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Voyager 1 near the termination shock: An update on energetic ion and electron observations

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Since 2002.6 the Low Energy Charged Particle (LECP) instrument on Voyager 1 (V1) (85-94 AU, N34°) has observed large variations in low-energy ion (40 keV to 30 MeV) and electron (26 keV to 1.5 MeV) intensities, ion energy spectra, and ion angular distributions. Comparable phenomena are not observed at Voyager 2 (66-74 AU, S25°). We focus on V1 data acquired during 2004.1 to ∼2005.1 (Period C), during which V1 observed a second major episode associated with proximity to the termination shock (TS). The first major episode was observed during 2002.6-2003.1 (Period A) [Krimigis et al., Nature, 426, 2003]. V1 also observed TS-associated energetic partile activity during the intervening period ∼2003.1-2004.1 (Period B); but, intensities at ion energies <1 MeV were relatively low and sporadic. In early 2004 ion intensities at V1 increased to levels that continue to exceed those reached during Period A. Ion intensities include superposed small-scale (∼few hours) and quasi-recurrent (∼13 days) variations, with the larger of these variations exhibiting little or no velocity dispersion over energies from 40 keV to 30 MeV. Significant intensity increases of electrons with energies from at least 26 keV to 1.5 MeV occurred during 2004.1-2004.2 and 2004.55-2004.8. As with the ions, these electron increases include smaller-scale, bursty (∼few hours to ∼day) components, with the largest peaks time-coincident (non-dispersive) with those of the ions. Ion anisotropies during Period C are mainly unidirectional outward (away from the sun) along the near-azimuthal direction, very similar to those observed during Period A. By contrast, electron intensities observed during the two large increases in 2004 (and also during Period A) have nearly isotropic angular distributions. We will summarize these results and also report on revised estimates of convection speeds during Periods A and C that are based upon re-analyses of angular distributions of ions 40 keV to 20 MeV.