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Signature of Shock Drift Acceleration of Energetic ($<\sim$1 MeV) Ions near the Earth's Bow Shock on May 4, 1998

G.C. Anagnostopoulos (1), E. Vassiliadis (1), V. Tenentes (2), C. Plainaki (2), H. Mavromichalaki (2)

(1) Space Research Laboratory, Democritus University of Thrace, Greece, (2) Physics Department, Kapodistrian University of Athens, Greece (evasilia@ee.duth.gr)

We present energetic ion, magnetic field and plasma observations from the Polar spacecraft in the magnetosheath and the region upstream from the bow shock during the major storm on May 4, 1998. In particular, we concentrate on the examination of the flux-time profiles, pitch angle distributions and energy spectra of the energetic ($\sim<$ 1 MeV) ion bursts observed on May 4, 1998 near the bow shock during four bow shock compressions ($\sim$0655, $\sim$0707, $\sim$0920 and $\sim$ 0947 UT). Our analysis revealed: (a) Highest flux peaks in association with bow shock crossings, (b) Field aligned anisotropies suggesting beams from the direction of the bow shock in the upstream region (c) Energy dependent reflection coefficient, (d) Strong cross-field anisotropies downstream from the shock (adjacent magnetosheath), (d) Extremely large values of the downstream magnetic field B_D ($\sim$ 80 nT), solar wind speed (V_{sw} $\sim$ 800 km/sec), magnetic field jump ratio $N = B_D/B_U$ ($\sim$ 4.5), and induced electric field $E = |\boldsymbol{V}_{sw} x \boldsymbol{B}|$, and (e) Quasi-perpendicular bow shock structure with quiet magnetic field. All the above observations are consistent with the major predictions of SDA. We infer, therefore, that energetic ions of a preexisting population of solar origin were accelerated at the quasi-perpendicular bow shock front by drifting on it in the presence of the strong induced electric field and increased their energies. Ions reflected at the bow shock were observed in the upstream region as field aligned beams. Ions transmitted in the downstream region appeared characteristic cross-field anisotropies (Anagnostopoulos and Kaliabetsos, 1994).