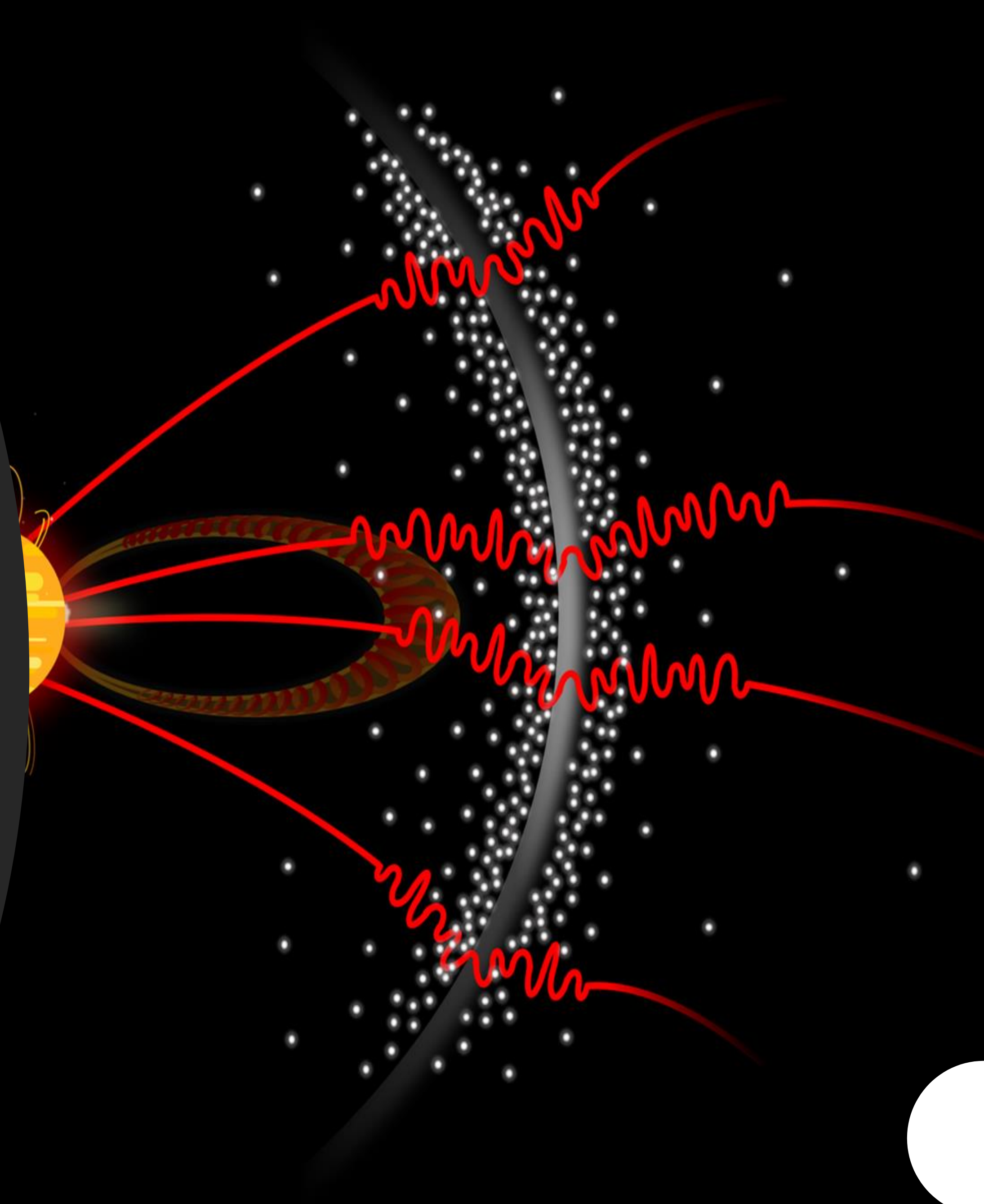
KU LEUVEN

Royal Observatory *of* Belgium

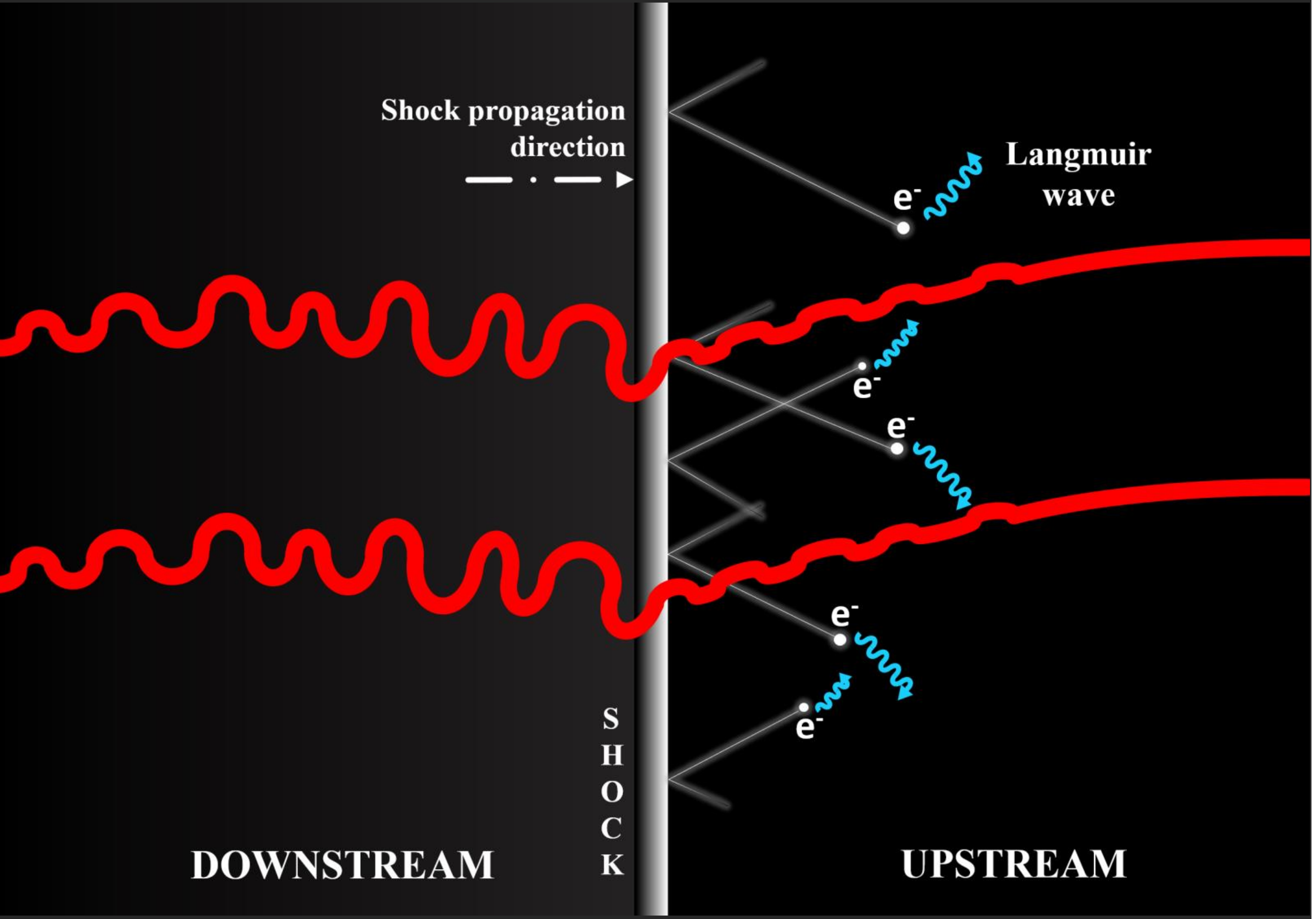
Source regions of type II radio emission on the surface of an interplanetary shock wave

I. C. Jebaraj, A. Kouloumvakos, J. Magdalenic, A. Rouillard, G. Mann, V. Krupar, S. Poedts

ESPM-2021, 06/09/2021



Shock-associated radio emission



A combination of shock and the shock upstream conditions are necessary for generation of type II radio emission.

