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Spike-like structures near the front of type-II bursts from ARTEMIS-JLS and NRH observations

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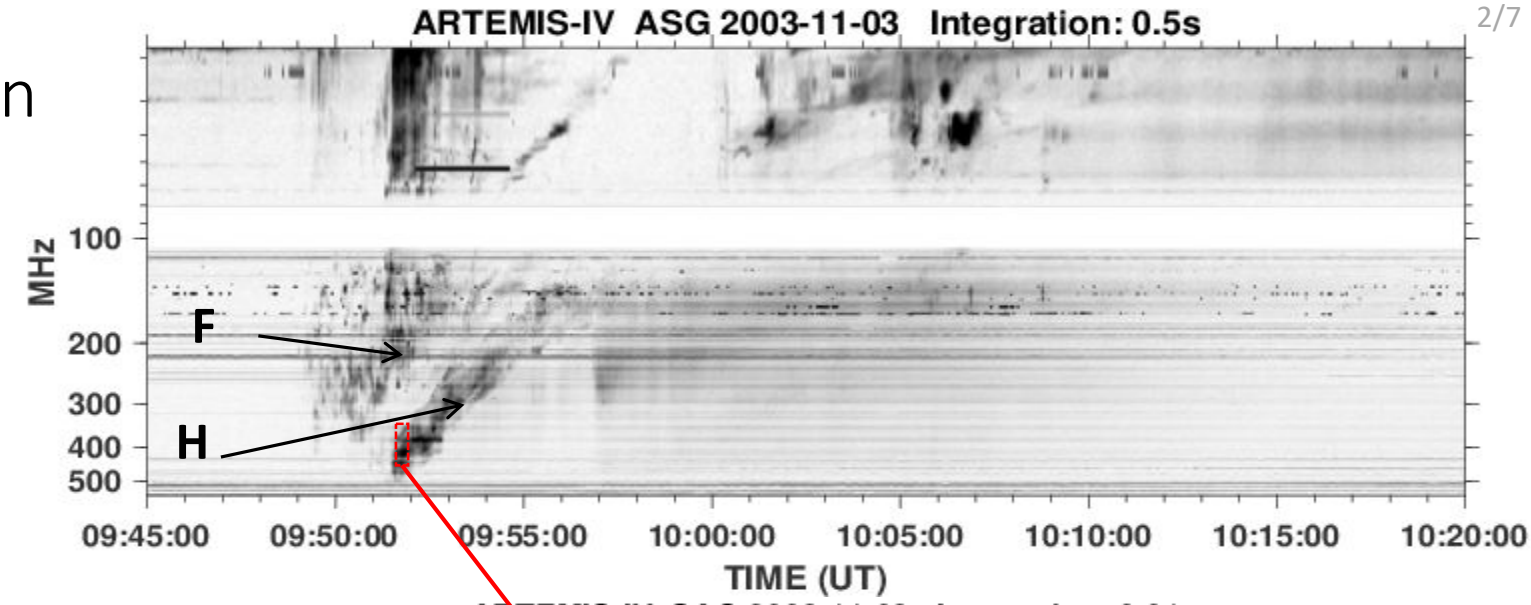
ESPM-16, 16th European Solar Physics Meeting

