

Radio Bursts in the Active Period January 2005

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Abstract. We present complex radio bursts recorded by the radiospectrograph ARTEMIS-IV in the active period of January 2005. The wide spectral coverage of this recorder, in the 650-20 MHz range, permits an analysis of the radio bursts from the base of the Solar Corona to 2 Solar Radii; it thus facilitates the association of radio activity with other types of solar energetic phenomena. Furthermore the ARTEMIS-IV¹, high time resolution (1/100 sec) in the 450–270 MHz range, makes possible the detection and analysis of the fine structure which most of the major radio events exhibit.

Keywords: Solar activity; Corona; Radio; Radiation and spectra; Solar electromagnetic emission

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INSTRUMENTATION & OBSERVATIONS

The Artemis-IV solar radio-spectrograph ([2], [3], [5]) covers the metric-decametric range with two receivers operating in parallel: A sweep frequency analyser (ASG) covering the 650–20 MHz range at 10 samples/sec and a high sensitivity acousto-optical analyser (SAO), which covers the 270–450 MHz range with a time resolution of 100 samples/sec.

In the active period 14–20 January 2005 the ARTEMIS-IV observed five major events January 14 (12:36 UT cf. figure 1 Top Two panels), January 15 (06:06 UT cf. figure 1 Bottom Two panels), January 17 (09:00 UT cf. figure 2 Top Two panels), January 19 (08:05 UT cf. figure 2 Bottom Two panels), January 20 (06:39 UT cf. figure 3) Combined with data from WIND-WAVES ([1]), these observations provide a complete view of the radio emission induced by shock waves and electron beams from the low corona to about 1 A.U. These recordings were supplemented with CME data from the LASCO lists on line² ([6]) and SXR (GOES) reports from SGD³. A brief overview of the five events is presented in the Table.

The high sensitivity and time resolution of the SAO facilitated an examination on fine structure within the three studied periods; all exhibited rich fine structure embedded in the Type-IV continua. In our analysis, the continuum background is removed by the use of high-pass filtering on the dynamic spectra (differential spectra in this case).

¹ Appareil de Routine pour le Traitement et l' Enregistrement Magnetique de l' Information Spectral

