Abstracts

Luca Fossati
Stellar activity in stars: evolution and observational characteristics

Late-type stars are characterised by a wealth of phenomena, all together called stellar activity, that are directly linked to the age, rotation rate, and magnetic field of a star. The generation and evolution of stellar activity involves the whole star, though the most evident signatures of stellar activity manifest themselves on the surface. Stellar activity is one of the few phenomena that can be observationally studied at almost any wavelength, from X-ray to radio wavelengths. Activity strongly affects the evolution of the atmosphere of a planet orbiting around the host star: it shapes for example planet atmospheric escape, which is the most prominent phenomenon contributing to the evolution of the extra-solar planets discovered so far. Despite its importance in stellar and planetary evolution, the origin of stellar activity is still unclear, and signatures of activity have been recently detected for stars believed not to hold the "right" physical characteristics. I will review the wealth of phenomena contributing to stellar activity mostly from an observer's point of view, concentrating on their links to large-scale stellar parameters and the latest advances on this topic.

Markus Roth
First Results of HELLRIDE

The HELioseismic Large Regions Interferometric Device (HELLRIDE) installed at the Vacuum Tower Telescope (VTT) in Izana, Tenerife has entered scientific mode in 2015. The instrument is a tunable filter that allows scanning sequentially through up to 32 spectral lines within short times delivering two-dimensional filtergrams of the Sun.
In this talk I will summarize the capabilities of the instrument and present first results obtained during the 2015 observing campaigns.

Jan Jurčák, N. Bello Gonzalez, R. Schlichenmaier, R. Rezaei
Formation of a penumbra at expense of a pore

We recently presented evidence that stable umbra-penumbra boundaries are characterised by a distinct canonical value of the vertical component of the magnetic field B_{ver}^{stable}.
In order to trigger the formation of a penumbra, large inclinations of magnetic field are necessary. The penumbra develops and establishes by colonising both umbral areas and granulation, i.e.,penumbral magneto-convection takes over in umbral regions with $B_{ver} < B_{ver}^{stable}$ as well as in granular convective areas. Eventually, a stable umbra-penumbra boundary settles at B_{ver}^{stable}. We present a Hinode dataset showing the development of a penumbra initiated at the boundary of a pore located close to the polarity inversion line. In time, the pore area decreases due to the intrusion of penumbra into the pore. Consequently, the pore disappears completely and we observe an orphan penumbra for some time. At all times, the vertical component of the magnetic field in the pore is smaller than B_{ver}^{stable} of 1.8~kG. Our findings confirm the importance of B_{ver}^{stable} for establishing a stable

umbrapenumbra boundary. If the maximum B_{ver} in the pore is smaller than B_{ver}^{stable}, the protrusion of penumbral grains into the pore area is not blocked, a stable pore-penumbra boundary does not establish, and the whole pore is colonised by the penumbra.

Michiel Van Noort
Image restoration of ground-based spectrograph data

When recording spectra from the ground, atmospheric turbulence causes degradation of the spatial resolution. I will describe a data reduction method that restores the spectra to their "undegraded" state by assuming that the PSF, estimated from a strictly synchronized slit-jaw camera, is the identical to that of the spectra. We can now quantify the linear combination of undegraded spectra that is present in each degraded data point for a large number of consecutively recorded spectra and cast it in the form of a linear problem. The linear problem was found to be generally well-conditioned and sufficiently diagonal to be solved using an iterative linear solver. The resulting solution has a spatial resolution comparable to that of image data restored using comparable methods.

Markus Roth
Helioseismology near magnetic active regions

Magnetic fields can strongly alter the amplitudes and phases of seismic waves. This makes helioseismic inferences difficult in the surroundings of active regions. Here I discuss the possibilities of probing seismically the structure of active regions. One of these possibilities is studying the moat flow outside the penumbra of a sunspot.

J. Zender, R. Kariyappa, A. Hanslmeier, J.F. Hochedez, A. Otto, I. Kraus, M. Bergman, L. Chitta, S. Kumara, L. Dame

Segmentation of Photospheric Magnetic Elements Corresponding to Coronal Features to Understand the EUV and UV Irradiance Variability

The magnetic field plays a dominant role in the solar irradiance variability. Determining the contribution of various magnetic features to this variability is important in the context of heliospheric studies and Sun-Earth connection. Aims. We studied the solar irradiance variability and its association with the underlying magnetic field for a period of four years (January 2011–January 2015). We used observations from the Large Yield Radiometer (LYRA), the Sun Watcher with Active Pixel System detector and Image Processing (SWAP) on board PROBA2, the Atmospheric Imaging Assembly (AIA), and the Helioseismic and Magnetic Imager (HMI) on board the Solar Dynamics Observatory (SDO).

