

Detection of spike-like structures near the front of a shock-driven solar radio burst

July 3 2019, by S. Armatas

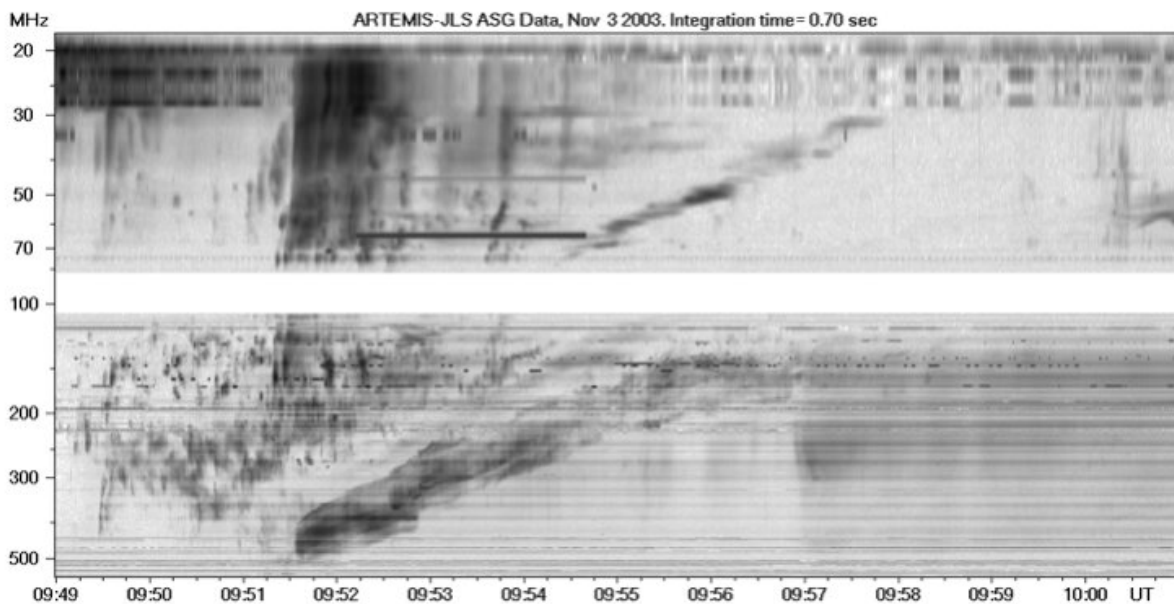


Figure 1 – An example of a Type II radio burst, along with type III and IV bursts, recorded with the sweep frequency receiver (ASG) of the Artemis-JLS spectrograph with 0.1s temporal resolution. Credit: Armatas et al (2019)

Type II solar radio bursts are the result of energetic electrons accelerated by a shock. This kind of burst appears on dynamic spectra as lanes drifting slowly from higher to lower frequencies. Often, scientists observe a fundamental harmonic structure, which sometimes exhibits a

division on each band called band split.

Fine structures are emissions with [short duration](#) and bandwidth embedded within all types of radio bursts, and constitute a useful tool for diagnostics of local parameters. Although spikes associated with Type III ([Benz et al, 1982, 1996](#)) and Type IV radio bursts have been analyzed, in Type II radio bursts, they have not been examined comprehensively. Most common fine [structure](#) reported in Type II radio bursts are herringbone. On the other hand, spike bursts have only been mentioned once in decametric wavelengths.

Using the high time resolution (10 millisecond) acousto-optic analyzer (SAO) of the Artemis-JLS radio spectrograph, researchers have now detected spike-like structures within Type II dynamic spectra.

They identified more than 100 Type II radio bursts using the ASG receiver (Figure 1) and selected four events that were recorded by the Artemis-JLS/SAO receiver in the 450-270 MHz frequency range. The high time resolution of the receiver facilitated the detection of small-scale bursts on the dynamic spectra. They identified 642 short and narrowband structures. These spike-like bursts mostly appeared in groups or chains that drifted almost parallel to the Type II front. Isolated bursts were also occasionally detected. Herringbones and pulsations were also observed to co-exist with these structures (Figure 2).

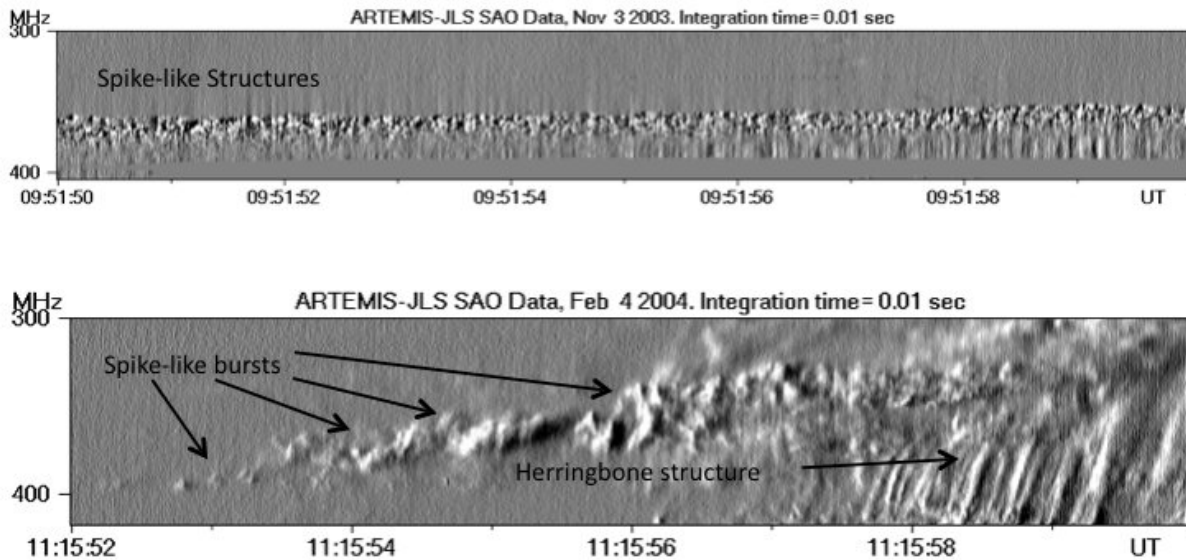


Figure 2 – Upper Panel: Artemis-JLS/SAO dynamic spectrum of the 3 November 2003 event; 10 sec segment and 110 MHz frequency range. Lower Panel: Artemis-JLS/SAO dynamic spectrum of the 4 February 2004 event; 8 sec segment and 110 MHz frequency range. In both cases the time derivative of the dynamic spectrum is displayed to enhance small time scale structures. Credit: Armatas et al (2019)

Their average duration (96 milliseconds) and relative bandwidth (1.7 percent) were measured and compared with similar structures observed within Type IV radio bursts.

In summary, Type II spikes constitute a new class of fine structure with properties similar to Type IV spikes. They are most probably manifestations of small scale reconnection events along the front of the shock.

The paper, "Detection of spike-like structures near the front of type-II bursts," was published in *Astronomy & Astrophysics*.

More information: S. Armatas et al. Detection of spike-like structures near the front of type-II bursts, *Astronomy & Astrophysics* (2019). [DOI: 10.1051/0004-6361/201834982](https://doi.org/10.1051/0004-6361/201834982)

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