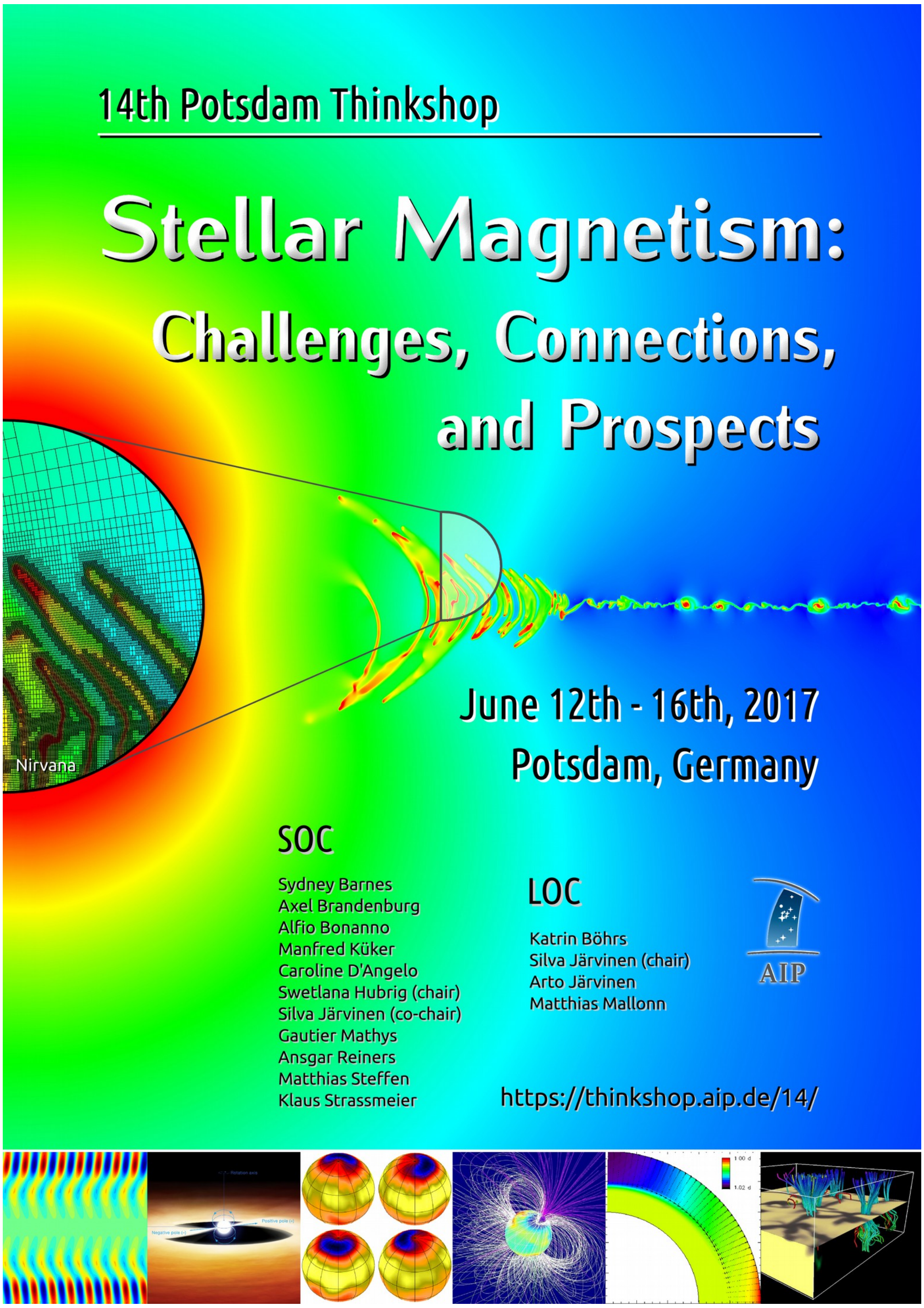
Abstract booklet



Talks

Tuesday 13th of June 2017

8:30 Registration and poster installation

9:00 Klaus Strassmeier: Welcome and introduction to the conference

Chair: Christopher Johns-Krull

9:10 Petri Käpylä: The origin of stellar magnetic fields

9:40 Jörn Warnecke: Identifying dynamo mechanism for slowly and rapidly rotating stars

10:00 Oskar Steiner: Small-scale magnetism of main-sequence stellar atmospheres

10:30 Eliana Amazo-Gomez: Understanding brightness variations of Sun-like stars on timescale of stellar rotation: A novel method to obtain stellar rotational periods

10:50 Mariangela Viviani: Axi- to nonaxisymmetric dynamo transition in semi-global convection models

11:10 COFFEE

11:40 Antoine Strugarek: Magnetic cycles in 3D turbulent global models of cool stars

12:10 Thomas Ayres: The Dynamo Clinical Trial

12:30 Katalin Oláh: Magnetic cycles in stars

13:00 Timo Reinhold: Evidence for photometric activity cycles in 3203 Kepler stars

13:20 LUNCH

Chair: Donald Kurtz

14:50 Thorsten Carroll: Active Regions on Sun-like Stars

15:20 Julio Ramirez: Using PCA-ZDI for the analysis of stellar spectropolarimetric data

15:40 Lisa Theres Lehmann: Connecting the large- with the small-scale surface magnetic field of solar-like stars

16:00 COFFEE

16:30 Martin Stift: Zeeman Doppler mapping: open issues

17:00 Oleg Kochukhov: Magnetic and abundance mapping of early-type stars. Results, techniques, and challenges.

17:25 Rachael Roettenbacher: Shifting the Starspot Paradigm through Imaging Stellar Magnetism with Photometric, Spectroscopic, and Interferometric Observations

17:45 END OF DAY

The origin of stellar magnetic fields

Petri Käpylä

Late-type stars exhibit photometric variability, chromospheric activity, and X-ray emission that are related to magnetic fields. The magnetic fields are produced by dynamos that are thought to originate from a complex interplay of rotation and turbulence in the convective envelopes of these stars. Explaining the magnetic fields of early-type stars is more challenging as they do not possess convective envelopes and have to rely on subsurface convection or processes within radiative zones for the magnetic field generation. I review some of the latest developments in the field that rely on numerical modeling interpreted within the framework of mean-field magnetohydrodynamics.

Identifying dynamo mechanism for slowly and rapidly rotating stars

Jörn Warnecke

The magnetic field in the Sun undergoes a cyclic modulation with a reversal typically every 11 years due to a dynamo operating under the surface. Observations of other stars have revealed magnetic activity being present at a large variety.

We simulate slowly to rapidly rotating solar-type stars, where the interplay between convection and rotation self-consistently drives a large-scale magnetic field. We apply the test-field method to characterize the dynamo mechanisms acting in this simulations by determining the 27 turbulent transport coefficients of the electromotive force, of which 9 are related to the alpha tensor. We find that the alpha-effect has a complex nature and does not follow the profile expected from kinetic helicity, however as expected it shows strong rotational dependency. The turbulent pumping velocities significantly alter the effective mean flows acting on the magnetic field and therefore challenge the flux transport dynamo concept, which is broadly used for solar-like stars. All coefficients are significantly affected due to dynamically important magnetic fields with quenching as well as enhancement being observed. This leads to a modulation of the coefficients with the activity cycle and might play an important role in non-linear saturations of these dynamos.

We will present for the first time the rotational influence of dynamo coefficients and therefore give an important contribution to the understanding the rotation-activity relation of stars.

Small-scale magnetism of main-sequence stellar atmospheres

Oskar Steiner

From observations of the Sun, we know of the existence of a small-scale magnetism in the form of photospheric magnetic flux concentrations of granular and sub-granular scales. This small-scale magnetic structure has consequences for global quantities such as the total solar irradiance, the convective blueshift, or for the determination of chemical abundances. Here we have a look at properties of the small-scale magnetism of cool stellar atmospheres other than the Sun and the Sun, in particular at effects on the radiative intensity and flux from the stellar surface. Lack of direct observations, these properties are derived from three-dimensional radiation magnetohydrodynamic simulations, which start with either, a homogeneous vertical magnetic field, or, for comparison, without a magnetic field. The two settings are thought to represent states of high and low small-scale magnetic activity corresponding to maximum and minimum of a stellar magnetic cycle. Besides radiative, we also discuss interesting magnetic properties of the stellar small-scale magnetism.

