Abdel Hady, Ahmed
The high energetic particles released during the decline phases of solar cycle 24
Poster B1
During the decline phases of the last five solar cycles, a new peak has appeared releasing high energetic particles. During October 2003 (so-called Halloween storms), a sudden increase of the solar activity occurred during the decline phase which has bigger that that occurred during the main peak of that solar cycle 23. The same situation was repeated again for the solar cycle 24, during its decline phase, giving a new peak during January 2014 and releasing high energetic particles, which was bigger than that occurred during the mean peak of cycle 24. This means that the solar cycles starting from the cycle 20 have two peaks, the second peak always producing higher energetic flares which affects the Earth’s magnetic field. The same situation happened in the cycles 21, and 22, but with lower release of energetic particle, compared with cycles 23 and 24. We will do descriptive studies of January 2014 events, according to data analysis, and compare the results.

Alvarado-Gomez, Hussain, Grunhut
The Coronal Structure of the Sun-Like Exoplanet-Host GJ 3021
Oral Session 8
GJ 3021 is a yellow-orange dwarf star of spectral type G8V, which in comparison to our Sun, has about 93% of its mass, 94% of its diameter, and 77% of its bolometric luminosity. It is also a confirmed exoplanet-host, making it a very interesting target for understanding the coronal structure and circumstellar environment around it. Using a time-series of high-resolution spectro-polarimetric observations from HARPSpol, in combination with the Zeeman Doppler Imaging (ZDI) technique, we have successfully recovered the magnetic field distribution in the surface of the star. These surface field maps serve as initial inputs for the BATS-R-US 3D MHD code to model in detail the winds/outflows and the coronal structure around the star. We present the initial results and analysis of the simulations including the different coronal structures obtained for a given magnetic field distribution/rotation period and the mass/angular momentum loss rates predicted for this system.

Amazo-Gomez
Line variations profile of a solar analog star, the search
Poster B 2
In the development of this work we use PolarBase and database that contains all stellar data collected with the ESPaDOnS and NARVAL high-resolution spectropolarimeters, with a spectral resolution of ≈65,000 in polarimetric mode or a higher resolving power of ≈76,000 when used for classical spectroscopy alone. During this work we analyze extracted data of a solar analog star with hosting-planets from PolarBase, we studied the line profile, their periodicity and variations. Finally we analyze the magnetic field and starspots correlations. We use Intensity spectra and simultaneous spectra in circular and linear polarization.

Anan, Casini, Ichimoto
Magnetic and electric fields inference in chromospheric jets using spectropolarimetric observations in HI Paschen lines
Oral Session 8
The solar chromosphere is a collisional and partially ionized plasma, whose dynamics is governed by magnetic and electric fields. When the velocity of neutrals is different from that of ions, multi-fluid effects may affect the dissipation of high-frequency waves and the physics of reconnection, and possibly break the ideal MHD approximation. Neutral atoms that move across the magnetic field also experience an electric field. The ensuing Stark effect for H-like ions can be large enough to be detectable with modern spectropolarimetric instrumentation, and occurs at spatial and temporal scales accessible to existing solar telescopes. Electric fields can also have an effect on the atomic polarization of H-like ions via the alignment-to-orientation conversion mechanism, when the plasma is irradiated non-isotropically. We present full Stokes spectra observations of the Paschen series of hydrogen in chromospheric jets at the solar limb. We found no definitive evidence of the linear polarization produced by the Stark effect for a macroscopic electric field, nor a significant amount of atomic orientation. Hence we inverted the Stokes spectra taking into account only the effects of magnetic fields, including the Hanle effect and level-crossing interactions. We found that the observed signals are compatible with a magnetic field approximately aligned with the visible structure of the jets, and we derived upper limits for the electric field in the moving
frame of the atoms. From this we estimated an upper limit to the velocity of hydrogen atoms across the magnetic field, which is far below the bulk velocity of the plasma measured by the Doppler shift. We thus concluded that the hydrogen plasma neutral must be highly frozen to the magnetic field in these plasma structures.

Anche, Anupama, Sen, Reddy, Sankarasubramanian, Sivarani, Sengupta, Skidmore, Ramprakash, Pandey, Atwood

Analytical Modelling of Thirty Meter Telescope Polarization

Poster Session A 1

The Thirty Meter Telescope (TMT) is an advanced, wide field (20 arcmin), altitude-azimuth telescope. The primary mirror is segmented, consisting of 492, 1.44-meter hexagonal segments. The telescope will have adaptive optics capability at first light, together with two instruments in the near-infrared region: Infrared imaging spectrograph (IRIS) an instrument with parallel imaging and integral field spectroscopy and Infrared multi slit spectrometer (IRMS) an imaging, multi-slit instrument. A seeing limited, wide-field, multi-object optical imaging spectrograph (MOBIE) will also be available at first light. Studies of many types of astrophysical processes or objects utilize the information conveyed in the polarisation properties of the light from the sources. Polarimetric observations are technically difficult to carry out but the scientific information that can be obtained is very rich. Polarimetric capabilities are now routinely provided at all major observatories and their use is growing over time. A polarimetric science capability is an important capability that the TMT will be called upon to support. The instrument development program will provide a means to respond to the needs of the community. However the telescope itself and the AO system should be able to support polarimetric instruments. Towards this, it is important to estimate the polarimetric budget of the telescope optics. An analytical model to estimate the polarimetric properties of the telescope optics is built on ray tracing from the primary till the tertiary (Nasmyth) focus. The instrumental polarization introduced after reflection from each mirror is estimated using this model. The Mueller Matrices are generated for each reflecting surface, which are compared with the respective Mueller Matrices generated using the Zemax optical design software. The estimation is done for all instrument configurations on the Nasmyth platform i.e., different orientations of the tertiary mirror and also for different zenith angles. The wavelength range considered is 300-5000 nm. The field of view considered in this study is 10 arcmin. In this study, the primary is considered as a 30m diameter monolithic, hyperboloid mirror. A baseline Gemini coating is assumed for the telescope optics. The study indicates that the instrumental polarization of the telescope optics is higher below 400nm. The study also indicates a change in the instrumental polarization with the field angle.

Asensio Ramos

New generation Stokes inversion codes

Oral Session 5

Our instruments are currently able to easily carry out two-dimensional spectropolarimetric observations of the solar surface. The interpretation of these observations has usually been achieved in a pixel-by-pixel manner. In this talk I will present our efforts to improve over current inversion codes and present what we consider the next generation 2D and 3D inversion codes.

Baes, Stalevski, Camps, Fritz, Popovic

Radiative transfer simulations of multiphase AGN tori: thermal emission and polarization

Poster Session B3

The unification model of active galactic nuclei postulates an accreting supermassive black hole as the central engine, surrounded by a putative dusty torus. This dust absorbs the incoming radiation, re-emits it in the infrared and obscures our view of the central region at certain inclinations. We present new radiative transfer simulations of AGNs, in which the torus is modelled as a 3D multiphase sponge-like medium. We show that these new models can explain the observed spectral energy distribution of AGNs over the entire infrared domain, including the observed silicate feature strength and the level of near-infrared continuum. We also show the first polarisation simulations of our new models, and compare the difference between the polarisation signature of clumpy and smooth models.
Bagnulo, Cellino, Sterzik
Linear spectro-polarimetry: a new tool for the physical characterization of asteroids
Oral Session 9
The surfaces of atmosphere-less objects of our solar system are traditionally probed via reflectivity measurements and/or broadband linear polarimetry. Little attention has been paid so far to the wavelength dependence of the linear polarization of the scattered light. We have decided to explore the potential of spectro-polarimetry as a remote sensing tool for asteroids in addition to traditional reflectivity measurements, and carried out a spectro-polarimetric survey of asteroids -- to our best knowledge, the first of its kind. We have observed a sample of asteroids of different albedo and taxonomic classes, as well as a few regions at the limb of the Moon. We show that objects exhibiting similar reflectivity spectra may display totally different polarized spectra, and we suggest that both intensity and polarized spectra should be used for asteroid classification. We found that the variation of linear polarization with wavelength is correlated with the albedo, and we found that in some cases the Ulov law is violated, that is, in contrast to what is expected from simple physical considerations, the fraction of linear polarization and the reflectivity may be correlated positively. We conclude that future modelling attempts of the surface structure of asteroids should be aimed at explaining both reflectivity and polarization spectra.

Bagnulo, Fossati, Landstreet, Kochukov
The importance of non-photon noise in astronomical spectro-polarimetry
Poster A2
Stellar spectro-polarimetry has become extremely popular during the last decade, and has led to major advances in the studies of stellar magnetic fields. Many important discoveries have been obtained thanks to ultra-precise measurements of very small polarimetric signals, which require very stable instruments and special observing strategies. The so called “beam-swapping technique” is a well-known polarimetric technique capable of suppressing many spurious signals due to various instrumental effects. However, when one is interested in ultra-high signal-to-noise ratio measurements, observers start to hit various limitations introduced by the instrument, by the atmosphere, and even by the software for data-reduction. These limitations cannot be overcome by the observing strategies, and sources of errors other than photon-noise must be taken into account. Here we will show in detail the advantages of the beam-swapping technique, and then we will discuss the impact of small instrument and atmospheric instabilities or data-reduction inaccuracies, and how these issues offer an explanation for the origin of the apparently significant observed polarisation signals produced by effects other than those intrinsic to the observed target. We will consider the case of sharp spectral lines observed with the Cassegrain-mounted instrument FORS of the ESO Very Large Telescope, and we will discuss how simple quality-check controls may help to distinguish between spurious signals and exciting discoveries.

