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Ion acceleration and wave-particle interaction at the interplanetary shocks associated with the 20-21 January 2005 and the 2-6 November 2003 CME events: SOHO/HSTOF and ACE/MAG observations

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We analyze suprathermal protons and plasma wave spectra upstream of the interplanetary shocks driven by three large coronal mass ejection events, the events on 2 and 4 November, 2003, observed by SOHO/LASCO and SOHO/EIT and the event on 20-21 January, 2005. In particular, we analyze the competition between two processes: 1) the upstream wave generation by suprathermal protons, and 2) the wave cascading from large scales to small scales where the wave energy is dissipated into the bulk plasma. For comparison, we include the well-studied Bastille Day event in 2000 [*Bamert et al., 2004*] into this analysis. Pending an analysis of a larger number of events, we find that the shocks with strong spatial gradients of suprathermal particle intensity in their upstream region are associated with efficient particle acceleration and upstream wave amplification. The roll-over in the spectra of amplified waves towards large wavenumbers to a Kolmogorov-type spectrum is interpreted as an indication that the cascading time scale becomes shorter than the wave amplification time scale, which usually does not vary much with wavenumber. We also find that the particle acceleration and wave amplification efficiency of shocks where the upstream plasma region is already filled with suprathermal particles from preceding events is much lower than for shocks moving into a 'quiet' solar wind plasma.