Understanding brightness variations of Sun-like stars on timescale of stellar rotation: A novel method to obtain stellar rotational periods

Eliana Amazo-Gomez

Brightness variability in Sun-like stars has been associated with different timescale phenomena. SATIRE, a model developed at the Max Planck Institute for Solar System Research allows replicating observed variations of solar brightness at all timescales that have until now been resolved. Furthermore, it provides the opportunity to link the observed stellar brightness variations to the properties of the magnetic field. Our understanding of this link is now mature enough to be extended from the Sun to Sun-like stars. In this context, we analyse and compare the activity patterns on light curves of stars observed by the Kepler spacecraft and synthetic ones. In particular, we explored whether power spectra of stellar brightness variations can be used to estimate stellar parameters such as the rotational period and the inclination of rotation axis. Based on this analysis, we present a novel method that allows us to achieve better constrained stellar rotational periods from photometric time series observations on solar analogs. Moreover, our method will allow us to perform a better comparison between the stellar and the solar case.

Axi- to nonaxisymmetric dynamo transition in semi-global convection models

Mariangela Viviani

Rotation is one crucial parameter that stellar magnetic activity is known to depend on. There is also growing evidence (both observational and from models, e.g., [1] and [2]) that the rotation rate also regulates the transition from solar-type axisymmetric dynamo modes to non-axisymmetric modes in more rapidly rotating stars. We investigate this transition using semi-global magnetoconvection models, where rotation rate is systematically varied. We have run several high-resolution models including the full azimuthal extent of the star, while still neglecting the stellar poles, and analyse the properties of the dynamo solutions from the models.
We compare the magnetic energy to the kinetic energy, to estimate the dependence of the dynamo efficiency on rotation. We also study the efficiency of the large-scale dynamo by comparing the energy contained in the mean field to the one in the fluctuations. We decompose the magnetic field into axi- and nonaxisymmetric modes, separating large-scale field from fluctuations, and calculate the energy in each of the modes. We find that at high rotation, non-axisymmetric modes are excited and there are also several evidences of an azimuthal dynamo wave. As the rotation rate is increased, retrograde dynamo waves can change into standing ones in the rotational frame of reference.
At very high rotation, the magnetic field seems to become axisymmetric again, in contrast with literature and observations. We presume that, at high rotation, our Rayleigh number is approaching the critical Rayleigh number, making our convection less efficient. When higher resolution is used, the solutions indeed change back to non-axisymmetric ones, supporting our hypothesis.

References

[1] Lehtinen, J., Jetsu L., Hackman T., Kajatkari P. & Henry, G. W., A. 2016, A&A, 588, A38.
[2] Käpylä , P. J., Mantere, M. J., Cole, E., Warnecke, J., & Brandenburg, A. 2013, ApJ, 778, 41.

Magnetic cycles in 3D turbulent global models of cool stars

Antoine Strugarek

Global simulations of the convective dynamo of the Sun and solar-type stars have exhibited in the past decade a rich variety of magnetic self-organization, from small-scale turbulent fields; stable magnetic structures; to periodically reversing large-scale magnetic fields. In the cyclic cases, tough, the physical ingredients setting the cycle period still need to be unveiled.

I will first give a brief tour of the present status of non-linear dynamo simulations in deep stellar convection zones, with a particular focus on results obtained using implicit large eddy simulations (ILES) for a solar-like, cyclic, turbulent dynamos. I will present a series of 3D global simulations performed with the EULAG code where the period of the simulated magnetic cycle systematically varies with the rotation rate and luminosity of the modelled star. The dynamo acting in these simulations is fundamentally non-linear, where the Lorentz force feedback on the mean flows plays a major role in the dynamo loop. These results shed a new light on non-linear dynamo processes possibly acting in solar-like stars.

The Dynamo Clinical Trial

Thomas Ayres

The Dynamo Clinical Trial evaluates long-term magnetic health of cool stars with semi-annual examinations (in X-rays by Chandra; in the UV by Hubble's Space Telescope Imaging Spectrograph). So far, only three subjects have been enrolled in the Trial: Alpha Centauri A (near solar twin), Alpha Cen B (early K dwarf, more active than the Sun), and Procyon (mid-F subgiant, very different from the others). Of these, Procyon is a new candidate, so it is too soon to judge its magnetic health. Of the other two, Alpha Cen B has shown a steady magnetic heartbeat of 8 years duration. On the other hand, sibling Alpha Cen A was in a magnetic cardiac lull during 2005-2010, but in recent years has begun cycling again, perhaps toward a new peak of magnetic health in the 2017 time frame. Indeed, it has been 20 years since A's last healthful peak, twice the middle-aged Sun's 11-year magnetic heartbeat, but perhaps in line with Alpha Cen A's more senescent state (in terms of "relative evolutionary age" apparently an important driver of activity). (Includes an exciting movie of the Alpha Cen stars' 20-year X-ray dance.)

Activity cycles in stars: old, yet unresolved problems

Katalin Oláh

The discovery of activity cycles in stars dates back to almost half a century. During this time several problems have been formulated: measure of cycle lengths, multiple and variable cycles, color index variability during the cycles, cycles of active stars of different evolutionary status, connection between the cycles and the rotational rate. Decades long continuous observations – observing the dynamo – did not resolve fully these problems, we still see through a glass, darkly. In the talk I will address some of these problems and show how we describe and understand them today.

Evidence for photometric activity cycles in 3203 Kepler stars

Timo Reinhold

In recent years it has been claimed that the length of stellar activity cycles is determined by the stellar rotation rate. It is observed that the cycle period increases with rotation period along two distinct sequences, the so-called Active and Inactive sequences. In this picture the Sun occupies a solitary position in between the two sequences. Whether the Sun might undergo a transitional evolutionary stage is currently under debate.

We present measurements of cyclic variations of the stellar light curve amplitude and the rotation period using four years of Kepler data. Periodic changes of the light curve amplitude or the stellar rotation period are associated with an underlying activity cycle. Using the McQuillan et al. 2014 sample we compute the rotation period and the variability amplitude for each individual Kepler quarter and search for periodic variations of both time series. To test for periodicity in each time series we consider Lomb-Scargle periodograms and use a selection based on a False Alarm Probability.

We detect amplitude periodicities in 3203 stars with cycle periods between 0.5 and 6 years, covering rotation periods between 1 and 40 days. Our measurements reveal that the cycle period shows a weak dependence on rotation rate, slightly increasing for longer rotation period. We further show that the shape of the variability deviates from a pure sine curve, consistent with observations of the solar cycle.

Our measurements do not support the existence of distinct sequences in the rotation period – cycle period plane, although there is some evidence for the inactive sequence for rotation periods between 5 and 25 days. Unfortunately, the total observing time is too short to draw sound conclusions on activity cycles with similar length as the solar cycle.

Active Regions on Sun-like Stars

Thorsten Carroll

Is the Sun's surface activity typical compared to other Sun-like stars. Indirect tomographic techniques could in principle provide a step towards answering this questions. However Zeeman-Doppler imaging of slow rotating solar or Sun-like stars are not easy to interpret in terms of observed solar magnetic fields and their basic building blocks like sunspots and flux-tubes. Doppler-Imaging on the other hand deemed inapplicable in the context of low projected rotational velocities. We show that this is not necessarily the case and how spectroscopic data from the ESO-HARPS archive could be utilized to apply Doppler-Imaging techniques to Sun-like stars.

Using PCA-ZDI for the analysis of stellar spectropolarimetric data.

Julio Ramirez

Currently, the big majority of the multi-line analysis techniques for the study and analysis of stellar magnetic fields are based in the weak field approximation. In this talk I will present the latest results obtained using PCA-ZDI, a technique based on a full polarized radiative approach, in the analysis of stellar spectropolarimetric data.