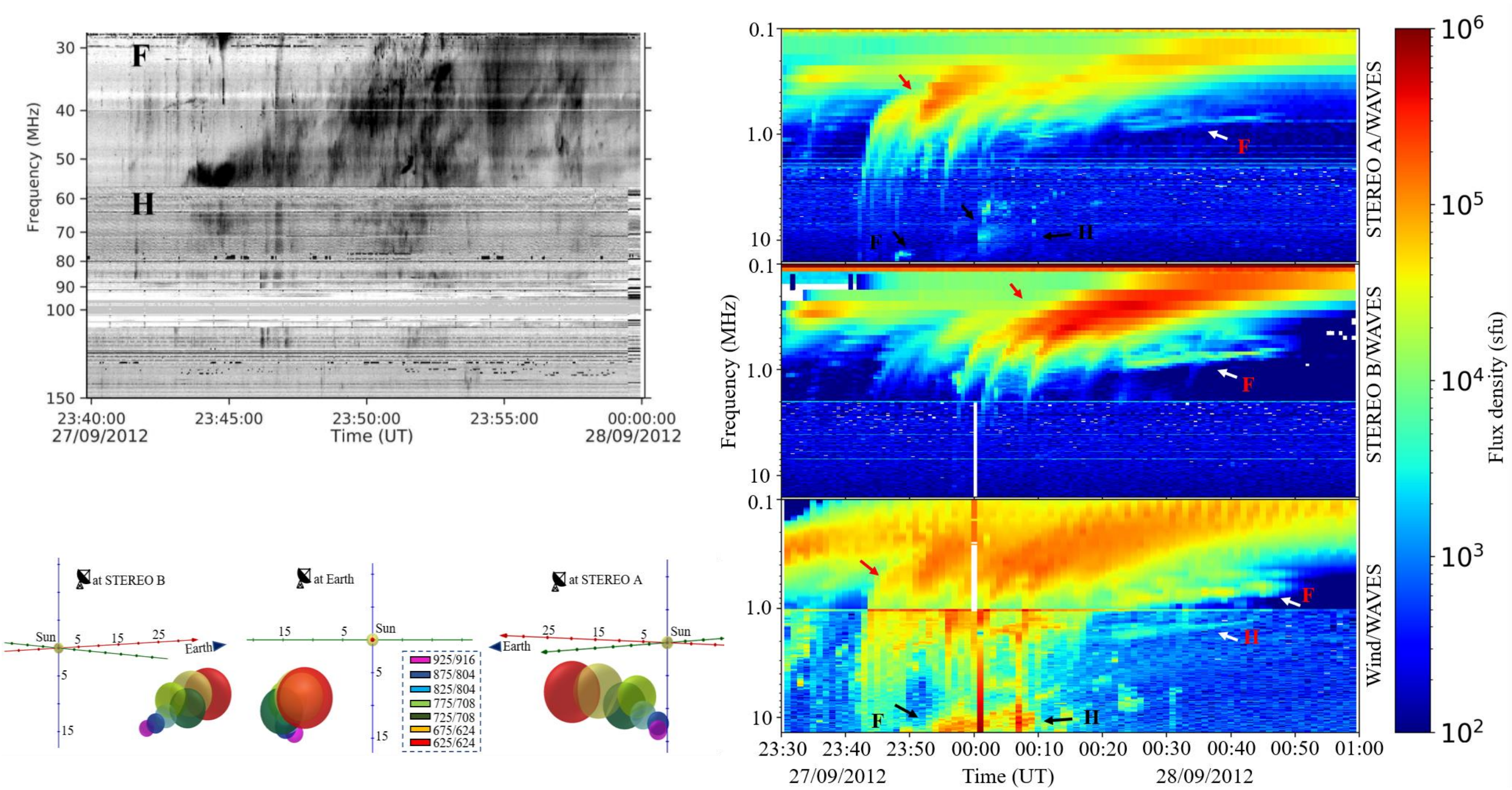
Intermittency in observed type II burst is due to localized source regions with rapidly changing geometry.

Low frequency type II bursts are largely dependent on shock wave interactions with streamer or heliospheric current sheet (HCS).

Radio triangulation can not only locate the 3D position of the radio sources but also help in understanding shock morphology.

Shock modelling shows high frequency type II can possibly have contributions from more than one region on the shock wave.