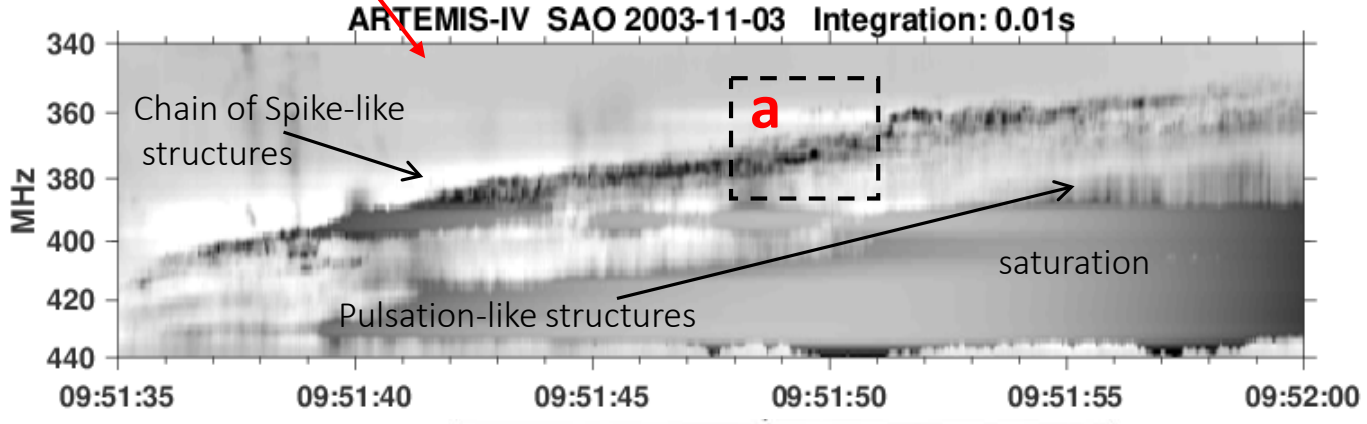
Session 4 - From Radio to Gamma Rays: Near-Sun Manifestations and Triggering of Solar Flares and Coronal Mass Ejections

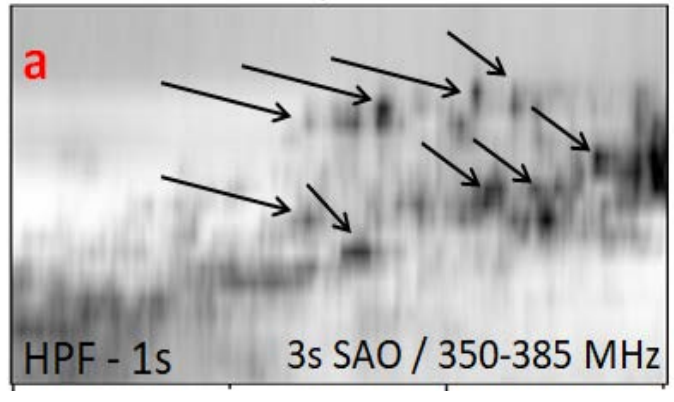
6-10 September 2021

Instrumentation and data selection

- ARTEMIS Jean-Louis Steinberg multichannel Radio spectrograph (Caroubalos et al., 2001; Kontogeorgos et al., 2006)
- Two receivers:
  - Spectrum analyzer (ASG) 650 – 20 MHz, 100 ms
  - Acousto-optic (SAO) 450 – 270 MHz, 10 ms
- New open access database under construction funded by the Onassis Foundation
- Nançay Radioheliograph (NRH) (Kerdraon & Delouis, 1997; Klein & Kerdraon, 2011)
  - 2D images at 5 frequencies (164 - 432 MHz), 150 ms



