ACCELERATION OF NEAR-RELATIVISTIC ELECTRONS BY CORONAL SHOCKS

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The time histories of near-relativistic electron impulsive beam events (40-300 keV, $0.4 < v/c < 0.8$) measured at 1 AU provide unique information on their solar acceleration process. Over 80 such events have been identified by ACE/EPAM from 1997 through 2000. We have performed a detailed statistical analysis of the timing between the near-relativistic electron injection and the peak emission of type III radio bursts measured by WIND/WAVES at 14 MHz and 2 MHz. We almost always found a type III radio burst closely associated with the near-relativistic electron beams. The average time difference between type III maxima at 14 MHz (2.5 Rs) and 2 MHz (5.0 Rs) is 90 seconds, precisely the time required for a 1 keV electron to travel the observed 2.5 Rs. We therefore conclude that the mean energy of the electron beam responsible for the type III radio bursts in the high corona is ~ 1 keV. However we find that the 40-300 keV beam electrons at ACE are injected on average 10 minutes after the type III burst at 14 MHz. We almost never see 40-300 keV electron injections simultaneous with the type III radio bursts. Therefore the electron populations at the time of the solar type III bursts must have a very soft spectrum compared to the populations when the 40-300 keV electron events are injected some 10 minutes later. We note that a 1000 km/s coronal shock moves one solar radius in 12 minutes. Hence, if the prompt type III emission is associated with the launch of a shock, it is reasonable that the acceleration process extends to higher energies, so that the near-relativistic electrons are released when the shock has traveled another solar radius higher into the corona. The relative timing of the ~ 1 keV and 40-300 keV electrons is such that the same coronal shock could have accelerated both populations of electrons.