the chromosphere is studied by examining the relationship between the white light and X-ray emissions from the 24 April 1981 (<1358 UT) solar flare. This flare was very well observed in the continuous emissions at the optical, hard X-ray and radio wavelengths. Impulsive and gradual components could be clearly identified in all the three emissions. The principal findings are: (1) The impulsive hard X-ray and white light emissions are well correlated; (2) the relationship between the gradual emissions is, however, relatively poor. (2) During the impulsive phase the temporal correlation between the white light and hard X-rays is better for 20-70 keV X-rays than for X-rays > 70 keV. (3) The impulsive white light emission could have been produced non-thermally through the energy provided by energetic (\( \geq 25 \text{ keV} \)) electrons, providing the white light source consisted of an over-dense layer higher in the chromosphere than the levels where the hydrogen density is normally \( < 10^{14} \text{ cm}^{-3} \). (4) At the maximum of the gradual phase, none of the emissions of the white light on higher energy (\( 10^{10} \text{ keV} \)) electrons in a normal chromospheric structure is consistent with the observations.

1.6  Impulsive and Gradual Gamma-Ray/Proton Flares: Their Rates of Occurrence in the Same Active Region

T. Bai (Stanford U.)

At the last AAS meeting in Tucson, we (Bai, Kiplinger, and Dennis) suggested that flares producing nuclear gamma-ray and/or interplanetary energetic protons can be classified into two classes: impulsive and gradual gamma-ray/proton (GR/P) flares. We also proposed that in impulsive GR/P flares protons are generated by energies above several MeV/nucleon during the impulsive phase, and that a small fraction (0.01 to 0.0001) of them escape into interplanetary (IP) space, accounting for small numbers of protons observed in IP space after such flares. We proposed that in gradual flares protons are accelerated in closed magnetic configurations during the gradual X-ray emission. These protons move gamma-rays interacting in the solar atmosphere, and again only a small fraction of them escape into IP space. But in gradual flares additional protons are accelerated by shock waves in the high corona, which mostly escape into IP space, accounting for large proton fluxes observed after gradual flares.

I have studied how soon another gradual GR/P flare can occur in the same active region after an initial occurrence. I found even in active regions very productive of impulsive GR/P flares it takes at least 2-3 hours to produce another gradual GR/P flare after one occurrence. On the other hand, impulsive GR/P flares can occur in the same active region after only three hours. This suggests with the following interpretation: During gradual GR/P flares large magnetio-field structures are disrupted, and it takes longer to form one configuration, leading to the production of another gradual GR/P flare. On the other hand, only localized regions are disrupted during impulsive GR/P flares, and therefore another impulsive GR/P flare can occur in the same active region shortly following the occurrence of an earlier one.

1.7 Flare Electron Densities Using X-ray Line Ratios

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HE Mason (Cambridge)

The 10-XOA x-ray spectrum obtained with a sounding rocket has been used to determine electron densities in the solar flare of 1982 July 13 2257 UT. Details of the spectrum are given in 1+Son etal(1985b). Here we discuss the electron density determination from the spectra of the heliumlike ions Ne IX, O VIII, N VI, and C V, and with new determinations from line pairs in Si IX (56/04/56/49), Fe XIV (58/55/52), and Ca XV (22.78/22.73). Temperatures regime spanned by these ions are 0.7 to 3.5 million degrees and the electron density found was about \( 3 \times 10^{10} \), with an indication of higher density at the higher temperatures.

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1.8  Frequent Ultraviolet Brightenings in Solar Active Regions


Earlier SMM observations of small bright sites in active regions have shown significant increases in intensity in spectral lines of Si IV and O IV on short time scales (Porter et al. 1984. Ap. J. 283, 877). The characteristics of these brightenings suggest that the spectrum of heating responses in the transition region due to magnetic field reconnection extends from flares and the relatively large amplitude bursts observed with OSO-8 down to the smaller, usually short-lived brightenings reported here. We have now made additional rapid-sampling observations (typically every 0.4 s) of active-region bright sites with the UVSP instrument on SMM, this time in the UV lines of C II and C IV. These new data confirm that the brightenings can vary considerably from one active region to another. Those active regions in our sample that are old and shrinking and producing few flares show little or no short-term variation for many consecutive satellite orbits. The intensity variations that do occur show typical increases of less than 50% over the background level. Temporal increases in the amplitude and frequency of the brightenings accompany the few isolated flares produced in these regions. The more flare-producing regions (two newly-developed, one old but vigorous) show a generally higher amplitude and frequency in the brightenings. At times some sites are almost continuously "bubbling" with rapid intensity fluctuations typically lasting 40 to 90 s, though some are as brief as 20 s. As in the less robust regions, flares appear to be preceded by a marked shift of the brightenings to larger amplitudes.

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1.9 Observations of the Physical Conditions in Solar Flare Transition Zone Plasma from SMM

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We present observations of several flares in Si IV 1402Å and O V 1401Å lines obtained with SMM. We studied the spatial and temporal evolution of the Si IV and O V intensity, density, and velocity distributions before, during, and after the flare. The main results are: 1) the impulsive UV brightenings occurred in small kernels; 2) at the times of impulsive brightenings, densities in the kernels, deduced from the Si IV/O V ratio, increased by more than one order of magnitude to \( > 10^{10} \text{ cm}^{-3} \); 3) there was little correlation between the locations of the UV kernels and evolutionary changes of the velocity field in the transition zone plasma; and 4) for most flaring kernels, there was correlation between the intensity and velocity changes. Just before the intensity maximum, the velocity at the flaring kernels showed downward motions and the velocity changed to upward motions after intensity had reached maximum.

The implications of the observations, particularly the correlation between the velocity and intensity during the impulsive phase, will be discussed in terms of models of the impulsive phase. This work is supported in part by a NASA grant.

1.10 Element Abundances from Solar Flare Spectra

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Ratios of solar element abundances are determined for Fe, Ca, Mg, and Ca, especially at high resolution solar