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New Developments in ARTEMIS IV Solar Radio Spectrograph

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Abstract We present recent developments of the ARTEMIS IV solar radio spectrograph operating at Thermopylae, central Greece. Observations are obtained daily in total intensity and in the frequency range from 20 to 650 MHz, using two antennas and two receivers. We are now in the process of developing a new system that will record consecutively the intensity of right-hand and left-hand polarized waves using one of the antennas and the same receivers.

Keywords Sun · Radio emission · Radio spectrographs

1 Introduction

Radio spectrography of the solar corona at decimeter, meter and decameter waves provides basic information on the origin and early evolution of many phenomena which later extend through the interplanetary medium. Significant problems include the formation of interplanetary shocks, the acceleration of energetic particles from shock waves, and the relation of energetic electrons emitted by active regions to the Heliospheric Current Sheet. All these problems require a close combination of high frequency observations covering the lower corona and obtained from the ground with low frequency observations spanning the interplanetary medium and obtained from space.

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2 Instrumentation

The ARTEMIS-IV solar radio spectrograph is a common project of the University of Athens, the Observatory of Paris Meudon, the Technological Education Institute of Lamia and the University of Athens. It is stationed near Thermopylae in central Greece. In its current configuration the instrument consists of two antennas and two receivers operating in parallel [1]. A 7 m parabolic antenna with a crossed-dipole log periodic feed is used for the metric range, whereas an inverted V fat dipole antenna is used for the decametric range. The two receivers operate in parallel: A global spectral analyser (Analyseur de Spectre Global, ASG) covers the entire spectral range from 20 to 650 MHz with a temporal resolution of 100 ms and 630 linearly spaced frequency channels, whereas an acousto-optic frequency analyser (Spectrograph Acousto-optique, SAO) covers a narrower band (270 to 450 MHz) in 128 frequency channels, but with much higher sensitivity and temporal resolution (10 ms). The data acquisition system consists of two PCs, one for each receiver. The sensitivity is about 3 SFU and 30 SFU in the 20–100 MHz and 100–650 MHz range respectively. The daily operation is fully automated: receiving

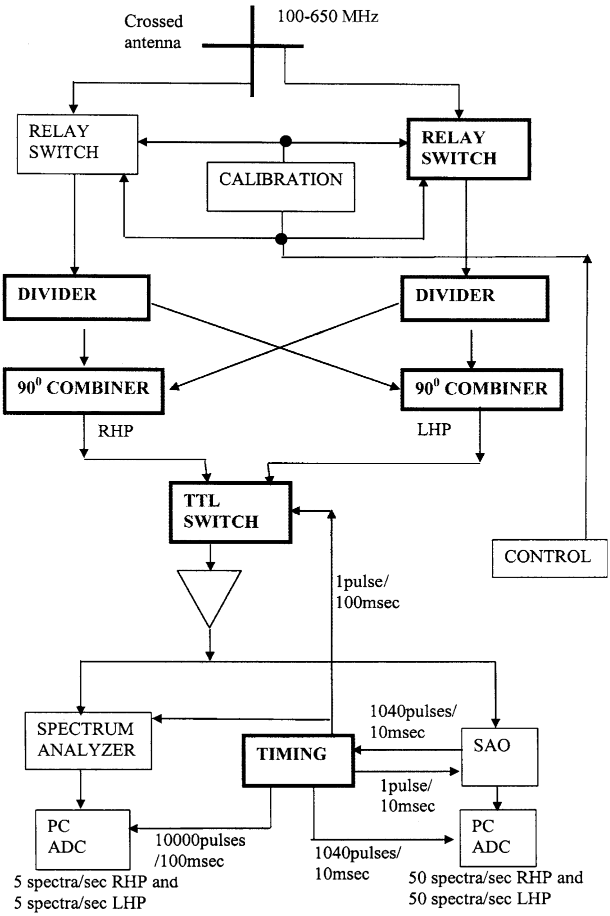

Fig. 1 Block diagram of the system for the measurement of circular polarization

universal time from a GPS, pointing the antenna to the sun, system calibration, starting and stopping the observations at preset times, data acquisition, and archiving on DVD. Whereas the ASG can give a global picture of radio bursts as observed from the earth, the SAO gives unprecedented fine temporal detail [2, 3]. Daily quick look observations can be found at http://www.cc.uoa.gr/artemis/ and, combined with other earth based and satellite radio data, at http://secchirh.obspm.fr/ The radiospectrograph so far is used in total intensity mode (Stokes parameter I). Since the circular polarization (Stokes parameter V) is a very important parameter for the analysis of the emission mechanisms responsible for solar bursts, we are currently in the process of expanding the system so that V can also be measured, making use of the already existing crossed dipoles in the metric antenna. Figure 1 shows the layout of the new system, with the new elements shown in thick boxes. The signal from each set of dipoles goes through relay switches; they are further split in two parts, shifted by 90° and combined to give the flux signal in R and L polarization. The acquisition system samples consecutively the two signals, so that the ASG gives 5 R and 5 L samples/s, while the SAO gives 50 R and 50 L samples/s. The advantage of this design is that it requires very little change of the existing system, at the expense of decreasing the time resolution by a factor of two. We expect the system to be tested by the end of 2007 and to be operational in a routine mode in 2008.

3 Conclusions

The measurement of circular polarization with a time resolution of 20 ms will primarily benefit the study of a variety of fine structures embedded in more extended continua and provide clues on their origin and their association with the different phases of flare development, including the energy release phase and associated mechanisms.

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