Connecting the large- with the small-scale surface magnetic field of solar-like stars

Lisa Theres Lehmann

The origin of the surface magnetic fields of cool stars are still not fully understood especially if they show strong toroidal fields. In order to better understand these observations, we compare the magnetic field topology of observed and simulated cool stars. For ease of comparison between the high-resolution non-potential magnetofrictional simulations and the relatively low-resolution observations, we filter out the small-scale field in the simulations using a spherical harmonics decomposition. We show that the large-scale field topologies of the solar-based simulations produce values of poloidal/toroidal fields and fractions of energy in axisymmetric modes which are similar to the observations. These global non-potential evolution model simulations capture key magnetic features of the observed solar-like stars through the processes of surface flux transport and magnetic flux emergence.

Zeeman Doppler mapping: open issues

Martin Stift

ZDM, a relatively young inversion technique, is at the origin of a considerable number of maps of the magnetic fields and the horizontal abundance distributions of upper main-sequence chemically peculiar stars. The importance of these magnetic and abundance maps for the understanding of magnetic stars is indubitable, but only recently have some of the foundations of ZDM been subject to a critical evaluation, shedding new light on a fair number of claims as to the (non)- correlation between magnetic field and chemical spots. Still, there remain open issues that need to be addressed at last in necessary depth. Some become visible as various patent contradictions when the laws of physics are applied to published maps. Others are found in unsuitable algorithms and specific numerical recipes for the treatment of spectral signals. In this talk I shall endeavour to illustrate the problem at hand with a few examples and to outline the way to be followed in the analysis of these open issues.

Magnetic and abundance mapping of early-type stars. Results, techniques, and challenges.

Oleg Kochukhov

The techniques of Doppler and Zeeman-Doppler imaging have been widely applied to early-type stars to derive surface magnetic field topologies and maps of chemical element distributions. These studies have recently gained a new momentum with availability of high quality four Stokes parameter spectropolarimetric observations. Analyses of these data have shed a new light on magnetic topologies of early-type stars, revealing remarkable examples of previously unseen complexities of the surface magnetic field distributions and their deviations from classical oblique dipolar geometries. Simultaneously, surface mapping studies provided a wealth of information on static and evolving chemical abundance distributions, demonstrating the presence of diverse, large-scale chemical inhomogeneities, largely incompatible with predictions of the currently available theoretical diffusion models. In this talk I present an overview of recent surface mapping studies of early-type stars, focusing particular attention on reliability of inversion techniques, interpretation of mapping results, and the need for full Stokes vector data.

Shifting the Starspot Paradigm through Imaging Stellar Magnetism with Photometric, Spectroscopic, and Interferometric Observations

Rachael Roettenbacher

In the outer layers of cool stars, stellar magnetism stifles convection creating localized, dark starspots. Studies have shown that starspots lead to inaccurate estimates of stellar parameters and obscure the signal of planets. In order to begin disentangling the signatures of stellar magnetism, we image active stellar surfaces with a three state-of-the-art techniques, including ground-breaking aperture synthesis imaging. Our efforts utilize interferometric data with sub-milliarcsecond resolution from the Michigan InfraRed Combiner (MIRC) at Georgia State University's Center for High Angular Resolution Astronomy (CHARA) Array. Combining our interferometric observations with high-resolution spectra and photometry, we characterize active RS CVn binary systems and compare images with Doppler and light curve inversion imaging. We observed wide-spread regions of suppressed convection on active RS CVn primary stars that would affect stellar parameter estimates and cannot be easily explained by dynamo theories. We extend this study by surveying spotted stars to understand how stellar magnetism affects stellar parameters, impacts the evidence of companions and their characterization, and differs from the Sun for stars with large convective envelopes.

Wednesday 14th of June 2017

Chair: Heidi Korhonen

9:00 Scott Gregory: Magnetic field geometry and evolution in pre-main-sequence stars

9:30 Constance Emeriau-Viard: Origin and evolution of magnetic fields in PMS stars: influence of rotation and structural changes

9:50 Christopher Johns-Krull: Magnetism in Pre-Main Sequence Stars

10:20 Silva Järvinen: Magnetic fields in Herbig stars

10:40 COFFEE + POSTER SESSION

Chair: Adela Kawka

11:30 Markus Schoeller: Massive stars and their magnetic fields

12:00 Asif ud-Doula: Magnetic fields in massive stars and magnetically confined winds

12:30 Manfred Küker: Mass loss of magnetic massive stars: Numerical simulations with the Nirvana code

12:55 Aleksandr Kholtygin: Statistics of magnetic field measurements and evolution of magnetic fields of OBA stars

13:15 Zdenek Mikulasek: Differential rotation in magnetic chemically peculiar stars of the upper main sequence

13:45 LUNCH

FREE AFTERNOON + Guided tour of the Einstein Tower

18:00 CONFERENCE DINNER in

Trattoria Zille

Karl-Liebknecht-Str. 19

14482 Potsdam

Magnetic field geometry and evolution in pre-main-sequence stars

Scott Gregory

Forming low-mass stars appear to be born with simple, dominantly axisymmetric, large-scale magnetic fields. Their magnetospheres transition to complex, multipolar, and dominantly non-axisymmetric, as they evolve across the H-R diagram towards the main sequence. I will discuss the evolution of stellar magnetism during the pre-main-sequence phase, and highlight both the evidence and current gaps in our knowledge. I will discuss some recent observations that may suggest that magnetospheric accretion during the star–disk interaction phase influences the magnetic topology of young stars.

Origin and evolution of magnetic fields in PMS stars: influence of rotation and structural changes

Constance Emeriau-Viard

As the star evolves along the PMS, it experiences drastic changes, especially on its structure and rotation rate. Hence we wish to assess the influence of such changes on stellar dynamo, internal magnetic field topology and activity levels by mean of HPC simulations with the ASH code.
To answer this question, we have performed a series pf 3D HD and MHD simulations with the ASH code. We choose five different models characterized by the radius of their radiative core and following an evolutionary path computed by a 1D stellar evolution code. These models characterize stellar evolution from 1 Myr to 50 Myr. First we computed the hydrodynamical simulations of each of these models to insure the equilibrium of the internal flows and the coupling between the convective envelop and the radiative core, when present. Then a seed magnetic field is introduced into the fully convective model and we spread its evolved state through all four remaining cases. Hence we observe systematic variations in the dynamical properties and magnetic field amplitude and topology of the models. The five MHD simulations show a strong dynamo field that reaches equipartition state, and even superequipartition one in the faster rotating cases, between the kinetic and magnetic energies. The magnetic energy increases as the star evolves along the PMS. Moreover the magnetic field becomes more and more complex with a drop of the dipolar component and a decreasing axisymmetric component and a non-axisymmetric one becoming predominant. The magnetic fields possess a mixed poloidal- toroidal topology with no obvious dominant component. Moreover the relaxation of the vestige dynamo magnetic field within the radiative core is found to satisfy MHD stability criteria. Hence it does not experience a global reconfiguration but slowly relaxes by retaining its mixed stable poloidal-toroidal topology.

Magnetism in Pre-Main Sequence Stars

Christopher Johns-Krull

Strong stellar magnetic fields are believed to play a vital role in the early evolution of newly formed stars, regulating their interaction with the circumstellar disk and thereby helping determine the environment where planets form. This talk will review observations and theory of stellar magnetism in pre-main sequence stars. Much of the talk will center on solar mass T Tauri stars; however, lessons learned from the higher mass Herbig Ae/Be stars will also be reviewed. Much of the focus will be on observational tests of theoretical models of the magnetic star-disk interaction. Lastly, recent observational results that inform the dynamo origin of strong fields on young stars will also be presented.

Magnetic fields in Herbig stars

Silva Järvinen

Herbig Ae/Be-type stars are analogs of T Tauri stars in the higher mass range. Spectropolarimetric studies involving sharp-lined Herbig Ae stars appear to be a promising approach for the detection of their magnetic fields. We report the results of our HARPS high-resolution spectropolarimetric analysis. The role of contamination by the surrounding warm circumstellar matter for the appearance of Zeeman features is discussed for the first time.

Massive stars and their magnetic fields

Markus Schoeller

Having employed spectropolarimetric surveys on four and eight meter class telescopes over the last decade, we are today aware of the large-scale organized magnetic fields in more than five dozen O and early B stars.
In this presentation, we will concentrate on the future directions needed to answer a number of important questions, including the origin of the magnetism in OB stars, the evolutionary change of the magnetic field geometry across the main sequence, the presence of magnetic field decay, and the role of magnetic fields for stellar evolution.