Bagnulo, Sterzik, Cellino, Azua
Is there life in our solar system?
Poster B4
Linear broad-band polarimetry is used to characterize the objects of our solar system, and has been proposed as a diagnostic tool for the atmospheres of exo-solar planets. Homochirality, which characterizes life as we know, induces circular polarization in the diffuse reflectance spectra of biotic material, hence it has been suggested that circular polarimetry may be used as a remote sensing tool for the search of extra-terrestrial life. Using astronomical instrumentation, we have decided to explore the potential of both linear and circular spectro-polarimetry as a diagnostic tool for remote sensing of biotic material. We have used the calibration unit of the EFOSC2 instrument of the La Silla Observatory and obtained low resolution circular and linear spectro-polarimetric measurements of a number inorganic and organic materials. Here we present linear and circular polarization signatures from chlorophyll-a pigment response around 680 nm and other pigments like carotenoids and phycocyanins. We then compare our "laboratory data" with linear and circular spectro-polarimetric observations of various asteroids, of the Moon, and of Earthshine obtained with instruments very similar to that one used for our laboratory samples.
Baur, Petrak, Schubert, Phipps  
**New Optics for Astronomical Polarimetry**  
**Oral Session 4**  
A variety of new polarization optics can be employed for polarimetry and for polarization control. Many are enabled by new materials including polymers and liquid crystals. We survey these and other relatively new devices and components available commercially that open new possibilities for astronomers.

Bellot Rubio, Gosic  
**The magnetic flux history of supergranular cells in the photosphere of the Sun**  
**Oral Session 1**  
Convection is an important process in the atmospheres of late-type stars. In the Sun, for example, supergranular cells provide an intimate connection between plasma flows and magnetic fields. They are surrounded by the magnetic network and their interior is home to myriad of weak internetwork magnetic patches that continually appear and disappear. However, the magnetism of solar supergranular cells is poorly understood, due to the absence of sufficiently sensitive polarimetric observations. In this work we use deep magnetograms acquired with the Hinode Narrowband Filter Imager to study the magnetic flux budget and evolution of supergranules. We determine the flux appearance and disappearance rates in individual supergranular cells over periods of up to 38 hours, covering a large fraction of their lifetimes. We find that flux appears in the cell interiors at a remarkably constant rate of 40 Mx cm\(^{-2}\) day\(^{-1}\) over the entire solar surface, with little temporal variations. Most elements show up as unipolar patches, but bipolar emergence is sometimes observed. The primary mechanism of flux removal from the cell interiors is transfer of internetwork flux to the network. Actually, the internetwork turns out to be the main source of flux for the network. This implies a change of paradigm, as ephemeral regions were previously thought to supply the bulk of the network flux. Magnetic flux is removed from the cells faster than it appears in the supergranules, by a factor of approximately 2.2. This is a result of the tendency of internetwork elements to gain flux upon appearance on the solar surface. Such a flux increase may indicate that elements form by coalescence of background flux that is too weak to be detected until it concentrates by some mechanism, or that the magnetic field lines become more vertical with time. Distinguishing between the two possibilities is important, since in the first case no new flux is brought to the surface and the actual amount of flux emerging in supergranular cells may be much smaller than currently thought.

Bhasari, Anusha, Nagendra, Uitenbroek  
**Effect of cross-redistribution on the resonance scattering polarization of O \(\text{I}\) line at 1302 \AA\**  
**Oral Session 5**  
In this paper we present the results of our recent study of scattering polarization in the resonance line of neutral Oxygen at 1302 \AA\. In particular we study the effect of cross-redistribution (XRD) on the fractional scattering polarization in this line using two-dimensional radiative transfer in a composite atmosphere constructed using a two-dimensional magneto-hydrodynamical snapshot in the photosphere and columns of the one-dimensional FALC atmosphere in the chromosphere. We compare the scattering polarization profiles computed using ordinary partial frequency redistribution and XRD scattering mechanisms. We find that to reproduce the amplitude and shape of scattering polarization signals of the O \(\text{I}\) line at 1302 \AA\, multi-dimensional radiative transfer including XRD effects becomes important.

Bermúdez Bustamante, Iñiguez-Garin, Bermúdez, Hiriart, Castro-Chacon, Colorado, García, Guisa, Herrera, Martínez, Nuñez-Alfonoso, Ochoa, Valdez, Ramire  
**Polima-2: A dual-beam imaging polarimeter for the San Pedro Martir National Observatory**  
**Poster Session A3**  
We present the design, construction and calibration of a new Dual-Beam Imaging Polarimeter (polima-2) to measure optical linear polarization of point sources in U, B, V, R, I and H-alpha bands. The instrument is mounted to the 0.84m telescope of the San Pedro Martir National Astronomical Observatory in Mexico. This dual-beam polarimeter is capable to measure two orthogonal polarization states simultaneously. The measurements are insensitive to atmospheric extinction effects or seeing. Polima-2 is capable to measure percentages of linear polarization for astronomical sources of V~10.8 mag with a precision of 0.03%.
**Bhasari, Anusha, K. N. Nagendra, Uitenbroek**

Effect of cross-redistribution on the resonance scattering polarization of O $\text{^{1}S_{0}}$ line at 1302 \AA

*Oral Session 5*

In this paper we present the results of our recent study of scattering polarization in the resonance line of neutral Oxygen at 1302 \AA. In particular we study the effect of cross-redistribution (XRD) on the fractional scattering polarization in this line using two-dimensional radiative transfer in a composite atmosphere constructed using a two-dimensional magneto-hydrodynamical snapshot in the photosphere and columns of the one-dimensional FALC atmosphere in the chromosphere. We compare the scattering polarization profiles computed using ordinary partial frequency redistribution and XRD scattering mechanisms. We find that to reproduce the amplitude and shape of scattering polarization signals of the O $\text{^{1}S_{0}}$ line at 1302 \AA, multi-dimensional radiative transfer including XRD effects becomes important.

**Bianda,**

A ZIMPOL polarimeter system installed at GREGOR in Tenerife, first results

*Oral Session 4*

High resolution polarimetric measurements of solar structures, from the blue atmospheric cut off up to about 900 nm, are possible with ZIMPOL. This polarimeter was initially designed and built at ETH, and it is now permanently installed and used at IRSOL, where it is maintained and further developed in collaboration with SUPSI. A ZIMPOL system is foreseen to be permanently installed at GREGOR in Tenerife. The first installation campaign was performed in 2013, while an observing campaign is foreseen in October 2014. In this talk, we present the first observations carried out by combining the high polarimetric sensitivity of ZIMPOL with the high spatial and spectral resolution of GREGOR. Observations at GREGOR are expected to complement IRSOL observations where high spatial resolution is required to explore the physical conditions of small solar structures, as well as the physical processes taking place therein. Examples of elusive polarimetric signatures to highlight this point will be shown. ZIMPOL at GREGOR will also be used for exploring the behavior of high resolution polarimeters on large aperture telescopes.

**Blazèrè, Petit, Lignières, Aurière, Böhm**

Ultra-weak magnetic fields and atmospheric dynamics of Am stars: beta UMa and theta Leo

*Oral Session 7*

An extremely weak circularly-polarized signature was recently detected in the spectral lines of the prototypical Am star Sirius A (Petit et al. 2011). With a prominent positive lobe, the shape of the phase-averaged Stokes V line profile was atypical of stellar Zeeman signatures, casting doubts on its magnetic origin. We report here on ultra-deep spectropolarimetric observations of two more bright Am stars: beta Uma and theta Leo. Stokes V line signatures are detected in both objects, with a shape and amplitude similar to the one observed on Sirius A. We demonstrate that the amplitude of the Stokes V line profiles depend on various line parameters (Lande factor, wavelength, depth) as expected from a Zeeman signature, confirming that sub-Gauss magnetic fields are likely present in a large fraction of Am stars. We suggest that the strong asymmetry of the polarized signatures, systematically observed so far in Am stars and never reported in strongly magnetic Ap stars, bears unique information about the structure and dynamics of the thin surface convective shell of Am stars.

**Bommier**

The multiline observations of the THEMIS telescope reveal the effect of the solar surface anisotropy on the magnetic field

*Oral Session 1*

The THEMIS telescope was designed in order to perform depth probing of the solar surface magnetic field, by means of multiline observations. The observations are spectropolarimetric ones, in order to infer the magnetic field vector. Magnetic inversion is performed on the observations, but the result is ambiguous, because two field vectors symmetrical with respect to the line-of-sight have the same polarimetric signature. Trying to solve this ambiguity by minimizing divB from observations in two lines formed at different heights, namely Fe I 6301.5 and 6302.5, also observed by HINODE/SOT/SP, we encountered the following problem. The observations have revealed a decrease of the vertical magnetic flux along height in sunspot umbrae and penumbrae, which is not compensated for by an increase of the horizontal magnetic flux. Turning to the literature, we found 15 references confirming the fact, and no reference invalidating it.
We show that the lack of spatial resolution, horizontal as well as vertical, cannot be responsible for this difference. This is confirmed by numerical tests about unresolved magnetic structures. We propose to explain the fact by a plasma effect, the Debye shielding, made anisotropic by the strong stratification, which is present as at any star surface. The strong stratification introduces an "aspect ratio" between horizontal and vertical typical lengths. When this aspect ratio is applied to the observed divB, this quantity becomes null again, and the ambiguity resolution becomes operational. This theoretical proposal about how the surface strong stratification affects the surface magnetic field via the Debye shielding, is available in the Open Access paper by V. Bommier at http://www.hindawi.com/journals/physri/2013/195403/.

