Physics 180E Homework #1

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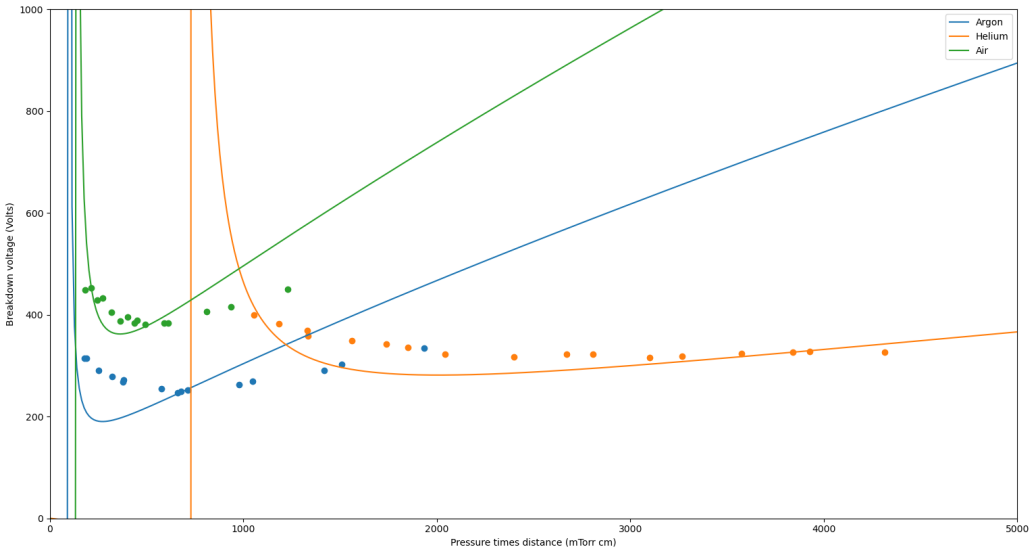
February 7, 2025

Problem 0.1.



(a) Air has the highest minimum breakdown voltage, and argon has the lowest minimum breakdown voltage. This makes sense because the first ionization energy for argon is fairly small, and the first ionization energy for diatomic nitrogen is fairly large. From Homework 2, we know that the minimum breakdown voltage is pretty much proportional to the first ionization energy.

(b) Unfortunately, I have not gotten the curve fit to work yet. I spent hours fiddling with the "initial guess" parameter for the curve fit function, but still have not gotten the curve fit to converge for any of the three gasses. My initial guesses (which were used to draw the curves above) have

Gas	A	B	γ
Argon	0.00002	0.7	500
Helium	0.000015	1	500
Air	0.000005	0.14	270

Problem 0.2.

Juri submitted our experimental plan on my behalf.

PHYSICS 180E, WINTER 2025

HOMEWORK 3
(DUE WEDNESDAY FEB. 5 BY MIDNIGHT ON GRADESCOPE)

1. Write a paragraph for each question below giving physical explanations. This can be a rough draft of an analysis/discussion section for your lab report.

   (a) On the same plot, show your measured Paschen curves for Nitrogen and Argon (and Helium if available). What is the ordering of the gases with respect to the minimum breakdown voltages? Does this order make sense? Why or why not? Can you make use of the result in problem 1 from Homework 2 (minimum breakdown voltage calculation) to make your argument?

   (b) Obtain a fit for Paschen's law with parameters A, B, and γ_{SE} for the gasses you studied. Do the values obtained from these fits make sense in terms of physical parameters?

2. With your lab group, write an experimental plan that you will execute for Lab 2 beginning in Week 5. The plan should outline the measurements you wish to take and the physical motivation for each setup. Make sure that your plan is feasible with respect to time and equipment. Submit your plan as a group on Gradescope prior to your lab session.