for: correlated bursts from widely-separated active regions connected by large-scale magnetic loops that cross the solar equator; an impulsive hard X-ray burst whose loop-like, radio wavelength counterpart has a size that increases rapidly with wavelength; possible flare triggering by the magnetic interaction of large-scale coronal loops; spatially separated radio sources during the precursor, impulsive and post-burst phases suggesting successive activation of different coronal loops; and simultaneous radio and X-ray (VLA and SUM) observations that test theoretical models of microwave burst emission.

21.02
The First Interferometric Observations with Arc-Second Resolution of Solar Radio Bursts at Millimeter Wavelengths

M.R. Kundu, S.M. White, N. Gopalswamy (U. Md., College Park) and J.J. Bleing (U.C. Berkeley)

The active region NOAA 5395 (March 6-18, 1989) was the first major-flare-producing region of the new solar cycle. Following the X15 flare of March 6th, arrangements were made to alter the observing schedule of the BIMA (Berkeley-Illinois-Maryland Array) millimeter interferometer for solar observations. At present the BIMA array consists of three 6-meter paraboloids (to be expanded to a six element array by early 1991) and operates over the frequency range 70-120 GHz in continuum as well as in spectral lines. At the time of our observing, the three antennas were located in a configuration such that the fringe spacing was 1" and the time resolution was 10 seconds. Using this system we observed the active region over the period March 12-18, 1989, usually between 16:00-24:00 UT, at a frequency of 87 GHz. We observed approximately a dozen flares, about half of which were associated with X and M flares. All 3 mm bursts were associated with GOES X-ray flares and no activity. The most striking result obtained was that some bursts are extremely strong and spiky, unresolved with 10 sec time resolution and 1" arc spatial resolution. We infer that the millimeter flaring region must contain extremely small kernels (< 700 km). Some spiky bursts have unequal intensities when observed at three baselines with different orientations but similar fringe spacing, implying non-circular source structure. During periods of common observing with SUM (SSBBD and UVSP) we observed a spiky burst which was associated with spiky hard X-ray and ultraviolet emission.

21.03
The Sun at the VLA’s Meter and Decimeter Wavelengths


During the week September 11-17, 1988, in the rise phase of the new solar cycle, the Sun showed several active regions without much flare activity. We observed the full disk of the Sun with the VLA at 333 MHz and 1.5 GHz on four days during this particular week, and observed a range of behaviour which we report on here. At 1.5 GHz there were a number of active region-associated sources which were seen to rotate and evolve through the week. The map at 333 GHz is quite different from that at 1.5 GHz. The quiet-Sun images show more pronounced polar coronal holes. An interesting result is the presence of limb brightening on all days. Early in the week the maps are dominated by several noise storm sources, which had weakened by the 17th. One component of a bipolar noise storm shows motion, and type I bursts occurring at different positions within another noise storm are seen.

21.04
The Owens Valley Solar Array

G.J. Hurford and D.E. Gary (Solar Astronomy, Caltech)

The current expansion of the frequency- agile interferometer at Owens Valley will result in a new solar-dedicated capability for microwave observations during MAX '91. The system will provide not only high resolution microwave spectra over the frequency range 1 to 18 GHz, but also good quality, spatially-resolved images. The combination of an imaging capability and spectral coverage will enable microwave diagnostics to be applied to bursts and active regions so that the location, morphology and energetic spectra of energetic electrons and the strength and distribution of the corresponding magnetic fields can be determined.

The system will combine the present pair of 27 m antennas with three new 2-m antennas to form a fully-calibrated, solar-dedicated 5 element interferometer. Each antenna will be equipped with a frequency-agile receiver capable of observing from 1 to 18 GHz. The imaging capability is achieved by using frequency-synthesis techniques during data analysis, whereby snapshot images averaged over an octave of frequency typically will be synthesized from measurements at ~100 uv points.

21.05
Observational Goals for Max '91 to Identify
The Causative Agent for Impulsive Bursts

D. A. Batchelor (NASA/GSFC)

Recent studies of impulsive hard X-ray and microwave bursts suggest that a propagating causative agent with a characteristic velocity of order 1000 km s\(^{-1}\) is responsible for these bursts. In this presentation, the results of those studies will be summarized and observed distinguishing characteristics of the various possible agents will be highlighted, with emphasis on key observational goals for Max '91 campaigns. The most likely causative agents suggested by the evidence are shocks, thermal conduction fronts, and propagating modes of magnetic reconnection in flare plasmas (although other possible agents cannot as yet be ruled out). With the new instrumentation planned for Max '91, high spatial-resolution observations of hard X-ray sources have the potential to identify the agent that is revealing detailed features of source spatial evolution. Coordinated observations with the Very Large Array and other radio imaging instruments are also obviously of great importance, as well as detailed modeling of coronal loop structures to place limits on density and temperature profiles in the loops. With the combined hard X-ray and microwave imaging observations, aided by loop model results, the simplest causative agent to rule out would be the propagating modes of magnetic reconnection. To fit the observational evidence, reconnection modes would need to travel at approximately the same velocity (the Alfven velocity) in different coronal structures that vary in length by a factor of 10\(^3\). Over such a vast range in loop lengths, it is difficult to believe that the Alfven velocity is constant. Thermal conduction fronts would be suggested by sources that expand along the direction of B and exhibit relatively little particle precipitation. Particle acceleration due to shocks could produce more diverse radially expanding source geometries with precipitation at loop footpoints.

21.06
Solar Flare Gamma-Ray, and Hard X-Ray Imaging with the GRID-on-a-Balloon


A primary scientific objective for solar flare research during the rapidly approaching maximum in solar activity is the imaging of gamma-ray and hard X-ray sources of solar flare emissions. These goals will be pursued by the Gamma Ray Imaging Device (GRID) instrument, one of three instruments recently selected for NASA's Max '91 Solar Balloon Program. GRID is based on the technique of Fourier