Rosseland Centre for Solar Physics

Waves in the Lower Solar Atmosphere

WaLSA Team Meeting Attendees:

Core Members

- Bernhard Fleck (USA)
- Shahin Jafarzadeh* (Norway)
- David Jess* (UK)
- Peter Keys* (UK)
- Elena Khomenko (Spain)
- Hannah Schunker (Germany)
- Marco Stangalini* (Italy)
- Oskar Steiner (Switzerland)
- Gary Verth (UK)

Associate/Affiliate Members

- Tony Arber (UK)
- Samuel Grant (UK)
- Ben Snow (UK)
- Samuel Skirvin (UK)

(*) team coordinator

and RoCS participants

12–16 August 2019; Oslo, Norway

www.WaLSA.team

Scientific Rationale

Heating of the solar atmosphere (i.e., the chromosphere, transition region, and corona) has been a much-debated topic in solar physics for several decades. Magneto-hydrodynamic (MHD) waves are often presented as a principal mechanism allowing the transfer of energy and momentum between the solar interior and these elevated layers.

Current generation solar telescopes, including the Swedish 1-m Solar Telescope (SST) and the Dunn Solar Telescope (DST), are producing a plethora of high-quality imaging and spectro-polarimetric datasets. Importantly, the multi-wavelength optical and infrared observations produced contain a wealth of information related to MHD wave processes created within the Sun's dynamic lower atmosphere. These oscillations, in the form of slow/fast magneto-acoustic and Alfvén waves, have the potential to transfer vast quantities of energy flux into the solar chromosphere and corona, where the immense radiative losses need to be balanced. Furthermore, the differing energy and plasma transmission rates as one moves through the various layers of the solar atmosphere naturally provides implications when relating the Sun's energetics to those encountered in the heliosphere.

Recent investigations have focussed on the detection and identification of mixed-property wave modes existing across different magnetic solar features (e.g., sunspots, pores, magnetic bright points, spicules, filaments, etc.). In order to make the quantification of wave properties as accurate as possible, theoretical aspects of spectro-polarimetry, partial ionisation and radiative transfer processes need to be incorporated, especially since the lower solar atmosphere is governed by optically thick plasma conditions. Many recent ground-breaking publications have begun to include Stokes inversion processes in order to better understand the spectropolarimetric signatures resulting from the passage of energetic wave fronts through the highly stratified solar atmosphere. However, these types of processes are not without significant challenges. Often, the captured spectro-polarimetric Stokes profiles are significantly asymmetric and evolve on timescales shorter than typical camera integration times.

It is therefore imperative to bring together leading experts in observations, instrument design, wave theory, numerical simulations, spectro-polarimetric inversions and radiative transfer processes in order to drive forward cutting-edge research that will benefit the global astrophysical community for decades to come. Importantly, this meeting, the second in the series, will bring together 12 international experts from 7 leading countries to concentrate research efforts in order to yield reliable estimates of the energy transported by MHD waves into the upper solar atmosphere, and provide new insight into the dissipation mechanisms of these waves and, hence, their contribution to heating the outer layers of the solar atmosphere.

It is worth highlighting that the timeliness for such a meeting is of vital importance, due to the upcoming Daniel K. Inouye Solar Telescope (DKIST) and European Solar Telescope (EST) facilities, which will revolutionise our vantage points of oscillatory phenomena in the Sun's atmosphere. It is expected that the in-depth discussions and subsequent focussed research efforts will have significant implications for upcoming DKIST, EST, and ALMA observations.

WaLSA Meeting Schedule

MONDAY, 12 August 2019: MHD waves – numerical simulations and theoretical aspects	
09:15–09:30	Welcome message (Mats Carlsson) and introduction (Shahin Jafarzadeh)
09:30–10:30	Challenges in MHD wave modelling and simulation: LAREx2D code (Tony Arber)
10:30–11:00	Coffee/tea break
11:00–12:00	Challenges in MHD wave modelling and simulation: MANCHA code (Elena Khomenko)
12:00–13:00	Challenges in MHD wave modelling and simulation: CO5BOLD code (Oskar Steiner)
13:00–14:00	Lunch break
14:00–15:00	Challenges in the modelling of MHD shocks (Ben Snow)
15:00–16:00	Challenges in the observation of MHD shocks (Samuel Grant)
16:00–close	Coffee/tea break and group discussion
TUESDAY, 13 August 2019: MHD waves in sunspots	
09:30–10:00	Open problems and identification of research projects (David Jess)
10:00–10:30	Available sunspot data sets and simulations
10:30–11:00	Coffee/tea break
11:00–12:30	Data analysis and group discussion
12:30–13:30	Lunch break
13:30–15:00	Data analysis and group discussion
15:00–15:30	Coffee/tea break
15:30–close	Project timeline discussion

WEDNESDAY, 14 August 2019: MHD waves in small magnetic elements	
09:15–09:45	Challenges in MHD wave simulation: Bifrost code (Mats Carlsson)
09:45–10:15	Open problems and identification of reserach projects (Peter Keys)
10:15–10:45	Small scale magnetic elements: available data sets and simulations
10:45–11:00	Coffee/tea break
11:00–12:30	Data analysis and group discussion
12:30–13:30	Lunch break
13:30–15:00	Data analysis and group discussion
15:00–15:30	Coffee/tea break
15:30–close	Project timeline discussion
19:00–	Meeting Dinner (location TBD)
THURSDAY, 15 August 2019: MHD waves with ALMA	
09:30–10:00	Open problems and identification of research projects (Shahin Jafarzadeh)
10:00–10:30	ALMA data and simulations
10:30–11:00	Coffee/tea break
11:00–12:30	Data analysis and group discussion
12:30–13:30	Lunch break
13:30–15:00	Data analysis and group discussion
15:00–15:30	Coffee/tea break
15:30–close	Project timeline discussion
FRIDAY, 16 August 2019: Future steps	
09:30–11:00	Github and Overleaf platforms: tutorial and project development
10:30–11:00	Coffee/tea break
11:00–12:30	Group discussion
12:30–13:30	Lunch break
13:30–16:00	Group discussion and conclusions

The team has received support for the meeting from the Research Council of Norway through its Centres of Excellence scheme, project number 262622 (the Rosseland Centre for Solar Physics).