value and a weighted Chi Squared of 1.48

- Based on the data acquired, this is a good model and experiment.
References

• “The Franck-Hertz Experiment.” Hyperphysics. March 3, 2011 http://hyperphysics.phy-astr.gsu.edu/hbase/FrHz.html
