23.01

Hard X-ray and Radio Spectra for Solar Flares from AR 6659

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We present radio and X-ray data for three simple flares observed during the June 1991 Gamma Ray Observatory (GRO) target-of-opportunity campaign. The X-ray data consist of high-resolution spectra from the BATSE and OSSE detectors on GRO; the radio data are patrol observations made by the RSTN network, together with observations at millimeter wavelengths by the Berkeley–Illinois–Maryland array. The data from different wavelength ranges are used to study the electron populations in different energy ranges produced by the flares. In particular, we look for spectral breaks and/or thermal components in the X-ray data, and compare them with the higher-energy distribution implied by the radio data.

23.02

Temporal Evolution of Gamma-Ray Continua and Lines in the Intense 4 June 1991 Flare


Active region 6659 erupted with an X1+ flare at 03:37 UT on 4 June 1991. The Oriented Scintillation Spectrometer Experiment on the Compton Observatory viewed the flare for the first 27 minutes, prior to entering satellite night, and for one hour intervals in subsequent orbits. Using data from selected detectors, which either viewed the sun directly or were offset in angle, we have been able to follow the temporal evolution of characteristic gamma-ray emissions over a dynamic range of 1000. Continuous emissions above a few hundred keV were monitored in anti-coincidence elements shielded from the sun. Continuum emissions above 10 MeV were monitored in the 10.6-cm-thick NaI spectroscopy detectors. Gamma-ray emissions were observed up to energies in excess of 100 MeV and intense fluxes of high-energy neutrons were also detected. Nuclear lines from neutron capture at 2.223 MeV and from deexcitation of carbon at 4.43 MeV were detectable at least 2 hours after the onset of the flare. The measured fluences in these lines were 690 and 70 gamma cm^{-2}, respectively. We estimate that the total fluences in these lines are about 30% higher, when corrected for times when the sun was not viewable. From the line ratios we derive estimates of the flare-averaged number and spectrum of interacting protons (e.g. Ramaty et al. 1993). The implied index for an assumed power-law spectrum is 2.8 and the estimated number of protons (>30 MeV) is ~10^{31}. This flare is therefore both one of the hardest and largest ever observed in the gamma-ray energy band. We compare the temporal evolution of the lines and continua to study delays as a function of energy and also any delays between the interactions of accelerated electrons and ions with ambient solar material.


23.03

The Formation and Dissipation of Current Sheets During Solar Flares

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Dissipation of magnetic field energy associated with current sheets has long been proposed as the main driving source for flares. In MHD, this dissipation occurs through magnetic reconnection but it requires an artificial (anomalous) resistivity several orders of magnitude greater than the known plasma resistivity to reconnection is to occur on flare time scales. Moreover, there is presently no way to relate the reconnection processes with the observed flare emissions. In this paper, the merging of two flux tubes is examined through combined particle and MHD simulations. It is shown that, while the MHD describes the formation of the current sheet between the two flux tubes, it neglects surface currents that are in the plane of the magnetic field. These surface currents thread the current sheet between the two flux tubes and are critical for two reasons. First, they produce a force that acts on the current sheet, producing a source of resistivity that can drive reconnection without the need for assuming an anomalous resistivity. Second, these currents have a field-aligned component that map to the chromosphere and thereby give an indication of the temporal and spatial evolution of possible hard X-ray sources. The evolution of these sources can be compared with the induced bulk flows in the coronal plasma to provide an estimate for the expected Doppler shifts in soft X-ray line emissions.

23.04

Radio Observations of the Solar Corona with the Nançay Radioheliograph during the MAX'91 Campaign of July 1992

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During the VLA July 1992 campaign the Nançay Radioheliograph was observing the solar corona at five frequencies in the 150-450 MHz band with both its east-west branch and north-south branch. The instrument thus provided independent scans of the solar brightness distribution (Stokes parameters I and V) projected upon two axes, with fields of view covering the whole sun, and spatial resolution of 2.7'x4.5' at 164 MHz, 1.7' at 435 MHz.

We present an overview of the solar activity which was observed at Nançay during the VLA campaign. We shall focus on the observations at five frequencies of a large storm, which occurred on July 12 1992 between 13 and 16 U.T.

23.05

The M1.9 Flare of 20 August 1992: Joint Imaging with the VLA, Yokoh, and a High-Speed Ho Cammera

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We present a comprehensive set of observations of the multiply impulsive M1.9 flare which occurred in NOAA/USAF active region number 7260 on 30 August 1992. It was imaged in microwaves by the VLA at wavelengths of 2 and 3.6 cm, in both senses of circular polarization, with a time resolution of 0.2 s. It was also imaged by the soft X-ray telescope on board the Japanese satellite Yohkoh, and by a high-speed Ho camera. The microwave emission shows clear evidence for the interaction of several, highly sheared magnetic loops. The inter-relationship between the microwave, soft X-ray, and Ho emissions is discussed and the observations are placed with the context of our current understanding of flare physics.