**Bommier**  
**Theoretical polarization spectrum of Na I D1 & D2 near the solar limb**  
**Poster A4**  
We present an application to the Na I D1 & D2 scattering polarization spectrum, of our new code XTAT for multilevel-multiline polarized radiative transfer with PRD. This code is based on the new theory including both coherent (Rayleigh) and resonant scatterings, presented in Bommier (1997a,b). Raman scattering was added later on (Bommier, 1999, SPW2). In this theory, which is straightly derived from the Schrödinger equation for the atomic density matrix, the radiative line broadening appears as a non-Markovian process of atom-photon interaction? The collisional broadening is included. The Rayleigh (Raman) scattering appears as an additional term in the emissivity from the 4th order of the atom-photon interaction perturbation development. The development is pursued and finally summed up, leading to a non-perturbative final result. In this formalism, the use of redistribution functions is avoided. The formalism has now been complemented for multilevel-multiline atom modeling, including lower level alignment. The role of the collisions as balancing coherent and resonant scatterings is fully taken into account. A code XTAT, based on this formalism, has been recently developed. We present numerical results about the modeling of the scattering polarization profile of Na I D1 & D2 formed near the solar limb. The solution of the radiative transfer (1D) is of the lambda-iteration type, but the statistical equilibrium equations for the atomic density matrix are resolved at each depth and for each atomic velocity class. Ng acceleration is applied.

**Carciofi, Faes**  
**High Precision Polarimetry of Magnetic Massive Stars**  
**Oral Session 7**  
Some massive stars possess quite strong magnetic fields (larger than several kilogauss) that trap the wind material in a magnetosphere. Spectroscopic and photometric observations of these structures were successfully modeled with the Rigidly Rotating Magnetosphere model of Townsend et al. (2005). Recently, such structure was detected and studied for the first time in polarized light for the helium-strong star \$\sigma$ Orionis E. The observed rotational modulation of the linear polarization was found to be quite small (between 0.03 and 0.07%), while the position angle varied by about 50 degrees. The polarimetric data presented a challenge for the Rigidly Rotating Magnetosphere model that failed at reproducing both the polarimetric and the photometric data simultaneously. This result suggests that the model, at least in its current formalism, cannot predict the correct distribution of material throughout the magnetosphere. In this contribution I will outline the main results obtained for sigma Ori E, and report on new observations made for two other stars: HR5907 and HR7355.

**Carlin Ramirez**  
**Chromospheric diagnosis with forward-scattering Hanle effect in hydrodynamical models**  
**Oral Session 3**  
The synthesis of polarization signals produced by scattering processes in Hanle regime offers an exceptional way of diagnosing the weak magnetic fields of the quiet Sun and the chromosphere through the detailed description of the atomic system, the solar atmosphere and the matter-radiation interaction. However, due to technical, physical and historical reasons the resolution of the corresponding radiative transfer problem has been typically limited to near-limb line of sights and semi-empirical models with no macroscopic velocities. This contribution breaks that trend by presenting several novel approaches and results. We summarize the several effects that solar dynamics has on the generation of scattering polarization signals and explain why solar dynamics is crucial for modeling the polarization signals produced by Hanle effect in chromospheric spectral lines. We also show the first scattering polarization
maps that have ever been calculated as well as the most interesting conclusions derived from their analysis. Furthermore, special emphasis will be put in the forward-scattering geometry as a new and more precise way of doing chromospheric Hanle diagnosis. Our arguments converge in the physical interest of combining all the ingredients to model the linear polarization of the 4227 Å line. We will show the great diagnostic capability and exciting challenge that means to consistently explain the whole spectral polarization profile of such line in realistic chromospheric models.

Casini

Theoretical Tools for Spectro-Polarimetry

Oral Session 3

The understanding of solar magnetism and of the Sun's short-term variability lies at the foundation of any predictive capability of Space Weather. The measurement of the solar magnetic field represents the necessary observational basis for such endeavor. As we cannot (yet) probe directly the Sun's magnetic field by means of in-situ measurements, we must rely on the remote sensing of the solar atmosphere's physical properties. In particular, the polarization state of the solar spectrum carries the signature of symmetry breaking processes that occur in the solar atmosphere, such as the interaction of the ambient electromagnetic field with the emitting gas, and the excitation of the latter by non-isotropic radiation and colliding particles. A reliable modeling of the Sun's polarized spectrum is needed to interpret observations, to develop new plasma diagnostics, and also to set realistic science requirements for new polarimetric instrumentation. Such modeling is rooted in the fundamental description of the interaction of radiation with matter based on quantum electrodynamics. In this talk, I will give an overview of the theoretical tools that are needed for the modeling of the Sun's polarized spectrum.

Cellino

Polarimetry: a primary tool for the physical characterization of the Asteroids

Oral Session 9

Asteroid polarimetry has taken profit in recent years of a renewed interest triggered by the results obtained in a series of investigations including both new observing campaigns and theoretical studies. One of the most important applications of polarimetry to asteroid studies is the derivation of the geometric albedo and of the typical sizes of the particles forming the regolith layer covering the surface. This information can be derived by measuring the variation of linear polarization as a function of phase angle. The most important developments in this field will be presented. This includes both a re-assessment of all available asteroid polarimetric data, and, for the first time, some evidence coming from the "ground truth", made possible by the in situ observations of the surface of the asteroid (4) Vesta.

Cellino, Bagnulo, Tanga

Barbarian asteroids: challenging open questions and constraints to the models of formation of the planetary system

Poster B5

The first Barbarian asteroid, (234) Barbara, was discovered in 2006. Since then, a handful of other objects were discovered before 2014. Barbarians are asteroids characterized by an unusual phase - polarization curve, exhibiting an anomalously high value of the so-called inversion angle. Starting since 2008, it has been discovered that Barbarians are often anomalous also for what concerns their reflectance spectra, which display very high abundances of the spinel mineral, one of the major constituents of the Calcium-Aluminum-rich Inclusions (CAIs) which are found in meteorites and represent the oldest sample of solid material dating back to the very early phases of solar system's history. In 2014, we have discovered that one dynamical family of asteroids, produced by the disruption of a common parent body, is a reservoir of Barbarians, whereas other. Barbarians are not parts of the family, but are located very close in the orbital element space. Even more recently, we have discovered that at least two Barbarians which have very different spectro-polarimetric spectra. The rarity of the Barbarians, and their puzzling properties open many questions which are related also more in general to the history of the early phases of the solar system and to the subsequent dynamical and collisional evolution of the early planetesimals.
Chakali, Chen  
Magnetic field structure in star-forming regions  
Oral Session 8

We present optical and near-infrared polarimetric observations of LDN 1225 (a dark globule located towards the Cepheus OB3 cloud complex), NGC 1893 (a young open cluster with ongoing star-forming activity), and RCW 57A (a mid-infrared bipolar bubble associated with massive star formation). Our aim is to trace the magnetic field structure in various star-forming environments, and in turn to delineate how the magnetic field governs the formation and evolution of molecular clouds, their fragmentation and further collapse to form stars. We would like to address the interplay of massive versus low-mass stars with molecular clouds, manifest as bright rimmed clouds and bubbles formed in and around OB stars. Optical polarimetric data from AIMPOL, and NIR polarimetric data from SIRPOL and MIMIR instruments lead to the following results: (i) There exist a coherent magnetic fields from large (around Cepheus OB3 cloud complex) to small scales (around LDN 1225), suggesting the influential role of magnetic field not only in the formation of a pre-existing Cepheus OB3 filamentary cloud complex but also its further fragmentation into individual clumps as seen in C18O (Yu et al. 1996) and 13CO (Yonekura et al. 1997) maps. (ii) In NGC 1893, there is a change in the magnetic field structure within the intracluster medium, especially around the two elephant-trunk clouds, Sim 129 and Sim 130, which is attributable to either the difference in the field strength in the pre-existing clumps, or the difference in the amount of radiation emanating from their neighboring OB stars. (iii) In RCW 57A, the NIR-polarimetry indicates that the field has shaped the cloud contraction in an hour-glass geometry.

Dayananda (Presenter: Nagendra)  
Modeling of the Center-to-limb variation of the Ca I 4227 A line using FCHHT models  
Poster Session B6

Ca \textsc{i} \(4227 \text{\AA}\) is a chromospheric line exhibiting the largest degree of linear polarization near the limb, in the visible spectrum of the Sun. Modeling of center-to-limb variation (CLV) observations of different lines in the Second Solar Spectrum helps to sample the height dependence of the magnetic field, as observations made at different lines of sight sample different heights in the solar atmosphere. Supriya et al. (2014) attempted to simultaneously model CLV of the \((I,S,I/Q/I)\) spectra of the Ca \textsc{i} \(4227 \text{\AA}\) line using the standard 1-D FAL model atmospheres. They found that the standard FAL model atmospheres and also an appropriate combination of them, fail to simultaneously fit the observed Stokes \((I,S,I/Q/I)\) profiles at all the limb distances \((\mu)\) satisfying at the same time all the observational constraints. This failure of 1-D modeling approach can probably be overcome by using multi-dimensional modeling which is computationally expensive. To eliminate an even wider choice of 1-D models, we attempt here to simultaneously model CLV of the \((I,S,I/Q/I)\) spectra using the FCHHT solar model atmospheres which are updated and recent versions of the FAL models. The details of our modeling efforts and the results are presented.

de Wijn, McIntosh, Tomczyk  
The Chromosphere and Prominence Magnetometer  
Poster A5

