# Plasma Physics

Athalia S. Meron[1, *] and Jorge García Ponce[1, †]
[1] *Harvard College, Cambridge, Massachusetts 02138, USA*
(Dated: February 11, 2025)

Plasma physics is cool!

## I. INTRODUCTION

1 [**Motivate Plasma Physics**] We will introduce plasmas and explain their numerous applications (ex: gas lasers, fusion, etching, etc). Also an abundant state of matter and understanding plasma moves towards understanding the universe.
2 [**Argon Plasma**] Argon plasmas are easily produced and characterized by virtue of argon's abundance and ease of use.
3 [**Outline the paper: 3 experiments**] We perform three important experiments to characterize a plasma. Should we briefly explain the experimental setup here? We can say we are able to prepare an argon plasma under different pressure/voltage conditions. We then study plasma formation conditions and construct the Paschen Curve at a fixed distance between the electrodes. We also use a Langmuir proble to measure the electron density of the argon plasma at different points along the parallel plate setup. Finally, we measure the electron density of the plasma using both the Langmuir probe and spectroscopic data.

## II. RESULTS AND DISCUSSION/FIGURES

### A. Paschen Curve

4 [**Explain setup/Data collection**] Talk about vacuum chamber, gauges, argon flow –we vary voltage and measure. Paschen curve calculated from equation (will be added in later) and then measured experimentally. Full detail of setup in the methods section.
5 [**Introduce Paschen's law**] Introduce's Paschen's law and explain its origin from statistical mechanics arguments
6 [**Experimental results**] Show and discuss figure

### B. Langmuir Probe

7 [**Explain setup**] Explain setup. Introduce Langmuir probe and measure the current at different points in the plasma.

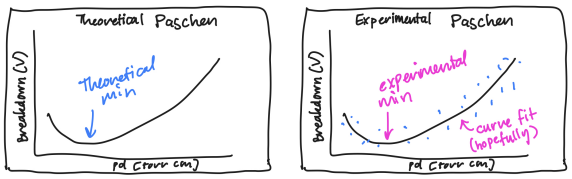


FIG. 1. plasma breakdown voltage obeys relation given by paschen curve

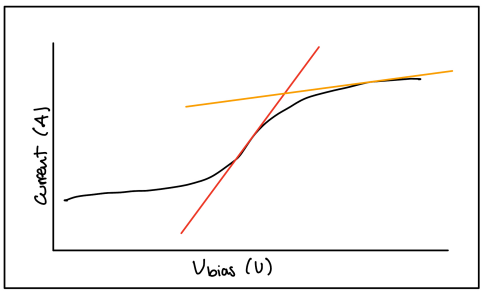


FIG. 2. The temperature and density of the plasma electron is obtained with a Langmuir probe

8 [**Introduce theory behind experiment**] Explain main equations relating measured current and electron temperature and density
9 [**Experimental results**] Show and discuss figure. Mention experimental shortcomings as well as shortcomings of the method. Explain in what regimes these measurements are not a reliable estimate of the desired quantities. Motivate the necessity of spectroscopy to compare and validate temperature measurements.

### C. Spectroscopy

10 [**Explain setup**] Explain alternative setup with chromatography chamber.
11 [**Explain method to obtain electron temperature from emission spectroscopy**] Explain the theory that allows to estimate electron temperature from the emission spectra of plasma.
12 [**Experimental results**] Again, show the experimental data and discuss it. Discuss the shortcomings of this technique (collection time/signal to noise ratio/sensitivity) and how it compares to the Langmuir

* ameron@college.harvard.edu
† jorgegarciaponce@college.harvard.edu

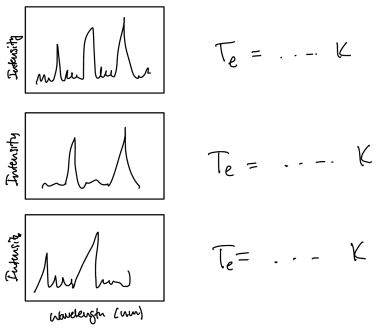


FIG. 3. Temperature of plasma at different regions determined by integrating its spectrum

probe experiment. Explain in which regimes this can be trusted and how they can both be used together.