Population Kinetics of a Repetitively-Pulsed Nanosecond Discharge

by

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I would like to dedicate this dissertation to someone else.

A C K N O W L E D G M E N T S

Who is this?

Preface

This is a dissertation about something; I really hope it's good.

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rpnd Repetitively-pulsed nanosecond discharge

CHAPTER 1

Introduction

1.1 Background

It is difficult to definitely define the discovery of plasma. The observation of plasmas has spanned the whole of human existence, with the very moment we began to gaze at the stars. Wikipedia credits Sir William Crookes with first identifying it as a new state of matter in 1872 (though Crookes credits Faraday with hypothesizing its existence as early as 1819). Curiously, the first applications of plasma preceded its discovery as a new state of matter by 15 years when Ernst Werner von Siemens described the use of a "silent discharge" in air for the preparation of ozone in the treatment of biologically contaminated water.

While the study of plasmas possesses a great deal of significance for astrophysics, it has always been undeniably linked to human applications. To this day, studies continue to explore the use of plasma to treat water, now with concern for industrial pollutants. In general, the last decade has seen a surge of research on the application of atmospheric-pressure plasmas. However, the formation of this subset of plasmas has always been shrouded in a degree of mystery.

The theory for traditional diagnostics is often ill-suited for the increase in neutral collision, while the instruments themselves are often too slow to capture the necessary physics. Separately, there has been a lack in motivation. For many years, the dominant application in plasma research has been fusion power at the neglect of low temperature plasmas. However, as the possibility for new and exciting opportunities has become apparent, it has become necessary to expand on our understanding of atmospheric-pressure plasmas.

My work is concerned with the study of one such plasma. In the literature, it has been given a variety of unimaginative names that do not reflect its unique

characteristics. As I am unlikely to change this trend, I will adopt the name 'repetitively-pulsed nanosecond discharge' (Repetitively-pulsed nanosecond discharge (rpnd))

My work concerns the study of one such atmospheric-pressure plasma. In the literature, it goes by several names; here, I will simply refer to it as a repetitively-pulsed nanosecond discharge (RPND). Of course, the choice of a name is only moderately useful, more important is a description. The RPND is a plasma that exhibits exceptional uniformity and volume, with minimal gas heating.

1.2 Theory

1.3 Literature Review