The Chromosphere and Prominence Magnetometer (ChroMag) is a synoptic instrument with the goal of quantifying the intertwined dynamics and magnetism of the solar chromosphere and in prominences through imaging spectro-polarimetry of the full solar disk in a synoptic fashion. The picture of chromospheric magnetism and dynamics is rapidly developing, and a pressing need exists for breakthrough observations of chromospheric vector magnetic field measurements at the true lower boundary of the heliospheric system. ChroMag will provide measurements that will enable scientists to study and better understand the energetics of the solar atmosphere, how prominences are formed, how energy is stored in the magnetic field structure of the atmosphere and how it is released during space weather events like flares and coronal mass ejections. An essential part of the ChroMag program is a commitment to develop and provide community access to the inversion' tools necessary to interpret the measurements and derive the magneto-hydrodynamic parameters of the plasma. Measurements of an instrument like ChroMag provide critical physical context for the Solar Dynamics Observatory (SDO) and Interface Region Imaging Spectrograph (IRIS) as well as ground-based observatories such as the future Daniel K. Inouye Solar Telescope (DKIST).
High contrast imaging of circumstellar disks in scattered light: the polarimetric approach of VLT/SPHERE

De Boer

Oral Session 9

In high contrast imaging of protoplanetary and debris disks, a powerful tool has been found in Polarimetric Differential Imaging (PDI). With a simultaneous measurement of orthogonal linear polarization states, we can separate the unpolarized stellar PSF from the polarized light scattered by the disk. Not only does polarimetry allow us to determine the shape of the circumstellar disks; the polarized intensity gives us one more observable to reduce the degeneracy of radiative transfer disk modeling of these disks. Differences in particle size, shape and density will result in differences in the disk's polarized colors. These dust particle properties are thought to reveal the evolution stage of protoplanetary and debris disks, which makes knowledge about them crucial in our understanding of planet formation. Current day polarimetric imagers, such as WHT/ExPo VLT/NaCo allow us to detect details of disks where other high contrast differential techniques remained without success. New polarimetric imagers with extreme adaptive optics systems, such as VLT/SPHERE/ZIMPOL and VLT/SPHERE/IRDIS/POL will become available to the community early next year, and will allow us to image the faint disks around much brighter stars at an unsurpassed contrast and resolution.

del Toro Iniesta, Requerey, Bellot Rubio, Bonet, Martinez Pillet, Solanki, Schmidt

The evolution of individual and groups of flux tubes as seen by IMaX/Sunrise

Oral Session 1

The formation and subsequent evolution of one isolated solar flux tube has been studied for half an hour with unprecedented spatial resolution and polarimetric accuracy by IMaX/Sunrise. The results tell a non-conventional history where merging of several polarity patches are merged up to the equipartition field is reached; the magnetic structure is further intensified to kG strengths by convective collapse with bright points and downflow plumes near the edges of the tube; later, the field weakens to be subsequently intensified in what could be the initial stages of an oscillation. The same observations also show groups of such individual flux tubes evolving as a single entity for almost the whole half-an-hour long series. The group is seen to share a common canopy in the upper photospheric layers while the individual tubes merge and separate much in the same way as groups of bright points have already been observed in photometric observations by other teams.

del Toro Iniesta, Cobos Carrascosa, Ramos Más, Aparicio del Moral, López Jiménez, Balaguer Jiménez

An electronic inverter of the radiative transfer equation for polarized light

Poster A6

Inversion techniques of the radiative transfer equation for polarized light have become the most important tool for interpreting the Stokes spectrum emerging from solar magnetic structures. They are implemented in complicated, computer-expensive, post-facto analysis codes that typically use non-linear, least-square fits between observed and synthetic line profiles. Specifically driven by the stringent telemetry requirements of the Polarimetric and Helioseismic Imager for the ESA’s Solar Orbiter mission (SO/PHI), we have developed an electronic device that carries out the inversion at speeds orders of magnitude faster than conventional codes. It will be in charge of the on-board analysis of SO/PHI data but can also help in quick (almost on-line) analyses of data from the upcoming, new-generation spectropolarimeters and magnetographs that are being developed for new facilities like the ATST or the EST or space missions like JAXA’s Solar C. We present the current status of the development and outline its possible applications.

del Toro Iniesta, Martinez Pillet

Assessing the behavior of modern solar spectropolarimeters and magnetographs

Poster B7

The design and later use of modern spectropolarimeters and magnetographs require a number of tolerance specifications that allow the developers to build the instrument and then the scientists to interpret the data accuracy. Such specifications depend both on device-specific features and on the physical assumptions underlying the particular measurement technique. Here we discuss general properties of every magnetograph, such as the detectability thresholds for the vector magnetic field and the line-of-sight velocity, as well as specific properties of a given type of instrument, namely, that based on a pair of
nematic liquid crystal variable retarders and a Fabry–Pérot etalon (or several) for carrying out the light polarization modulation and spectral analysis, respectively. We derive formulae that give the detection thresholds in terms of the signal-to-noise ratio of the observations and the polarimetric efficiencies of the instrument. Relationships are also established between inaccuracies in the solar physical quantities and instabilities in the instrument parameters. Such relationships allow, for example, one to translate scientific requirements for the velocity or the magnetic field into requirements for temperature or voltage stability. We also demonstrate that this type of magnetograph can theoretically reach the optimum polarimetric efficiencies of an ideal polarimeter, regardless of the optics in between the modulator and the analyzer. Such optics induce changes in the instrument parameters that are calculated.

Demidov, Wang, Kiselev, Su

On the Cross-Calibration of the Hsos Smat Full Disk Longitudinal Magnetograms with Data Sets from Other Instruments

Poster A7

To predict conditions in the solar corona and in the interplanetary medium, what is extremely important for many space weather problems, we need reliable information about distribution of magnetic fields across the whole solar surface. And at present time there are several solar instruments which provide this very important data. It is well known also, that the results of extrapolations of the photospheric measurements of magnetic fields using different observations, made at different observatories or/and in different spectral lines, differ very significantly often. So the problem of choosing of the correct data set is very interesting. And it is closely connected with the problems of cross-calibrations of different data sets. In the case of using different spectral lines (on the same or on the different instruments) the comparison of observations is very important as well for the diagnostics of nature (hidden spatial structure) of solar magnetic fields. No wonder that there are many studies devoted to analysis of observations made with different instruments. The main goal of this investigation is the first time comprehensive analysis of the HSOS SMAT full disk magnetograms. Some important instrumental issues of this instrument are described briefly. The results of comparison of SMAT magnetograms with ones obtained at STOP telescope (Irkutsk, Russia, spectral line Fe I 525.02 nm) and with SDO/HMI (line Fe I 617.3 nm) are presented. Some essential differences between SMAT measurements from one side and STOP and SDO/HMI from the other side are found. To understood the reasons for that the additional quasi simultaneous observation at STOP telescope in different spectral lines used in the instruments under consideration are explored. The results re obtained partly due to support from a cooperative project under NNSF of China and RFBR of Russia (grant 13-02-91158-GFEN-a).

Deng

Polarimetry initiatives in China with new ground-based facilities

Oral Session 2

Solar polarimetry has been a long history in China. In the Hairou Solar Observing Station (HSOS), we have carried out more than 25-year routine observations of photospheric vector and chromospheric longitudinal magnetic field. Recently, HSOS proposed an IR telescope to accurately measure the vector magnetic field by means of “direct measurement of Zeeman split”. Real time multi-layers polarimetry has been pursued by solar physicists for a long time. One way is to achieve a high sensitive spectro-imaging-polarimetry at multiple lines, represented by a prototype Fiber Arrayed Solar Optic Telescope (FASOT) adapting the integral field unit (IFU) to polarimetric optic switching (POS). In this talk, we introduce its observational results. 1m New Vacuum Solar Telescope (NVST) is the primary optical and near infrared observational facility of china. The polarization analyzer of NVST is a rotating modulation system with classical wave plates. The anticipated accuracy is expected to be better than 5×10-3 spatial resolution magnetograph is also being designed in order to match the resolving power of NVST. All the above developments aim to push a next generation Chinese major solar project—Chinese Giant Solar Telescope. In addition, for stellar and extragalactic source, we have developed a simple polarization photometer for the Cassegrain focus of Lijiang 2.4m optical telescope. Both polarization flux density and polarization angle can be measured at the 2.4m telescope.
Elmore
Polarization calibration techniques and scheduling for the Daniel K. Inouye Solar Telescope
Oral Session 2
The Daniel K. Inouye Solar Telescope (DKIST, formerly Advanced Technology Solar Telescope) when fully in operation in 2019 will be by a significant margin Earth's largest solar research telescope. Science priorities dictate an initial suite of instruments that includes four spectro-polarimeters. Accurate polarization calibration of the individual instruments and of the telescope optics shared by those instruments is of critical importance. The Alt-Az telescope mount, off-axis primary and secondary mirrors, a spectral range spanning 380nm to 5000nm and the need for high polarimetric accuracy place challenges on the telescope calibration. A range of techniques will be utilized including use of a set of polarization calibration optics at the Gregorian Focus, and use of observations themselves to infer the primary and secondary mirror contributions in particular use of symmetry of Zeeman sensitive spectrum lines emitted from active regions near disc center. Other techniques being considered include use of sky polarization, solar K-corona polarization, and standard polarimetric stars. Efficient use of telescope observing time leads to a requirement of sharing polarization calibrations of common path telescope components among the spectro-polarimeters and for those calibrations to be repeated only as often as dictated by degradation of optical coatings and instrument reconfigurations. Solar science observations can be used to update calibrations. As a consequence the polarization calibration of the DKIST is a facility function that requires facility wide techniques.

