A FINAL REPORT TO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

for research titled

# MAGNETIC FIELDS EXPERIMENT

under

Contract NAS 5-11173

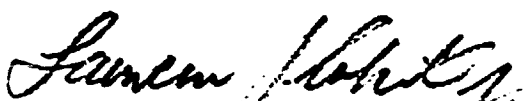
Conducted at the

Space Science Center
University of Minnesota
Minneapolis, Minnesota 55455

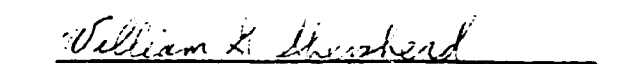
during the period of

1 October 1968 to 31 March 1975





Laurence J. Cahill, Jr.
Principal Investigator



William G. Shepherd
Director, Space Science Center

September 23, 1975

FINAL REPORT, NASA CONTRACT NAS5-11173

This contract was in force at the University of Minnesota from the fall of 1968 to the spring of 1975. During this period the major portion of the design of the Explorer 45 magnetic fields instruments was carried out. The complete construction and testing were also accomplished. We participated in the payload integration of Explorer 45 at Goddard Space Flight Center and took part in the launch activities at the San Marco Platform, Kenya. After the launch there was a period of correcting errors in the computer programs and we enjoyed three years of support for initial data analysis.

The Explorer 45 magnetic fields instruments included the three axis fluxgate magnetometer with two ranges of sensitivity and a two axis search coil magnetometer with onboard filters for spectrum analysis, a wideband telemetry transmission mode, and a rapid sampling mode. All portions of the magnetic fields instruments operated as planned from launch in November of 1971 until late June of 1972. At that time there was a malfunction in the calibrate sequence of the fluxgate magnetometer. Data was received after that in a useful form, but the data was generally available only from the low gain state. Between January and March of 1973 the

onboard data processing system of Explorer 45 malfunctioned with increasing severity so that the analog data, including our fluxgate and search coil data, were unavailable after March, 1973. Wideband data from the search coil continued to be available through the end of 1973. Since launch approximately ten papers have been accepted for publication based on results of the Explorer 45 magnetic fields instruments. Another five papers have used data from the Explorer 45 magnetic fields instruments, and five more papers are now in the process of being published. A list of the first ten papers is attached. The scientific return represented by these papers, and probably ten or more papers to follow, represents the principal contribution of the effort supported by this contract.

In addition to the scientific results mentioned, however, are the contributions made to the people who have been involved in this project at the University. First, consider the graduate students, whose apprenticeship at research physics has been supported by the project. Bodo Parady, a Ph.D. candidate, worked with the search coil data as his thesis research, finishing in June of 1974. He has since transferred to the University of California at Berkeley, where he works with Forest Mozer as a research associate. C. C. Lin is currently a physics Ph.D. candidate, working with mag-

netic fluctuation data from the fluxgate magnetometer for his thesis research. His thesis has been completed and he should receive his Ph.D. during the fall of 1975. Four Master of Science theses were earned, in part, through work done on the project. Of particular note is the Master of Science work done by D. D. Eberlein. He was the project engineer during the construction phase of the magnetic fields instruments and, concurrently, wrote a M.S. thesis for the Department of Electrical Engineering on the design of the search coil preamplifier. Approximately twenty other students, mostly undergraduate, worked on various phases of the project, including construction of electronic circuits, testing, assistance with computer programming and computer operations. Most of these students were physics or electrical engineering majors, but some were enrolled in programs such as English or History. All of the students received financial support, working on the projects, that enabled them to continue their education. They also received very valuable experience while working with advanced electronic circuits and advanced programming techniques.

L. J. Cahill
Principal Investigator

Explorer 45 Magnetic Fields Papers (6/30/75)

Magnetic Storm Inflation in the Evening Sector, J. Geophys. Res., 78, 4724-4730, 1973.

ELF Observations During the December 1971 Storm (with Bodo Parady) J. Geophys. Res., 78, 4765-4770, 1973.

Storm Time Pc5 Magnetic Pulsation at the Equator in the Magnetosphere and Its Latitude Dependence as Measured on the Ground (with L. J. Lanzerotti, H. Fukinishi and C. C. Lin), J. Geophys. Res., 79, 2420-2426, 1974.

Explorer 45 ($S^3$-A) Observations of the Magnetosphere and Magnetopause during the August 4-5, 1972, Magnetic Storm Period (with R. A. Hoffman, R. A. Anderson, N. C. Maynard, P. H. Smith, T. A. Fritz, D. J. Williams, A. Konradi and D. A. Gurnett), J. Geophys. Res., submitted April 1974.

Pi 2 Pulsations in the Magnetosphere, (with C. C. Lin), Planet. Space Sci., accepted 1974.

Protons as the Prime Contributors to the Storm Time Ring Current, (with F. W. Berko and T. A. Fritz), J. Geophys. Res., submitted 1974.

Quiet Time Inflation of the Inner Magnetosphere in the Afternoon and Evening Quadrants (with Yue C. Lee), J. Geophys. Res., 80, 1003, 1975.

Plasmaspheric Hiss Observations in the Evening and Afternoon Quadrants, (with B. Parady, D. Eberlein, J. Marvin and W. Taylor), J. Geophys. Res., accepted 1975.

Explorer 45 Observations of 1-30 Hz Magnetic Fields near the Plasmapause during Magnetic Storms (with W. W. L. Taylor and B. Parady), J. Geophys. Res., accepted 1974.

Pc 4 and Pc 5 Pulsations during Storm Recovery (with C. C. Lin), J. Geophys. Res., submitted 1974.