THE ENERGY SPECTRUM OF 20 keV - 20 MeV ELECTRONS ACCELERATED IN LARGE SOLAR FLARES

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We present IMP 6, 7, and 8 measurements of the energy spectrum of 20 keV to 20 MeV electrons observed from large solar flares. To minimize propagation effects, only events from flares located at west 30 to 90 degrees solar longitude were chosen for study. We have analyzed the interplanetary propagation of these energy electrons using a simple diffusion model. This analysis shows that the functional dependence of the diffusion coefficient on radial distance is the same for electrons over the entire energy range. Furthermore the value of the diffusion coefficient varies by only ∿ 25% over the energy range. These findings indicate that the energy spectra constructed using the maximum flux observed at each energy are representative of the spectra of the electrons escaping from the Sun. We find that every event shows the same spectral shape: a double power law with a smooth transition around 100-200 keV and power law exponents of 0.6-2.0 below and 2.3-4.4 above (Figure 1). The more intense the event the harder the spectrum observed. Often a steepening is observed above 3 MeV. The spectra are generally similar to those inferred from hard x-ray and microwave measurements, and the peak > 20 keV electron flux is well correlated with the peak microwave emission at 10 cm. These findings suggest that the observed electron spectra are representative of the accelerated electron spectra at the Sun. Thus a double power law appears to be the characteristic spectral shape produced in flare second stage acceleration. Comparison with proton spectra suggests that the acceleration is velocity dependent. The shock waves observed in these large flare events appear likely to be the accelerating agent.

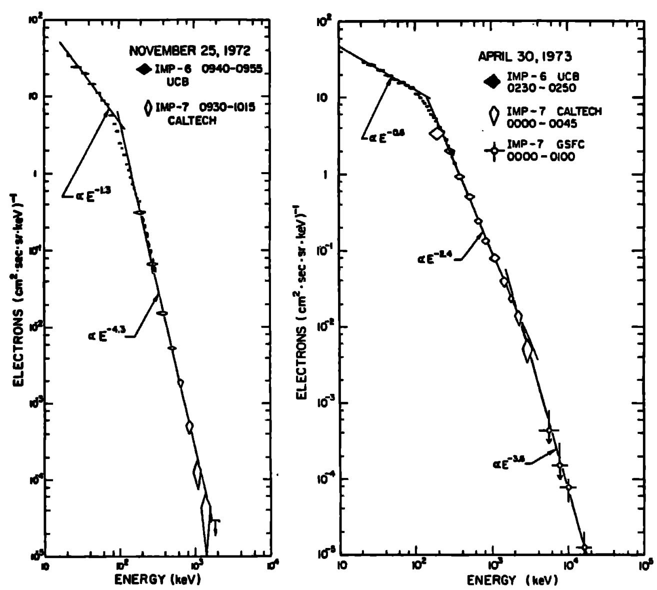

Figure 1