Chapter 1

Introduction

Curiosity is the driving force behind the development of human civilisation. Over centuries, scientists have discovered new methods for understanding Nature and the fundamental mechanisms governing the Universe, using continually improving research methods and technology to peer ever deeper into the heart of matter.

After the initial discovery of atoms, their underlying structure was soon revealed to be that of a positively charged core surrounded by a cloud of orbiting electrons. The atomic nucleus was subsequently decomposed into protons and neutrons, which themselves were found to consist of three tiny quarks. Studying these minuscule building blocks of visible matter has made it possible to understand more about the intricate complexities of the Universe, and the mechanisms that guide its behaviour and evolution.

Discoveries of this magnitude would not have been possible without the technologies developed to carry out such experiments. On one hand, the energy of the experimental devices has been increasing continually, allowing smaller and smaller distance scales to be probed. On the other hand, the devices used to observe and measure the phenomena created in these experiments have had to be designed with improved precision, speed and durability.

Keeping these factors in mind, the goal of this work was to find "the perfect material". Diamond proved to be a worthy contender, offering both outstanding electrical and mechanical properties which make it the material of choice for a number of applications in experimental physics. However, much remains to be learned about its behaviour, and this thesis adds a small piece to the shimmering mosaic of diamond research efforts.

The first chapter introduces some of the leading particle physics research institutes, and describes how their research is carried out. The second chapter discusses the properties of diamond detectors used in high energy particle physics experiments. A diamond sensor irradiation study is presented in chapter 3. The conclusions of this study, which define the constraints for the two diamond detector applications, are presented in the final two chapters.