HELIOS OBSERVATIONS OF THE EARTHWARD-DIRECTED
MASS EJECTION OF 27 NOVEMBER, 1979

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Abstract. The Helios spacecraft zodiacal light photometers are used to observe the earthward-directed solar mass ejection transient of 27 November, 1979 described by Howard et al. (1982) that completely circles the Sun in coronagraph observations. At this time, Helios B was situated 30° east of the Sun–Earth line at 0.5 AU. The brightness increase moved outward directly along the Sun–Earth line over a period of approximately 24 hr, indicating a strong collimation of the ejection. The outward motion and mass estimates of the ejected material from the photometers compared with near-Earth observations from IMP spacecraft show that at least a portion of the density increase observed at Earth on 29 and 30 November was associated with this ejection.

1. Introduction

Earth-orbiting coronagraphs (MacQueen et al., 1974; Koomen et al., 1975) have imaged coronal mass ejection transients as they propagate outward from the Sun, from 1.5 to 10 \( R_\odot \). Coronagraph observations of a mass ejection transient on 27 November, 1979 that completely circles the Sun and is presumed to be directed toward Earth have been presented by Howard et al. (1982). A shock at Earth three days later has been associated with this mass ejection and the flare related to it. Here, Helios zodiacal light photometers are used to remotely monitor the progress of this ejection as it moves outward half way between Sun and Earth.

The exact details of how mass ejections propagate from Sun to Earth are uncertain because of the distance involved and because of conflicting measurements of co-rotating features and discrete but multiple solar mass ejections. The exact placement of shocks in relation to mass ejections near the solar surface (e.g. Gary et al., 1984) is likewise uncertain.

The zodiacal light photometers on board the Helios spacecraft (Leinert et al., 1975, 1981) allow low resolution imaging of mass ejection transients (Richter et al., 1982; Jackson and Leinert, 1985; Jackson et al., 1985) at very great distances from the Sun. These data can thus determine the extents of mass ejections beyond the realm of simple \textit{in situ} measurements. At the time of the 27 November, 1979 mass ejection, Helios B was situated 30° east of the Sun–Earth line 0.5 AU from the Sun. The Helios B photometer observed the 27 November ejection as it moved outward past the spacecraft at an altitude of 16° above ecliptic plane. The Helios A photometer pointed 16° south of the ecliptic plane viewed the ejection from a different perspective.

Section 2 details the Helios and near-Earth observations of this ejection. Section 3 discusses these data with respect to the shape and extent of the mass ejection as
observed in white light with Helios photometers. The Helios B photometers traced the ejection as it moved outward between 0.3 to 0.6 AU from the Sun. *In situ* plasma measurements from Helios B and Earth orbiting IMP spacecraft help determine the extent of the ejection.

2. Observations

Figure 1 is a schematic representation of the positions of Earth, the Sun and Helios A and B during the mass ejection of 27 November, 1979. The motion of each object is shown over a two-day period. Both spacecraft were operating and measured plasma *in situ* as well as photometric brightnesses in the directions indicated.

![Diagram of positions](image)

Fig. 1. Ecliptic positions of the Sun, Earth, Helios A and Helios B on 12:00 UT, 27 November (solid figures) and 12:00 UT, 29 November (dashed figures). Ecliptic plane projections of the directions to the centers of the sectors viewed from Helios A and B are given as line segments extending from the spacecraft and numbered.