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The quasi-perpendicular bow shock as a temporal barrier and accelerator of magnetospheric particles

G.C. Anagnostopoulos (1), **V. Tenentes** (2), E. Vassiliadis (1), E. Sarris (1), V. Lutsenko (3) and H. Mavromichalaki (2)

(1) Space Research Lab, Democritus University of Thrace, (2) Physics Department, Capodistrean University of Athens, (3) Space Research Institute, Russian Academy of Sciences

Bow shock has been studied so far mostly as a boundary that influences the particles incident from the upstream region (of solar origin). In this study we provide for the first time observational evidence from the EPE and CPME experiments onboard the IMP-8 and the DOK-2 experiment onboard Interball Tail spacecraft that ions leaking from the magnetosphere during storms or substorms are affected by the quasi perpendicular bow shock and are either transmitted into the upstream region or are (temporally) trapped in the magnetosheath, downstream from the shock, in a magnetic configuration opposite to the magnetic mirror. The observations examined in this study suggest that magnetospheric energetic (> 50 keV) ions show general flows along the field lines, in the direction from the magnetosheath toward the interplanetary space, in both sides of the shock (upstream and downstream) and characteristic cross-field anisotropic distributions just downstream from the shock consistent with a 'trapped population'. The IMP-8 and Interball Tail spacecraft observed intensity gradients towards the magnetosheath in a series of successive bow shock crossings (within several hours), which strongly suggest a spatial modulation of magnetospheric ions at the quasi-perpendicular bow shock. Highest peaks of ion intensities and veryt strong spectrum at energies of $\sim 100 - 400$ keV were observed just at the shock front and suggest additional acceleration of magnetospheric particles at the bow shock. The observations at / near the Earth's bow shock examined in this study are well explained in terms of the Shock Drift Acceleration (SDA). The phenomenon discussed here appears to be an important mechanism that influences the particle distributions near the Earth's bow shock and may have important implications in other shocks in our solar

system (planetary, heliospheric, interplanetary and corotating shock waves), and the interstellar medium (supernova shocks). An example near the Jovian bow shock is also presented and discussed.