ABSTRACTS

1989BAAS...21R.834W

particles and their energy loss in the solar medium as a function of magnetic field strength and plasma temperature, density and degree of ionization. In particular, we have generalized the previous results of Cramell and Lang (C. J. Cramell and F. L. Lang, AIP Conference Proceedings, 170, 1988) to estimate the expected 15.10- to 4.438-MeV fluence ratio for thick-target proton and alpha-particle spectra incident on carbon and oxygen in a variety of flaring environments. An extensive ionization measurement has been conducted to identify the additional measurements that are still required to determine the fluence ratios more precisely. This work was supported in part by the National Science Foundation and NASA RTOP 185-33-0194 and was performed in part at Goddard Space Flight Center, Greenbelt, Maryland under NASA Grant NGS-5066.

6.03 Solar Flare Gamma-Ray Line Shapes

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Gamma rays from reactions of the type \( A(\gamma,\gamma')A' \) have been observed in solar flares (Chupp, in Ann. Rev. Astron. Astrophys. 22 (1984) 359). In the laboratory such gamma-ray lines are often Doppler broadened with a shape that is a rapidly-varying function of the angle between the incoming projectile and the emitted gamma ray (Kolata, Asble, and Galonsky, Phys. Rev. 102 (1956) 557). The spectrum of a single line can be expressed as a weighted integration over projectile scattering angles of the correlation function (Satchler, Nucl. Phys. 52 (1964) 1) \( W(\theta, \phi, \theta', \phi') \) for the reaction \( A(\gamma,\gamma')A' \). Using an excited-nucleus density matrix calculated from a coupled-channel code with \( \alpha = A \) optical potential input, shapes of the 4.438-MeV and 0.129-MeV lines from the \( \alpha^2 \gamma_4 \) and \( \alpha^4 \gamma_4 \) reactions have been calculated as a function of alpha-particle energy and gamma-ray emission angle. The laboratory shapes obtained are compared to earlier line shape calculations (Werntz, Lang, and Kim, submitted to Astrophys. J. (Supplement Series), 1988) for \( (p, \gamma) \) excitations and to experimental (B. Bodansky, private communication) \( (\alpha, \gamma) \) shapes. For simplified particle directionals, line shapes resulting from protons and alpha particles accelerated in solar flares are also presented and compared to the measured line shape (D. Forrest, private communication) for the 27 April 1981 limb flare. This work was performed at Goddard Space Flight Center in Greenbelt, Maryland under NASA Grants NGS-5066 and NAGW-1365.

6.04 Ultraviolet Imaging of the Flare Hard X-ray Production Region

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Previous studies of XMM of bursts in hard X-rays and ultraviolet (UV) have shown a close temporal and spatial relationship between the fast spikes in hard X-rays (Drake, Astrophys. J. 296, 1986, Poland et al. 1983). In fact, it is consistent with instrumental resolution of \( \sim 1 \) s, there is frequently no discernable delay between peaks in the hard X-rays and the UV. Within the context of thick-target X-ray emission, this near simultaneity suggests that the UV is produced very close to the fast-electron energy loss region. For a number of flares we have compared hard X-ray time profiles with an array of spatially resolved UV light curves using the SMM Hard X-ray Burst Spectrometer (HXRB) and the SMM UV Spectrometer Polarimeter (UVSP). The spatially unresolved HXRB data are obtained with a sampling time of \( \sim 1.28 \) s over a 15 channel energy range from 70-400 keV. The UVSP data are obtained at a wavelength of \( \lambda = 5575 \AA \) and consist of the time histories of a 3 x 3 array of 10 arcsecond pixels, sampled every 1.3 s, centered on a previously identified UV bright point.

6.05 Partially Obscured Microwave and X-ray Flares


We have observed the aftermath of a solar limb flare using the VLA at 6 cm, the HXIS instrument in soft X-rays, and the HXRB and ISSRE-2 hard X-ray spectrometers at photon energies above 100 keV. The initial burst of the events we have studied occurred at 14:52 UT on November 18, 1980, and has been discussed in detail by Schmahl, Kundu and Dennis (1986) and Simnett and Strong (1985). This flare was followed by smaller, gradual bursts in microwaves and soft X-rays at limb locations ranging from a few to several arc sec away from the initial impulsive burst. We shall discuss these in some detail.

These events may have been part of the decay phase of the initial flare, but it appears more likely that they were independent bursts in nearby parts of the active region. Only one of the events was associated with an impulsive burst in hard (> 100 keV) X-rays. The X-ray spectrum of this event suggests that it was partially occulted by the limb. In another event, the impulsive phase was absent at all energies, suggesting that it was even further occulted. A puzzling feature of these flares is that they both lacked an impulsive phase in microwaves. There are a number of possible explanations for this absence. Among them are cyclotron absorption, electron beam anisotropy and ion beaming during the impulsive phase. We shall discuss the spatial, spectral and temporal constraints given by our observations for the various likely explanations.

6.06 VLA Observations of a Small Impulsive Flare


We present 6 cm VLA observations of a small impulsive flare on May 16, 1981. It occurred within a complex active region containing several sunspots. The flare itself lay over a neutral line well away from any of the sunspots. It showed a simple time profile, with low polarization. The flare morphology is consistent with onset occurring in a single loop and subsequently spreading to a larger volume.

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