Fauré Robert, Ricort, Lites
Do the quiet Sun magnetic fields vary with the solar cycle?
Oral Session 1
The quiet Sun observed in polarized light exhibits a rich and complex magnetic structuring which is still not fully resolved nor understood. We shall present analysis of center-to-limb polarization measurements obtained with the SOT/SP spectro-polarimeter onboard the Hinode satellite outside active regions in 2007 and 2013, i.e. at a minimum and a maximum of the solar cycle, respectively. The large scale structure of the magnetic field is investigated through the center-to-limb variations of the unsigned circular and linear polarizations in the FeI 630 nm lines averaged over 20” x 30” regions. We observe very different center-to-limb variations in the 2007 and 2013 data, showing that the large scale structure of the quiet Sun magnetic field changed significantly. The small scale structuring was investigated by computing the spatial spectra of the unsigned circular and linear polarization fluctuations over the spatial scale range between 20” and 0.3 “, measured at the center of the solar disk. The maximum of the spectra observed at large scales is broader at the cycle maximum than at the minimum. The slope of the unsigned circular polarization fluctuation spectrum does not vary significantly, whereas the linear polarization spectrum is more flat over the granulation scale range at the solar maximum than at the minimum, showing that there is significantly more energy in the horizontal magnetic field small scale fluctuations at the solar maximum.

Feller, Iglesias, Nagaraju K., Solanki
Fast Solar Polarimeter
Oral Session 4
We are developing a novel Fast Solar imaging Polarimeter (FSP), with an emphasis on significantly increased polarimetric accuracy in combination with high spatial resolution. FSP is based on a high frame-rate (400 fps), low-noise (< 3 e- RMS) pnCCD camera, and ferroelectric liquid crystals. The fast polarization modulation, yielding up to 100 individually recorded full-Stokes frame sets per second, considerably reduces spurious polarization signals induced by external disturbances such as atmospheric turbulence or instrument jitter. On the other hand, high-precision polarimetry in the presence of fast solar evolution (1-10s at the targeted spatial resolution) asks for short exposure times allowing for post-facto reconstruction of the Stokes images, and for high throughput and duty cycle, in order to reach a given polarimetric sensitivity in the shortest possible time. The main scientific focus of FSP will be on studies of small-scale magnetic fields in the photosphere, and of highly dynamic chromospheric magnetic structures. The observing regime covered by this instrument also requires novel approaches in data analysis, like feature tracking or feature based averaging, in order to cope with the low photon limited per-pixel signal-to-noise ratios. The FSP development is split in 2 phases. During phase 1 we have developed a prototype based on a small 264 x 264 pnCCD, and tested its performance at the spectrograph and filtergraph instruments of the German Vacuum Tower Telescope on Tenerife. Phase 2, which has started this year with
the development of a 1k x 1k pnCCD sensor by the semiconductor lab of the Max Planck society, will lead to the first science-ready version of FSP. We will describe the FSP instrument and present some first results obtained with the prototype.

**Fineschi, Capobianco, Girella, Rybak, Gibson**

**Coronal Magnetograph (CorMag) for Space- and Ground-based Solar Observatories**

**Oral Session 4**

This presentation gives an overview of the present advancements and the near-future perspectives of visible-light and ultraviolet spectro-polarimetric instrumentation for probing coronal magnetism from space- and ground-based solar observatories. Magnetic fields in the solar atmosphere provide the energy for most varieties of solar activity, as well as powering the solar wind. Despite the key role of magnetic fields in solar and heliospheric physics, there exists only very limited measurements of the field above the base of the corona where the magnetic pressure dominates over the plasma thermal pressure. Spectro-polarimetric imaging of coronal emission-lines in the visible-light wavelength-band provides an important diagnostics tool of the coronal magnetism. The interpretation in terms of Hanle and Zeeman effect of the line-polarization in visible-light forbidden emission-lines and in permitted UV emission-lines yields information on the direction and strength of the coronal magnetic field. As a study case, this presentation will describe the Torino Coronal Magnetograph (CorMag) for the spectro-polarimetric observation of the FeXIV, 530.3 nm, forbidden emission-line. CorMag has been recently installed on the Lomnicky Peak Observatory 20cm Zeiss coronagraph. The results from CorMag used during the 2010 eclipse will be presented. As a case study of space-borne UV spectro-polarimeters, this presentation will describe the future upgrade of the Sounding-rocket Coronagraphic Experiment (SCORE) to include the capability of imaging polarimetry of the HI Lyman-alpha, 121.6 nm. SCORE is a multi-wavelength imager for the emission-lines, HeII 30.4 nm and HI 121.6 nm, and visible-light broad-band emission of the polarized K-corona. SCORE has flown successfully in 2009. This presentation will describe how in future re-flights SCORE could observe the expected Hanle effect in corona with a HI Lyman-alpha polarimeter and with a FeXIV CorMag.

**Fossati, Bagnulo, Haswell, Patel, Busuttil, Kowalski, Shulyak, Sterzik, Valyavin**

**Polarimetry as a tool to find and study habitable planets orbiting white dwarfs**

**Oral Session 10**

There are several ways planets can survive the giant phase of the host star, hence one can consider the case of Earth-like planets orbiting white dwarfs. As a white dwarf cools from 6000 K to 4000 K, a planet orbiting at 0.01 AU would remain in the continuous habitable zone (CHZ) for about 8 Gyr. Polarization due to a terrestrial planet in the CHZ of a cool white dwarf (CWD) is 10^2 (10^4) times larger than it would be in the habitable zone of a typical M-dwarf (Sun-like star). We will show that polarimetry is thus a powerful tool to detect close-in planets around white dwarfs. Multi-band polarimetry would also allow one to reveal the presence of a planet atmosphere, even providing a first characterization. With current facilities a super-Earth-sized atmosphereless planet is detectable with polarimetry around the brightest known CWD. Planned future facilities render smaller planets detectable, in particular by increasing the instrumental sensitivity in the blue. We will also show that photosynthetic processes can be sustained on Earth-like planets orbiting CWDs and that the DNA-weighted UV radiation dose for an Earth-like planet in the CHZ is less than the maxima encountered on Earth, hence white dwarfs are compatible with the persistence of complex life from the perspective of UV irradiation. We will finally explore the case of planets orbiting magnetic white dwarfs.

**Garbanzo-Salas, Hocking**

**Digital Radar in Costa Rica: design, tools and results**

**Poster A8**

A boundary layer—low troposphere MST type radar is operational in Santa Cruz, Costa Rica. A wide bandwidth system combined with digital receivers allow for the implementation of the deconvolution process in the information gathering. Using interferometry, multiple receivers and 50 metre resolution data, location of atmospheric scatterers is possible. Different modes of operation have been implemented in the radar, generating unified receiver power information as well as 3 receiver information. Results obtained for different phenomena are shown.
Geise, Stencel
Probing disk inhomogeneities using spectropolarimetry in the extreme binary epsilon Aurigae
Poster B10
The epsilon Aurigae system is a single-lined spectroscopic binary system that consists of a variable F0 supergiant star and an occulting disk surrounding an unseen object, probably a B star. The eclipse occurs every 27 years and lasts for almost 2 years. Spectral features attributed to the disk exhibit line shifts due to the rotation of the disk that are easily observed in spectra. In order to better understand the origin and evolution of the disk in the system and to probe disk substructure, we and collaborators Nadine Manset, David Harrington and Jeff Kuhn, obtained 50+ epochs of high dispersion optical spectropolarimetric data from the ESPaDOnS instrument at the Canada--France--Hawaii Telescope before, during, and after the most recent eclipse (2009--2011). The spectra included out-of-eclipse observations rich with polarization features attributable to both the F0 star and the disk. We found numerous 3-sigma (or greater) linear polarization features in the spectra and associated them with atomic absorption features also present in the spectra. We measured position angles associated with scattering in atomic lines and noted several dramatic changes to polarization and position angles with time during eclipse. Many observers of the epsilon Aurigae system have noted that absorption lines deepen and shift with eclipse phases. Our CFHT observations revealed that polarization increased dramatically during eclipse in species such Fe I, Fe II, Ti II, Sc II and others. Polarization peaked around 3rd contact for many species consistent with spectral line behavior. For example, significant linear polarization (>3 sigma) was not observed in K I (7699 Å) in our spectra until Nov 2010, more than 100 days after mid-eclipse, even though red-shifted absorption attributed to the disk was observed in the line near 1st contact, in Sept 2009. The linear polarization returned to near zero by August 2011, our first observation after 3rd contact, even though the line still exhibited deep blue-shifted absorption during that time. Polarization features associated with absorption lines revealed that gas is not distributed evenly in the disk. For example, the leading edge of the disk was observed to be less polarized than the trailing edge of the disk for many gas species. Some lines exhibited greater polarization for a brief time (c. 2 months) in spectra taken before 3rd contact, similar to the continuum polarization as noted by others. The increased polarization could be due to a localized increased number of scatterers because the underlying variability of the F0 star did not appear to change significantly during the period of observation.

Gibson
Forward modeling coronal magnetic fields
Poster B9
The FORWARD suite of Solar Soft IDL codes is a community resource for model-data comparison, with a particular emphasis on analyzing coronal magnetic fields. FORWARD may be used both to synthesize a broad range of coronal observables, and to access and compare to existing data. FORWARD works with numerical model datacubes, interfaces with the web-served Predictive Science Inc MAS simulation datacubes and the Solar Soft IDL Potential Field Source Surface (PFSS) package, and also includes several analytic models (more can be added). It connects to the Virtual Solar Observatory and other web-served observations to download data in a format directly comparable to model predictions. It utilizes the CHIANTI database in modeling UV/EUV lines, and links to the CLE polarimetry synthesis code for forbidden coronal lines. FORWARD enables "forward-fitting" of specific observations, and helps to build intuition into how the physical properties of coronal magnetic structures translate to observable properties.

