Report from the event supported by RadioNet

TITLE	*LOFAR SOLAR AND SPACE WEATHER KSP BUSY WEEK*
DATE:	*21 – 25 OCTOBER 2019*
LOCATION:	*DWINGELOO, THE NETHERLANDS*
MEETING WEBPAGE:	*https://www.astron.nl/~zucca/KSP-BusyWeek/index.html*
HOST INSTITUTE:	*ASTRON – NETHERLANDS INSTITUTE FOR RADIO ASTRONOMY*
RADIONET BENEFICIARY / NO:	*ASTRON / 02*

RadioNet has received funding from the EU's Horizon 2020 research and innovation programme under the grant agreement No 730562

Report:

1 SCIENTIFIC SUMMARY

The Solar and Space Weather LOFAR KSP busy week was held in ASTRON, Dwingeloo from the 21st to the 25th of October successfully. The event website can be found at the following web address: https://www.astron.nl/~zucca/KSP-BusyWeek/index.html.

1.1 SCIENTIFIC SUMMARY

This meeting focussed both on the training and on the data processing of Solar and Heliospheric data recorded with LOFAR. In particular, the busy week addressed the recent campaign of observations in conjunction with the NASA mission Parker Solar Probe (PSP).

Some examples of the work carried out and/or continued during the week:

(1) The frequency drift and fine structures of Solar S-bursts in the high frequency band of LOFAR - PeiJin Zhang, Pietro Zucca and the KSP - In review A&A: This work avails of the high resolution dynamic spectrum of the Sun in HBA to perform detailed analysis of the fine spectral features called S-Bursts. These radio bursts have been recently studied with LOFAR in LBA, with this work an extension of the analysis is performed for the HBA band. A total of 204 bursts were analysed in the frequency range 120-180 MHz. In Figure 1 (left) an overview of the S-burts can be seen, some of the burts show multiple lanes, while Figure 1 (right) shows the extended statistical study including LBA and HBA results.

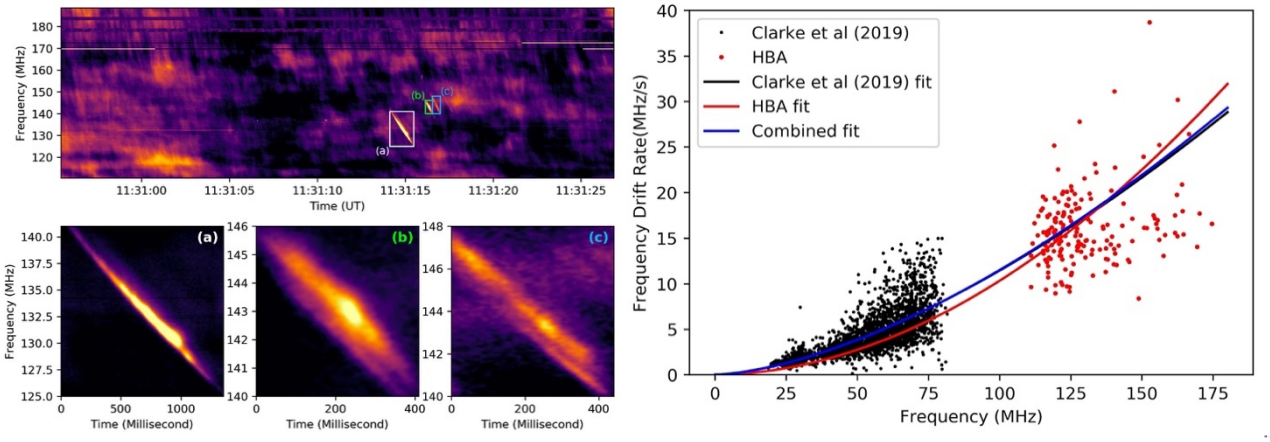

Figure 1 (left) An example of the dynamic spectrum of HBA during the type-III storm. Three S-burst is labeled as (a,b,c) in the upper panel, the zoom-in view of these there S-burst is shown in the lower panel. Figure 1 (right) The frequency drift rate of S-bursts. The black points contains the previous result of low frequency band of 20MHz to 70MHz including observation from McConnell (1982); Dorovskyy et al. (2017); Morosan & Gallagher (2017); Clarke et al. (2019). The red points mark the 204 events in the frequency range of 120 - 180MHz on 2019 April 13. The red line shows the fitting result to the events in HBA (df=dt = -0:0015f1:92), the black line shows the fitting result in low frequency (df=dt = -0:0084f^1.57), the blue lines shows the combined fitting result of the S-bursts in HBA and low frequency (df=dt = -0:0077f^1.59).