Magnetic fields in massive stars and magnetically confined winds

Asif ud-Doula

Massive stars (at least eight times as massive as the Sun) possess strong stellar winds driven by radiation. With the advent of collaborations like MiMeS or BOB, an increasing number of these massive stars have been confirmed to have global magnetic fields. Such magnetic fields can have significant influence on the dynamics of these stellar winds which are strongly ionized. Such interaction of the wind and magnetic field can generate copious amount of X-rays, they can spin the star down, they can also help form large scale disk-like structures. In this presentation I will discuss the nature of such radiatively-driven winds and how they interact with magnetic fields, often leading to confined winds.

Mass loss of magnetic massive stars: Numerical simulations with the Nirvana code

Manfred Küker

Strong surface magnetic fields have been detected in a number of massive stars. As OB stars lose large amounts of gas through radiation-driven winds, the interaction between gas flow and magnetic wind can lead to X ray emission, which is indeed observed. We present numerical simulations carried out with the Nirvana MHD code to study the interaction of stellar wind and magnetic field in detail. The simulations show an opening up of the field lines far away from the star as well as the formation of a closed field line region where the gas is trapped and falls back to the star. We apply the model to a number of OB and Wolf-Rayet stars.

Statistics of magnetic field measurements and evolution of magnetic field of OBA stars

Aleksander Kholtygin

We review the measurements of magnetic fields of OBA stars and compile the catalog of magnetic OB stars. Based on these data we confirm that magnetic field values are distributed according to a log-normal law with a mean log(B)=2.5 and a standard deviation sigma=0.5. The shape of the magnetic field distribution is similar to that for neutron stars. This finding is in favor of the hypothesis that the magnetic field of a neutron star is determined mainly by the magnetic field of its predecessor, the massive OB star. We model the evolution of an ensemble of magnetic massive stars in the Galaxy. We use our own population synthesis code for obtaining the distribution of stars on radii, ages, masses, temperatures, effective magnetic fields and magnetic fluxes from the pre-main sequence (PMS) up to TAMS stages. A comparison of obtained in our model magnetic field distribution (MFD) with that obtained from the recent measurements of the stellar magnetic field let us to conclude that evolution of magnetic fields of massive stars is slow if not absent. The shape of the real MFD has no indications of the magnetic desert proposed by Lignieres et al. (2014). Based on this finding we argue that the observed fraction of magnetic stars is determined by physical conditions at the pre-main sequence stages of stellar evolution.

Differential rotation in magnetic chemically peculiar stars of the upper main sequence

Zdenek Mikulasek

Magnetic chemically peculiar (mCP) stars are common upper main sequence stars having an abnormal abundance of some chemical elements in their photospheres and a strong magnetic field. Most of them exhibit strictly periodic light, magnetic, radio, and spectral variations which can be fully explained by the model of a rigidly rotating main-sequence star with persistent surface structures and stable global magnetic field frozen into the body of the star. Long-term observations of phase curves of those variations enable us to test the absence of surface differential rotation with unprecedented accuracy and reliability. The analyses of the light curves and other phase curves in the best-observed mCP stars show that the location of photometric and spectroscopic spots, as well as the geometry of the magnetic field, remain constant for at least many decades. The strict periodicity of the observed variations of the most of the mCPs supports the concept of outer layers of the upper main sequence stars without differential rotation. Nevertheless, there is an inhomogeneous group consisting of a few mCP stars whose rotation periods vary on timescales of decades. The period oscillations reflect real changes in the angular velocity of outer layers of the stars, fastened by their global magnetic fields. In CU Vir, V901 Ori, and maybe BS Cir, the rotational instability indicates the presence of the differential rotation in the stars; however, the nature of it has remained elusive up to now. The differences in the stellar magnetism in hot and cool main-sequence stars are also briefly discussed.

Thursday 15th of June 2017

Chair: Zdenek Mikulasek

9:00 Ernst Paunzen: Photometric detection of the global (organized) magnetic field in upper main-sequence stars

9:30 Miroslav Jagelka: Global study of photometric spot distribution on magnetic chemically peculiar stars

9:50 Evgenii Semenko: New general database of the mCP stars

10:10 Iosif Romaniuk: Magnetic Stars in Orion OB1 Association

10:30 Donald Kurtz: Why isn't KIC 11145123 an Ap star?

10:50 COFFEE + POSTER SESSION

Chair: Katalin Oláh

11:40 Swetlana Hubrig: Upper main sequence binaries with magnetic components

12:00 Thomas Hackman: Rotation and spot activity of solar-type stars from long-term monitoring

12:30 Sydney Barnes: Rotation of cool stars in open clusters: characteristics and trends

12:50 Patryk Iwanek: The largest modern analysis of chromospherically active stars towards the Galactic Bulge

13:10 Dario Fritzewski Stellar rotation in NGC 3532

13:30 LUNCH

Chair: Oskar Steiner

15:00 Maarit Käpylä: Long-term variations and irregularities in solar and stellar dynamos

15:25 Sandra Jeffers: Magnetic Activity and Cycles on Cool Stars

15:55 Igor Savanov: Starspot activity on G-M stars from Kepler observations

16:15 COFFEE

16:45 Rakesh Yadav (VIDEOLINK): Dynamo models for fully convective stars

17:15 Ansgar Reiners: A fresh view on low-mass stellar activity: The power of near-infrared spectroscopy

17:35 Gaetano Scandariato: The HArps-n red Dwarf Exoplanet Survey (HADES). A spectroscopic analysis of the steady chromosphere of low-activity early-M dwarfs.

17:55 END OF DAY

Photometric detection of the global (organized) magnetic field in upper main-sequence stars

Ernst Paunzen

Chemically peculiar (CP) stars are upper main sequence objects (spectral types early B to early F) whose spectra are characterized by abnormally strong (or weak) absorption lines that indicate peculiar surface elemental abundances. The observed chemical peculiarities are thought to arise from the diffusion of chemical elements due to the competition between radiative pressure and gravitational settling. CP stars constitute about 10% of upper main sequence stars and are commonly subdivided into four classes. Some subgroups are notorious for exhibiting strong, globally organized magnetic fields of up to several tens of kiloGauss. Because surface abundance patches or spots are present, they are leading to photometric variability, which is considered to be caused by rotational modulation and explained in terms of the oblique rotator model. As a result, the observed photometric period is the rotational period of the star. CP stars that exhibit this phenomenon are normally classified as alpha2 Canum Venaticorum (ACV) variables.

I will review the current status of detecting ACVs among the different subgroups of the CP stars. This includes ground-based (for example ASAS and SuperWASP) and spaced-based (for example, BRITE, CoRoT, MOST, and Kepler) surveys. The widely different time-basis and accuracies are discussed. Based on the current available sample and the parallaxes from Hipparcos and Gaia, an analysis of the rotational behaviour of ACVs is given.

Global study of photometric spot distribution on magnetic chemically peculiar stars

Miroslav Jagelka

Magnetic chemically peculiar stars are characteristic by uneven distribution of some chemical elements. These concentrate into the spots and cause uneven distribution of flux creating photometric spots. It is believed that the distribution of elements is connected with magnetic field. We study the shape of observed light curves of 650 stars and compare them with simulations of predicted light curves of spotted stars following the symmetry of simple magnetic dipole field.

New general database of the mCP stars

Evgenii Semenko

The rapid increase in the number of stars with measured large-scale magnetic fields achieved in recent decades has necessitated the structuring of general information about these objects. The well-known and widely used catalogs of magnetic stars, like those were compiled, e.g., at Special Astrophysical Observatory, often do not provide practical tools for quick analysis of heterogeneous data sets. We initiate the work on a new database that will incorporate information about individual magnetic CP stars, their fields, and physical properties on a single platform and provide the tools for accessing them in a uniform and comfortable manner.

