RESTORATION OF APOLLO MAGNETIC FIELD DATA. P. J. Chi[1], C. T. Russell[1], R. J. Walker[1], and D. Williams[2], [1]Institute of Geophysics and Planetary Physics, UCLA, Box 951567, Los Angeles, CA 90095-1567; pchi@igpp.ucla.edu, [2]National Space Science Data Center, Code 690.1, NASA Goddard Space Flight Center, Greenbelt, MD 20771.

Introduction: The Apollo missions at the close of the 1960s and beginning of the 1970s provide the only magnetic field measurements on the lunar surface environment to date. These data, collected by the Apollo Lunar Surface Experiment Packages (ALSEPs), and the accompanying magnetic measurements by subsatellites can provide a wealth of information for scientific studies and planning for future lunar exploration in today's environment.

These data were examined in the 1970's but have not been widely used since then. The major obstacle to study the Apollo data at the present time is that much of these data are stored in cumbersome forms which make them inaccessible to most users.

In this paper we outline a plan to restore these data from the Apollo surface and subsatellite magnetic field experiments and make them available to the lunar exploration community. We will recast these data into widely used formats, including ASCII tables and CDF. In a two-year time frame, this data restoration project builds a dedicated online server for all the Apollo magnetic field data, providing researchers and mission planners a unique and valuable data set that helps analyze the lunar electromagnetic environment faced by future astronauts. The project also archives all these data at the Planetary Data System (PDS) and at the Lunar Exploration Enabling Database (LEED) through the collaboration with the Lunar Data Project (LDP).

Apollo magnetic field experiments and their importance: The magnetic field experiments conducted by the Apollo missions started with the Lunar Surface Magnetometer (LSM) installed by Apollo 12 astronauts on November 19, 1969, marking the first ever magnetic field measurements on the surface of the Moon. Later, Apollo 14 astronauts used the Lunar Portable Magnetometer (LPM) to measure the magnetic vector field at various positions near the landing site. Apollo 15 added a biaxial magnetometer aboard the subsatellite orbiting the Moon, making joint observations with an LSM on the lunar surface. The Apollo 16 had all three magnetic field experiments: LSM, LPM, and the subsatellite magnetometer.

The LSM measured the magnetic field on the lunar surface and determined from these measurements some of the deep-interior electrical properties of the Moon, such as magnetic permeability, electrical conductivity, and temperature. The subsatellite biaxial magnetometer (SBM) experiments extended the measurements of the lunar magnetic field (the permanent as well as the induced components) and were used to study the interaction of the Moon with the field and charged particles of its environment.

The LSM and SBM data have been identified as valuable in the following areas:

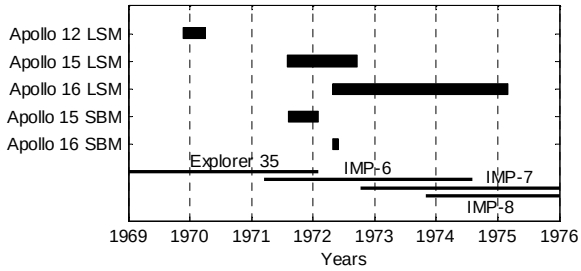
Internal structure of the Moon. The magnetic field oscillations on the surface of the Moon can be used to infer the internal electric conductivity profile. This knowledge can impose constraints to the various models of lunar formation and evolution.

Crustal magnetic fields and their origins. The detection of crustal magnetic fields by Apollo surface magnetometers and subsatellites is one of the major surprises of the Apollo program. The paleomagnetic field on the lunar surface provides important clues to the ancient terrestrial and lunar environments.

Heliophysics Science. The relevant subjects include characterization of near lunar electromagnetic/plasma environment, magnetotail dynamics at lunar orbit, and lunar wake as a heliophysics plasma laboratory.

Space weather for human exploration. The variations of lunar electromagnetic and plasma environments are essential to the radiation and dust conditions encountered by the astronauts when they return to the Moon.

Data restoration: We will restore the data from five Apollo LSM or SBM by converting them into modern formats. The figure below shows the duration of these Apollo experiments included in this data restoration project, as well as the concurrent plasma and magnetic field observations by other NASA satellites in the solar wind or magnetotail (data available at GSFC's Space Physics Data Facility).



The digital data of these Apollo magnetic field experiments are currently stored as 36-bit words. We will translate the data into several modern formats that

are commonly used in the space science community. In the beginning the data will be converted to the IGPP flat file format, which allows us to make use of an available suite of utility programs for data processing and web server development. Then data will be further converted into ASCII tables and Common Data Format (CDF) for archiving at PDS and LEED.

We also prepare data in different coordinate systems for the convenience of future users of these data. The original set of LSM data are stored in the ALSEP local coordinate system, and the subsatellite magnetometer data are expressed in transverse and parallel directions to the spacecraft spin axis. To facilitate the comparison between the two types of measurements and with other experiments of interest to potential users, we provide additional versions of the data in the geocentric (such as GSE and GSM) and selenocentric (Selenocentric Solar Ecliptic and Selenographic) coordinate systems. The calibration of the LSM and SBM data sets will either be included in the restored data set or stated in the documentation.

The restored Apollo magnetic field data will be accessible through three different channels. First, we will build a dedicated online data server for these data, which allows data users to quickly access and view the data through an easy-to-use web interface. Second, the restored data will be submitted to the Planetary Plasma Interactions (PPI) Node of the PDS for archiving. This effort includes the tasks to prepare the data in a PDS-compliant form, as well as detailed documentation for users to interpret the data. Third, a copy of the restored data will also be submitted to the Lunar Exploration Enabling Database (LEED) through an agreement involving PDS and LEED.