EXTREMELY UNUSUAL SOLAR WIND FLOWS OBSERVED AT 1 AU

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The solar wind at Earth orbit (1 AU) is known to be strongly supersonic and super Alfvénic with Mach and Alfvén numbers being on average 12 and 9 respectively. Also, solar wind densities (average ~10 cm^{-3}) and velocities (average ~450 km s^{-1}) at 1 AU are known to be inversely correlated with low velocities having higher than average densities and vice versa. However, there have been several events when unusually low densities (< 0.1 cm^{-3}) and low velocities (< 350 km s^{-1}) with Alfvén Mach numbers significantly less than 1 have been observed at 1 AU, for durations of ~1 day or more. These extreme low density and long lasting events have come to be known as solar wind disappearance events. In this paper we will presents the result obtained from a detailed study of three disappearance events that took place in May 1999, March 2002 and May 2002 respectively. We will show that all three events originated from large active regions located at central meridian on the solar disk. We will also present arguments to show that the solar wind flows responsible for these events were stable and unipolar flows originating in coronal holes or active region open fields. Furthermore, we will examine the reasoning behind speculations about the association of such events with global phenomena like solar polar field reversals that take place at the maximum of each solar cycle and show that these events are not associated with large scale solar phenomena like polar field reversals.

SOLAR BURST SUBMILLIMETER WAVE EMISSION COMPONENTS ASSOCIATED TO MICROWAVES, UV, X- AND GAMMA - RAYS CONTINUUM IN TIME AND SPACE

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The presence of a solar burst spectral component peaking somewhere in the terahertz (THz) range, along with, but distinct from, the well-known microwave spectral component, bring new possibilities to explore the flaring physical processes, both observational and theoretical. The solar event of December 6, 2006, starting at about 18:30 UT, exhibited a particularly well-defined double

spectral structure, with the THz spectral component detected at 212 and 405 GHz by SST and microwaves (1-18 GHz) observed by OVSA. The burst was observed by instruments in satellites at high energies, UV by TRACE, soft X-rays by GOES, X- to gamma- rays by RHESSI. Although the event occupied a rather extended area at optical and UV wavelengths, showing various brightnings extending along several arcminutes, the hard X-ray emission region is more restricted (contained within a region 30" x 50") and shows three sources at low energies (< 150 keV) and a single source above 300 keV. At submillimeter-waves, a precursor was observed, followed by a rapid impulsive event and a post-burst long-enduring component. This post-burst component was also accompanied by the largest flux-density decimeter burst ever reported, reaching 1 million solar flux units. The submillimeter impulsive burst centroid position at 212 GHz was clearly displaced from the precursor component by almost 1 arc-minute. The maximum limit sizes, estimated at 212 GHz, were of the order or smaller than the beam-sizes (4?). The microwave spectra for the precursor and long-enduring burst components peak at about 5-10 GHz. The submillimeter precursor spectrum might be optically thick emission of the cold chromospheric plasma. Despite the complexity in space, time and spectra of the superimposed impulsive and post-impulsive emission, it was remarkable that the THz impulsive component had its closer counterpart only in the higher energy X- and gamma-rays ranges, suggesting that they are part of the same physical process, produced by a source of continuously accelerated high-energy particles.

OBSERVATIONS OF SOLAR PHENOMENA AT METER WAVELENGTHS WITH COMBINED DATA FROM GMRT & GRH

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The present knowledge about Solar phenomena at meter wavelengths is limited to the angular resolution of ~ 2' that is achieved by the dedicated telescopes in operation until the present time. Such synthesized beams are generally larger than the structures observed on the Sun, hardening the physical interpretation of the observed phenomena. Here, an attempt is made to obtain observations with high angular resolution and combine them with neighbouring frequencies with better UV coverage, so as to increase the dynamic range of the images. The main phenomena investigated are Coronal Holes. A large interferometer like the Giant Metrewave Radio Telescope (GMRT) is capable of producing images of celestial sources with ~ 20" at 150 MHz. However, the sparse *uv* coverage of GMRT at low spatial frequencies, limits the dynamic range of the solar maps. On the other hand, the Gauribidanur Radio Heliograph (GRH), operating at 115 MHz,

provides a very dense *uv* coverage, and very high dynamic range solar images, at the cost of angular resolution. The telescopes are closely located and operate at complimentary frequency bands. We discuss the results and prospects of a program of simultaneous observations using GMRT and GRH. We present the first results, from successful observations of a Coronal Hole (CH) on June 4, 2005, for which we used the combined observations to determine the boundaries, brightness temperature (T_B=7.7×10^5 K) and electron density (n_e=6.79×10^7 cm^{-3}) of the CH. We also present results for ongoing studies of the Quiet Sun on December, 2005.

SOLAR ATMOSPHERIC MODEL OVER A HIGHLY POLARIZED 17 GHz ACTIVE REGION

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A 3-D solar atmospheric model was developed to reproduce the radio frequency observation at 17 and 34 GHz from Nobeyama Radioheliograph. The model includes both the bremsstrahlung and the gyro-resonance emission mechanisms. It considers the magnetic field structure extrapolated from MDI magnetograms, and the changes in the quiet Sun density and temperature distributions of the atmosphere. We analyzed a highly polarized active region at 17 GHz (74-97%) on June 25 of 2002 (NOAA 10008). For 34 GHz the emission was totally free-free with a brightness temperature maximum in agreement with the observations, and indicated that all the region between the magnetic field footpoints changes its density and temperature constitution. The 17 GHz results showed that: a) the magnetic field intensity measured by MDI are not able to yield gyro-resonance emission in agreement with the observations; b) the magnetic field intensity in the solar atmosphere is at least two times the values resulting from a direct potential extrapolation from MDI magnetograms, and c) the brightness temperature maxima resulting from a factor of 2 increment in the magnetic field intensity reproduced all maxima observed during the day (11.4-17.6×10^4 K); d) the area of the active region was delimited by the intense core with negative polarization. In summary the model yields good agreement with the emission at both frequencies, which are caused by distinct emission mechanisms.

SUBMILLIMETER RADIATION DUE TO GYROSYNCHROTRON EMISSION FROM ACCELERATED ELECTRONS IN THE 2 NOVEMBER 2003 FLARE

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The flare on November 2nd, 2003, starting at 17:17 UT, occurred on the very active region 10486 located at S17W63. This flare, classified as a X8.3 and 2B event, was simultaneously detected by RHESSI and the Solar Submillimeter Telescope (SST) at 212 and 405 GHz. The time profile of the submm emission resembles that of the high energy X-rays observed by RHESSI and the microwaves observed by OVSA. Nevertheless, the submm spectra are distinct from the usual microwave spectra, showing a flux density increase with frequency. Gyrosynchrotron emission from the same population of accelerated electrons that emit hard X-rays observed by RHESSI, the same number of electrons (5×10^{35}) between 50 keV and 20 MeV, is found to fit the high frequency radio spectra. The fit to the spectra yield a very compact submm source of 0.8 arcsec, resulting in a density of accelerated electrons of 3.8×10^{11} cm^{-3}, in a high magnetic field region of 4500 G. A smaller magnetic field is possible if one considers emission from an anisotropic electron distribution.