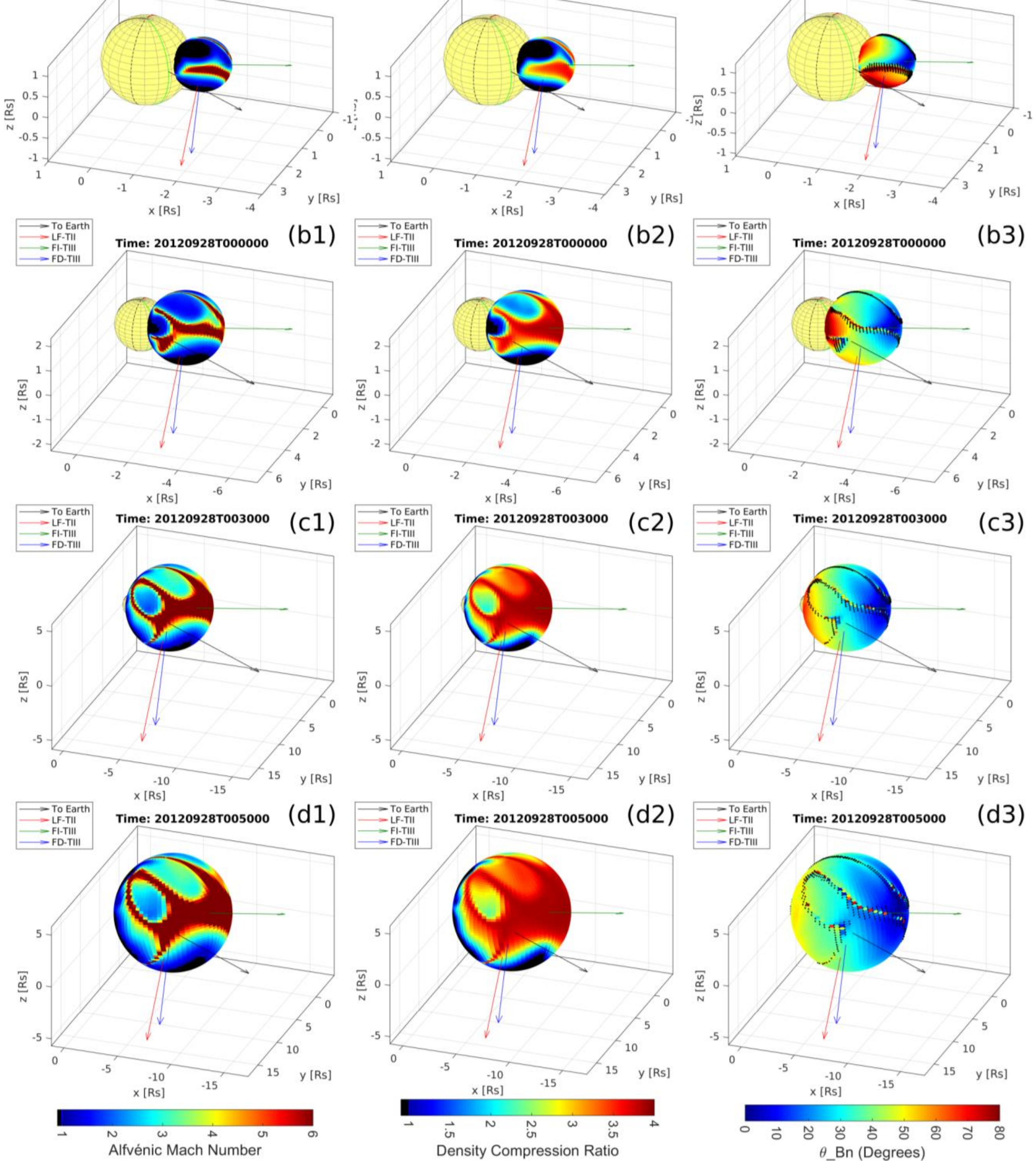
Radio emission associated with shock streamer interaction