² http://cdaw.gsfc.nasa.gov/CME_list

³ <http://www.sel.noaa.gov/ftpmenu/indices>

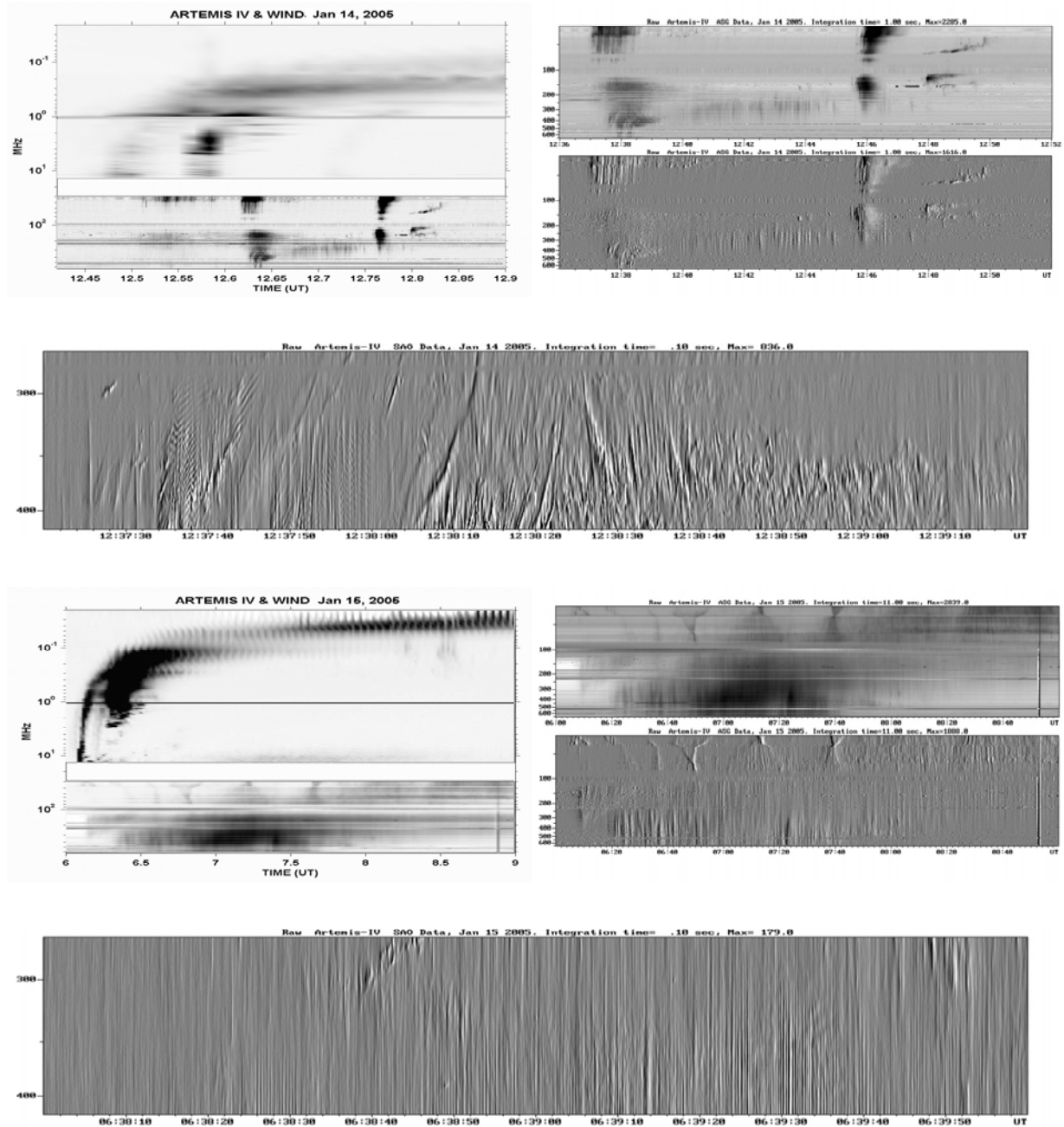


FIGURE 1. UPPER PANEL: LEFT: Combined ARTEMIS-IV and WIND-WAVES spectra of the January 14, 2005 event. RIGHT: ARTEMIS-IV ASG Spectra in the frequency range 20–650 MHz; Intensity (top) and its time derivative (bottom), enhancing fine temporal details. SECOND FROM TOP: Fibers, Zebra, Pulsations and *Lace Bursts* (cf. [4]) from the same event (Differential Spectrum). THIRD PANEL: Same as UPPER PANEL but for the event of January 15, 2005. LAST PANEL: Narrow Band Spikes & Pulsations from the same event (Differential Spectrum).

We present certain examples, which are divided according to a published morphological classification scheme ([4]) based on Ondrejov Radiospectrograph recordings in the