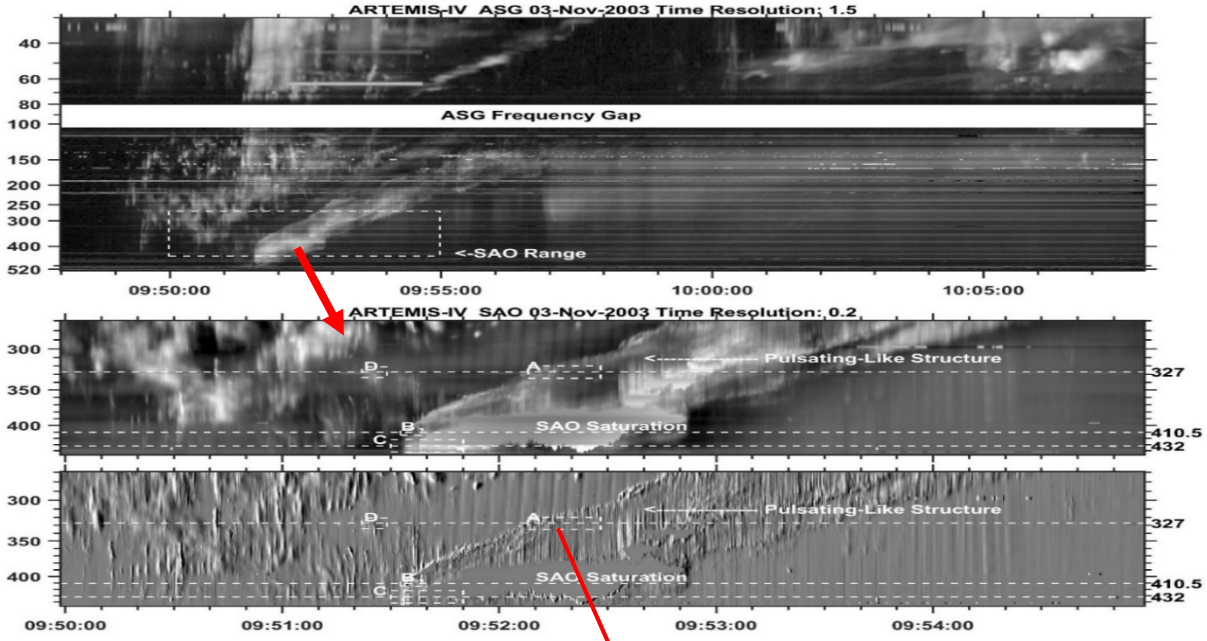




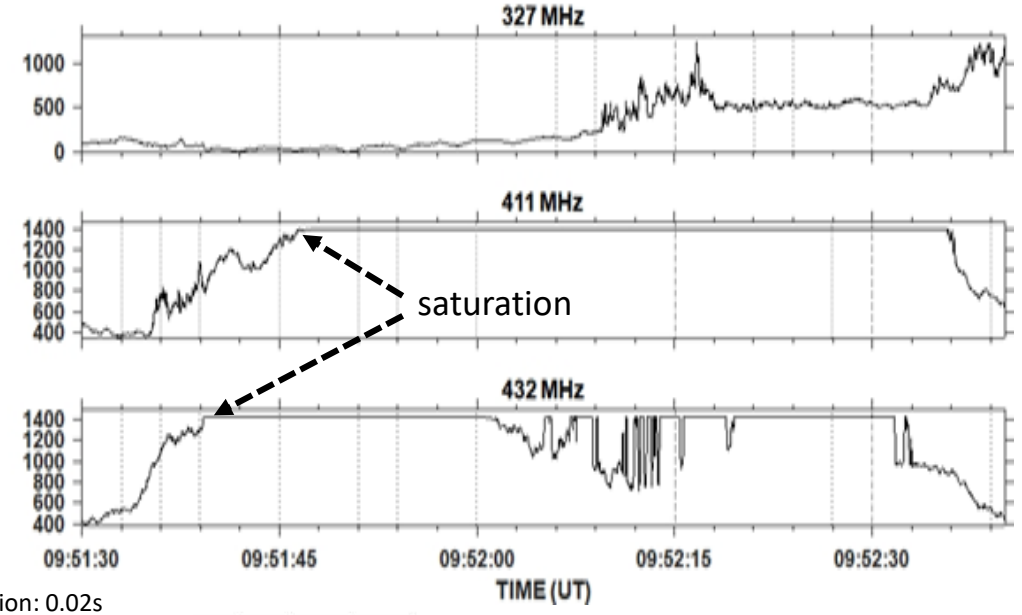
Type II Fine Structure

- 1 event (3 Nov 2003) out of 6 events recorded by ARTEMIS/SAO & NRH
- Spike-like structures (Armatas et al., 2019; Tan et al., 2019; Magdalenic et al., 2020)

