Chapter I
Introduction

A solar flare is an explosion on the surface of the Sun, which often releases particles known as "cosmic rays." Cosmic rays are energetic particles moving in interplanetary, interstellar, or intergalactic space. Most cosmic rays are charged particles, which consist of charge atomic nuclei ($\approx$ 98%) and electrons and positrons ($\approx$ 2%). The nuclei are hydrogen, helium, and heavier nuclei (Simpson 1983). Cosmic ray particles have a wide range of energies, from 10^6 to 10^{21} eV, the latter being far higher than the highest energies available from man-made accelerators (10^{12} eV). The majority of low-energy (10^3-10^8 eV) cosmic ray particles are accelerated near the surface of the Sun. Cosmic rays have important effects on the Earth, such as disrupting radio communications, causing electric power failures and causing radiation warnings on transoceanic airplane flights. Much of the interest in solar cosmic rays regards the study of solar flares, the mechanism of acceleration and cosmic ray propagation using a transport equation. In particular, recently there have been substantial technical improvements in the method for simulating the transport of cosmic ray particles through the interplanetary medium.

This work examines cosmic rays from solar flare events, which are called "solar cosmic rays." Most of the data are used to analyze the intensity and anisotropy of energetic electrons and protons coming from the Sun. Samples of data are from the *ISEE-3/ICE* spacecraft (see Figure 1.1).

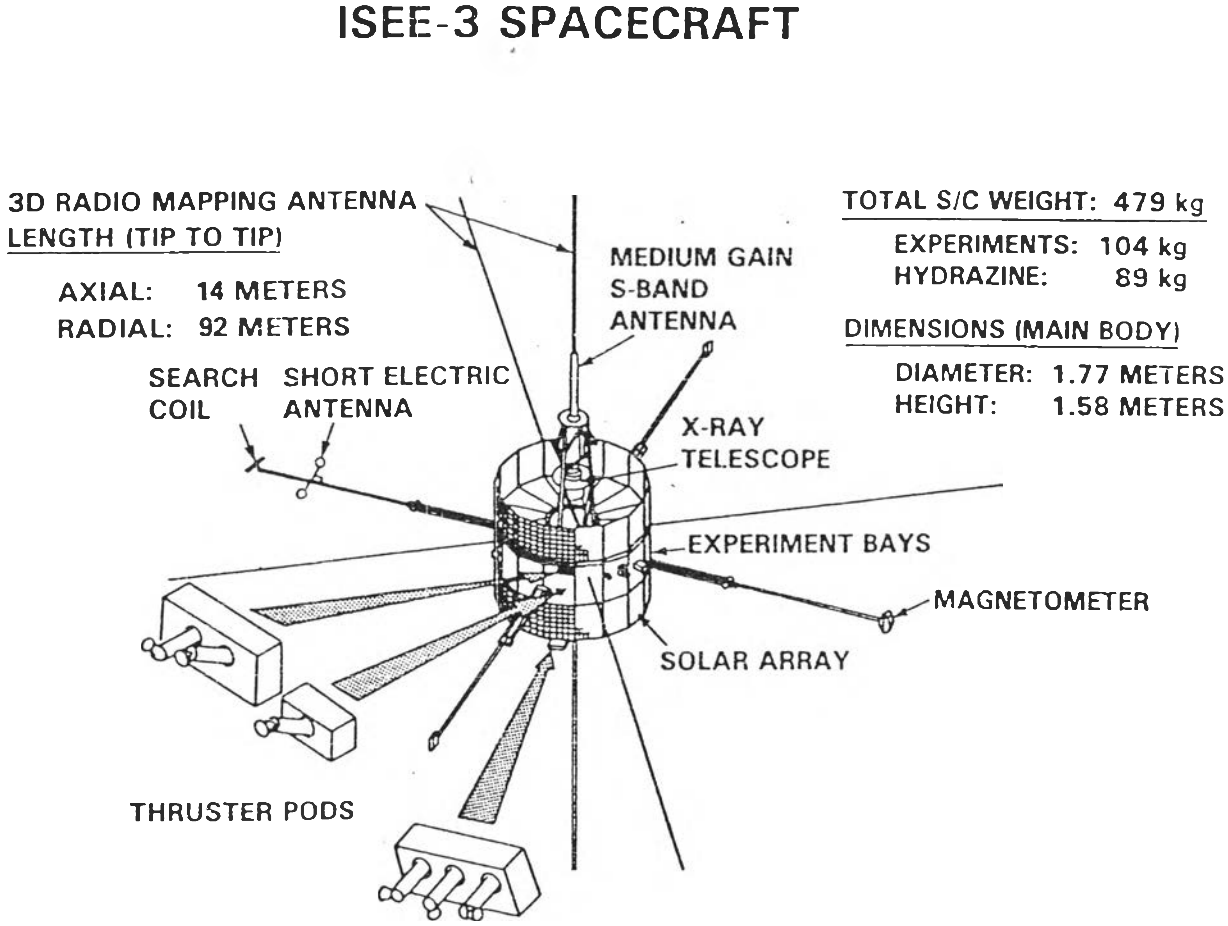

Figure 1.1: The *ISEE-3/ICE* spacecraft.

The Objectives of This Thesis

1. To analyze the characteristics of dense pulses of particles released from the Sun.

2. To analyze the effects of drifts and diffusion which influence the transport of particles.

3. To simulate the transport of particles released from the Sun and analyze the duration of particles released from impulsive and gradual flares.

Procedure and Outline of This Work

In this work, the author analyzes the characteristics of dense pulses of particles released from the Sun. The author uses the basis of the Fokker-Planck equation for the transport of solar cosmic rays, as will be described in chapter 2. The transport of solar cosmic rays from the Sun to the spacecraft is simulated computationally is described in chapter 3. The results of a comparison between such simulations and approximate theoretical are described in chapter 4. The effects of drifts and diffusion, which influence the transport of these particles are discussed in chapter 5. The results of fitting gradual and impulsive flares are discussed in chapter 6. Finally in the last chapter will be discussion and conclusions. The procedures in preparing this thesis were:

1. To study the research that is involved.
2. To study the transport of particles released from the Sun.
3. To perform computational simulations.
4. To study the effects of drifts and diffusion on this transport.
5. To study an impulsive flare and a gradual flare.
6. To conclude and write the thesis.

The Usefulness of This Work

In this research the author should analyze the data from a spacecraft to compare with accurate simulations, so this research can address how to interpret the data on cosmic rays from spacecraft and how to use the data from simulations. This research will make the reader understand the solar flare events better. This research will also provide the direction for others to improve the techniques in the computational simulation.