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(2) Source Size and Position of a Type IIIb-III Pair using the remote baselines of LOFAR : A case study - PeiJin Zhang, Pietro Zucca and the KSP - In preparation: This paper uses the interferometric mode including the remote baselines to study the fine structures of the Type IIIb pair. In particular, the position of the fundamental and harmonic emission have been considered in order to investigate the effects of coronal scattering and diffraction in the apparent source position. An overview of this work is shown in Figure 2. There are significant differences between the source properties of the fundamental and harmonic waves. For the frequency channel of 26.6 MHz, the source size of the fundamental part increases fast, the increasing rate is 382 Arcmin^2 per second starting from about 40 Arcmin^2. While, the source size increase rate of the harmonic part is nearly zero for 26.6 MHz, and 8.7 Arcmin^2 per second for 41.2 MHz. The speed of the apparent source is also widely divergent between the fundamental and harmonic part.

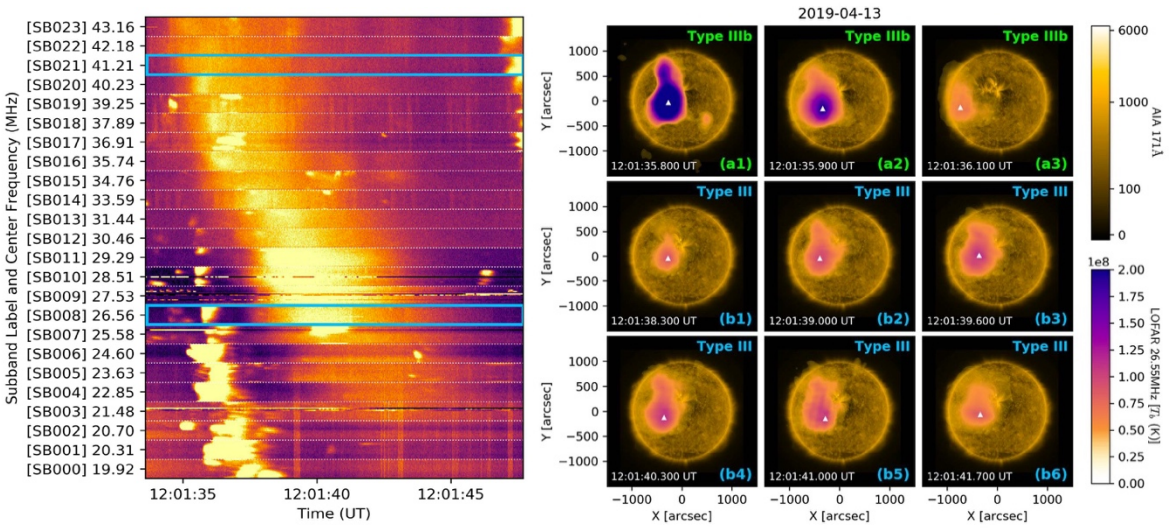

Figure 2 (left) The Subband Tiled Image of The Type IIIb-III pair event, this figure consists of 24 Sub-band, the band width of each Subband is about 0.183MHz. The frequency of this "dynamic spectrum" is not continuous. The band range center frequency of these subbands is elaborated in Table 2. The blue box highlighted the Subband SB008 and SB021, which is used in the interferometry imaging. Figure 2 (right) The interferometry observation of the peak part type IIIb-III pair. Panel (a1 3) is the interferometric image of the fundamental (type IIIb) part. and Panel (b1 - 6) shows the second harmonic (type III) part in subband SB008 (26.56MHz). The radio flux intensity is overlapped on the EUV image observed by SDO/AIA at 12:01:33 UT. The unit of radio flux intensity in this is converted to brightness temperature (Kelvin). The time of these snapshots is marked in the top sub-panel of Figure 2 (right). The peak position of the radio flux intensity is marked as white triangle in each snapshot.

(3) Comparison of the tied-array beam and interferometric imaging of the Sun with the Low Frequency Array - Pietro Zucca, Diana Morosan and the KSP - In preparation: An important work carried out using the current proposal dataset is the full comparison of the tied-array observations with the interferometric mode using both the core baselines only, and the full remote baselines. An overview of this comparison is shown in Figure 3.