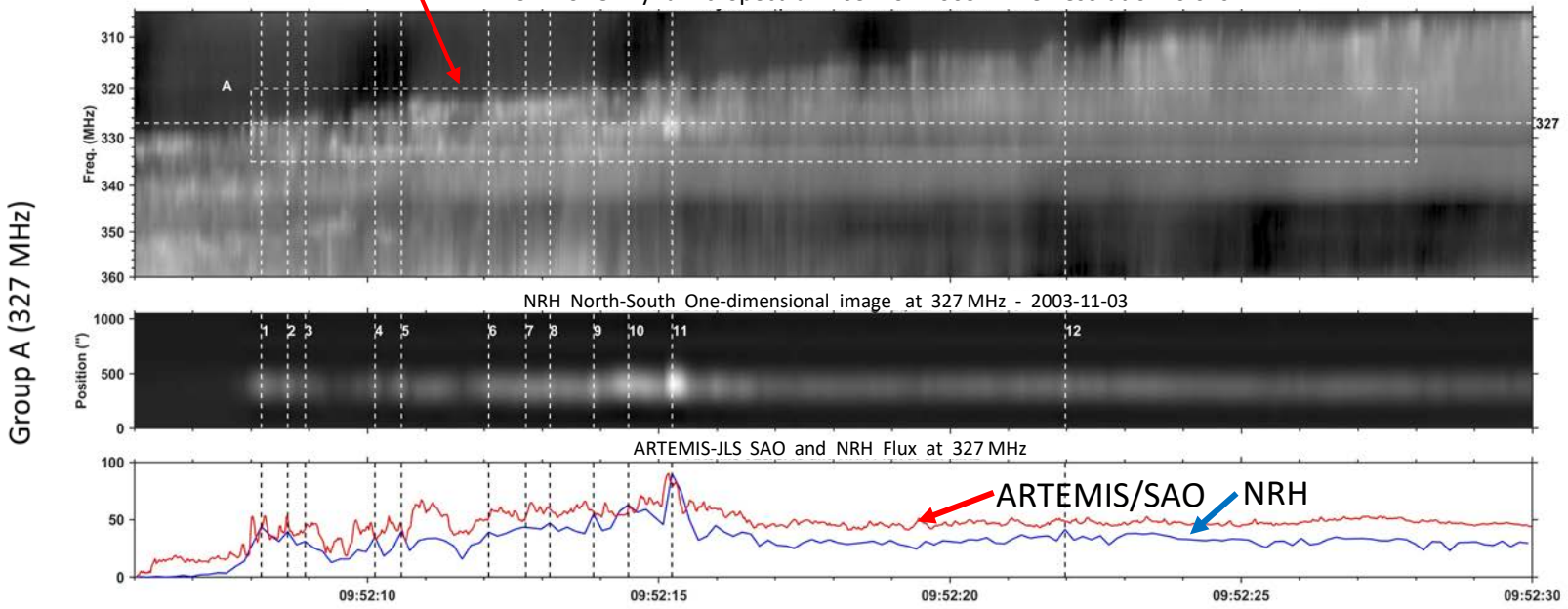
Imaging Spectroscopy of spike-like structures