The Spatial Possibilistic Clustering Algorithm (SPoCA) is applied on the EUV observations obtained from the AIA to segregate coronal features by creating segmentation maps of the Active Regions (ARs), the Coronal Holes (CHs) and the Quiet Sun (QS). Further, these maps are applied on the full-disk SWAP intensity images and the full-disk HMI line-of-sight (LOS) magnetograms to isolate the SWAP coronal features and photospheric magnetic

counterparts, respectively. We then computed full-disk and feature- wise averages of EUV intensity and LOS magnetic flux density over ARs/CHs/QS. The variability in these quantities is compared with those of LYRA irradiance values.

Variations in the quantities resulting from the segmentation, namely the integrated intensity and the total magnetic flux density of ARs/CHs/QS regions are compared with the LYRA irradiance variations. We find that the EUV intensity over ARs/CHs/QS is well correlated with the underlying magnetic field. In addition, variations in the full-disk integrated intensity and magnetic flux density values are correlated with the LYRA irradiance variations.

Using the segmented coronal features observed in the EUV wavelengths as proxies to isolate the underlying magnetic structures is demonstrated in this study. Sophisticated feature identification and segmentation tools are important in providing more insights into the role of various magnetic features in both the short and long-term changes in the solar irradiance.

Isabella Kraus
Solar Segmentation and Analysis of EUV Bright Points

In my presentation I will talk about my upcoming master thesis about EUV bright points in the solar corona with AIA (Atmospheric Imaging Assembly) data from SDO (Solar Dynamics Observatory). Therefore I did some research of statistical properties of solar coronal bright points to compare them with the first results of our average bright point statistic (e.g.: number of bright points and their lifetime). Additionally, I will also show individual coronal bright points with their number of pixels, maximum and FFT (Fast Fourier Transformation). There are several possible origins for bright points, so I will also discuss these possible origins too. Further I will give an outlook for my future work: possible oscillation effects, possible difference in different wavelengths?

Roman Brajša
Observation of the solar chromosphere in the mm and sub-mm wavelength ranges

Various solar features can be seen in emission or absorption on maps of the Sun in the millimeter and submillimeter wavelength ranges. Several examples of such maps, where active regions, filaments and coronal holes can be seen, are presented and compared with images obtained in other wavelength ranges. A hypothesis that local enhancements of radiation are related to locations of small-scale magnetic field areas is considered. Thermal bremsstrahlung and gyromagnetic (cyclotron) radiation mechanism are important for explaining the observed phenomena. A procedure for calculating the brightness temperature for a given wavelength and model atmosphere, which integrates the radiative transfer equation for thermal bremsstrahlung, is used for interpretation of the measurements. The models are developed for different structures of the solar atmosphere on a broad wavelength range (from 0.3 mm to 1 cm), closely related to that of the Atacama Large Millimeter/submillimeter Array (ALMA) and the results are compared with available test observations. An important conclusion is that thermal bremsstrahlung is the dominant radiation mechanism in the millimeter and submillimeter wavelength ranges which can explain previous observations. In the very near future it will be possible to compare the results of developed models with new observations of the ALMA radio telescope.

M. Sobotka, P. Heinzel, M. Svanda, Jan Jurčák, D. Del Moro, F. Berrilli
An estimate of chromospheric heating by acoustic waves reloaded

Several mechanisms may heat the solar chromosphere: acoustic waves, magnetoacoustic waves (slow, fast, and Alfven waves), and small-scale magnetic reconnections. Based on observations in the Ca II 854.2 nm line, the contribution of acoustic waves to the heating of quiet and plage regions in the chromosphere is discussed. The point is to compare the energy released by radiative losses with the energy deposited by acoustic waves. Radiative losses are computed using a grid of semi-empirical chromospheric models. The deposited acoustic flux is calculated using power spectra of Doppler oscillations measured in the Ca II line core. The comparison shows that the spatial correlation of maps of radiative losses and acoustic flux is 72 %. The deposited acoustic flux covers at least 20 % of radiative losses in quiet chromosphere and 50 % in plage areas.

