

Voyager Interstellar Mission Science Notes



- The first major milestone of the Voyager Interstellar Mission will be the crossing of the solar wind termination shock by one of the two Voyager spacecraft. This shock is the place where the solar wind speed abruptly drops and the magnetic field strength abruptly increases because the pressure of the local interstellar medium is finally able to overcome the pressure of the solar wind. The location of this shock will provide important new information on the nature of the local interstellar medium.
- The solar wind shock is also the structure which accelerates the low energy pickup ions to become the anomalous cosmic rays (ACRs), which are readily detected by two instruments on the Voyager spacecraft, the Cosmic Ray Subsystem (CRS) and the Low Energy Charged Particle (LECP) experiment. We have just completed a study which suggests that by the time of the next solar maximum period in approximately 2001, if the Voyager 1 (V1) spacecraft hasn't already crossed the shock, the shape of the energy spectra of ACRs will be diagnostic for its location, if the shock is within ~ 15 AU of the V1 spacecraft at that time.
- Because ACR fluxes are greatly reduced by modulation at times of maximum solar activity, previous estimates of the distance to the termination shock were made during periods of reduced or minimum solar activity when the flux is much larger. Based on 1994 observations, we estimated that the shock was at 85 ± 5 AU. The flux is large at such times because the ACRs drift rapidly across the heliospheric magnetic field due to the field's large scale regularity during periods of minimum solar activity. However, extrapolation to the shock is uncertain because of the computational complexity of modulation models involving drifts.
- Voyager 1 will reach 80 AU in January 2001, a time of maximum solar activity when the complexity of the heliospheric field suppresses the effects of drifts, and diffusion of particles across the magnetic field dominates. Models without drifts are computationally much simpler and have been used to determine the diffusion coefficient based on observations at the previous solar maxima in 1980-82 and 1990.
- The resulting model for ACR propagation at solar maximum has been used to predict what Voyager 1 will observe in 2001 if it has not yet crossed the termination shock. The predicted fluxes are sufficiently large and the model uncertainties small enough that it should be possible to determine the remaining distance to the shock to within ± 1 AU if the shock is within ~ 4 AU, -2 to $+5$ AU if the shock is within ~ 10 AU, and -3 to $+10$ AU if the shock is within ~ 15 AU.
- The results of this study are being prepared for publication and will be presented at the 32nd COSPAR Scientific Assembly in Nagoya, Japan in July 1998.