population of non-thermal electrons being responsible for both emissions if the magnetic field strength ranges from ~200 G to ~1000 G. This clarifies the long existing impression (first pointed out by Peterson and Winckler 1959, J.G.R. 64, 697,) that a single population of electrons leads to the production of far more microwaves than is observed (see also Gary and Tang 1985, Ap.J. 288, 385). We however find a considerable dispersion in the ratio of microwaves to X-rays, so that in some flares the derived length of the coronal part of the loop is large enough to indicate that there may be a considerable amount of trapping in the corona. Consequences of these results for the relative X-ray and microwave time development will be discussed. This work was supported by NSF grant ATM8320439 and NASA grant NSG7092.

70.06
Limb Brightening of Gamma-ray Continuum Emission from Solar Flares

T. Bai (Stanford University)

By studying the distribution of flares detected with the Gamma-Ray Spectrometer (GRS) aboard SMM as a function of heliocentric angle, Vestrand et al. (1987, Ap. J., in press) concluded that flares observed near the solar limb are brighter in gamma rays above 300 keV than flares observed near the disk center. In addition, limb flares were found to have, on the average, flatter gamma-ray spectra than disk flares. These results are caused by anisotropic distributions of momentum vectors of energetic electrons. However, the limb brightening factor has not been determined so far. In order to find the average limb brightening factor of gamma rays, I have studied the cross correlation between GRS fluences and peak count rates of the Hard X-Ray Burst Spectrometer (HXRBS). Because HXRBS counts are due mainly to long-energy hard X-rays (≥30 keV), for which directivity is negligible, HXRBS peak rates can be used for calibration. The results of my study are as follows: (1) GRS fluences are well correlated with HXRBS peak rates. However, the GRS fluence is not proportional to the HXRBS peak rates, but the GRS fluence increases on the average faster than the HXRBS peak rate. (3) The geometrical mean of the limb brightening factor is about 3.5. There is some evidence that the limb brightening factor increases on the average as the HXRBS peak rate increases. Here limb flares are defined as those with heliocentric angle greater than 64°.

70.08
A Mechanism for the Rigid Rotation of Coronal Holes


We use numerical simulations of photospheric and coronal magnetic fields to study the evolution of coronal holes. In our simulations of the photospheric field we include differential rotation, supergranular diffusion and meridional flow but exclude the ongoing eruption of new flux. Assuming that coronal currents are negligible, we extrapolate this field to a hypothetical source surface and we define "coronal holes" to be the photospheric footpoint locations of open field lines. Although located in the differentially rotating photosphere, these holes eventually rotate at the same quasi-rigid rate which we previously found for the source-surface field. To attain this rate of rigid rotation under the constraint of a current-free corona, the field lines extending from the boundary of a coronal hole must continually reconnect. We suggest that this process of magnetic field reconnection is necessary to explain why coronal holes sometimes rotate rigidly.

* Applied Research Corporation

70.09
Sunspot - Cycle Variations of the Interplanetary Field Strength: Implications for Coronal Models

Y.-M. Wang*, N.R. Sheeley, Jr., C.R. DeVore (NRL)

Spacecraft measurements since the 1960's have shown that the average strength of the interplanetary magnetic field (IMF) undergoes surprisingly little long-term variation, unlike the total solar magnetic flux. Attempts to model the IMF during sunspot cycle 21, based on current-free coronal extrapolations of the observed photospheric field and the assumption of a spherical source surface of fixed radius, yield calculated IMF intensities that change by a factor of ten. Improved agreement with observations is obtained with a coronal model that incorporates the following effects:

(1) Pressure balance requires that the closed-field regions of the corona expand outward as the photospheric flux intensity increases. Thus the source-surface radius adjusts so as to reduce the time variation of the IMF intensity.

(2) Current sheets located between regions of opposite-polarity field reduce the latitudinal variation of the IMF.

(3) Strong solar fields contribute to the interplanetary flux near sunspot minimum.

We evaluate the relative importance of these factors in the long-term evolution of the coronal and interplanetary fields.

* Applied Research Corporation