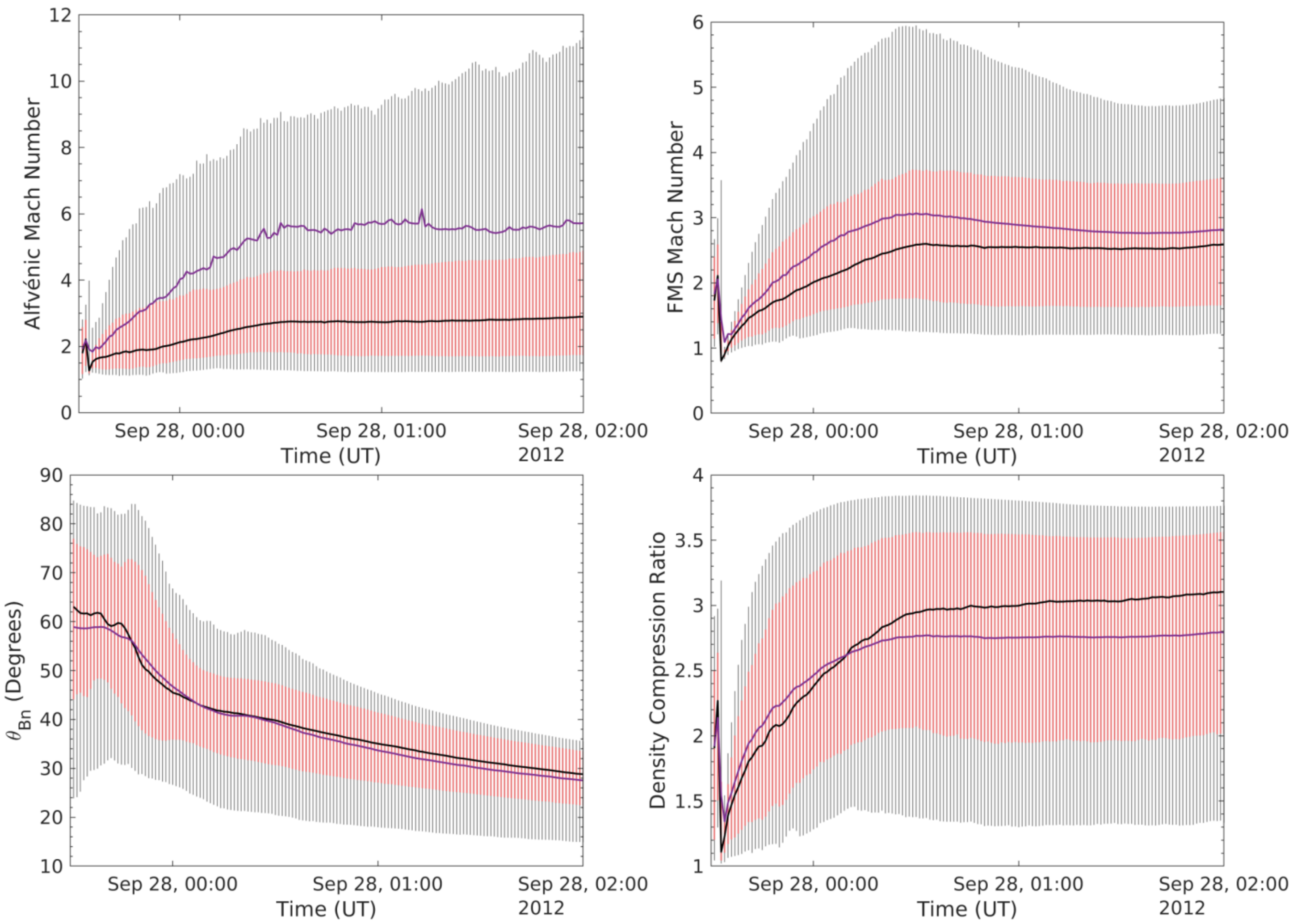
- Radio event observed on September 27, 2012.
- Two type II radio bursts (High & Low frequency)
- LF-type II is not continuation of HF-type II burst
- More details in **Jebaraj et al., 2020**

Shock modelling

- Large amplitude wave front was reconstructed using multi-viewpoint EUV and white light observations.
- Propagated in a 3D MHD medium (MAS-thermodynamic model)
- Shock modelled between 23:40 UT (September 27) and 02:00 UT (September 28).
- Evolution analyzed in two steps:
  1. Analysis of the global wave structure
  2. Focused Analysis of the specific regions on the wave front.
- More details on shock modelling in **Kouloumvakos et al, 2021.**