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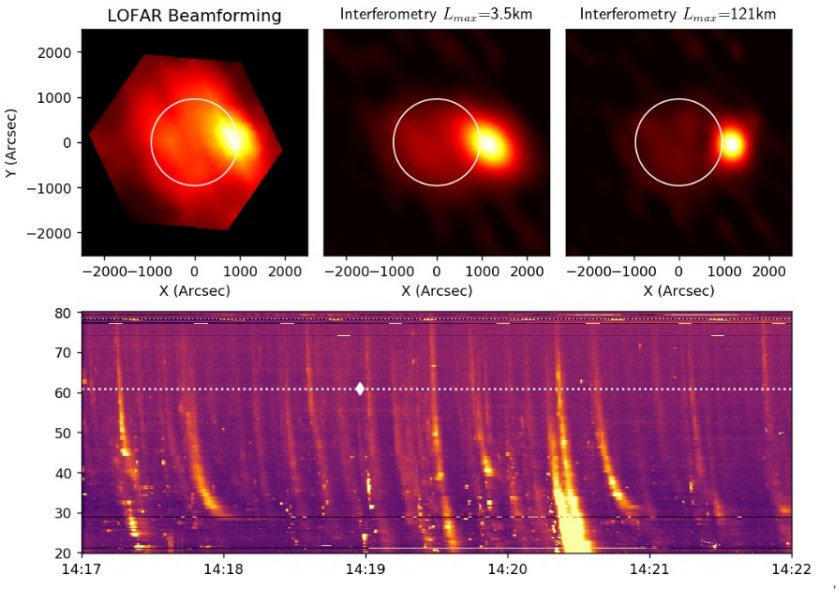

Figure 3. Overview of the LOFAR observing modes for the Sun.

1.2 RADIONET RELEVANCE

The work of this busy week enhanced the scientific results achieved using the RadioNet facility LOFAR, as well as LOFAR technical development which enables exciting new science opportunities for the Solar and Space weather field with LOFAR.

The event is cross-disciplinary as it brought together astronomers from Solar, Ionospheric, and Heliospheric expertise and triggered discussions between scientists working in different fields. It exploited the links of LOFAR with complementary data of major space missions such as PSP. Experts from NASA joined the busy week and participated directly in the data reduction.

1.3 IMPACT

The meeting had multiple impacts, (1) training of young researchers on LOFAR data analysis enlarging the community, (2) the set-up of a common working environment and collaborations for expert researchers of the different fields. (3) The meeting allowed the definition of the various scientific studies arising from the LOFAR/PSP observing campaign.

2 AGENDA OF THE EVENT

Monday, 21.10.2019
10:30 am – Badge collection and coffee **(main all)**
11:30 am – Welcome and program presentation **(Auditorium)**
12:30 pm – Lunch **(main all)**
14:00 pm – Start of tutorials **(Oort room)/(Minneart)**
14:20 pm – Solar intro
15:30 pm – Coffee Break **(main all)**
17:00 pm – End of day
Tuesday, 22.10.2019
9:00 am – Tutorials/data analysis **(Oort room)/(Minneart)**
10:30 am – Coffee Break **(main all)**
12:30 pm – Lunch **(main all)**

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15:30 pm – Coffee Break **(main all)**
17:00 pm – End of day
Wednesday, 23.10.2019
9:00 am – Tutorials/data analysis **(Oort room)/(Minneart)**
10:30 am – Coffee Break **(main all)**
11:00 am - IPS intro (Auditorium)
11:20 am – DM and FR of pulsars intro/demo
11:40 am – CME/Pulsars occultations intro/demo
12:00 pm – Ionospheric intro/demo
12:30 pm – Lunch **(main all)**
15:30 pm – Coffee Break **(main all)**
17:00 pm – End of day
Thursday, 24.10.2019
9:00 am – Tutorials/data analysis **(Oort room)/(Minneart)**
10:30 am – Coffee Break **(main all)**
12:30 pm – Lunch **(main all)**
14:00 pm – PSP Update from NASA and Discussion **(auditorium) Telecon with A. Vourlidas (NASA)**
15:30 pm – Coffee Break **(main all)**
17:00 pm – End of day
19:00 pm – Social Dinner **(t'hof van Dwingeloo)**
Friday, 25.10.2019
9:00 am – Tutorials/data analysis **(Oort room)/(Minneart)**
10:30 am – Coffee Break **(main all)**
12:30 pm – Lunch **(main all)**
14:00 pm – Students/researchers reports
15:30 pm – Coffee Break **(main all)**
16:00 pm – End of day

3 PARTICIPANTS

The busy week had a full international impact from researchers and students from Europe (Ireland, UK, Poland, Germany, France, The Netherlands, Finland, Italy, etc.) and US including experts in interplanetary scintillation (IPS) and scientific PI of the PSP at NASA.

31 participants: 12 female, 19 male.

3.1 RADIONET NEWSLETTER

7 participants subscribed to the RadioNet newsletter.

4 RADIONET FINANCIAL CONTRIBUTION

The RadioNet funding of 3000€¶ was used to fully support participation costs of 7 students.

5 PUBLICATIONS

The project leading to this publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730562 [RadioNet]

6 CONFIRMATION

Following the Regulation (EU) 2016/679 - General Data Protection Regulation:
We allow RadioNet to publish the report and the relative pictures of the event.