Magnetic Stars in Orion OB1 Association

Iosif Romaniuk

The Ori OB1 association is one of the most popular groups of early type stars. We selected 85 CP stars among 814 members of association. Of those, 23 are non-magnetic Am stars and 62 are Ap/Bp stars. We obtained zeeman spectra of all these stars using the 6m telescope of SAO RAS. We found about 10 new magnetic stars in association. Most unique is HD 34736 – double star with very strong field (Bz curve changes from -5 to +5 kG and is complex). Secondary component pass in very close distance from Primary in periastron. We demonstrate our results of magnetic field measurements for 50 chemically peculiar stars in Orion OB1 association.

Why isn't KIC 11145123 an Ap star?

Donald Kurtz

KIC 11145123 is a remarkable late A main sequence star which asteroseismology shows to be a nearly rigid rotator with a period near 100 d. High resolution spectroscopy shows the star to be a metal-deficient, high-velocity Population II star. It is thus probably a field blue straggler. Questions that remain for this star are: 1) how did it lose its angular momentum? 2) Why does it not show any evidence of atomic diffusion? There is no evidence of a magnetic field or Ap/Am peculiarities. There are now several late-A stars with core-to-surface rotation measured asteroseismically that are very slow rotators. The braking mechanism for these stars is probably not magnetic, hence is an interesting problem.

Upper main sequence binaries with magnetic components

Swetlana Hubrig

Surveys of the presence of a magnetic field in components of upper main sequence binary systems have the potential to uncover the field generation mechanism and to learn about the impact of the magnetic field on the binary evolution. Due to the obvious lack of magnetic components in binaries with short orbital periods, a merging scenario for the origin of Ap stars was suggested. Indeed, only two close binaries with a magnetic Ap component are currently known. Importantly, the magnetic field behaviour in these Ap components is closely related to the position of the companion. Also the inhomogeneous surface element distribution appears to be affected by the presence of the companion. In our talk we present the results of our study of a few recently detected systems with magnetic components and discuss the implication for the origin of their magnetism.

Rotation and spot activity of solar-type stars from long-term monitoring

Thomas Hackman

In order to better understand the past, present and future of the Sun's magnetic activity we need observations of other solar-type stars. A sample of active solar-type stars has been monitored by automated photometric telescopes for 20-30 years. Time series analysis of this data reveals long-term phenomena such as spot cycles, persistent active longitudes, possible dynamo waves and flip-flops, where the main spot activity gradually or suddenly switches from one side of the star to the opposite. Furthermore, these studies provide constraints for the differential rotation, which is an important parameter for the dynamo action causing stellar magnetic activity. By applying Doppler imaging and Zeeman-Doppler imaging to more recent data sets of high resolution spectroscopy and spectropolarimetry the evolution of the spot distribution and surface magnetic field topology of some active solar-type stars has been revealed. Combining the results of photometric, spectroscopic and spectropolarimetry monitoring we are able to study the differences between the spot activity of young solar-type stars and the Sun, reflecting the different types of dynamos operating in these. Furthermore, the observations provide constraints, which will enable a better theoretical understanding of stellar magnetic activity.

Rotation of cool stars in open clusters: characteristics and trends

Sydney Barnes

Cool stars in open clusters have been actively monitored by the community to yield a steadily increasing database of rotation periods. The measurements have been made both from the ground, and increasingly, from space. This presentation will highlight certain such measurements, pointing out key features. It will also discuss the key trends that are observed, especially those with mass and age that make it possible to derive stellar ages from rotation periods, a procedure known as gyrochronology.

The largest modern analysis of chromospherically active stars towards the Galactic Bulge

Patryk Iwanek

We present the discovery and statistical analysis of the largest sample of spotted, variable stars known to date, which contains about 13 000 objects towards the Galactic Bulge. Our study is based on the long-term massive photometry obtained by the Optical Gravitational Lensing Experiment (OGLE). Typical time span of light curves is 15 years and in some cases it is up to 25 years. Our collection consists of many types of single and binary stars with dark, cold spots (BY Dra, FK Com, T Tau, RS CVn, W UMa). We also find stars with bright, hot spots. Our huge sample of chromospherically active stars allowed us to check known correlations between observed parameters (like rotational period, galactic latitude, brightness, variability amplitude) and to discover new dependencies. Our research suggests existence of two groups of chromospherically active stars. The first one consists of early-type, pre-main-sequence and main sequence fast rotating stars with variability amplitude smaller than 0.1 mag, and the second one consists of late-type slow rotating giants and subgiants with variability amplitude up to 0.5 mag. Bright stars in our sample (brighter than 16.5 mag in I-band) do not exhibit large amplitudes of brightness variations (larger then 0.3 mag). We find significant correlation between brightnesses and rotational periods of these stars. Furthermore, thanks to the long-term OGLE photometry we confirm the existence of activity cycles in most chromospherically active stars from our collection. We discover that most of our stars show activity cycles from 4 to 8 years with the most common value at about 5-6 years. Moreover, we are still discovering spotted stars among the stars observed by OGLE. Our main result of this work, will be the largest catalogue of chromospherically active stars in the history of astronomy.

Stellar rotation in NGC 3532

Dario Fritzewski

Stars with the intermediate age of 250 Myr are crucial to the understanding of the stellar rotational evolution. We have measured rotation periods in the 300 Myr old, very rich open cluster NGC 3532 over a 1 degree field. Combined with the radial velocity membership we are able to construct a clean colour-period diagram for this intermediate aged cluster and put the results in context with other open clusters to expand the understanding of rotational evolution of main sequence stars.

Long-term variations and irregularities in solar and stellar dynamos

Maarit Käpylä

Global numerical simulations have recently advanced to a level where solar-like dynamo solutions can be found. Some of these solutions exhibit also irregularities over time, and some grand minima -type events can be isolated. Even though the models are still operating in a parameter regime far from the real Sun, the models provide a laboratory for inspecting the possible mechanisms behind the irregular behavior. In this talk we discuss two different scenarios of turbulent magneto-convection producing such events.

First we discuss a solar-like dynamo solution, where irregularities are caused by co-existing multiple dynamo modes with vastly different periods and symmetry properties. In particular, we show that the interpretation of Maunder minima -type events is not trivial, as such an event can occur even during a global magnetic field maximum, when the strong magnetic fields are hidden near the bottom of the convection zone.

We also discuss another scenario for more rapidly rotating stars, where the interaction of large-scale vortices induced by the strong rotational influence generate shear to amplify magnetic fields, which in turn quench the vortices. As an end result, one observes irregular cycles with disappearance and re-emergence of magnetic field.

Magnetic Activity and Cycles on Cool Stars

Sandra Jeffers

Observations of magnetic cycles on the Sun and other Solar-type stars give an important insight into the internal dynamo processes. One of the aims of the BCool project is to understand how a star's large-scale magnetic field geometry evolves as a function of its magnetic and chromospheric cycles. From the long-term monitoring of the large-scale field over nearly 10 years we are starting to see cyclic behaviour in several targets. In this presentation I will show our results and highlight a few cases where the behaviour is surprising compared to the Sun.

Starspot activity on G-M stars from Kepler observations

Igor Savanov

I shall review the results of our stellar activity analysis based on Kepler light curves. Starspots on objects of different types: stars with planetary systems, superflare stars, solar analogues, stars in clusters and M dwarfs will be discussed.

Dynamo models for fully convective stars

Rakesh Yadav

M-stars are among the most active and numerous stars in our galaxy. Their activity plays a fundamentally important role in shaping the exoplanetary biosphere since the habitable zones are very close to these stars. Therefore, modeling M-star activity has become a focal point in habitability studies. The fully convective members of the M-star population demand more immediate attention due to the discovery of Earth-like exoplanets around our stellar neighbors Proxima Centauri and TRAPPIST-1 which are both fully convective. The activity of these stars is driven by their convective dynamo, which may be fundamentally different from the solar dynamo due the absence of radiative cores. We model this dynamo mechanism using high-resolution 3D inelastic MHD simulations. To understand the evolution of the dynamo mechanism we simulate two cases, one with a fast enough rotation period to model a star in the `saturated' regime of the rotation-activity relationship and the other with a slower period to represent cases in the `unsaturated' regime. We find the rotation period fundamentally controls the behavior of the dynamo solution: faster rotation promotes strong magnetic fields (of order kG) on both small and large length scales and the dipolar component of the magnetic field is dominant and stable, however, slower rotation leads to weaker magnetic fields which exhibit cyclic behavior. In this talk, I will present the simulation results and discuss how we can use them to interpret several observed features of the M-star activity.