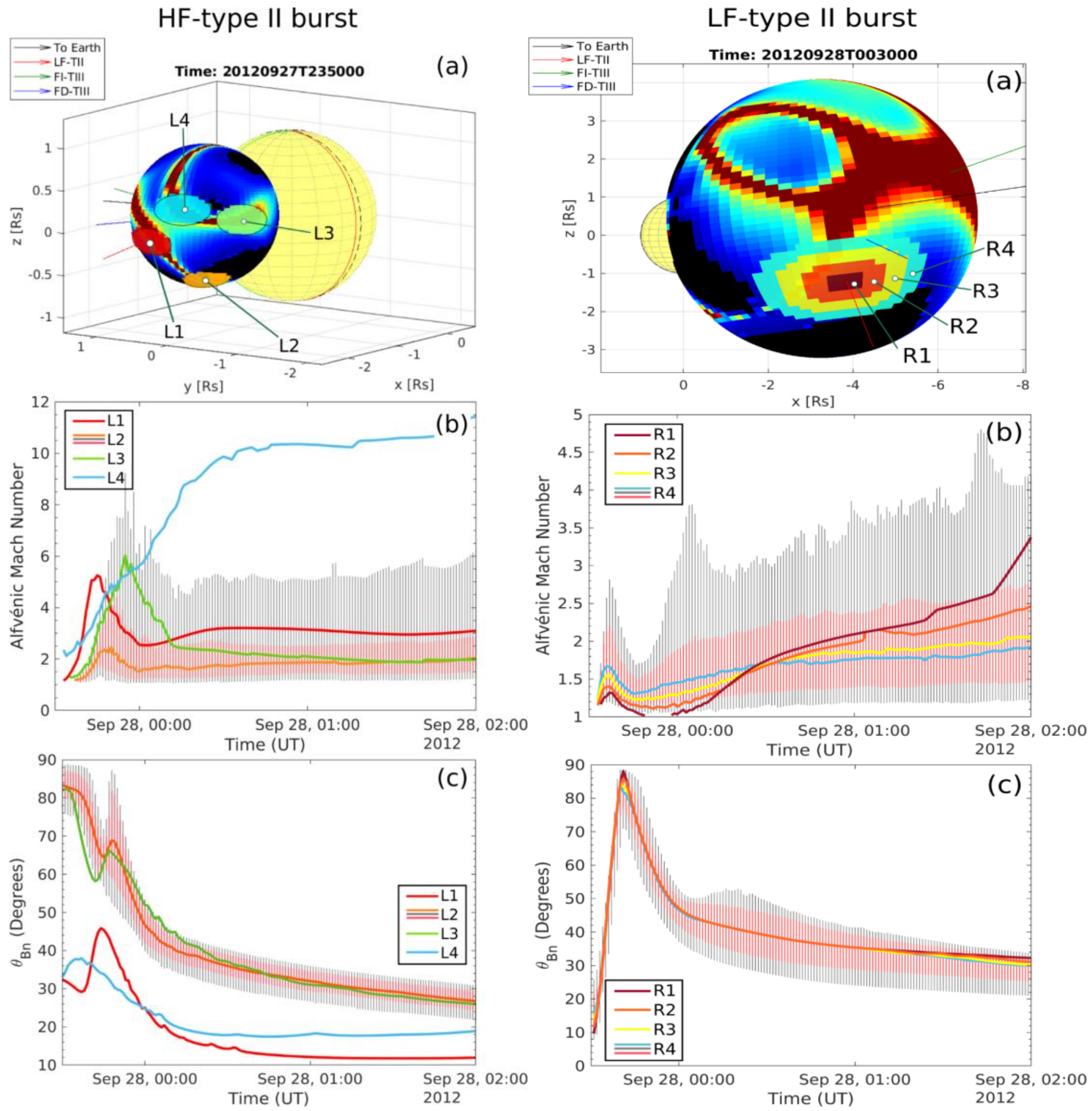


Global shock characteristics



- Shock formed shortly after the onset of the eruption.
- Shock wave is quasi perpendicular at the start and becomes quasi-parallel as it propagates further outward.
- Shock strength is M_A ~ 2 most of the time in interplanetary space.
- Shock is on average compressive (X~2.5)