Gosain, Harvey
Design of Full Stokes Polarimeter for Chromospheric Measurements with SOLIS/VSM
Poster A9
The synoptic magnetic field measurements of the sun continue at National Solar Observatory since 1970s. The daily fulldisk maps of the longitudinal magnetic field were compiled to form synoptic chart of magnetic flux on the solar photosphere. These maps have since then been used for a variety of studies related to solar magnetism. The current NSO synoptic facility is Synoptic Optical Long-term Investigation of the Sun/Vector Spectro-Magnetograph (SOLIS/VSM), which provides photospheric vector and chromospheric longitudinal magnetograms. In near future, an upgrade of SOLIS/VSM to produce chromospheric vector magnetograms is planned. We will present the design of a new polarimeter that will provide optimal efficiency for Stokes vector polarimetry in chromospheric Ca ii 8542 nm spectral line.
Grunhut

**Magnetic Fields in Early-Type Stars**

**Oral Session 7**

For several decades we have been cognizant of the presence of magnetic fields in early-type stars, but our understanding of their magnetic properties has recently (over the last decade) expanded due to the new generation of high-resolution spectropolarimeters (ESPaDOnS@CFHT, Narval@TBL, HAPRSpol@ESO). The most detailed surface magnetic field maps of intermediate-mass stars have been obtained through Doppler imaging techniques, allowing us to probe the small-scale structure of these stars. Thanks to the effort of large programmes (e.g. the Magnetism in Massive Stars (MiMeS) Project), we have, for the first time, addressed key issues regarding our understanding of the magnetic properties of massive \((M > 8 \, \text{Msun})\) stars, whose magnetic fields were only first detected about fifteen years ago. In this talk I will review the spectropolarimetric observations and statistics derived in recent years that have formed our general understanding of stellar magnetism in early-type stars. I will also discuss how these observations have furthered our understanding of the interactions between the magnetic field and stellar wind, as well as the consequences of this interaction.

Gutiérrez, Taliashvil, Mouradian, Lazarian

**Magnetic Evolution of Coronal Hole and the Associated Filament**

**Poster B11**

We report the results of a detailed study of magnetic evolution of equatorial coronal hole and the nearby filament. Particularly, we analyze the small-scale magnetic reconfiguration of their surrounding related with the filament instability using SDO/AIA, SDO/HMI and GONG and Observatory Paris-Meudon images and magnetograms. We observed the signatures of magnetic reconnection between the filament channel and the boundary of coronal hole accompanied by the moving plasma from filament’s surroundings toward coronal hole. Additionally, MHD waves are observed along the moving plasma trajectory, related with magnetic reconnection and followed by the disappearance of a coronal hole and magnetic diffusion.

Hanaoka, Sakurai, IRMag Group

**Solar Full-Disk Polarization Measurement with the Fe I 15648 Line**

**Poster A10**

A near-infrared absorption line, Fe I 15648 A, which has a large Lande g-factor of 3, shows particularly wide Zeeman splitting. We regularly take full-disk polarization maps of the Sun in the Fe I 15648 line (as well as He I 10830 A) with an infrared spectropolarimeter installed into the Solar Flare Telescope of NAOJ. It is known that weak, mostly horizontal magnetic fields ubiquitously distribute in the quiet region on the Sun, besides the strong magnetic field seen in active regions and network boundaries. The weak horizontal fields have not been sufficiently investigated due to the difficulty in the observations. However, the polarization maps in Fe I 15648 show the magnetic field strength at each pixel regardless of the filling factor, and therefore, we can easily isolates the weak horizontal field signals from strong magnetic fields using the Stokes V signals of the Fe I 15648 line. We will present the instrumental aspect and the observational results of the solar near-infrared full-disk polarimetry, highlighting the weak horizontal field seen in Fe I 15648.

Harrington

**Polarized Continuum Radiation from Stellar Atmospheres**

**Poster B12**

We present a simple method for evaluating the polarization and limb darkening of the radiation from stellar atmospheres. We use this method to obtain results for (1) late type stars, based on the MARCS models (Gustafsson et al.), and for (2) early type stars, based on the NLTE model atmosphere code TLUSTY (Hubeny and Lanz). While the net polarization vanishes for an unresolved spherical star, the symmetry is broken by rapid rotation or by the masking of part of the star by a binary companion or during transit of an exoplanet. We give some numerical results for these last two cases. We compare our results with some other published calculations.
Harvey
Two Centuries of Solar Polarimetry
Oral Session 1
In 1811, F. Arago observed the disk of the Sun with his ‘lunette polariscopique’. From the absence of
detectable polarization he concluded that the Sun’s visible surface is an incandescent gas. Thanks to orders
of magnitude technology improvements, a remarkable amount of what we know about the physics of the
Sun has continued to flow from solar polarimetry. This short review compares some selected polarimetric
discoveries with subsequent modern observations to illustrate the tremendous progress of solar polarimetry
during the last two centuries.

Hiriart, Iniguez-Garin, Nunez-Alfonso, Valdez, Valyavin, Ramirez-Velez, Castro-Chacon, Herrera,
Colorado, Garcia, Ochoa
A Simple Low-resolution Spectropolarimeter for Zeeman Measurements of Stellar Magnetic Fields
Poster A11
We present a simple spectropolarimeter based on the low- and medium resolution slit spectrograph of the
2.1-m telescope of Observatorio Astronomico Nacional at San Pedro Martir Sierra, Mexico. The instrument
is intended to measure stellar longitudinal magnetic fields of stars from visual magnitudes 8m to 16m with
characteristic accuracy from 0.5 kG to 10 kG depending on stellar magnitudes and spectral class. In this
poster we describe the spectropolarimeter and present test observations of the longitudinal magnetic fields
in the famous Babcook star (GL Lac), and magnetic white dwarf WD1658+441.

Hoffman
Polarimetry as a Window into Supernova Explosions and Progenitors
Oral Session 8
Supernovae of all types exhibit time-dependent spectropolarimetric signatures produced primarily by
electron scattering. These reveal the presence of aspherical and variable phenomena such as complex
velocity structures, changing illumination, and asymmetric or clumpy morphologies within the ejecta or
surrounding circumstellar material. In addition, the gradual thinning of the ejecta over time allows us to
probe different scattering regions as the supernova evolves. Interpreting the time variations of these
spectropolarimetric signatures yields unprecedentedly detailed information about supernova explosion
mechanisms, the physical processes that shape the density and velocity distributions of the ejecta and
circumstellar material, and the properties of the progenitor star. I will present an overview of supernova
spectropolarimetry, highlighting recent observational and computational results. This versatile technique
helps us to constrain explosion mechanisms, connect SNe with their massive progenitors (as well as other
high-energy transient phenomena such as GRBs), and investigate the process of stellar evolution in other
galaxies.

Hull, Plambeck, Wright,Pillai, Zhao, Sandell
CARMA observations of magnetic fields in star-forming filaments
Oral Session 8
Here we present interferometric observations of polarization in both low- and high-mass star-forming
filaments. All of the data discussed here were obtained with the CARMA 1.3 millimeter dual-polarization
receiver system as part of the TADPOL survey, a key project at CARMA. In the high-mass category we
have NGC 7538 IRS 1, where ~2.5" resolution images show a remarkable spiral pattern in the magnetic
field (B-field), the dust emission, and the molecular outflow. And in the low-mass category we have a
string of three low-mass cores in Serpens, all of which have clearly formed along the same filament. The B-
field toward two of these cores, Ser-emb 8 and 8(N), looks as if it may lie along the filament, and appears
to be unrelated to the orientation of the bipolar outflows from the cores. It is now becoming clear that
filamentary structures are ubiquitous across many orders of magnitude in spatial scale; studying both B-
field morphology and dynamics in these filaments will be crucial for understanding the role B-fields play in
the star- and filament- formation processes. And more specifically, understanding the B-fields in filaments
will help to explain the results from the TADPOL survey: (1) overall, magnetic fields and outflows in
protostellar cores are randomly aligned at 1000 AU scales; however (2) in cores with lower polarization
fractions, B-fields tend to be perpendicular to outflows, which suggests that in these sources the B-fields
have been wrapped up by envelope rotation.
Ibarra, Arrieta, Arias

Study of Polarization in Proto-Planetary Nebulae
Poster B13

In this work we present imaging polarimetry of some compact young Planetary Nebulae and Proto-Planetary Nebulae. Planetary Nebulae are formed by stellar winds interaction in low mass stars. In this scenario a slow and massive stellar wind from AGB phase collides with a subsequent fast and less massive wind forming a shell of shocked gas. Planetary Nebulae have a diversity of morphologies and shapes and especially high collimation mechanism in bipolar nebulae are not well understand yet but binary central stars have been proposed as the shaping mechanism. Extremely high extinction in central regions of planetary nebulae, mainly by dust, makes hard the use of conventional techniques, as photometry or spectroscopy, in order to detect the expected variability of a binary system. Monitoring polarization of selected objects has been done along several observing runs. Variation of polarization values is analyzed and results are discussed in terms of both, nebulae with bipolar morphologies and binary central stars.

Ichimoto, Solar-C WG

Polarimetry and the Solar-C Mission
Oral Session 2

We present the instrument design of one of major solar observation payload planned for Solar-C mission: the Solar UV-Visible-IR observing Telescope (SUVIT). The Solar-C mission aims at fully understanding of the origin of the dynamic solar atmosphere by observing small-scale plasma processes and structures taking place across different geometrical heights and temperature range. The role of the SUVIT is to provide high-angular-resolution investigation of lower solar atmosphere from the photosphere to the uppermost chromosphere with advanced spectroscopic and spectro-polarimetric capabilities. The system consists of a ~1.4m aperture Gregorian telescope and focal plane instrument packages equipped with narrowband/broadband filter imagers and a Littrow-type spectrograph. The basic feature of SUVIT is as follow; - diffraction limited angular resolution; < 0.1" in visible and 0.13”– 0.4" in near IR, - large field of view that covers typical active regions; >180"x180", - wide wavelength coverage; include Ca II 854nm and HeI 1083nm for chromospheric magnetic field measurements, CaII K 393nm (and MgII 280nm,optional) for observing chromospheric fine scale dynamics, visible photospheric lines, and continuum, - high precision spectro-polarimetry; SN ~ 3 x 10^4 achieved for 10"x10" FOV in 10 second with a 2 dimensional spectrograph (IFU). The mission proposal is now under preparation for the submission to JAXA in this year. Solar-C is a Japan-led mission with a substantial international collaboration participated by NASA and ESA. SUVIT will provide a unique opportunity for exploring the nature of the sun’s dynamic atmosphere and highly complementary role to the large aperture ground-based solar telescopes.