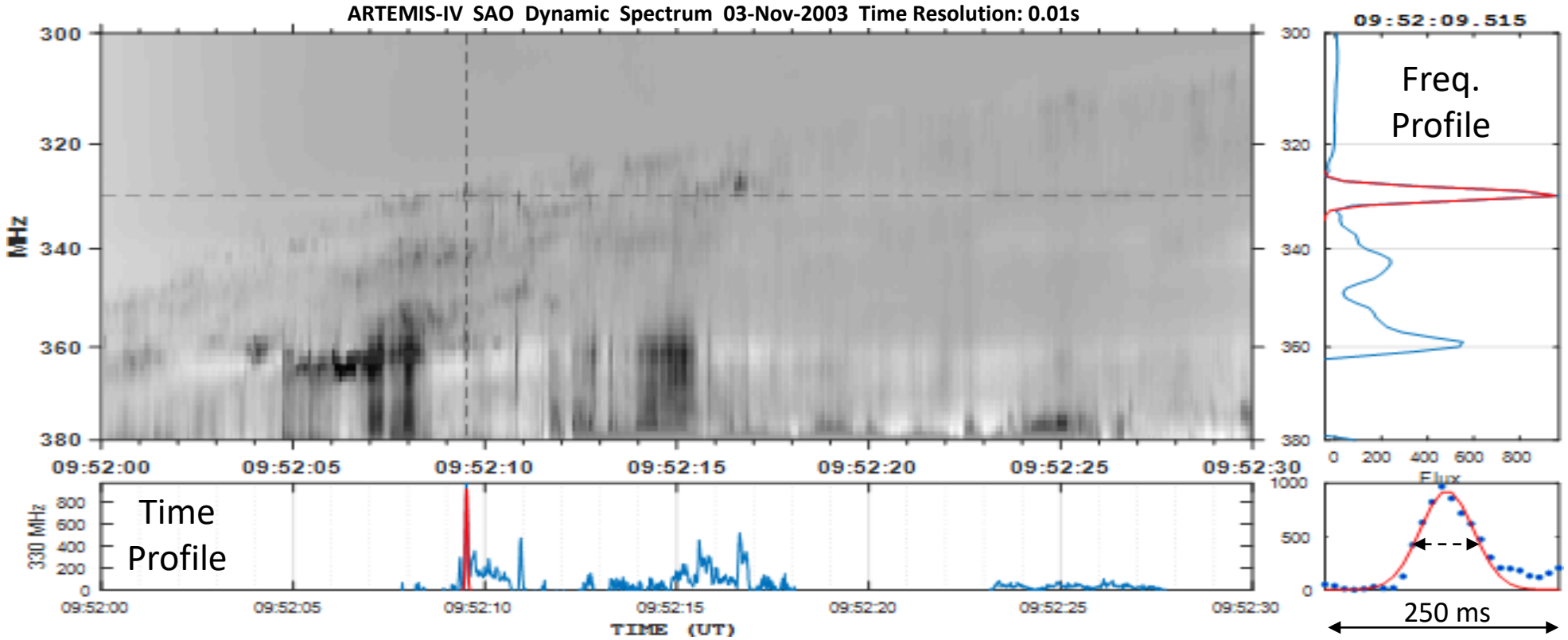
SAO flux at NRH frequencies



ARTEMIS-IV SAO Dynamic Spectrum 03-Nov-2003 Time Resolution: 0.02s



Measurements of duration and bandwidth (ARTEMIS/SAO)

