3.09

Evolution of Active Regions at 20 cm


We report the preliminary results of an investigation on the evolution of active regions at 20 cm wavelengths using VLA. More than a dozen active regions were present on each day during the period Sept. 11-17, 1986 (International Solar Month). Active regions occurred in groups and formed two bands parallel to the equator. Both long lived complex active regions and small compact ephemeral regions were observed. The sizes of the radio sources were well correlated with the features in Hα 10850, Hα and Calcium K line profiles. Comparison of polarization (V) maps with Kitt Peak magnetogram shows that the 20 cm radiation was polarized in the sense of extraordinary mode. Changes in the magnetogram were closely followed by similar changes in the radio maps although they correspond to different heights. Since there were a large number of active regions and several unclassified peaks, we were able to perform a statistical analysis of some of the parameters of active regions. We found that (i) most AR sources were - 100" in size; (ii) lower TR regions show higher degree of polarization. Maximum polarization was found at the edge of active regions but well within the associated plage regions. Polarization of up to 50% was found in the plage associated sources whereas the AR polarization never exceeded - 20%. We explore the emission mechanisms that can explain this polarization.

3.10

VLA Observations of Solar Active Regions at 6 and 20 cm During the Spacelab 2 Mission

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We report on the VLA observations at 6 and 20 cm obtained during the period July 30-August 3, 1985 covering the period of operation of the Spacelab 2 mission. Two active regions NOAA 4680 and 4682 in the northern and southern hemispheres respectively were observed as well as plage associated sources. In the region 4680 the 6 cm source consisted of three components which were about 50% polarized; they were associated with small sunspots and pores except for one component. The 20 cm source also consisted of three components, the strongest of which was located above a neutral line, in a region of strong magnetic field and strong magnetic field gradient. The other two components were mostly associated with plage regions. Near the CMP the region showed a clear bipolar structure in the V maps, with the sense of polarization, as expected from the polarity of the photospheric magnetic field. As the region moved across the disk the polarization structure changed due to wave propagation effects. The region 4682 was well developed with a bipolar structure. The 6 cm maps on August 2 and 3 showed the typical characteristics of gyroresonance emission associated with sunspots. On August 3 a second source appeared, S8 of the main source, with a lower intensity and almost 100% circular polarization. The characteristics of this newly emerging region indicate gyro emission at the third harmonic. The source was located above a local enhancement of the photospheric longitudinal magnetic field. The 20 cm emission spanned the entire active region. The peak of its emission was in the northern part of the region and was clearly associated with a spot, suggestive of the gyro-resonance process playing a role in its emission.

3.11

Multi-Species Treatment of Mass Flow Through the Solar Transition Region

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We present steady-state calculations which show the effects a steep electron temperature gradient can have on the temperature and density distributions in a multi-species treatment of a downflow through the solar transition region. Coupled continuity, momentum, and energy equations are solved for protons, alpha particles, and a trace minor ion species for a prescribed electron density and temperature profile consistent with the observed solar transition region. The multi-species treatment allows us to consider the likelihood that significant temperature differences can exist and to be able to evaluate the effect of the thermal force on, in particular, the minor ions. The thermal force acts in the direction of the temperature gradient and is due to the coulomb collision frequency increasing with decreasing temperature so that the lower temperature component of an interacting species will more effectively transfer momentum to a given species than the higher temperature component. This force (because of the charge dependence of the coulomb interaction) will preferentially slow the highly ionized minor ion species relative to the protons resulting in an abundance enhancement of the minor ion. We evaluate this enhancement and consider the conditions under which this effect can alter the interpretation of the observed emissivities and thus alter the shape of the observationally inferred emission measure curve. We also consider whether the differing electron and ion temperatures can bear on the interpretation of large nonthermal line widths which are typically observed in transition region lines.

3.12

Observations of Doppler Shifts in BUV Emission Lines from a Coronal Active Region

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We have developed and used an imaging BUV spectrograph to obtain the first measurements of coronal plasma velocities over a wide range of electron temperatures in active region emission features. The observations were obtained during a sounding rocket flight of the Solar BUV Rocket Telescope and Spectrograph (SRRTS) on May 5, 1985. The instrument provided: a) BUV spectroheliograms (about 6 arc sec resolution) of the active region, b) high resolution (50 mÅ) stigmatic spectra along a chord through the central portion of the region, and c) slit jaw images at 3820-3860 Å. Consequently, the