Jaeggli

The persistence of apparent non-magnetohydrostatic equilibrium in NOAA 11035
Oral Session 1

Spectropolarimetric observations of NOAA 11035 (Dec 17-19, 2009) at first glance show evidence for a very strong, 3800 Gauss magnetic field outside of the main umbra of the sunspot, in a region where a following polarity magnetic element appears to be pulled through the leading polarity sunspot penumbra. Although the active region produced several small flares during the period of observation, this feature persists for several days as the active region rotates from disk center to the limb, gradually decreasing in strength until the feature completely disappears. This highly unusual magnetic feature raises many questions. How can such a feature persist apparently out of magnetohydrostatic equilibrium? Is this a composite feature produced by multiple velocity and magnetic components along the line of sight? How does the interaction with the opposite polarity produce this feature? Observations from the DST/FIRS 630, 1083, and 1565 nm channels, Hinode/SOT-SP, TRACE, and SOHO/MDI are brought to bear on this problem to create a complete picture of the evolution of this active region in the photosphere, chromosphere, and corona. The Stokes spectra in the strong field region are interpreted with a Milne-Eddington model atmosphere with two magnetic components which has been developed within the framework of the 2CMO inversion code.
Jin, Wang
Cyclic variation of internetwork magnetic fields
Poster A12
With the observation of spectro-polarimeter aboard Hinode in the interval from January 2007 to March 2014, the cyclic behaviour of internetwork magnetic fields is studied. More than 1.3 million internetwork magnetic elements are identified, whose magnetic flux focuses on 2.0e16Mx. The following results are obtained: The internetwork magnetic field increases from solar minimum to maximum, and contributes (3.7-4.5)e22Mx magnetic flux to the Sun. However, the number of internetwork magnetic elements dose not changeduring this period. These results provide insight for the source of internetwork magnetic fields.

Josselin, Lambert, Aurière, Petit, Ryde
Magnetism, polarization processes and mass loss of red supergiant stars
Poster B14
Red supergiant stars (RSG) are not only a key evolutionary stage of massive stars, participating in the chemical evolution of galaxies. They also represent a fantastic and challenging laboratory of (magneto-)hydrodynamics. We will present recent results and on-going polarimetric studies of RSG, and their implications on magnetic field generation, atmosphere dynamics and mass loss process in these stars.

Judge, Kleint, Sainz Dalda, Casini, Lites
Flare footpoint infrared spectropolarimetry including He I 1083 nm
Oral Session 1
While observing active region NOAA 12017 on March 29 2014, we obtained infrared spectra of the X1 flare SOL2014-03-29T17:48 using the Facility Infrared Spectropolarimeter (FIRS) instrument. At infrared wavelengths, flare brightness enhancements were modest, all data remaining unsaturated. The FIRS slit crossed a bright ribbon at the footpoint of flaring plasma associated with a weak acoustic source. We obtained Stokes profiles of various lines between from 1081.93 to 1085.01 nm, with a spatial sampling of 0.3". The profiles of the photospheric Si I 1082.71 nm line are generally consistent with polarization induced by the Zeeman effect. Intensity-like linear polarization is present at levels of a few percent in the 1083.03 nm blend of the He I multiplet during the impulsive phase. The unpolarizable J=0 to J=1 transition at 1082.91 nm shows evidence of smaller polarization, likely from I to QU crosstalk, induced by rapid evolution of the He line during the 1.3s modulation cycle of FIRS. We examine origins of this polarization and argue that particle beams are responsible for the impulsive phase polarization at 1083.03 nm. We advocate for the use of infrared spectropolarimetry for diagnosing important physical properties of flaring plasma and magnetic field, such as the impact polarization reported here.

Keller (no abstract received)

Kim, Lagg, Solanki, Narayan, van Noort
Studies of Supersonic Downflows in Sunspot Penumbrae using spectropolarimetric data
Poster Session B15
Supersonic downflow patches was found in the outer edge of sunspot penumbra. These patches are believed to be the return channels of the Evershed flow. There was previous study to investigate their structure in detail using Hinode SOT/SP observations (M. van Noort et al. 2013) but their data sample was only two sunspots. To make general description it needs to check more sunspot data sample. We selected 242 downflow patches of 16 sunspots using Hinode SOT/SP observations from 2006 to 2012. Height-dependent maps of atmospheric parameters of these downflows were produced by using HeLix which was height dependent LTE inversion code of Stokes profiles. Statistical analysis of magnetic field strength, inclination angle of field line, temperature and line-of-sight velocity are presented. The recovered atmospheric data tell us that downflow patches have different physical signatures comparing normal penumbra properties. Furthermore, our results of three height-dependent layer support that heating process should occur on the downflow patches in the middle of layer.
**Kleint, Sainz Dalda**  
*Photospheric and chromospheric polarimetry of solar flares*

**Oral Session 1**

Solar flare processes are important drivers of space weather, but are not known well enough for reliable predictions. Polarimetric measurements of flares allow us to investigate flare-related magnetic changes in the solar atmosphere, and also the properties of the flare accelerated electrons, for example if they appear as anisotropic "beams", which are crucial questions for flare models. Using the ground-based IBIS instrument at the Dunn Solar Telescope, we have observed multiple flares of different strengths, including the X-flare on March 29, 2014, at subarcsecond resolution. During this unprecedented observing campaign, we also obtained co-temporal data from RHESSI, Hinode, IRIS, and SDO, giving us additional information in different solar layers. The polarimetric observations of the photospheric 6302 Å line and the chromospheric 8542 Å line show intriguing Stokes profiles. The photospheric data can be inverted with various codes (SIR, Nicole) to obtain the physical parameters (e.g., velocity, temperature, B) of the solar atmosphere. We found unusual photospheric signatures, such as reverse Evershed flow, in different flaring active regions, and step-wise changes in the magnetic field. Chromospheric polarimetry is much more difficult, especially during flares, because of the complex non-LTE conditions. But the Stokes V profiles allow us to determine the Doppler velocities and multiple atmospheric components during flares, showing simultaneous up- and downflows. Polarimetric data may shed light on a crucial part of the yet unknown details of flare activity, such as flare triggering, and possibly help to clarify the role of the lower solar atmosphere before and during flares.

**Kochukhov**  
*Multi-line techniques for inference of stellar magnetic fields*

**Oral Session 5**

Spectropolarimetric studies of stellar magnetic fields have to deal with extremely weak line polarisation signatures for all but a few stars. The amplitudes of Stokes signals, even in magnetically sensitive spectral lines, are typically well below the noise level realistically achievable with current instrumentation. Consequently, a detection of these polarisation signatures and their meaningful analysis is impossible without applying some version of the line-addition technique. Here I review basic theoretical foundations of the multi-line spectropolarimetric diagnostic methods employed in stellar magnetometry, give examples of their application, and discuss recent efforts to interpret mean polarisation line profiles with the help of detailed polarised radiative transfer calculations.

**Krishnamurthy (Presenter: Sampoorna)**  
*Paschen-Back effect involving fine and hyperfine structure states*

**Poster A13**

The polarization in the spectral lines is significantly modified by the quantum interference between the atomic states in the presence of a magnetic field. When the magnetic fields produce a splitting which is of the order of or greater than the fine or hyperfine structure splitting, an effect commonly referred to as the Paschen-Back effect (PBE) occurs. In general, PBE occurs for sufficiently strong fields when the fine structure states are involved and for weaker fields in the case of hyperfine structure states. In this work, we apply the recently developed theory of the PBE in atomic fine and hyperfine structure states including the effects of partial frequency redistribution to the case of Li 6708 Å doublet. We explore the signatures of the PBE in a single scattering event and their applicability to the solar magnetic field diagnostics.
**Krishnappa, Feller, Iglesias, Lagg, Solanki**  
**Measurement of Seeing Induced Spurious Polarization**  
**Poster A14**

Ground based polarimetric observations are detrimentally affected by the rapid image distortions introduced by atmospheric seeing. Because of the non-simultaneous nature of the polarization measurement process, seeing causes intermixing of the Stokes vector components. This intermixing, also known as seeing induced cross-talk, has been measured as a function of polarization modulation frequency as well as the number of image aberration terms corrected by an adaptive optics system. The preliminary analysis of these measurements shows that while at lower modulation frequencies (≈ 2 Hz) the cross-talk decreases with increase in number of image aberration terms corrected, at higher modulation frequencies (>25 Hz) the AO corrections don’t seem to play any significant role. However, in agreement with earlier findings, there is a significant reduction in cross-talk with increase in modulation frequency.

**A Sounding Rocket Experiment for the Chromospheric Lyman-Alpha Spectro-Polarimeter (CLASP)**  
**Oral Session 6**

A sounding-rocket experiment called the Chromospheric Lyman-Alpha Spectro-Polarimeter (CLASP) is presently under development to measure the linear polarization profiles caused by scattering processes and the Hanle effect in the hydrogen Lyman-alpha line (121.567nm). Accurate measurements of the linear polarization signals caused by scattering processes and the Hanle effect are essential to explore the strength and structures of weak magnetic fields. The primary target of future solar telescopes is to measure the weak magnetic field in outer solar atmospheres (from the chromosphere to the corona through the transition region). The hydrogen Lyman-alpha-line is one of the best lines for the diagnostics of magnetic fields in the outer solar atmospheres. CLASP is to be launched in 2015, and will provide, for the first time, the observations required for the diagnostics of magnetic fields in the upper chromosphere and transition region. CLASP is designed to have a polarimetric sensitivity of 0.1% and a spectral resolution of 0.01nm for the Lyman-alpha line. CLASP will measure two orthogonal polarizations simultaneously for about 5-minute flight. Now the integration of flight mirrors and structures is in progress. In addition to our strategy to realize such a high-precision spectro-polarimetry in the UV, we will present a progress report on our pre-launch evaluation of optical and polarimetric performances of CLASP.