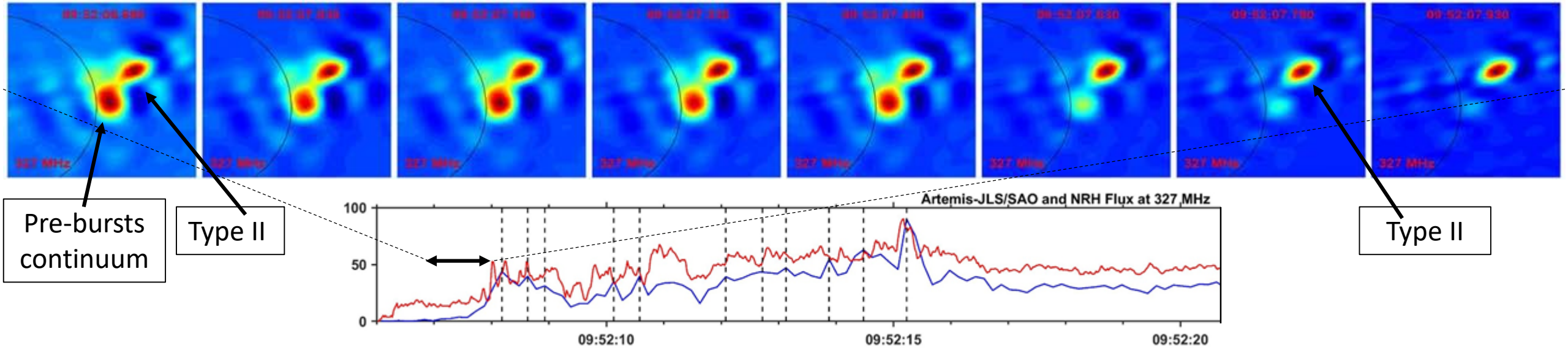


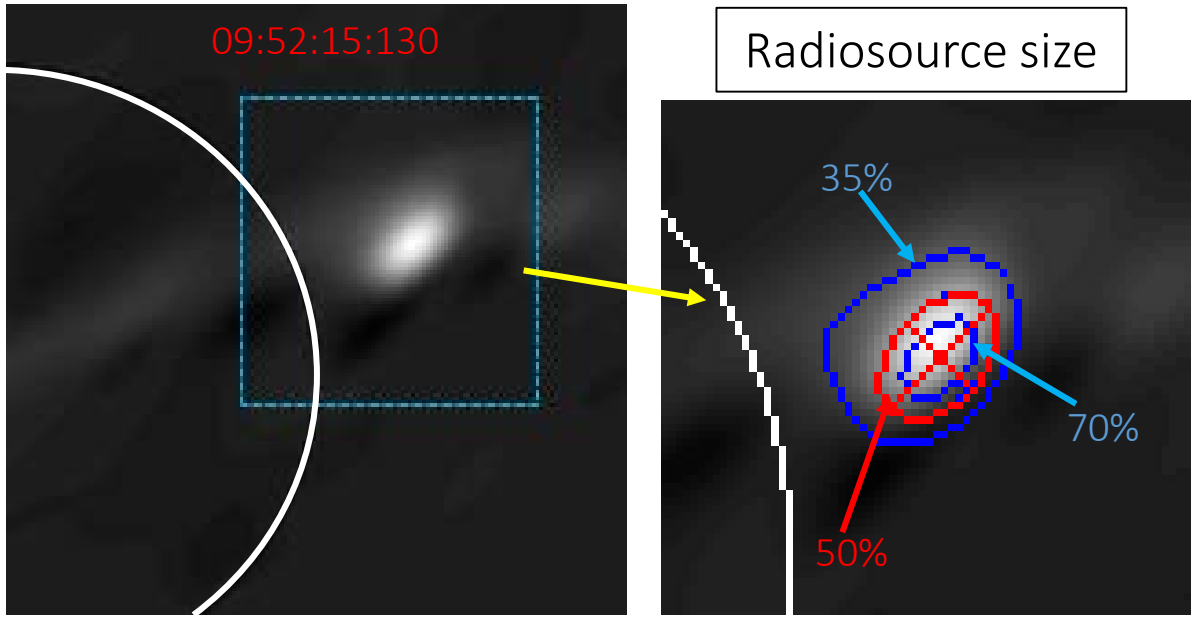
Results

- Number of spike-like structures detected with SAO:
  642 (all events) – 200 (3/11/2003)
- Duration of the structures:
  96 ms (all events) – 73 ms (3/11/2003)
- Relative Bandwidth: 1.7%
- Average Bandwidth: 7.4 MHz

(Armatas et al., 2019; Bouratzis et al., 2016)