Shock characteristics in type II regions

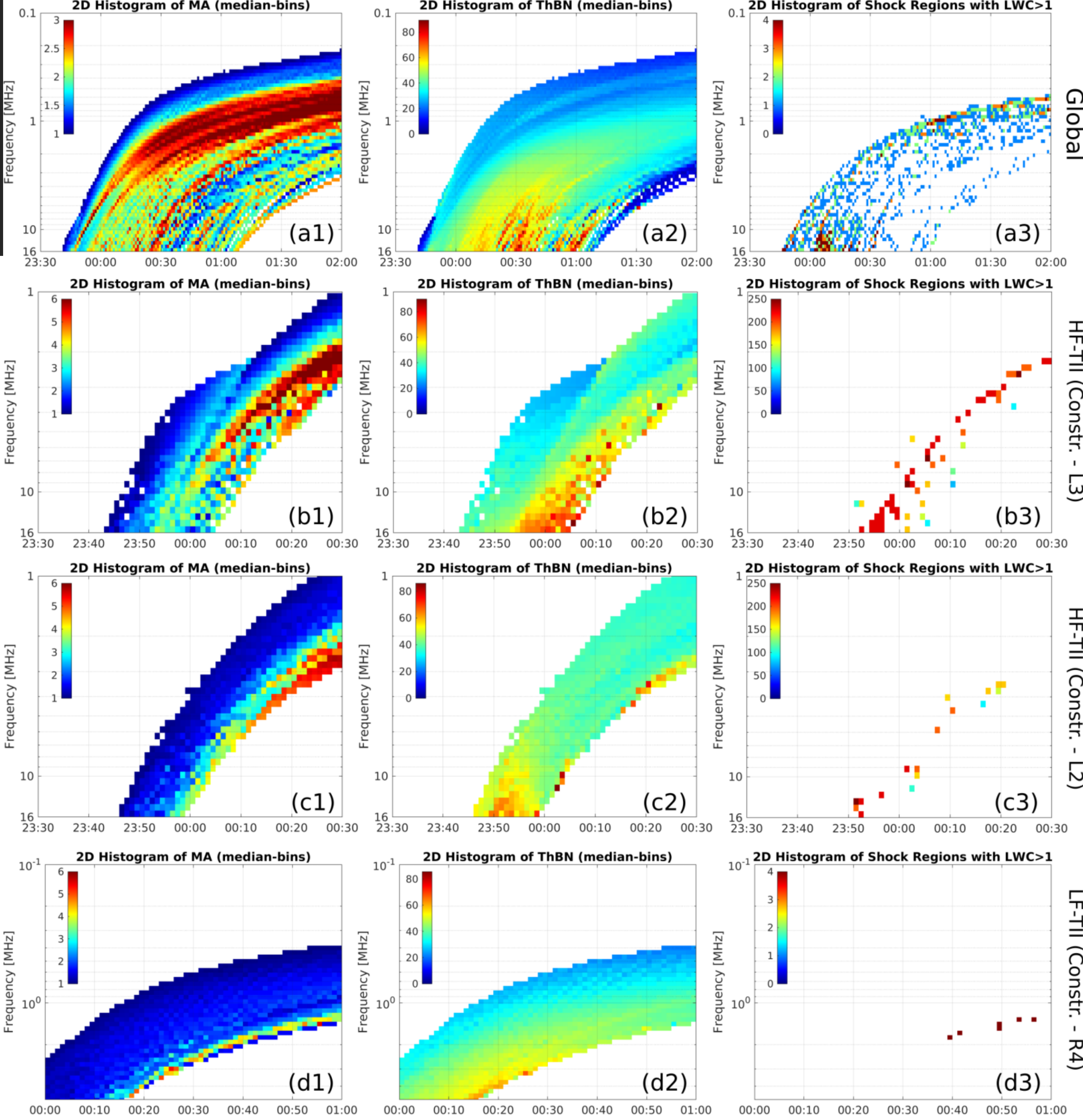


- Onset of HF-type II ~ 23:43 UT
- Modeling results show that Shock formed before type II onset.
- Shock modelling shows both L2 and L3 can be potential source regions of HF-type II.
- Very strong shock and highly quasi-perpendicular geometry in L2 and L3.
- HF-type II burst stops when the geometry is mostly oblique in regions L2 and L3 while strength plateaus at M_A~2.

- Onset of LF-type II ~ 00:20 UT.
- LF-type II formed in regions close to HCS.
- LF-type II is produced when shock wave interacts with HCS/Streamer, which results in enhancement of radio emission.

Synthetic spectra

- Spectrum-like representation of shock parameters and the Langmuir wave conversion (LWC; Mann et al., 2018).
- LWC gives measure of Langmuir wave production.
- Spectra of the global wave characteristics show that while a shock may have formed, type II emission is produced only under specific conditions.
- Spectra of L2 and L3 regions show that HF-type II may have contribution from both regions.
- LF-type II is produced only in regions where shock wave interacts with streamer/HCS.



Using radio triangulation to understand the origin of two subsequent type II radio bursts

DOI: 10.1051/0004-6361/201937273

Coronal Conditions for the Occurrence of Type II Radio Bursts

DOI: 10.3847/1538-4357/abf435

Generation of interplanetary type II radio emission

I.C. Jebaraj, A. Kouloumvakos, J. Magdalenic, A. Rouillard, G. Mann, V. Krupar, S. Poedts

DOI: 10.1051/0004-6361/202141695