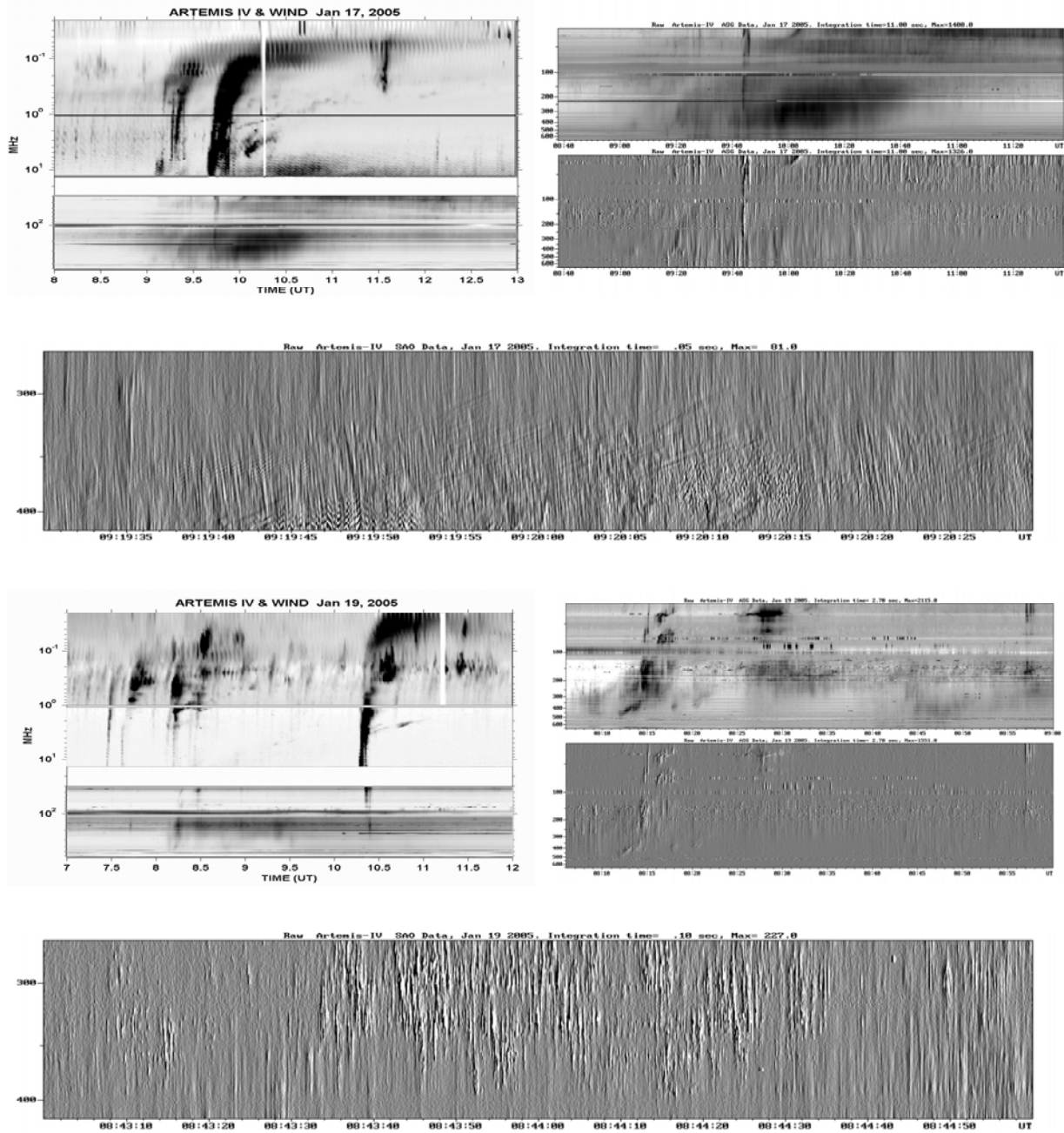


FIGURE 2. UPPER PANEL: LEFT: Same as figure 1 but for the events of January 17, 2005. SECOND FROM TOP: Fibers, Zebra, Pulsations and a Narrow band spike group from the same event (Differential Spectrum.) THIRD PANEL: Same as UPPER PANEL but for the event of of January 19, 2005. LAST PANEL:Narrow Band Spikes & Pulsations from the same event (Differential Spectrum).

0.8–2.0 GHz. In our recordings we have detected:

- Narrow Band Spikes (figures 1, 2, 3)
- Fibers (figures 2,1)