A fresh view on low-mass stellar activity: The power of near-infrared spectroscopy

Ansgar Reiners

Several high-resolution near-infrared spectrographs are under construction or already operational. These spectrographs deliver data of exquisite quality and cover regions of the spectra that have not been excessively exploited in the past. Near-infrared spectra are extremely useful for understanding stellar activity and magnetism because here both the spectral contribution of cool starspots and the Zeeman effect show more of an influence than at shorter wavelengths. I will present examples from near-infrared high precision spectroscopy including data from the CARMENES instrument.

The HArps-n red Dwarf Exoplanet Survey (HADES). A spectroscopic analysis of the steady chromosphere of low-activity early-M dwarfs

Gaetano Scandariato

While most of the planets discovered so far have been found orbiting around solar-type stars, low-mass stars have recently been recognized as a "shortcut" to glance into an exo-life laboratory. Currently, stellar activity is one of the most limiting factors for achieving the precision required to detect Earth-twins via the radial velocity method. Understanding the chromospheres of M dwarfs is crucial to solve this problem. In this contribution I present the spectroscopic analysis of the quiet early-M dwarfs currently being monitored in the framework of the HADES (HArps-n red Dwarf Exoplanet Survey) radial velocity survey. The wavelength range covered by the spectra allows us to analyze simultaneously the CaII H&K doublet and the Balmer series, while the intensive follow up gives us a large number of spectra (up to ~100) for each targeted star. I present the study of the activity-rotation-stellar parameters and flux-flux relationships, and I also discuss the correlation of the CaII H&K and Hα fluxes at low activity levels and the evolution timescales of chromospheric active regions.

Friday 16th of June 2017

Chair: Ansgar Reiners

9:00 Heidi Korhonen: Stellar magnetism in late-type stars

9:30 Sarah Schmidt: M dwarfs in ASAS-SN: Stellar flares from sparse cadence observations

9:50 Stephane Vennes: The wealth of magnetic fields in white dwarfs: Inherited or acquired?

10:20 Oleksii Kuzmychov: Surface magnetic field of the radio-emitting dwarf LSR J1835+3258

10:40 COFFEE

11:10 Adela Kawka: The challenges of magnetic and polluted white dwarfs

11:30 Simon Daley-Yates: Magnetic Exoplanets: Interacting Fields and Flows

11:50 Krisztián Vida: The question of habitability around TRAPPIST-1

12:10 Thomas Ayres: Summary of the conference

END OF THINKSHOP 14

Stellar magnetism in late-type star

Heidi Korhonen

The existence of starspots on late-type stars has been known for more than five decades based on photometric observations. The development of observing and analysis techniques that has occurred during the past two decades has also enabled us to study the detailed starspot and magnetic field configurations on late-type stars. We now have information on magnetism in many different types of late-type stars from M dwarfs and young main sequence stars to evolved giants. Recently, starspots have even been directly imaged on the surface of an active late-type giant. In this talk I will review what is known of the magnetism in late type stars with different ages and spectral types.

M dwarfs in ASAS-SN: Stellar flares from sparse cadence observations

Sarah Schmidt

The All-Sky Automated Survey for Supernovae (ASAS-SN), operating since 2012, now takes a V-band image (with a limit of V <17) of the entire sky once every night. In addition to hundreds of supernovae, it has also discovered over fifty transient events initially classified as large M dwarf flares based on the rapid decay of their light curves over the initial three images and the very red colors of their quiescent counterparts. We had undertaken a program to spectroscopically classify these candidate M dwarfs and estimate the energies of these dramatic flares. Of the 53 objects in our initial sample, we have spectroscopically confirmed 49 M dwarfs, one L dwarf, one T-Tauri object, and obtained spectra for two possible extra-galactic sources. We estimate a minimum V-band energy for each flare event based on the three initial data points combined with an empirical flare model. These minimum energies range from 10^31 erg to 10^34 ergs in the V-band, which places these among the strongest M dwarf flares observed. The ASAS-SN M dwarfs with strong flares have a higher incidence of Halpha emission than a comparison sample selected without reference to magnetic activity (typical M dwarfs), but the average chromospheric emission strength from the ASAS-SN M dwarfs is close to that of the typical M dwarfs. This is evidence that the flare stars are primarily drawn from active M dwarfs, but are not remarkable (hyper-active) compared to M dwarfs with typical activity levels. ASAS-SN and similar surveys have the potential to enable further studies of flare stars as an ensemble compared to their less active counterparts.

The wealth of magnetic fields in white dwarfs: Inherited or acquired?

Stephane Vennes

The nature of magnetic fields in white dwarfs is complex and the causes are diverse. Magnetic white dwarfs (MWD) are found in close interacting or post-interacting binaries, but many also appear to be isolated. The original proposal linking MWDs to their magnetic main-sequence progenitors remains in part valid, although it fails to account for low-field white dwarfs (<1 MG) and for the absence of MWDs paired with non-interacting low-mass companions which could act as counterparts to the magnetic CVs in the same way detached WD+dM pairs are non-interacting counterparts to dwarf novae. Moreover, variability studies in MWDs show that the simple, inclined dipole fails to account for the polarimetric and spectroscopic properties of many MWDs. I will review the increasingly rich and diverse observational properties of magnetic white dwarfs particularly in the time domain. I will also examine recent proposals aimed at explaining global and individual properties and that involve binarity. Finally, I will follow likely evolutionary scenarios generating surface fields in old white dwarfs.

Surface magnetic field of the radio-emitting dwarf LSR J1835+3258

Oleksii Kuzmychov

Recent radio surveys revealed more than a 100 of brown dwarfs with radio emission, which is associated with their magnetic activity (McLean et al. 2012). Studying the surface magnetic field of brown dwarfs with the help of spectropolarimetry is challenging from both observational and theoretical sites. On the one hand, large telescopes are needed to acquire data of objects as faint as brown dwarfs. On the other hand, the vanishing of atomic lines in the sub-stellar spectra hinders the application of common techniques for probing the stellar magnetic fields based on atomic lines.

We present the first detection of the surface magnetic field of a brown dwarf based on its full-Stokes data in molecular bands (Kuzmychov et al. 2017, submitted). Our technique makes use of the Zeeman and the Paschen-Back effects in the molecules CrH, TiO, and FeH as well as in the Na I doublet at 819 nm (Kuzmychov & Berdyugina 2013; Berdyugina et al. 2017, submitted). We will introduce our molecular technique, and we will discuss the magnetic field topology of the M8.5 dwarf LSR J1835+3258 as it has been inferred with the help of our technique. The feasibility of using the VO molecule for magnetic field measurements in low-mass stars and brown dwarfs will be discussed as well (Kuzmychov & Berduygina, in prep.).

Our study demonstrates that the surface magnetic field of brown dwarfs can be successfully studied with the help of spectropolarimetry, provided the magnetic signatures in the bands of diatomic molecules are understood and modeled correctly.

This work is based on the full-Stokes data obtained with the Low-Resolution Imaging Spectropolarimeter (LRISp) at the Keck observatory on August 22nd and 23rd, 2012.

The challenges of magnetic and polluted white dwarfs

Adela Kawka

In the past few years, a number of cool, magnetic and polluted white dwarfs were discovered. We have found that below 6000 K, which corresponds to white dwarfs with cooling ages greater than ~ 1 Gyr, the incidence of magnetism in polluted hydrogen-rich white dwarfs is close to 50%. This is significantly higher than the ~ 5% incidence found in the younger white dwarf population. I will present the challenges that have been encountered in modelling the spectra of these stars. I will also present possible scenarios for the origin of magnetic fields.