R. Oliver, R. Soler, J. Terradas, T. V. Zaqarashvili, M. L. Khodachenko
Dynamics of coronal rain blobs

Coronal rain blobs are dense condensations with chromospheric to transition region temperatures that form in catastrophic cooling events near coronal loop apexes and then fall down with typical speeds in the range 30–150 km/s, which are considerably smaller than free-fall velocities. Coronal rain blob dynamics are studied using a very simple one-dimensional model. We find that the presence of a heavy condensation in a loop gives rise to a dynamical rearrangement of the coronal pressure that generates an upward pressure gradient that eventually cancels the gravity force. Then, the blob descent is characterized by an initial acceleration phase followed by an essentially constant velocity phase. These two stages can be identified in observed time–distance diagrams of coronal rain events. In our model, the blob contains both charged and neutral species that display a velocity drift smaller than 1 m/s. This drift provides a coupling force between the two species and results in neutrals and charges falling together. In addition, the maximum descending blob speed is clearly correlated with the ratio of blob to environment density.

M.Leitzinger, P.Odert, T.V.Zaqarashvili, R.Greimel, A.Hanslmeier, H.Lammer
Stellar prominences - the cases of HK Aqr and PZ Tel

Prominences are manifestations of solar/stellar coronal magnetic fields. Coronal magnetic field supports cool dense prominence plasma against gravity, which may be kept for several rotations (quiescent prominences) or may be ejected because of disturbances in the stellar plasma causing the plasma to accelerate very fast (eruptive prominences). On the Sun, prominences are known to exhibit oscillations, so-called small- and/or large-amplitude oscillations, which show amplitudes of a few km/s for small amplitude oscillations and >20 km/s for large amplitude oscillations. The periods of large amplitude oscillations are in the range of 6-150~min. So far no prominence oscillations have been detected on stars. With existing observatories the stellar analogon of large-amplitude oscillations can be searched on stars which are known to host prominences. Furthermore, stars hosting prominences are

good targets for searching for stellar mass ejections, because erupting filaments and mass ejections (CMEs) are closely correlated on the Sun, moreover the CME core often represents the filament itself. We present the analysis of six nights of optical spectroscopic monitoring of the young and fast rotating stars HK Aqr and PZ Tel, which are known to host prominences. We detect on both stars prominences. In two prominences on HK Aqr we detect indications of prominence oscillations reminiscent to solar large amplitude oscillations, at least with period. We detect no oscillations in the prominences of PZ Tel. Furthermore we find no eruptive prominences on both stars. We explain the non-existence of eruptive prominences using geometrical considerations.

Zoltán Vörös
Turbulence in the heliosphere

Space and astrophysical plasmas are commonly found in complex motion and interactions involving multi-scale turbulent structures and intermittency across wide ranges of temporal and spatial scales. Turbulence is responsible for enhanced transport, diffusion, mixing, particle acceleration and dissipation throughout the heliosphere including the planetary environments. We will review the basic features of plasma turbulence at different heliospheric distances in the solar wind. Special attention will be devoted to the dissipation processes and turbulence generated structures which are associated with plasma heating.

Petra Odert, Martin Leitzinger, Arnold Hanslmeier ,Helmut Lammer
Occurrence rate and observability of stellar mass ejections

Young Sun-like stars exhibit high levels of magnetic activity, resulting in frequent and powerful flares. The close association of flares and Coronal Mass Ejections (CMEs) on the Sun has led many scientists to believe that young stars could therefore also have frequent mass ejections. If their CME activity were orders of magnitude higher than solar, CMEs could even be the dominating source of mass- and angular momentum loss, thereby severely affecting the early stellar evolution. Moreover, frequent and powerful CMEs can influence orbiting planets by compressing their magnetospheres and removing substantial amounts of their atmospheres. Thus, knowledge of the CME activity of young stars is important for understanding the early evolution of stars and their potential planets. Direct observations of CMEs on other stars are, however, rare. To address this topic, we estimate the occurrence frequency of CMEs and the related mass-loss rates on young stars using an empirical model which combines stellar flare rates and relations between flare and CME properties known from the Sun. We discuss our results and compare them with observational constraints on stellar mass-loss rates. Furthermore, we discuss the observability of stellar mass ejections and the results found so far.

Davor Sudar, Mateja Dumbović, Bojan Vršnak
Analysis of CME arrival times at 1 AU with neural network

Predicting CME arrival times to Earth from CME initial parameters is one of the most important topics in space weather research. We used initial CME velocity and central meridian distance, CMD, of CME's associated flare source position as input parameters to train the neural network, while CME transit time was used as the output parameter. The network was trained on the sample of 130 CME-ICME events, while the remaining 23 were used as the test sample. Once trained, the network can be used to plot empirical curves of transit time as a function of the full range of input parameters. Resulting curve as a function of initial CME speed reveals a drag-like behavior, while its CMD shape indicates that CMEs are subjected to deflection in the east-west direction. Average error of the trained neural network is about 12 hours which is comparable to other works.