HARD X-RAY AND RADIO DISCRIMINATORS OF FLARE CLASSIFICATION

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Solar flares observed in hard X-rays tend to fall into two classes; short-lived flares with single or multiple peaks in the hard-X-ray flux, and flares with, in addition, a longer and more gradually varying component. Images of a few flares obtained with the HXIS on SMM show that the impulsive X-ray spikes originate primarily at the footpoints of magnetic loops in the low corona. During the gradual phase, however, the hard X-rays and microwaves probably come from higher in the corona. X-ray spectral hardening with time is sometimes observed in the larger events in the gradual phase, and suggests either trapping of the high-energy electrons in coronal magnetic structures and/or the further acceleration of electrons, possibly by the shock wave which is observed as a Type II radio burst. It is curious that most 'shock-acceleration' events are associated with long-duration events lasting several hours in soft X-rays, apparently connecting them with the extended events in the classification scheme of Pallavicini et al. It is not clear if Pallavicini's compact events can all be associated with impulsive hard X-ray flares. Other classes of flare may exist in which very few hard X-rays or no impulsive phase are observed.

The current uncertainty about the validity and inter-relationships of various classification schemes based on data in different energy and/or frequency ranges can only be reduced by careful correlation analyses of the vast quantity of new data from several spacecraft and many ground-based observatories. The suggested connection of impulsive and gradual hard-X-ray phases with compact and extended soft-X-ray flares is one possible relationship. But many questions remain unanswered. Do all extended flares have compact or impulsive precursors? Do the pre-flare conditions in the active region—the magnetic-field configuration, the plasma density and temperature distributions, et cetera—control the type of flare produced, and if so, how? Are there really two or more distinct classes of events or is there merely a smooth distribution of event sizes, durations and energy densities? We can look forward to the answers to some of these questions in the near future.

OBSERVATIONS OF FLARES IN LOOPS

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X-ray and ultraviolet observations have shown that flares possess a complex structure which extends from the chromosphere to the corona and consists of magnetically confined loops, with a wide variety of sizes and lifetimes. Longer flares tend to occur in larger structures. Compact flares are formed by loops which appear to remain unchanged throughout the flare development. The loops are nearly uniformly bright but tend to be brighter close to the footpoints. All types of flare are frequently highly structured, with different loop-like features which evolve on different time-scales. The term simple flare, often used to indicate compact events, may be misleading.