

## 20 years of the Franco-Hellenic Jean-Louis Steinberg ARTEMIS solar radio spectrograph at thermopylae, Greece

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The Franco-Hellenic Solar Radio spectrograph Jean-Louis Steinberg ARTEMIS-IV run by the University of Athens and the Technological Education Institute of Lamia is installed at the Thermopylae Satellite Station of COSMOTE and works since 1996 observing the emissions Sun at radio frequencies. The observations cover radio emissions from almost the base of the Solar Corona (650 MHz) to about 2 Solar Radii (20 MHz) with time resolution 1/10 and 1/100 sec respectively. The spectrograph has a 7-meter moving parabola fed by a log-periodic antenna for 100650 MHz and a stationary inverted V fat dipole antenna for the 20100 MHz range. The instruments recordings, being in the form of dynamic spectra, measure radio flux as a function of height in the corona; our observations are combined with spatial data from the Nancy Radioheliograph whenever the need for 3D positional information arises. The ARTEMIS-IV contribution in the study of solar radio bursts is two fold: Firstly in investigating new spectral characteristics since its high sampling rate favours the study of fine structures in radio events. On the other hand it is used in studying the association of solar bursts with interplanetary phenomena because of its extended frequency range which is, furthermore, complementary to the range of the WIND/WAVES receivers and the observations may be readily combined. Joint observations with STEREO/WAVES and a similar one on board Solar Orbiter permit a much wider frequency range and 3 dimensional observations and directionality of events.

J.L. Steinberg ARTEMIS IV has a pass band filter 270-450 MHz, an RF amplifier, and a very fine acousto-optic frequency analyzer (Spectrograph Acousto-Optique, SAO) for this frequency range with low dynamic linear range (20db), and very good frequency resolution at 176kHz and very fast frame rate recording 100 spectra per second. The SAO output drives an ADC card at the second PC. The SAO output comes from the discharge of a linear CCD with 1024 pixel so that every pixel corresponds to a different frequency. This instrument initially takes 1024 samples recorded with 12bit. The data record every night is enormous and the samples are averaged by eight, and the whole spectrum is recorded in 128 channels with resolution bandwidth 1.4MHz. This arrangement leads to a high signal to noise ratio. The daily data are about 1Gbyte (from an initial 8 to 10GB). The Global Spectral Analyser (ASG), is a sweep frequency receiver that records 10 spectra per second the frequency range of 20 to 650 MHz in 630 frequencies. We have studied almost all strong solar events that have occurred at the hours of operation of the instrument and presented them in a series of articles and in conferences and several PhD, BSc and MSc theses of the University of Athens.

In this article we present some characteristic solar events observed by J.-L. Steinberg ARTEMIS IV

solar radio spectrograph in combination with other instruments on board spacecraft like WIND and STEREO during the last two solar cycles. These events include several very complex radio events like the observed on 14 July 2000, the series of October 26. 28 and November 3 2003 events, the January, 2005 series of strong solar events.