Magnetic Exoplanets: Interacting Fields and Flows

Simon Daley-Yates

We present Magnetohydrodynamic (MHD) simulations of the magnetic interactions between a solar type star and a short period hot Jupiter exoplanet using the publicly available MHD code PLUTO. The magnetic interactions between stars and their hosted exoplanets is a complex and challenging field of research, providing novel insights into planetary migration, angular momentum loss and stellar spin down via magnetic breaking. Previous work in this field has concentrated on ideal Hydrodynamic and MHD simulations of both the immediate surroundings of the exoplanet and the global evolution of the system. We build on this work by expanding to non-ideal MHD with the effects of resistivity. In our simulations, a planetary outflow, due to UV evaporation of the exoplanets atmosphere, results in the build-up of circumstellar and circumplanetary material. We analyse the behaviour of this material in the context of the magnetic topology. While recent theoretical studies have shown that an observational reduction in UV emission from these systems is not likely, there is however the possibility of detecting emission due to magnetic interactions such as electron cyclotron emission.

The question of habitability around TRAPPIST-1

Krisztián Vida

The TRAPPIST-1 system got into focus with the discovery of its complex planetary system of seven planets, with three of them in the habitable zone of the host star. The discovery was even more interesting, as the lowest age estimate of the system, ~500Myrs, makes the formation of basic life possible.

We analyzed the recent K2 light curve of TRAPPIST-1, and found indications of strong magnetic activity, that possibly has serious impact on the orbiting planets. We also evaluate the chance of life in the TRAPPIST-1 system.

Posters

Far Beyond the Sun: Mapping the Magnetic Cycle of the Young Solar-Analog ι Horologii

Amazo-Gomez, Eliana

We present the results from a recent HARPSpol@ESO3.6m observational campaign devoted to map the magnetic cycle of ι Horologii using Zeeman Doppler Imaging (ZDI). Additional large-scale magnetic field maps at different epochs are being recovered. Detailed 3D MHD simulations, driven by the recovered ZDI maps, are used to self-consistently model the coronal structure, stellar wind and astrospheric conditions around the star. These models will be compared with an ongoing X-ray monitoring of the cycle using XMM-Newton, and possibly, with stellar wind diagnostics from HST. Furthermore, as ι Horologii is a planet-hosting star, our observations and numerical simulations will be also used to understand the effects of magnetism and activity on habitability, and to study stellar wind and planetary exosphere interactions during different stages of the on-going magnetic cycle.

General Magnetic Field on the yellow subgiant beta Aql

Butkovskaya, Varvara

We have performed the search for solar-like activity on yellow subgiant beta Aql (Sp G9.5 IV) using the circularly polarized spectra obtained at CrAO during 1997 – 2015 (about 50 nights). We detected the magnetic field on beta Aql with confidence level 3-15 sigma. Here we present the result of study of the magnetic field variation on scale from day-to-day to year-to-year.

BW Vul: first result of magnetic field measurement in Helium and Hydrogen lines

Butkovskaya, Varvara

BW Vul (HD 199140, HR 8007, Sp B2III) has a largest known amplitude of light variation (of 0.2m in visual domain) and radial velocity variation (of 200 km/s) among the beta Cephei stars. BW Vul pulsates in radial mode with period about 0.2 day. There is clear line doubling in the spectra of BW Vul, possibly caused by the propagation of shock waves through the atmosphere of the star. We report the preliminary result of the study of magnetic field on BW Vul measured in Helium and Hydrogen spectral lines using circularly polarized spectra obtained at CFHT ESPaDOnS under Proposal ID 11AF04 at 2011-06-21 and 2011-07-03 and downloaded from open database CADC. Total durations of the observation sets are about 2h and 6h (0.3 and 1 pulsation period respectively). We suppose that the magnetic field on BW Vul varies in the complex manner during the pulsation period.

Early main-sequence evolution of Sun-like stars rotation and magnetic activity

Gondoin, Philippe

Characterizing the long-term evolution of magnetic activity on Sun-like stars is important not only for stellar physics but also for determining the high-energy radiation environment in which planets evolve. Unfortunately, the direct measurement of the average magnetic activity level of cool stars as a function of their age is difficult.

In the past decades, many photometric surveys of open clusters have produced extensive rotation period measurements on Sun-like stars of different ages. Also, it has been observed that the magnetic activity of Sun-like stars is closely linked to stellar rotation. I used this information to gain new insights on the early evolution of Sun-like stars rotation and magnetic activity on the main-sequence.

Statistical analysis of the photospheric magnetic field evolution without feature tracking

Gorobets, Andrei

Small-scale magnetic fields (SMF) in the photosphere appear as randomly distributed concentrations over the solar surface. Studying their evolution is an important aspect of system-wide understanding the solar magnetism, magnetoconvection, solar (stellar) long-term atmospheric activity. The common approach of feature tracking is divergent and subjective technique, since magnetic features and their interaction are not well-defined.

We propose a novel framework for the analysis of solar SMF based on interdisciplinary methods of statistical mechanics, interacting particle systems and non-equilibrium thermodynamics.

Using the new method, we found that SMF treated as random sequences in the quiet Sun have properties of Markov chains, whose fluctuations are irreversible and their total entropy production obeys the so-called fluctuation theorem.

The new method provides quantitative measures of consistency of models and observations by means of exact statistical relations for observables which can be tested in both observations and models for solar and stellar astrophysics.

Searching for the presence of a weak magnetic field in the Be star lambda Eri using FORS 1/2 spectropolarimetric time series

Hubrig, Swetlana

The presence of magnetic fields in Be stars is highly controversial and still under debate. In this work we report the results of our search for the presence of a magnetic field in the well-known non-radially pulsating single bright Be star lambda Eri using several low-resolution spectropolarimetric time series obtained with the ESO FORS 1/2 instruments in 2006, 2007, and 2016.

First Doppler images with PEPSI

Järvinen, Silva

We present the first Doppler images based on ultra-high resolution (R=220,000) spectra obtained with the Potsdam Echelle Polarimetric and Spectroscopic Instrument (PEPSI) at the Large Binocular Telescope (LBT) and the Vatican Advanced Technology Telescope (VATT). The selected targets are the young solar twin EK Dra, the hot-Jupiter host tau Boo, and the close double-lined active binary HR 5110. All these targets have rather small projected rotational velocities and the earlier attempts to map them have been limited by the surface resolution via the Doppler effect. With PEPSI we can have 25-30 resolution elements across the stellar disk and are able to detect more subtle temperature variations than ever before.

A search for spectral variability in the highly magnetized O9.7 V star HD 54879

Järvinen, Silva

Magnetic fields have been detected only in a dozen of O-type stars. The first measurement of a longitudinal magnetic field of almost -600 G in HD 54879, a presumably single O9.7 V star with a low projected rotational velocity, indicates a dipolar magnetic field strength of 2 kG. However, despite the presence of a strong magnetic field, no sign of photospheric line profile variations has been detected in the past. Here we present our search for spectral variability in this star based on HARPS and FORS 2 polarimetric spectra.

Halpha Categorization of Low Mass Stars

Johnson, Erik

Low mass stars are the most numerous stars in the galaxy and are very promising candidates for exoplanet surveys. These stars, however, are subject to a radial velocity jitter that has proven problematic for these surveys. It is thought that since these stars tend to have high levels of stellar activity that the stellar activity caused the radial velocity jitter. When we were investigating this, using Halpha as an activity indicator, there was no evidence for a stellar-activity induced radial velocity jitter. However, we found that the spectra of the 176 CARMENES stars surveyed could be placed into four categories. The exact ordering of the activity levels between these categories are still in question.

Lithium enrichment with antisolar type surface differential rotation on single K-giants

Kovari, Zsolt

Stars of 1-2 solar masses arriving at the red giant branch represent an exciting period of stellar evolution when different mixing episodes occur. These processes can raise surface Li abundance as well as convey angular momentum from the deep towards the poles, yielding antisolar type differential rotation. At the moment three single giants with this peculiar rotation pattern are known, all three having enhanced surface Li abundance, supporting the common origin.

The VaMoS survey – Variability monitoring of exoplanet host stars

Mallonn, Matthias

Transmission spectroscopy is currently the most successful technique for spectroscopy of extrasolar planets. However, a unique physical interpretation of the measurements is not possible without a sound knowledge about the host star. Star spots influence the planetary parameters derived from transit light curves and can mimic a slope in the transmission spectrum, which can be misinterpreted as scattering signature of aerosols in the planet atmosphere. We established the VaMoS (VAriability MOnitoring of exoplanet host Stars) survey to study the star spot properties of the exoplanet host stars most interesting for transmission spectroscopy. VaMoS will aid in the interpretation of exoplanet spectra and act as a service for the astronomical community of exoplanet spectroscopy.

