Rosseland Centre for Solar Physics

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Waves in the Lower Solar Atmosphere

Rosseland International Team

Team Members

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- Tony Arber (UK)
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- Vasco Henriques (Norway)
- Sven Wedemeyer (Norway)

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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 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.

Meeting Schedule

MONDAY, 07 January 2019: Excitation and dissipation mechanisms	
09:15–09:30	Welcome message and introduction
09:30–10:00	Challenges in the theory of wave excitation and dissipation mechanisms (Gary Verth)
10:00–10:30	Challenges in the observation of wave excitation and dissipation (Nazaret Bello González)
10:30–11:00	Coffee/tea break
11:00–12:30	Group discussion
12:30–13:30	Lunch break
13:30–14:50	Group discussion
14:50–15:10	Coffee/tea break
15:10–16:30	Group discussion
TUESDAY, 08 January 2019: Spectropolarimetric characterisation	
09:30–10:00	Challenges in the spectropolarimetric characterisation of MHD wave modes (Marco Stangalini)
10:00–10:30	Challenges in the inversion of spectropolarimetric observations linked to MHD wave modes (Andrés Asensio Ramos)
10:30–11:00	Group discussion
11:00–11:20	Coffee/tea break
11:20–11:50	Challenges in the inversion of spectropolarimetric observations linked to MHD wave modes (Vasco Henriques)
11:50–12:30	Group discussion
12:30–13:30	Lunch break
13:30–14:50	Group discussion
14:50–15:10	Coffee/tea break
15:10–16:30	Group discussion

WEDNESDAY, 09 January 2019: Non-linear and non-stationary analysis techniques and ALMA	
09:30–10:00	Challenges in the use of non-linear and non-stationary analysis techniques (David Jess)
10:00–11:00	Group discussion
11:00–11:20	Coffee/tea break
11:20–12:30	Group discussion
12:30–13:30	Lunch break
13:30–14:00	The capabilities of ALMA for studies of MHD wave phenomena in the solar atmosphere (Sven Wedemeyer)
14:00–14:50	Group discussion
14:50–15:10	Coffee/tea break
15:10–16:30	Group discussion
19:00–	Meeting Dinner
THURSDAY, 10 January 2019: Wave propagation in realistic complex structures	
09:30–10:00	Challenges in the simulations of wave propagation in realistic solar atmospheres (Bernhard Fleck)
10:00–10:30	Challenges in the observations of waves along complex solar structures (Richard Morton)
10:30–11:00	Group discussion
11:00–11:20	Coffee/tea break
11:20–12:30	Group discussion
12:30–13:30	Lunch break
13:30–14:50	Group discussion
14:50–15:10	Coffee/tea break
15:10–16:30	Group discussion
FRIDAY, 11 January 2019: Next generation instrumentations for focused wave observing/modelling	
09:30–10:00	Challenges related to the design of new instrumentation for wave observations (Shahin Jafarzadeh)
10:00–10:30	Solutions to challenges with upcoming DKIST & EST observations (Peter Keys)
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

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