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Interplanetary Magnetic Field IMP-1,
Motion Picture of the Transverse Components

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This note describes a 16 mm movie representing a portion of the IMP-1 magnetometer observations of the interplanetary magnetic field. In a previous movie the view was from the north looking down on the ecliptic plane. In the present movie the view is parallel to the ecliptic plane, and at an angle of 50° to the earth-sun line. Thus an interplanetary magnetic field in the Archimedes spiral direction would appear as a point, and the transverse variations (in the north-south direction and in the azimuthal direction) will be seen. The movie may be borrowed upon request to Dr. John M. Wilcox, Space Sciences Laboratory, University of California, Berkeley, California.

The movie represents approximately 12 days of interplanetary field observations, beginning with the second orbit of IMP-1. As shown in Figure 1, the film begins with a portion of a small sector with field toward the sun, followed by a sector boundary at which the field direction changes from predominantly toward the sun to predominantly away from the sun. This corresponds to the commencement of a recurring geomagnetic storm at 2117 UT on 2 December 1963. After the sector boundary the first day and a half of a large "away" sector is shown, and the satellite then enters the magnetosphere on day 338 at approximately 1500 UT, and observations of the interplanetary medium are not possible. In the intervals during which IMP-1 was near perigee and was within the geomagnetic field the present representation goes off scale. On orbit 3 the satellite began observing the interplanetary medium at about 0600 UT day 339 and re-entered the magnetosphere at about 1100 UT day 342. This orbit is a continuation of the large away sector associated with the long series of recurring geomagnetic storms. This sector also contained the recurring stream of ⌐1 Mev protons observed by Fan, Gloeckler and Simpson (1965). Orbit 4 displays the trailing portion of this large away sector. The satellite began observing the interplanetary medium at about 0600 day 343 and re-entered the magnetosphere at about 0800 UT day 346. A toward filament was contained within this away sector, extending from about 2200 UT day 343 to 0330 UT day 344. Orbit number 5 shows the preceding portion of a large toward sector. The satellite began interplanetary observations at about 1000 UT day 347 and the film ends about day 350. A clock in the upper left hand corner of the picture indicates the time of observation. The movie emphasizes in an unique way the dynamic character of the transverse components of the interplanetary field.

The movie was produced on an IMB 7094 computer equipped with a DD-80 data display system at the Lawrence Radiation Laboratory, Livermore. The format is

shown in Figure 2. North is at the top of the screen and south at the bottom. The ecliptic intersects the plane of the screen in a horizontal line, and the projection of the orbital velocity of the earth is from left to right. A dotted circle centered at the origin represents a magnitude of 4γ (4×10^{-5} gauss). The observed interplanetary field component transverse to the Archimedes spiral direction is represented as a line with one end fixed to the origin and the other end representing the magnitude and direction of this component. When the interplanetary field is away from the sun this line is solid, and when the field is toward the sun this line is dashed. Each data point represents a 5.46 minute average of the original observations, and there are seven linear interpolations between each of the 5.46 minute data points. Each day's observations takes about 2 minutes on the movie so that time is compressed by a factor of about 700. It is recommended that for group viewing the film be projected at sound speed.

The interpolations are made as follows: between two 5.46 minute vectors, a vector is constructed whose position bisects the angle between the data vectors and whose magnitude is the average of the magnitudes of the two data vectors. This process is then repeated until a total of seven interpolated vectors have been constructed.

Some of the published discussions of the interplanetary magnetic field observed by IMP-1 are included in the references.

Acknowledgements

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Figure Legends

Figure 1.   The movie includes the time interval from 1 December 1963 to 14 December 1963, as indicated on this sector diagram. The + (away from the sun) and - (towards the sun) signs at the circumference of the figure indicate the direction of the measured interplanetary magnetic field during successive 3 hour intervals. A parenthesis around a + or - indicates a time during which the field direction has moved beyond the "allowed regions" shown in Figure 2 for a few hours in a smooth and continuous manner. The inner portion of the figure is a schematic representation of a sector structure of the interplanetary magnetic field that is suggested by these observations. The deviations about the average streaming angle that are actually present are not shown in this figure.

