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Physical Chemistry
Franck-Hertz Lab
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Results and Discussion

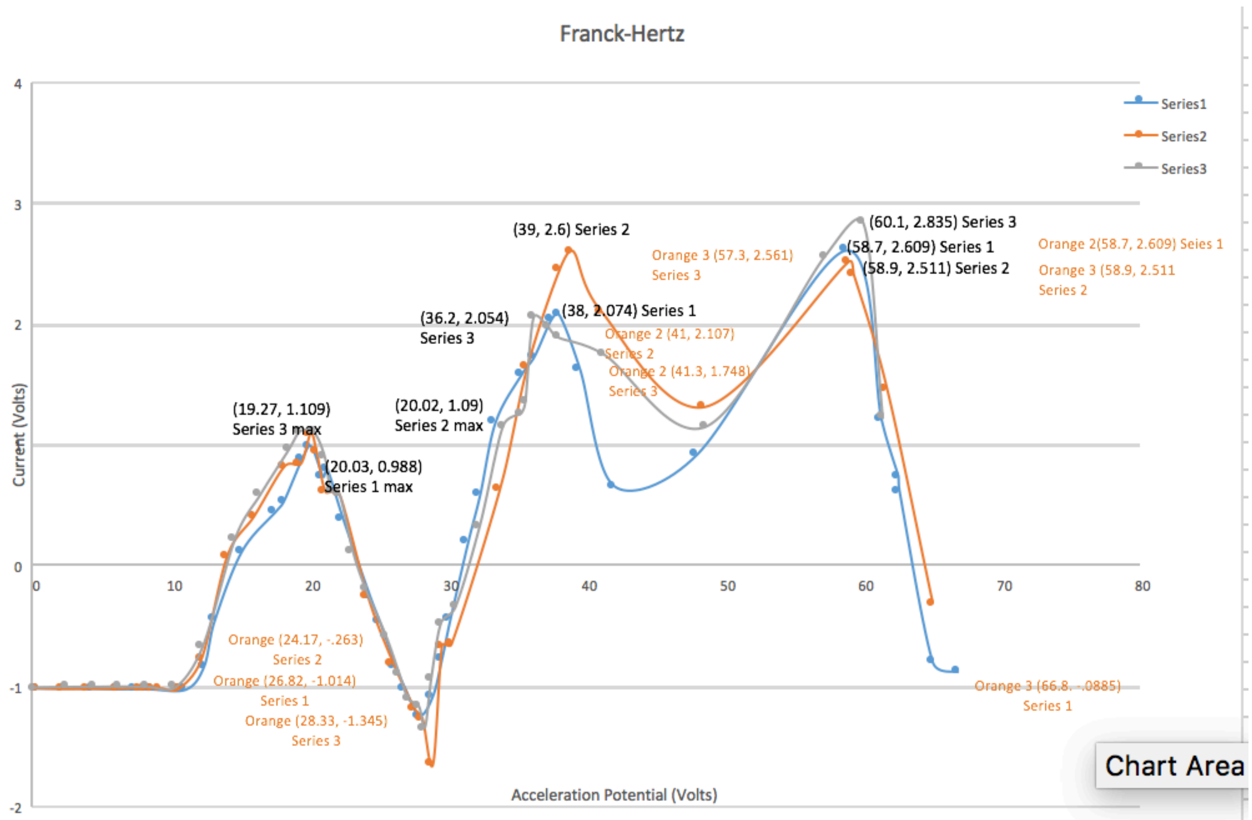

Figure one

Average	Acceleration P Volts	Current			
Average max 1	20.38	0.99			
Average max 2	37.73333333	2.242666667			
Average max 3	59.23333333	2.651666667			
Resonance P.	Max 2- Max 1 V	Max 3- Max 2 V	Volts	Joules	Wavelength
Trail 1	17.97	20.7			
Trail 2	18.98	19.9			
Trail 3	15.11	23.9			
Average	17.35333333	21.5	19.42666667	3.1125E-18	60.33735587
Standard Dev.	2.671177435				

Figure 2

The resonance potential of for the Franck-Hertz experiment on neon was found to be 19.42eV on average. The number was calculated by subtracting the maximum from peak 2 from the maximum of peak 3, then subtracting the maximum of peak 1 from the maximum of peak 2 over three trials and then taking the average of the 6 numbers. The peaks were expected to be the same distance apart, but peak 1 and 2 were closer together than peaks 2 and 3. The plot and data can be found in figure one and 2, or in the Physical Chemistry lab notebook on page 8 and 9.

During the experiment, the Franck-Hertz tube was observed to see when it glowed orange and when the rings appeared. In general, the tube glowed orange just after the first peak. In trial one, it took much longer as the lamp was still warming up. The second ring of orange was observed in general after the second peak, and the third ring was observed just after the third peak.

The expected wavelength of orange is 590nm, but the wavelength of our resonance potential was found to be 70nm. This was found by converting 19.42eV to Joules, and then using wavelength=hc/E to find wavelength. Since h and c are both constants, the only calculated value was E, in joules. This wavelength is found in the microwave section of the electromagnetic spectrum.

The wavelength for the resonance potential does not equal the wavelength of the orange light, but the orange light was observed after the peaks of the graph. That being said, the orange light should not be the same as the resonance potential. The resonance potential is the potential from the ground state to the excited state. The orange glow was observed somewhere after the excited state as the electrons began to relax back down, but not all the way back to ground state.

Using figure 3 in *J. Chem Educ.* the electron transfer observed probably followed the 2_{p1} pathway, from ground state to around 19eV. The electron then had to relax from excited state for the orange glow to be observed in the Franck-Hertz tube, which may have occurred around the 2_{p10} line.

The energy of excitation differs from the energy given off upon relaxation because the tube does not light up at the excited state where the energy is at the maximum. The orange glow begins after the peaks, suggesting that these two energy levels are different.

The difference between the ground state of an electron and the excited state is the resonance potential, but there are other levels between the two that can be achieved after excitation and found using an experiment similar to the Franck-Hertz experiment. The experiment shows quantized energy levels. This was directly observed using the Franck-Hertz tube, as the glow of orange was not constantly present or constantly getting brighter. It was not present, then it was, then it was 2 rings, then it was 3 rings.

References

Kash, M. M.; Shields, G. C. Using the Franck-Hertz Experiment to Illustrate Quantization. *Journal of Chemical Education.* **1994,** *71(6)*, 446-448.