



Report from the event supported by RadioNet

TITLE *CESRA SUMMER SCHOOL 2018*

DATE: *SEPTEMBER 10 -14 2018*

LOCATION: *BRUSSELS, BELGIUM*

MEETING WEBPAGE: *<https://events.oma.be/indico/event/53/>*

HOST INSTITUTE: *ROYAL OBSERVATORY OF BELGIUM*

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BENEFICIARY / NO:** *UMAN / 6*

Report:

1. SCIENTIFIC SUMMARY

The event sponsored by RadioNet was a summer school organized in the name of CESRA (Community of European Solar Radio Astronomers), an organization chaired by Dr. Eduard Kontar (University of Glasgow). This was the 3rd CESRA Summer School since 2010 (the first one took place at Nançay Observatory, in 2010, the second one at University of Glasgow, in 2015). Since the second one, the aim is to organize a school one year prior to the plenary CESRA meeting (the next one will be in Potsdam in 2019).

The goal of the school (<https://events.oma.be/indico/event/53/>) was to introduce students holding at least a master degree to the different aspects of solar radio physics: emission mechanisms, observational evidences, modelling basis, instrumentation, particle acceleration, multi-wavelength studies, interplanetary physics and link to space weather.

While these courses were introductory to the field, they did deal with contemporary issues in solar physics that were reviewed by European experts. One key point of the school was to show how solar radio observations fit in a very dynamic solar observational context: in addition to ground based solar telescopes, space missions like SDO, RHESSI, the new Parker Solar Probe or the future Solar Orbiter provide or will provide a wealth of new data complementary to the information derived from radio observations. All lecturers during the school are first experienced solar physicists, theoreticians, instrumentalists, before being radio astronomers. The courses that they gave were relevant for a proper investigation of solar phenomena linked to eruptive events, and an effort was put on showing how radio data can be combined with other diagnostics (EUV, Xrays, or radio at different wavelengths) to understand the process of radio emission generation and particle acceleration in solar eruptive events. These topics are relevant for the exploitation of existing solar radio facilities like the Nançay Radio Heliograph (France) for example, or different solar radio spectrographs around the world. They are relevant as well for RadioNet supported facilities like LOFAR and ALMA, which are not solar dedicated but do observe the Sun at request.

If high frequency solar physics and ALMA observations were discussed in the introduction to solar radio physics, given at the start of the school, it is fair to say that low frequency solar radio physics was the core theme of the school. The rise, in recent years of LOFAR as a unique low frequency facility for the observation of the Sun and soon, possibly as a space weather monitoring system, was made clear by the topics covered by several lecturers (introduction, modelling of radio emission, observation of accelerated particles) and simply by the number of attendants working with LOFAR (students from Trinity College Dublin, which operates a LOFAR station, lecturers working with LOFAR: E. Kontar, J. Magdalenic, C. Marqué...). It is actually striking to notice the revival of low frequency radio astronomy in solar physics, even outside the LOFAR community (there was for example a talk given by a student on MWA solar observations, and a brief introduction to SPADE, a low frequency phased array developed in Belgium).

Technical tutorials were set up to help students deal with the data: a tutorial about solar imaging with CASA, which was generic enough to be applicable to the processing of LOFAR data, and a tutorial on the analysis of hard x-ray data, a key complementary means for understanding particle acceleration in solar flares.

Other tutorials were real-time exercises and discussions about typical questions that arise from solar radio observations: how to recognise typical spectral signatures in obvious and non-obvious cases; which simple theoretical considerations can be derived from dynamic spectra; what information a quick analysis of multiple radio light curves can provide on the release of energetic particles, etc.

These exercises, combined to the plenary lectures given during the school should help the students to work with LOFAR and ALMA and possibly to set up observing proposal for these RadioNet-supported facilities.

2. AGENDA OF THE EVENT

The summer school was held from 10-14 September 2018. It started on Monday and finished on Friday at lunch time. Time was allocated for students to present to other participants their current work.

The agenda was as followed:

Monday

9:30 – 11:00: *Introduction to the Radio Sun (I)*, **Alexander Nindos**, University of Ioannina, Greece

11:30 – 13:00: *Introduction to the Radio Sun (II)*, **Alexander Nindos**, University of Ioannina, Greece