Time series of NRH images at the beginning of Type II





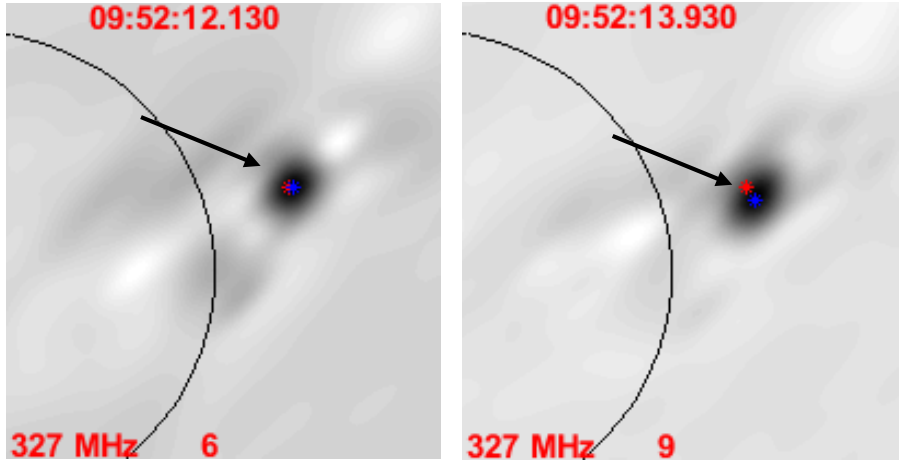
Results

2D Resolution (Beam size) at 327 MHz:
B_{maj} : 236''
B_{min} : 100''

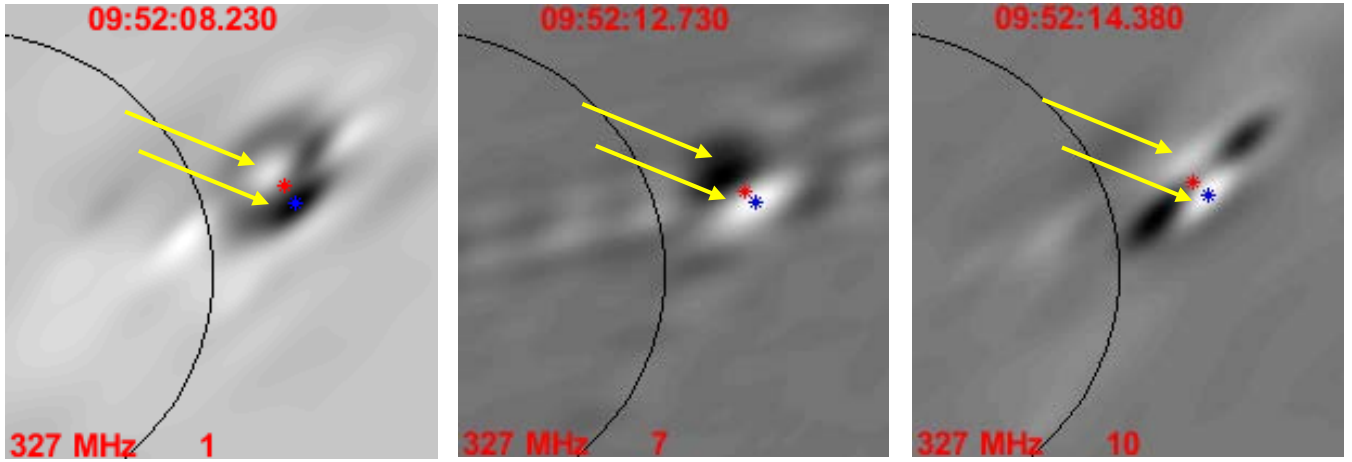
Dimension (size) from 2D (ellipse) at 327 MHz:
B_{maj} : 270±5''
B_{min} : 208±10''
Position Angle: -58±4°