The study of CP stars HD 5601 and HD 27404 on the 6-m SAO RAS telescope

Moiseeva, Anastasiia

Based on observations with the 6-m SAO RAS telescope, we have found two peculiar stars with a large depression of the continuum at λ 5200 A, which have a strong magnetic field. We have enough spectra for both stars to determine a period of variation of the longitudinal field component Beff, which match with period of their photometric variability of brightness. We determined the variability of the radial velocity at times of about tens of years pointing to a possible binarity of both objects. We have built a magnetic model of these stars, determined the inclination angles of the rotation axis to the line of sight i and of the dipole axis to the rotation axis β, and the field strength at the pole Bp. We carried out a chemical composition analysis and found the fundamental parameters for these stars.

Spectropolarimetric oservations of the star FK Com: 2012-2016 years

Puzin, Vasily

We present an analysis of new photometric and spectropolarimetric observations of a chromospherically active star FKCom. Based on this observational data and the data from the literature sources, applying a common technique, we performed an analysis of a complete set of the available photometric data, which were divided into 218 individual light curves.
For each of them a reverse problem of restoring large scale temperature irregularities on the surface of the star from its light curve was solved. We analyzed the time series for the brightness of the star in the U-, B-, and V-bands, the brightness variability amplitudes, the total area of the spots on the surface of the star, and the average brightness of each set considered. The analysis of determination results of the positions of active longitudes leads to the conclusion about the existence of two systems of active regions on the FK Com surface. It was determined that the positions of each of these systems undergo cyclic changes. This confirms the conclusion on the likely absence of a strongly pronounced regularity of the flip-flops in FK Com, earlier suggested by other researchers. The results of the new polarimetric observations FK Com in 2014-2015 are presented. These measurements evidence the legitimacy of the proposed interpretation the behavior of the longitudinal magnetic field strength <Bz>, indicating the settling-in of a more symmetric distribution of magnetic region on the FK Com surface. An increasing activity of the star over the recent years, registered from the photometric observations is also consistent with the probable onset of growth in the <Bz> parameter starting from 2014.

Is the new paradigm of X-ray emission for O stars correct?

Ryspaeva, Elizaveta

Stars of 1-2 solar masses arriving at the red giant branch represent an exciting period of stellar evolution when different mixing episodes occur. These processes can raise surface Li abundance as well as convey angular momentum from the deep towards the poles, yielding antisolar type differential rotation. At the moment three single giants with this peculiar rotation pattern are known, all three having enhanced surface Li abundance, supporting the common origin.

Simulation of the small-scale magnetism in main sequence stellar atmospheres

Salhab, René

Three-dimensional radiation magnetohydrodynamic simulations of main-sequence stellar atmospheres were carried out in order to investigate structure and global consequences of the small-scale magnetism in these atmospheres. To this aim, the simulations start with either, a homogeneous vertical magnetic field of 50 G and 100 G field strength, or, for comparison, without a magnetic field. These two settings are thought to represent states of high and low small-scale magnetic activity corresponding to maximum and minimum of a stellar magnetic cycle. It is found that the presence of small-scale magnetism increases the bolometric intensity and flux from the stellar surface in all investigated models. The surplus in radiative flux of the magnetic over the magnetic field-free atmosphere turns out to be most pronounced for early G-type stars. The strength of the magnetic field concentrations on the surface of optical depth unity stays remarkably unchanged at approximately 1700 G throughout the considered range of spectral types but the degree of rarefaction of the magnetic flux concentrations monotonically increases with effective temperature and so does their depression at the visible optical surface (Wilson depression).

Periodicities of the effective magnetic field of Eps Eri

Scalia, Cesare

We obtained high resolution spectropolarimetric observations of the cold active star Epsilon Eridani using CAOS (Catania Astrophysical Observatory Spectropolarimeter). We measured the effective magnetic field of Eps Eri for all the available spectropolarimetric observations in the archives. We reported the periodically variation of longitudinal field of the star probably due to dynamo process.

Spectroscopic signatures of magnetospheric accretion in the two magnetic Herbig Ae stars HD104237 and HD190073

Schoeller, Markus

We have examined magnetospheric accretion in the two Herbig Ae stars HD104237 and HD190073, using lines sensitive to accretion in both the visible and the near-infrared. The data were obtained with the ISAAC and X-shooter spectrographs on the VLT, as well as with other telescopes. We found that the temporal behavior of He I 10830, Pa_gamma, and He I 5876 in the spectra of HD104237 and HD190073 can be explained by variations of the amount of accreted matter between the star and the observer. Since both objects are oriented nearly pole-on, the accretion flows reach from the equatorial plane of the disk to high latitudes on the stellar surface, following the magnetic field. In HD104237, we found modulation of the diagnostic line parameters with the period P = 5.37+-0.04 d, which is probably due to rotation.

The study of CP stars HD 5601 and HD 27404 on the 6-m SAO RAS telescope

Semenko, Evgenii

Based on observations with the 6-m SAO RAS telescope, we have found two peculiar stars with a large depression of the continuum at н 5200 A, which have a strong magnetic field. We have enough spectra for both stars to determine a period of variation of the longitudinal field component Be, which match with period of their photometric variability of brightness. We determined the variability of the radial velocity at times of about tens of years pointing to a possible binarity of both objects. We have built a magnetic model of this stars, determined the inclination angles of the rotation axis to the line of sight i and of the dipole axis to the rotation axis н, and the field strength at the pole Bp. We carried out a chemical composition analysis and found the fundamental parameters for these stars.

Multiple short-lived stellar prominences on O stars: The O7.5III((n))(f) star xi Persei

Sudnik, Natallia

A variety of spectral lines in many O- and B-type stars show unexplained variability on a rotational timescale, which is cyclical, but not periodic. This variability occurs in the so-called discrete absorption components (DACs) that accelerate through the UV-wind line profiles as well as in many optical lines. No dipolar magnetic fields have been detected for such OB stars, with typical upper limits of ~300 G. We investigate whether multiple magnetic loops on the surface, as proposed earlier for the O star lam Cephei, may explain the observed cyclical UV and optical spectral line variability.

We present time-resolved, high-resolution optical spectroscopy of the O7.5III((n))(f) star xi Persei. We apply the same simplified phenomenological model as for lam Cep, in terms of multiple spherical blobs attached to the surface, which represent magnetic-loop structures, called stellar prominences (Sudnik and Henrichs 2016). We compare the observed with calculated relative changes in subsequent quotient line profiles as a function of rotational phase, adopting a rotation period of 2.0406 d. This period followed from an analysis of 307 IUE archival spectra collected over 16 years.

We identify many periodicities in spectral lines, almost none of which is stable over timescales from months to years. We show that the relative changes in various optical absorption and emission lines are often very similar. Our proposed model had been applied to the He II 4686 line, from which the number of coexisting equatorial blobs and their lifetimes can be derived. This will be compared with results of space-based photometry of this star (Ramiaramanantsoa et al 2014).

Given the irregular timescales involved, we propose that the azimuthal distribution of DACs corresponds to the locations of stellar prominences attached to the surface. This could explain the observed variability of optical and UV lines, and put constraints on the strength and lifetime of these structures, which can be compared with recent theoretical predictions, in which bright magnetic surface spots are formed by the action of the subsurface convection zone.

Looking for stellar activity in brown dwarfs

Vida, Krisztián

We present photometric measurements of a sample of ultracool objects, in order to find photometric changes that could indicate magnetic activity, in the hope of broadening the currently rather small sample of magnetically active brown dwarfs.

New CP stars in Kepler field based on photometric and spectroscopic survey

Yakunin, Ilya

Chemically peculiar (CP) stars are characterized by strong anomalies in abundances of a number of elements. Some of them posses global dipolar magnetic fields which are influencing rotation, atmospheres and evolution of the objects. CP stars are often used for the analysis of stellar formation and evolution in the context of diffusion as well as meridional circulation. Recently, there is an increasing number of studies dedicated to searching of new CP stars based on large modern photometric surveys. We present the first attempts of spectroscopic confirmation of CP nature of candidates found using Kepler photometric data.