Student presentations

- 14:00-14:15 **Atul Mohan** "*Evidence for Super-Alfvénic oscillation in type-III burst sources*"
14:15-14:30 **Brendan Clarke** "*The Properties and Magnetic Origins of Solar S bursts*"
14:30-14:45 **Nasrin Talebpour Sheshvan** "*Study of the directivity of Compact Interplanetary Type IV Radio Bursts*"
14:45-15:00 **Nicolina Chrysaphi** "*CME-driven shock and Type II solar radio burst band-splitting*"
15:00-15:15 **Alexandros Koukras** "*Analyzing the kinematics of EUV waves by combining simulations and multi-instrument observations*"
15:15-15:30 **Ciara Maguire** "*Insights into Coronal Mass Ejection Shock Kinematics with the Irish Low Frequency Array (I-LOFAR)*"
16:00-16:15 **Fernando Hidalgo** "*Center-to-limb variation of solar bursts polarization at millimeter wavelengths*"
16:15-16:30 **Savvas Raptis** "*Forecasting Coronal Mass Ejections using Artificial Intelligence*"
16:30-16:45 **Alexander Shain** "*Identification of quasi-transverse propagation effect for solar flare microwave emission*"
16:45-17:00 **Artūrs Vrubļevskis** "*Investigating isolated sunspots as sources of slow solar wind*"

Tuesday

9:30 – 11:00: *Theory and modelling of radio emission*, **Eduard Kontar**, University of Glasgow, United Kingdom

11:30 – 13:00: *Theory and modelling of radio emission (Tutorial)*, **Eduard Kontar**, University of Glasgow, United Kingdom

14:00 – 15:30: *Radio instrumentation and observing techniques*, **Christophe Marqué**, Royal Observatory of Belgium, Belgium

Student presentation:

16:00 – 16:15 **Antonio Martinez** "*Using SPADE for radio meteor observations*"

16:15 – 17:30: *Tutorial on CASA*, **Christophe Marqué**, Royal Observatory of Belgium, Belgium

Wednesday

9:30 – 11:00: *Radio Evidence on particle acceleration in the solar atmosphere*, **Karl-Ludwig Klein**, Paris Observatory, France

11:30 – 13:00: *X-ray and EUV signatures of accelerated electrons*, **Marina Battaglia**, University of Applied Sciences Northwestern, Switzerland

14:00 – 15:30: *Radio Evidence on particle acceleration in the solar atmosphere (Tutorial)*, **Karl-Ludwig Klein**, Paris Observatory, France

16:00 – 17:30: *X-ray and EUV signatures of accelerated electrons*, **Marina Battaglia**, University of Applied Sciences Northwestern, Switzerland

Thursday

9:30 – 11:00: *Interplanetary Radio Emissions*, **Milan Maksimovic**, Paris Observatory, France

11:30 – 13:00: *Interplanetary Radio Emissions*, **Milan Maksimovic**, Paris Observatory, France

14:00 – 15:30: *Interplanetary Scintillations*, **Mario Bisi**, UKRI-STFC RAL Space, United Kingdom

16:00 – 17:00: *Interplanetary Scintillations*, **Mario Bisi**, UKRI-STFC RAL Space, United Kingdom

Student presentations

17:00-17:15 **Pearse Murphy** "*Finding Fast Solar Radio Transients in I-LOFAR Transient Buffer Board Data*"

17:15-17:30 **Aoife Maria Ryan** "*Interferometric Imaging of the 2015 Solar Eclipse using LOFAR*"

17:30-17:45 **Jorge Valle Silva** "*Recent observations with the Solar Sub-millimeter Telescope*"

17:45-18:00 **Immanuel Christopher Jebaraj** "*CME and associated shock wave on September 27, 2012*"

Friday

9:30 – 11:00: *Radio observations and space weather*, **Jasmina Magdalenić**, Royal Observatory of Belgium, Belgium

11:30 – 13:00: *Radio observations and space weather (Tutorial)*, **Jasmina Magdalenić**, Royal Observatory of Belgium, Belgium

3. PARTICIPANTS

There were 16 participants registered as students, plus 8 participants as lecturers. Extra persons from the Royal Observatory of Belgium occasionally attended some of the lectures.

Most of the students were coming from institutes within the EU, with one student from India (a second one who was originally registered could not get her visa), two from Brazil and one from Russia. A large majority of them were PhD students (at any stage), with only two being post docs, one a master student and one engineer. There was unfortunately no gender balance with only 4 women out of 16 participants.

Among the 8 lecturers, 4 were supported by RadioNet: 2 from France, and 2 from the UK. The four other lecturers were from Belgium, Switzerland and Greece. Two lecturers were women.

The school group picture and the list of RadioNet-supported attendants (students and lecturers) is shown below.



Figure 1 Group picture of the CESRA Summer school 2018

4. RADIONET FINANCIAL CONTRIBUTION

Financial support from RadioNet of 5250 EUR was exclusively devoted to help participants attending the school. All (non-local) students received up to 350 EUR to help them cover their expenses (travel and lodging). Four lecturers were granted up to 175 EUR for the same purpose.

For the rest, the meeting was funded from local sources (Royal Observatory of Belgium and Solar Terrestrial Center of Excellence): all meals and refreshments were provided for free and 2 participants got a guest room at the Observatory (one lecturer not supported by RadioNet and one student).

5. PUBLICATIONS

N/A