Final Technical Report for
NASA Grant NAGW-3974
A Study of Currents in the Middle and Outer Magnetosphere
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1. Introduction

The purpose of this grant was to study the electrical current flow along and across the magnetic field lines in the middle and outer magnetosphere. These currents are both time stationary and fluctuating. Our study of the time stationary currents formed part of the Masters dissertation of graduate student Tom Meseroll. This work was also undertaken in part by visiting research scientist W. X. Jiao. Our study of the fluctuating currents formed part of the Ph.D. dissertation of graduate student Peter Chi. In the bibliography below we list the papers in journals and at meetings arising from these studies. In addition to these studies, we were asked to assist in several studies of the currents in the magnetotail, in the dayside magnetosphere, and near the polar cusp (with Hawkeye data). Also we undertook a study of the currents associated with sudden impules caused by sudden solar wind pressure changes. These studies were also supported in whole or part by the subject grant. Below we say a few words about these studies. This is followed by a bibliography listing the papers. There were no patents issued or inventions associated with this study.

2. Field-Aligned Current Systems

The ISEE 1 and 2 spacecraft provide the opportunity to distinguish steady features from transient features in the magnetic field. One of the more permanent features is the shear in the field caused by currents running parallel to the magnetic field. Graduate student, F. K. Chun, studied the control of these currents by geomagnetic activity (1.11). R. J. Strangeway examined the effect of the interplanetary magnetic field on these currents. W. X. Jiao examined the velocity of these current sheets (2.5) and graduate student T. Meseroll examined their temporal stability and IMF effects (2.8, 2.19, 2.21, 2.25, 2.28).

3. ULF Waves

Our wave studies concentrated mainly on the Pc 3-4 band Graduate student, Peter Chi, showed how pulsations in the magnetosphere behaved when the IMF was a low cone angle for long periods (1.2) and he examined the simultaneous behavior over large distances (1.8, 2.7, 2.13, 2.20, 2.26, 2.27). He examined waves near the magnetopause (2.24), the Poynting flux of these waves and the phenomenon known as phase skipping (2.30, 2.32, 2.33). He also examined the latitudinal behavior of these waves (2.29).

4. Current Sheet in the Tail

With graduate student Z. Kaymaz we undertook a study of the twist of the current sheet in the tail caused by the IMF (1.1). With visiting scientist X.Y. Zhou we studied the structure and dynamics of the tail current sheet on a day when the conditions were quite disturbed (1.9, 1.13, 1.14, 2.9, 2.10, 2.14, 2.15, 2.16, 2.22, 2.31). With H. Nakai we undertook a study of the statistical behavior of the tail current. With Don Mitchell we examined the current sheet behavior during substorms and bursty bulk flows.

5. Sudden Impulses

We examined how the magnetosphere responded to sudden impulses when the IMF was southward (1.3). We looked at the response close to the auroral electrojet when the IMF was northward (1.5, 1.6, 2.4, 2.6).

6. Geomagnetic Activity

We examined the inferred control of reconnection by solar wind beta using geomagnetic activity as a proxy measure (1.4). We examined transient disturbances in the dayside outer magnetosphere with both J. Sanny and G. I. Korotova (1.7, 1.16, 2.12).

7. Currents Near the Polar Cusp

When Hawkeye data became available we examined the current systems around the polar cusp to understand how that region differed from low latitudes and from the various theories that had been proposed (1.10, 2.11, 2.18). This work will be one aspect of the dissertation research of graduate student X. W. Zhou.

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I. Papers in Books and Journals

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