Differential images

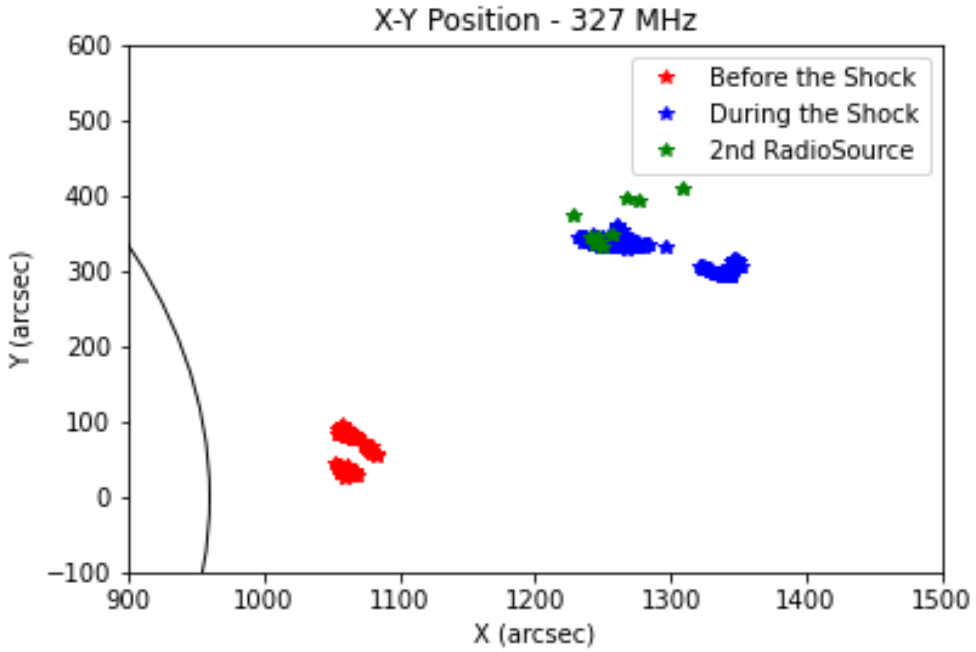
Single source

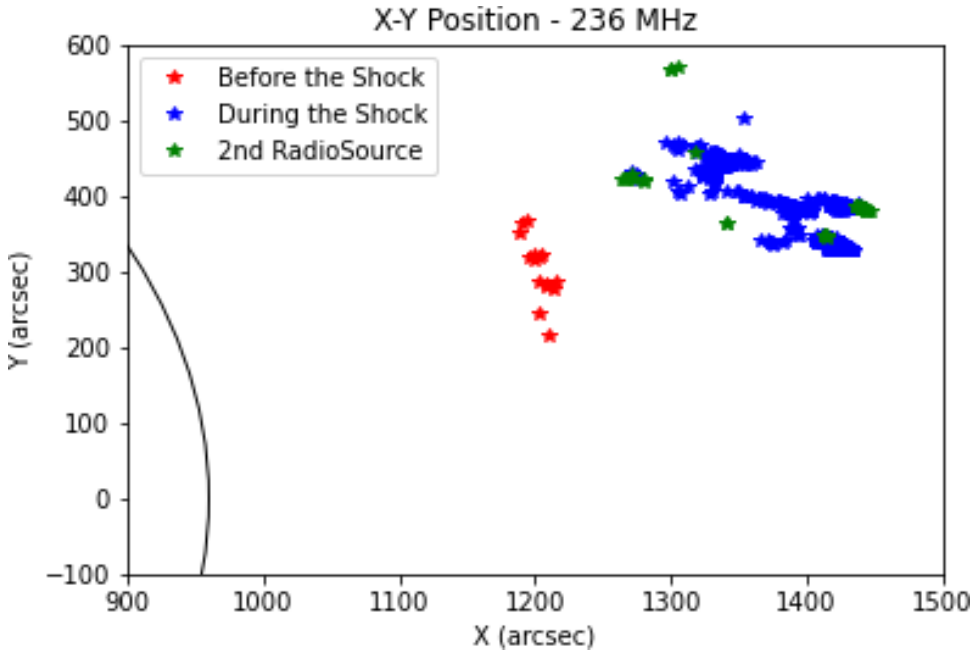


Double source



Plots





Conclusions

- Combined observations of ARTEMIS-JLS/SAO spectra and 1D/2D images of the Nançay Radioheliograph made possible an almost three-dimension study of spike-like structures. Single bursts of the NRH correspond to a group of spikes recorded from SAO.
- Radio source size depends on the recorded frequency and was measured 3′-5′, for each group of spikes.
- Spike-like bursts mostly appear in chains which drift almost parallel to the type II front and co-exist usually with herringbone structures and occasionally with pulsation-like structures.
- The origin of spike-like bursts is probably the small scale magnetic reconnection between the pre-existing Magnetic Field of the solar corona and MHD front of the shock. This proposal is supported by drift rate measurements, which are similar to type IIIs.

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Acknowledgements

We wish to thank the Onassis Foundation for financial support for the continued operation of the ARTEMIS-JLS radio spectrograph.