such as chromospheric evaporation, in coronal flare loops. I discuss recent progress in atomic physics and its effect on determining physical conditions in flares. I briefly summarize future solar flare space missions that are under development or in the planning stage, and in particular I emphasize the need for combined high spatial and spectral resolution X-ray experiments.

28.02
Coronal Mass Ejections
R. Fisher (HAO/NCAR)

For the past two decades it has been possible to detect Coronal Mass Ejection (CME) events using space based coronagraphs. This class of solar activity is a dramatic process in which solar material is transported to high altitudes in the Sun's outer atmosphere and into interplanetary space. Observations with instruments on OSO-VII and Skylab yielded information concerning the basic properties of CMEs as seen at heights greater than 2.0 R⊙ in the solar corona. In 1980, with the completion of an imaging K-coronameter, it became possible to investigate the behavior of CMEs in the inner portion of the corona. With the advent of longer duration facilities, such as the SOLWIND and SMM coronagraphs, the relationship of CMEs to the evolving Sun can now be discussed with a level of detail previously unavailable.

A review of the observational facts of CME events is presented with the aim of generalization in terms of event morphology and evolution. The interpretative tools available have allowed an investigation of the physical conditions of the CME and the physical processes operating in the corona. The present state of knowledge concerning conditions and processes is reviewed. The long-term data sets are crucial to our present understanding of the origin of such events and the association with other kinds of solar features and evolution. This aspect of the research field is also briefly discussed.

28.03
Terrestrial Effects of Solar Flares and Coronal Mass Ejections
G. Heckman (NOAA/SEL)

Solar activity associated with the rise of Solar Cycle 22 has produced frequent periods of comparatively extreme effects in the terrestrial environment. Solar particle event fluxes have been recorded since Solar Cycle 19. The cumulative fluxes for 1989 are the largest of any year preceding or including the year of solar cycle maximum in the period from 1955 to 1989. The effects of the particle events include the first increase in solar particle radiation exposure for astronauts on U.S. space missions, the first activation of the radiation alarm on the Concorde airplane, and decreased reserve in the operating lifetime of solar power cells on long duration interplanetary space missions. Geomagnetic storm effects from solar flares and mass ejections in March 1989 included a power system blackout in Quebec, large geomagnetic disturbance in New Jersey, and power system tripping from New England to California. Atmospheric density increases from the storm were of the order of ten times background. Effects on satellites operating in that environment included excessive spin of gyrocompass pointing systems, loss of positioning by navigation satellites, and in some cases, loss of satellite orientation. The catalogs used in real time to monitor the status of satellites and orbiting debris showed the number of "lost" objects increased from around a normal level of 200 per day to nearly 6000 in the March storm. Past experience indicates terrestrial effects typically remain strong or increase after solar maximum. Bubble Space Telescope is among the satellites likely to experience effects on operations if such activity levels materialize.

Session 29: Sunspots and Magnetic Fields
Oral Session, 10:00–11:30 am

Acoma

29.01
Recent High Resolution Observation at BBSO
H. Wang and H. Zirin (Big Bear Solar Observ. Caltech)

In the summer of 1989, we added (at the suggestion of R. D. Dunn) a cooling system in front of the window of the 66-cm reflector at BBSO, thereby improving the performance of the telescope. The duration of sub-arcsecond seeing has been increased from one hour to about three to four hours on good days. Here we present data obtained on July 17 and July 30, 1989. The white light images are taken with a CCD video camera and recorded with S-VHS VCR. The best images are digitized and processed with the shift-and-add technique. We also show new high-resolution magnetograms obtained with the same telescope providing exceptional resolution.

We obtained following results based on the study of granules and sunspots:

1. Both dark fibrils and bright grains in the penumbra of sunspots move towards the umbra with a speed of about 0.5 km/s. Starting near the outer edge of the penumbra, the penumbra material and photospheric granules move outwards. This outflow is consistent with the velocity field of moving magnetic features (MMFs).

2. Correlation tracking of white light images shows the convergence of flow patterns towards almost every pore. This implies that formation of pores is likely due to the concentration of existing magnetic flux.

3. The granules have an average lifetime of 20 minutes. In the area just outside the penumbra of sunspots, about 18% of granules exploded, somewhat fewer than the normal fraction. The majority of granules disappeared into the intra-granule lasses. Better statistics are needed.

4. From July 29 to August 1, 1989, we followed an Emerging Flux Region (EFR) composed of a large number of bipolar mixed together. After the first day of emergence, the leading and following polarities moved apart. Because they were mixed, considerable cancellation occurred during this process. In about 20 hours, the positive and negative fluxes separated and spots grew by merging of smaller flux elements. Thus, apparently driven by sub-surface connections, fields segregate by polarity.

29.02
Continuum Contrast of Photospheric Faculae Compared to their Magnetic Flux
J.K. Lawrence, G.A. Chapman, and S.R. Walton (SFO/CSUN)

Video Spectra-Spectroheliograms (VSSHG), have been obtained of NOAA region 5643 during the latter half of August 1989. These data have been digitized to produce images of line-of-sight magnetic fields, velocity, continuum and line core. The continuum and line-core contrast of photospheric faculae will be compared with magnetic flux, all quantities are determined simultaneously using the 6300Å vacuum telescope and vacuum spectroheliograph, at the San Fernando Observatory. Each pixel corresponds to the sum of 5 raw pixels digitized to 8 bits. Each summed video spectrum is corrected for the dark and bright response of the CCD camera. The telluric lines on either side of the 6300Å line are removed, and the solar line is processed to give a weighted U-Stokes parameter, that is proportional to the strength and separation of the U profile peaks giving a quantity that is proportional to the line-of-sight magnetic field and line strength. The average spectrum is used to obtain the mean line position which determines the line-of-sight, velocity from the Doppler effect. The continuum image is obtained from 10 adjacent spectral elements near 6300Å. A line core image is determined from 5 adjacent spectral elements at the location of the line core in the quiet sun. Results will be presented from analyses when the active region was at several positions on the solar disk. This research was partially supported by NSF Grant AST-8603309.