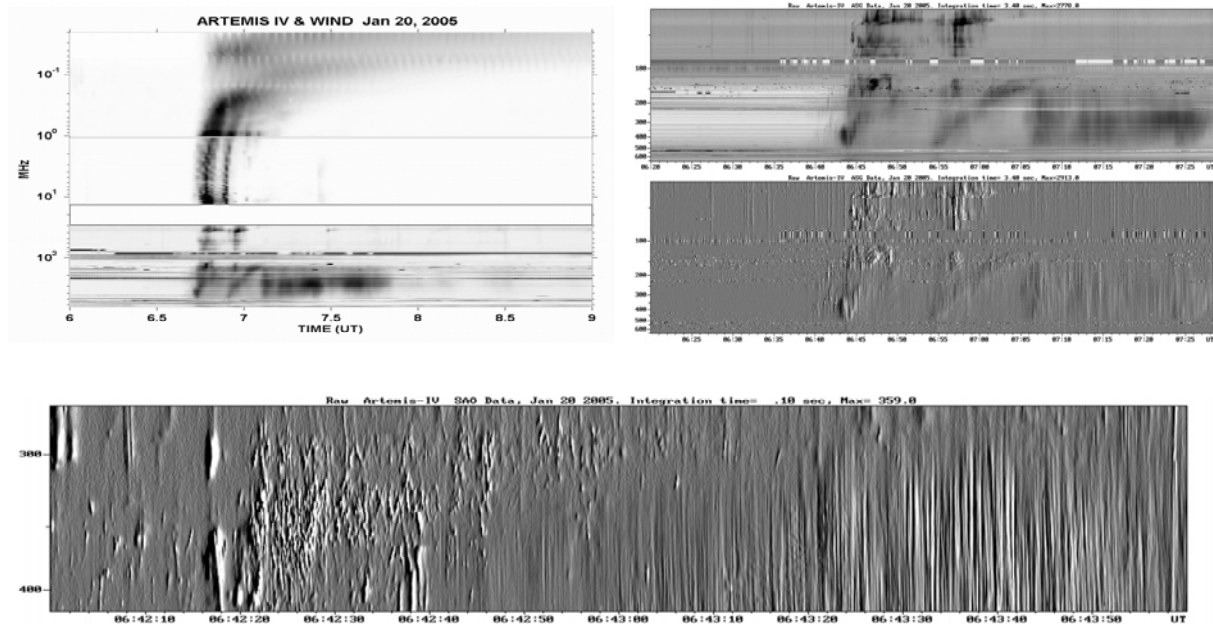


FIGURE 3. UPPER PANEL: Same as figures 1 & 2 but for the event of January 20, 2005. LOWER PANEL: Narrow Band Type III, Spikes & Pulsations from the same event (Differential Spectrum).

- Narrowband Type III Bursts (figure 3)
- Laces (figure 1)
- Zebra patterns (figure 2)

DISCUSSION & CONCLUSIONS

The ARTEMIS–IV radio–spectrograph, operating in the range of 650–20 MHz, observed 5 complex events during the super–active period 14–20 January 2005. WIND–WAVES data complement nicely the ARTEMIS data and trace the radio emission from the middle corona all the way to almost 1 A.U. The high resolution SAO recordings on the other hand reveal a variety of fine structure which, almost, matches the comprehensive Ondrejov Catalogue ([4]). This last, although it refers to the spectral range 0.8–2 GHz, seems to produce similar fine structure with the metric range.

ACKNOWLEDGMENTS

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TABLE 1. Overview of the Events 14–20 January 2005

Event	Start UT	AR	Freq. Range MHz	Class	Speed Km/sec	Accel Km/sec ²
14 Jan 05						
Type II	12:48	718	30–70		1190	-
SXR	12:33	718		C4.6		
15 Jan 05						
Type II	06:08	720	100–400		690	
Type IV	06:15	720	20–650			
SXR	05:54	720		M8.6		
CME (lift off)	06:00				2049	-30.7
17 Jan 05						
Type II	09:43	720	150–500		3256	
Type IV	09:16	720	20–400			
SXR	06:59	720		X3.8		
CME (lift off)	09:15				2094	-118.0
19 Jan 05						
Type II	08:12	720	20–500		1624	
Type IV	08:06	720	150–400			
SXR	08:03	720		X1.3		
CME (lift off)	08:15				2020	-43.8
20 Jan 05						
Type II	06:43	720	20–500		2294	
Type IV	06:39	720	150–450			
SXR	06:36	720		X7.1		
CME (lift off)	05:55				882	16

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