ABSTRACTS

2.02
Near-infrared Measurements of the Radiance of the Solar Corona
R. Smartt (National Solar Observatory/SP)

Measurements of the radial distribution of the solar corona at a mean wavelength of one micron during total eclipse have been analyzed and compared with published values of the combined contributions of the radiance of the K- and F-components. The data were obtained from radial scans on opposite sides of the sun along directions close to the ecliptic out to elongations of about 9 R☉. A small deficit in the measured radiance over elongations from ~2 R☉ to ~4.5 R☉, as compared with F+K, is interpreted as evidence of a dust-free zone with an outer boundary between 4.0 R☉ and 4.5 R☉. With some assumptions about the form of the diffraction profile for interplanetary dust particles, a lower limit of dust-particle radius ~0.3 μm is obtained.

2.03
Magnetic Modulation of Solar Luminosity by Photospheric Activity
F. Foukal (CRI, Inc.), J. Lean (Applied Research Corp.)

We study the behavior of slow changes in solar irradiance, S, using measurements obtained with radiometers on the SMM and Nimbus-7 spacecraft. Our analysis of the 1978-1984 ACRIM and ERB radiometry reveals time scale amplitudes (0.04%, -0.07%) in S on time scales of four to nine months that are well correlated between these two data bases. This agreement on slow variations measured by radiometers on two separate spacecraft, and also the finding that the variations correlate very well with changes in facular radiations measured by the HEL 10830 and CaK plage indices, demonstrates that photospheric activity modulates the total solar irradiance on time scales greatly exceeding the days to weeks known to be caused by disc passage of individual active regions.

We show also that the slow down trend in S seen since 1981 by the ACRIM and ERB arises mainly from a decreasing irradiance contribution of bright photospheric magnetic elements outside the large faculae included in the daily CaK plage index. Our finding that this network contribution is unbalanced over several years shows that photospheric activity has a net influence on solar luminosity, besides the more nearly balanced contributions of the spots and the large faculae.

Our demonstration that solar luminosity variation over the 11-year activity cycle is controlled by bright photospheric magnetic elements rather than by dark spots significantly increases the likelihood that the sun was dimmer during extended periods of decreased magnetic activity such as the Maunder Minimum. This result indicates that solar dimming over many decades may well have played an important role in climatic anomalies such as the Little Ice Age of the 17th century.

2.04
Distribution of Sunspot Umbral Areas: 1917-1982
T. J. Bogdan, P. A. Gilman (HAC/NCAR), I. Lerche (U. South Carolina), R. Howard (NSO/NOAO)

Over 24,000 measurements of individual sunspot umbral areas taken from the Mount Wilson white-light plate collection covering the period 1917-1982 give the relative size distribution of sunspot umbral areas in the range 1.5-150 millionths of a solar hemisphere. The sunspot umbral areas are found to be distributed lognormally. Moreover, the same distribution is obtained for all phases of the solar cycle (maximum, minimum, ascending, descending), as well as for various individual years, between 1917 and 1982. Both the mean and the geometric logarithmic standard deviation of this distribution appear to be intrinsically constant over the entire data set; only the number of spots exhibits the familiar solar cycle variations. If the lognormal fit remains valid below 1.5 millionths of a hemisphere, then our data predict a maximum in the size spectrum of photospheric magnetic structures for flux tubes with radii in the range 500-5000 km. The absence of solar cycle variations in the relative distribution of umbral areas and the lognormal character of this distribution both argue for the fragmentation of magnetic elements in the solar envelope.

2.05
Magnetic Fields on the Sun, Variation of Solar Cycle 21

The variations of magnetic flux on the Sun from 1975 through March 1985 have been studied using the synoptic rotation magnetic field maps. These data are constructed from daily full-disk magnetograms taken by the National Solar Observatory with the 512-channel magnetograph at the Vacuum Telescope on Kitt Peak. The spatial resolution of the data studied is 1° in longitude and 0.011 in sine latitude and temporal resolution is one carrington rotation (27.34 days).

For each carrington rotation, the total magnetic flux (B+ - B-1) was calculated for fields >25G (inferred to be active regions), and for fields <25G (quiet sun fields and dispersed active region flux). The northern and southern hemispheres were also considered separately. Comparisons of the variations of the magnetic flux over solar cycle 21 shows that:

1. The magnetic flux of contributed by active region fields (>25G) varies by a factor of 10-15 from cycle minimum to maximum. The quiet sun fields (<25G), vary by no more than a factor of 2 during the same interval. This strongly supports the idea that most of the active region flux being lost in situ (as was found by Giaiausas et al. (1983) in an active region complex), with only a small fraction dispersing on the surface.

2. On average, increases in the quiet sun fields lag the injection of active region magnetic flux by about 2 rotations and disappear substantially slower than the active region fields.

3. There are very strong north-south asymmetries of the active region magnetic flux over the course of the solar cycle varying. The asymmetries of the magnetic fields outside active regions (<25G) are in the same sense as for active regions but appear to lag about 2 rotations.

4. There appear to be quasi-periodic pulses or episodes of activity of longer duration (~9 rotations) during the rise and decline of the cycle and of shorter duration (~3 rotations) during the few years (1979 through 1981) of "maximum".


2.06
Photometric Measurements of Facular Contrasts near the Solar Disk Center
J. K. Lawrence (S. Fernando Obs./CSUN)

We have analyzed digital, photometric images of several solar active regions on several days during 1983 and 1984. The images were made with the San Fernando Observatory 28 cm vacuum solar telescope and vacuum spectrophotograph, together with 512 element Reticon linear diode arrays. The original images have been square averaged to 256 x 256 with 1.8 arcsec pixel spacing. The primary data are co-registered pairs of images made in 3 A passbands in the IR Ca line at 8662 A and simultaneously nearby clean continuum at 8642 A or 8602 A. The bright facular emission in the Ca line is used to identify facular pixels in the corresponding continuum images. The intensity distribution of the identified facular pixels is then compared with the intensity distribution of quiet photospheric pixels. We find that for 0.8 < μ < 1.0 the average facular contrast is about 0.5 percent. This result leads to a few percent increase in estimated facular contributions to solar luminosity fluctuations.

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