Figure 2.   Format of movie. The screen is normal to the ecliptic plane. North is up and south is down. The projected direction of the earth's orbital velocity is to the right. The origin O represents the spacecraft (or for present purposes also the earth). The dashed circle represents a field magnitude of 4 γ (4 x 10^{-5} gauss). The interplanetary magnetic field component transverse to the Archimedes spiral direction is shown as the line OA. The end O remains fixed and the A moves about to represent the magnitude (on the scale of the 4 γ circle) and direction of this component. When the field is away from the sun OA is solid and when the field is toward the sun OA is dashed.
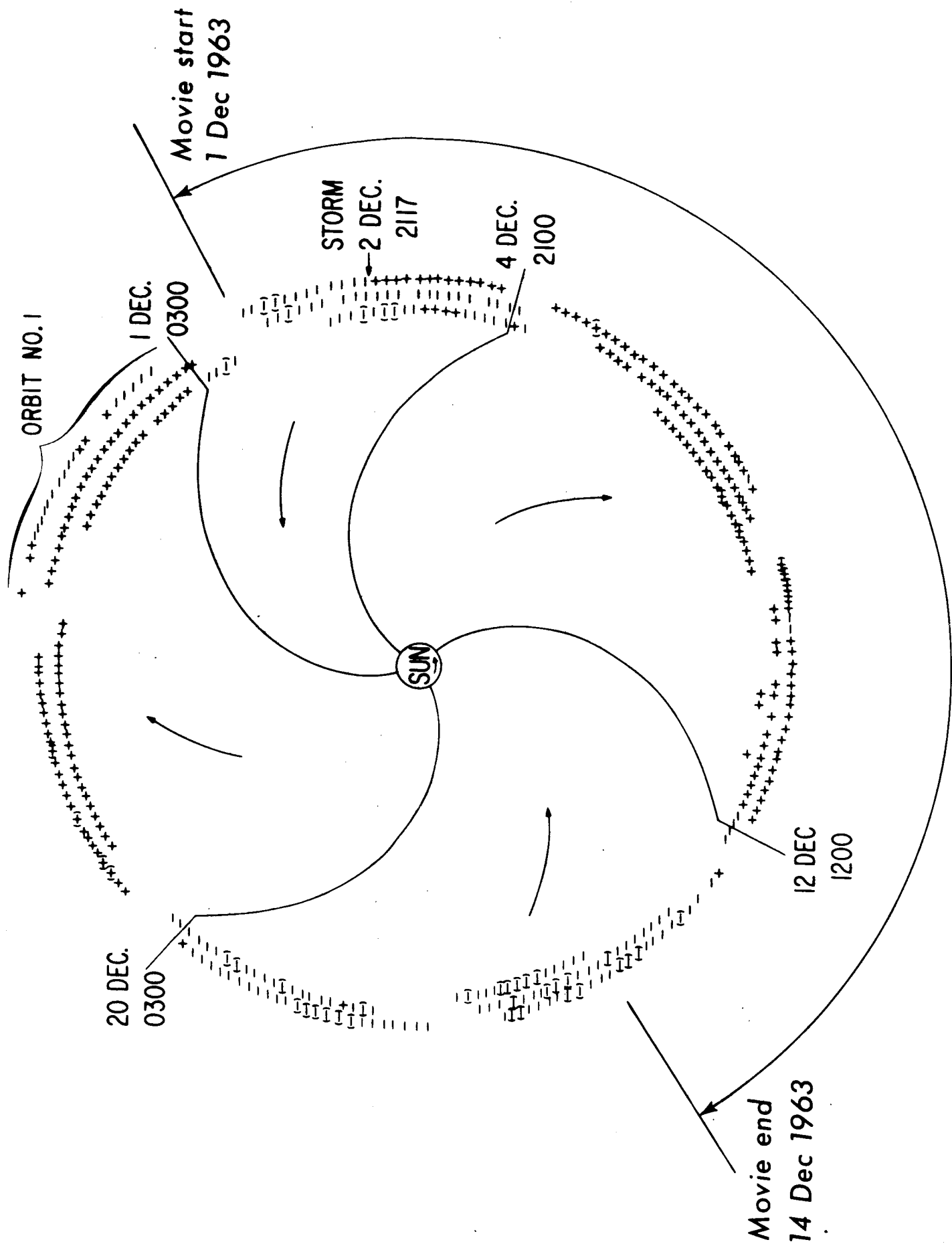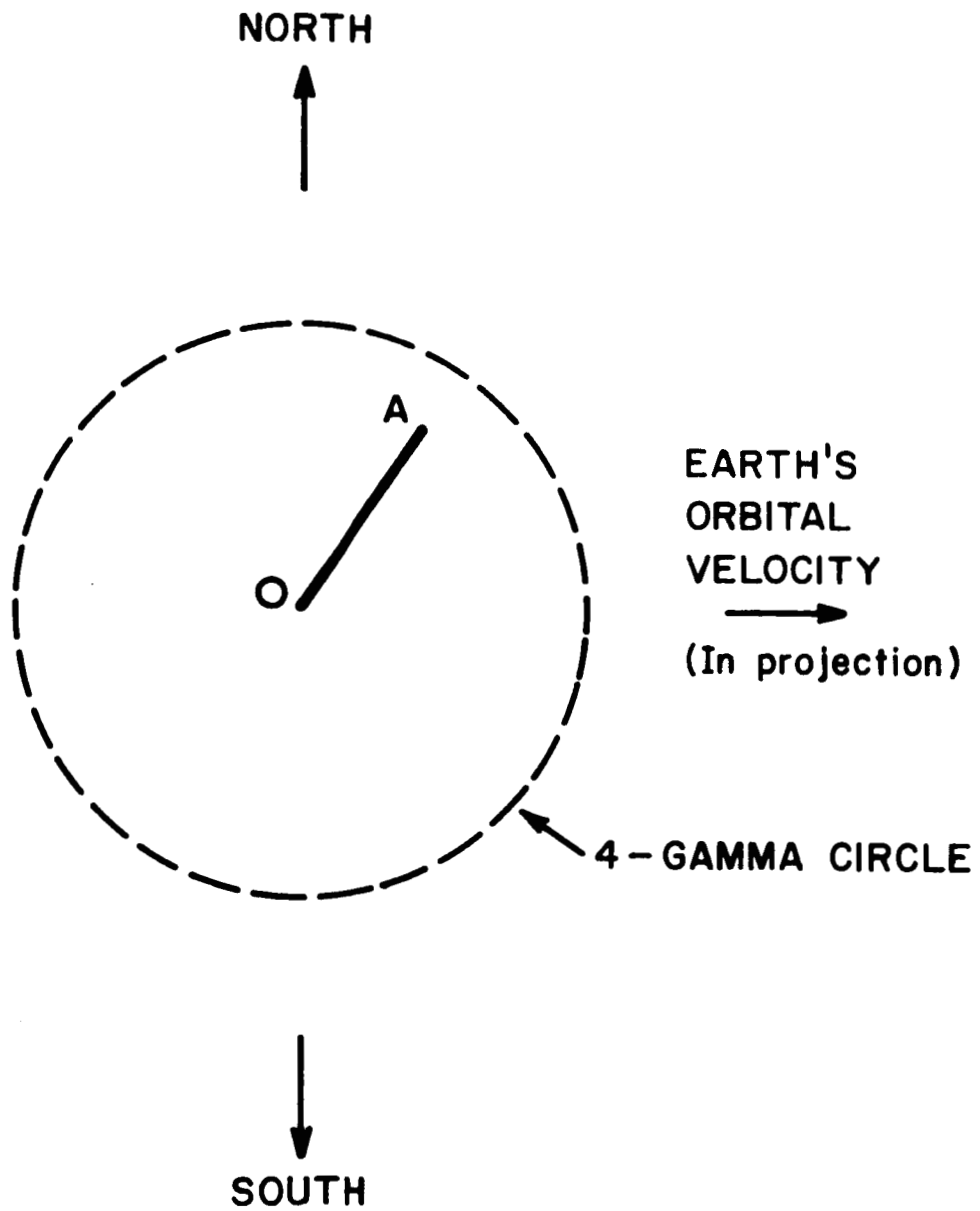
Figure 1

NORTH

A

EARTH'S
ORBITAL
VELOCITY

(In projection)

O

4 - GAMMA CIRCLE

SOUTH

Figure 2

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13. ABSTRACT

A 16 mm movie representing the components normal to the Archimedes spiral direction of the interplanetary magnetic field observed by the IMP-1 satellite during December 1 - 14, 1963 is described. The movie displays in an unique way the dynamic character of these components of the field. It may be borrowed upon request to Dr. John M. Wilcox, Space Sciences Laboratory, University of California, Berkeley, California . (U)

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