one case (in AR 6952) where a SXR brightening was associated spatially with a change in the vertical electric current. In this case, the vertical current dissipated between December 8, 00:35 UT and the next observation at 00:48 UT on December 9, leaving a bright SXR structure which was observed at 24:27 UT on December 8. Hence, although more data must be analyzed to make a compelling case, it is possible that the SXR emission is related more closely to changes in the electric current systems rather than simply to the presence of these currents.

30.05
Electric Currents and Hard X-ray Images in the X Class Flare of November 15, 1991
We present co-aligned observations of hard x-rays observed with the Hard X-ray Telescope (HXT) on board the YOHKOH spacecraft and vertical electric currents derived from a vector magnetogram obtained at the Mees Solar Observatory, Haleakula, Hawaii. Previous work comparing the wings of the Hα line to vertical electric currents has suggested that electron precipitation in flares occurs at the edges of these currents. The Stark wings of Hα were interpreted as a signature of non-thermal electrons penetrating the relatively dense chromosphere and used as a proxy for direct observation of the non-thermal electrons. The hard X-rays used in this study provide a direct determination of the locations of the electron energy losses. In the X class flare of November 15, 1991, we find the same relation between hard X-ray emission and vertical electric currents as was found between Hα Stark wing emission and vertical currents: the hard X-ray emission occurs predominantly at the edges of the vertical current sites, and not spatially on top of these currents. Canfield, R. C., de la Beaujardière, J., and Leka, K. D., in "The Physics of Solar Flares", ed. Cullane and Jordan, The Royal Society, London, 1991 Canfield, R. C., Leka, K. D., and Walsworth, A. P., in "Flare Physics in Solar Activity Maximum 22", ed. Uchida, Canfield, Watanebe, and Hiei, Springer-Verlag, Berlin, 1991

30.06
Directivity of 100 - 500 keV Solar Flare Hard X-Ray Emission
P. Li, K. C. Hurley (SSL/Berkeley), C. Barat, M. Niel, R. Talon (CESR/Toulouse), V. Kurt (IKI/Moscow)
We have identified 15 solar flares jointly observed by the SIGNE detector onboard the Venera 13 and 14 spacecraft and Hard X-ray Burst Spectrometer (HXRBS) onboard the Solar Maximum Mission (SMM). The view angles for Venera B3, varied in the range 45°-70°, while the view angles for HXRBS B3 varied in the range 8°-90°. The view angle differences θ3-θ4 were in the range 1°-52°. Using the database of these flares, we have conducted both stereoscopic and statistical studies regarding flare hard X-ray anisotropy. It was found that the directivity of the energetic photon source in the energy range of 100-500 keV is less than 2.5. On the other hand, statistical study shows clear center-to-limb hardening. A comparison between hard X-ray directivity models and our stereoscopic measurements showed that both isotropic and downward-peaked electron models fail to reproduce the general features of observed directivity distribution. Only the "pancake" electron model whose angular distribution peaked along the direction of the photosphere roughly accounts for the observations.

30.07
Solar Flare Pion and Neutron Production
D. J. Forrest and W. T. Vestrand (SSC/UNH)
During cycle 21, the Gamma Ray Spectrometer on SMM observed three large flares with clear evidence for pion decay gamma rays and high energy neutrinos. Two of these had an extended emission phase. The emissions observed in these extended phases were clearly different from those observed in the impulsive phase.

Compared to the impulsive phase, the extended phase emissions were strongly deficient in electron bremsstrahlung relative to the nuclear line emission in the 1.0 - 7.0 MeV band and appeared to have a reduced energetic neutron to pion gamma ray emission in the >10 MeV band. These changes can be produced either by a strong hardening of the accelerated ion spectrum together with a relative decrease in the energetic electron spectrum, or by a pronounced change in the geometry of the particle spectrum downwards towards the photosphere. We review the observational evidence in terms of these two possibilities. A dramatic change in the energetic particle geometry appears to offer the simplest explanation. If these two flares represent the first clear evidence of strong particle geometry effects within individual flares.

30.08
Numerical Investigation of a Proposed Mechanism for Coronal Mass Ejections
G. Roumeliotis (C.S.S.A. Stanford University)
A coronal mass ejection involves the sudden expulsion from the surface of the Sun of a convoluted magnetic structure along with the entrained plasma. According to one school of thought, a coronal mass ejection is the result of slow photospheric shearing motions beneath a coronal magnetic structure. As the magnetic energy of the coronal field approaches some critical value, the whole structure becomes unstable and makes a spontaneous transition to a state of lower potential energy by expelling magnetic field and plasma.

In this poster, I present a numerical study of the evolution of sheared, cylindrically symmetric magnetic structures. The initial field is assumed to arise from a dipole embedded within the Sun. Shearing motions analogous to differential rotation are then applied about the equator. The subsequent evolution is followed using the magnetofrictional method. A key difference between this study and previous efforts is the placement of the outer numerical boundary at a hundred solar radii. This is achieved by writing the relevant equations in terms of the logarithm of radial distance.

Work supported by Air Force grant F49620-92-J-0015, NASA grant NAGW-2265, and Lockheed Solar-A subcontract S704A3100R.

30.09
VLA-PHOENIX-BATSE Studies of Impulsive Bursts
We discuss observations of impulsive solar bursts detected simultaneously with the Very Large Array (VLA), the PHOENIX Digital Spectrometer and the Burst and Transient Source Experiment (BATSE) aboard the Compton Observatory. The VLA was used to produce snapshot maps of impulsive bursts on timescales of 1.7 seconds at 20 and 91 cm while the high temporal and spectral resolution of the PHOENIX provided measurements of the drift rate and bandwidth of these events at the same wavelengths. Hard X-ray spectra from BATSE as well as soft X-ray data from GOES specify the electron energy distribution during the impulsive and decay phases of the bursts. These X-ray data are combined with VLA observations in order to constrain thermal and nonthermal models and to provide estimates of the electron density and magnetic field strength in the microwave sources. For one limb flare we infer significant (≥50%) changes in the magnetic field strength during the impulsive phase. For another intense (X1 class) burst, electron acceleration was observed in the high corona (h = 0.4 - 0.5 R_Sun) several minutes before the onset of the hard X-ray bursts detected by BATSE. PHOENIX observations show a variety of 20 cm bursts, including type III bursts, intermediate drift bursts and quasi-periodic pulsations during different stages of this X1 flare. From the drift rate of these radio bursts, we derive information about the density scale heights, the speed of the radio emissions, and the local magnetic field. Radio emission at 91 cm shows a type IV burst moving outward with a constant velocity of ≈240 km s⁻¹.