**Kubo, Low, Lites**  
**Unresolved Mixed Polarity Magnetic Fields at Flux Cancellation Site in Solar Photosphere at 0”.3 Spatial Resolution**  
**Poster A15**

We investigate anomalous circular polarization (Stokes V) profiles observed with the spectropolarimeter of Hinode at the polarity inversion line (PIL) in a magnetic flux cancellation event. The theoretically-expected horizontal fields between the canceling opposite-polarity magnetic elements in this event are not detected at granular scales. We show that the observed anomalous Stokes V profiles are reproduced successfully by adding the nearly symmetric Stokes V profiles observed at pixels immediately adjacent to the PIL. This result suggests that these observed anomalous Stokes V profiles are not indications of a flux removal process, but are the result of either a mixture of unresolved, opposite polarity magnetic elements or the unresolved width of the PIL, at an estimated resolution element of about 0”.3. The hitherto undetected flux removal process accounting for the larger-scale disappearance of magnetic flux during the observing period is likely to also fall below resolution.
Kuckein, Collados, Manso Sainz, Asensio Ramos

Full Stokes observations in the He 1083 nm spectral region covering the pre-, main- and post-flare phases of a M3.2 class flare

Oral Session 7

Solar flares are among the most energetic processes in the solar system. A M3.2 flare was observed in active region NOAA 11748 on 2013 May 17 with the Vacuum Tower Telescope (VTT) at Observatorio del Teide, Tenerife, Spain. Two-ribbon flares are often accompanied by filament eruptions. However, in this case the active region filament tracing the polarity inversion line (PIL) remained stable. Spectropolarimetric measurements of the four Stokes profiles in the chromosphere (He I triplet at 1083 nm) and in the underlying photosphere (Si I line at 1082.7 nm) were obtained with the Tenerife Infrared Polarimeter (TIP-II). In addition, co-temporal spectroscopic data of another chromospheric spectral line (Calcium II at 854.2 nm) and H-alpha filtergrams were acquired with the Echelle spectrograph. Several hours of observations covered the entire flare, including the pre-flare, impulsive, gradual, and post-flare phases. The ground-based observations were compared with different ultraviolet-wavelength images from the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO). Physical properties of the flare and its surroundings were derived with different spectral inversion codes. Post-flare loops crossing the PIL were detected both, in the H-alpha and He I slit-reconstructed images, but not in the Ca II images. The He I intensity profiles show unprecedented strong emission where the flare originates and when the flare starts. In regions with flare emission, Stokes V amplitudes are larger in He I than in Si I.

Landstreet
Surface magnetic fields across the Hertzsprung-Russell Diagram
Oral Session 1

Magnetic fields have been detected in stellar atmospheres, starting with that of the Sun, for over a century. The solar example shows that these fields can have important and unexpected effects. For decades it has also been known that large fields occur in chemically peculiar Ap stars, in pulsars and some white dwarfs, and in rapidly rotating cool stars. However, it’s only in the last decade or so that we have finally obtained a really good overview of the occurrence of fields throughout stellar evolution. We are currently able to detect and characterise at least a few fields in pre-main sequence T Tau and Herbig stars, in main sequence stars from M dwarfs to O stars, in giants and AGB stars, in compact remnants such as white dwarfs and neutron stars, and in a variety of close binary systems. This exciting new observational situation has stimulated a lot of theoretical interest. Magnetic fields can control accretion during star formation, and allow a pre-main sequence object to exchange angular momentum with its surroundings. On the main sequence, dynamo field in cool stars produce a great variety of complex stellar activity, while on the upper main sequence strong fields can control atomic diffusion through the stellar atmosphere, leading to strong chemical peculiarity. Furthermore, fields facilitate angular momentum transport between the stellar core and outer layers, modifying mixing processes. Similar effects occur in later stages of evolution. Currently theoreticians are trying to understand how fields affect the stars in which they are found, and how in turn the stellar structure affects and changes the field. A fundamental issue is to understand how a field forms and evolves as a star goes through its life.

Lebre, Aurière, Fabas, Gillet, Josselin, Mathias, Petit

Full Stokes (IQUV) polarimetry of AGB and post-AGB stars: probing surface magnetism and atmospheric dynamics
Oral Session 1

Full Stokes spectropolarimetric observations of a Mira star and a RV Tauri star are presented and analyzed comparatively. For these cool and evolved radially pulsating stars, we report strong Stokes U and Stokes Q polarimetric structures that are time variable along the pulsating phase. They are clearly associated (i) to the Hydrogen emission lines directly generated by an atmospheric shock wave propagating periodically throughout the stellar atmosphere, (ii) to some metallic lines that are known to be easily polarizable in case of a global asymmetry at the photospheric level. Moreover these observations have revealed the presence of a faint surface magnetic field, while the atmospheric shock waves could imprint an efficient compressive effect on the surface magnetic field.
Challenges of Time-Domain Spectropolarimetry

Oral Session 4

The sun is an active star, with activity occurring at all spatial and temporal scales. Understanding the interactions between the plasma and the electromagnetic fields requires detailed information of the physical conditions within the space volume that these events occur. Comprehensive informations about the physical conditions of the solar atmosphere are contained in the polarized and unpolarized atomic spectra, and a key to our eventual understanding of the working of the sun is observations of the solar atmosphere with high spatial, spectral, and in particular temporal resolution sufficient to resolve the timescale of the dynamic events. Current instruments are capable of providing high quality spectra over a substantial field, although not at the high cadence required for the study of highly dynamic events. Therefore, observational study of these activities represents one of the most challenging problems of modern observational solar astronomy. Recent progress in high speed large format visible and IR focal plane arrays, fiber optic integral field units, and advanced spectrograph and polarimeter design now allow us to construct new instruments that can observe a 3D volume with high spatial, spectral, and in particular high temporal resolution sufficient for the study of highly dynamic phenomena and eruptive events. We will present new instrument concepts specifically developed to address these challenging problems.

Modeling AB Aurigae's Envelope

Oral Session 8

The circumstellar disk around the Herbig Ae star AB Aur has many interesting features, including spirals, asymmetries, and non-uniformities. However, comparatively little is known about the envelope surrounding the system. Recent work by Tang et al (2012) has suggested that the spirals in the disk may instead be due to areas of increased density in the envelope and projection effects. We report polarimetric modeling results of AB Aur designed to begin to place constraints on properties of the envelope such as infall rate and cavity opening angle, compare our results to observations in order to determine the origin of the spiral structures, and place constraints on the location of planetary bodies within the system.

Mass Transfer in the V356 Sgr Binary System

Poster B16

V356 Sgr is an eclipsing binary system currently undergoing Roche-lobe overflow. This has formed an optically thin accretion disk around the primary, mass-gaining star. An extended O VI emission region that is outside of the orbital plane has also been interpreted as evidence for an outflow of material from the impact of the mass stream on the disk. Here we present new and recalibrated spectropolarimetric data, taken with the University of Wisconsin’s Half-Wave Spectropolarimeter (HPOL) at both the Pine Bluff and Ritter Observatories, and discuss these data with an emphasis on their implications for the disk-jet geometry of the system.

Pattern Recognition Techniques for Astronomical Polarization Measurements: Challenges and Opportunities

Oral Session 5

Beyond the classical least-squares fitting used for the inversion of Stokes profiles, the on-going revolution in information technology is contributing a multitude of new statistical tools that change our way of thinking and handling polarization measurements. Pattern recognition techniques used for de-noising or inversion, compressed sensing to re-design our instruments and detectors or bayesian analysis to measure the confidence on our results are but a few of the recent application of these techniques to our field. A review of these "faits marquants" is a harbinger of things to come. Perhaps the infinite zoom on images from Hollywood movies is neither so impossible nor far in the future: how could we use it to improve our polarimetric science?
**Lopez-Barquero, Xu, Desiati, Alex Lazarian, Pogorelov**

**TeV cosmic ray anisotropy from the turbulent magnetic field at the heliospheric boundary**

**Poster B17**

Cosmic ray anisotropy was observed by a variety of experiments to be persistent in a wide energy range. At energies below about 100 TeV, particles are affected by the heliospheric magnetic field structure, in particular by the turbulent perturbations along the flanks of the heliopause. Using the state of the art magnetic field model of the heliosphere, particle trajectories were integrated to study how cosmic rays arrival direction distribution is perturbed when they cross the boundary region with the interstellar medium. Collisionless scattering processes on the turbulent perturbations of heliospheric magnetic fields are shown to have the effect of producing an apparent excess of cosmic rays observed on Earth toward the heliotail at energies below about 100 TeV. In addition, such scattering processes are found to produce large gradients in cosmic ray spatial distribution and anomalous anisotropic features that can be interpreted as small scale anisotropy structures.

**Lueftinger, Guedel, Kochukhov, Johnstone**

**Stellar magnetic activity and its influence on the habitability of exoplanets**

**Oral Session 10**

Stellar magnetism, explorable via Polarimetry, is a crucial driver of activity, ionization, photodissociation, chemistry and winds in stellar environments. Thus it has an important impact on the atmospheres and the magnetospheres of surrounding planets. Modelling of stellar magnetic fields and their winds is extremely challenging, both from the observational and the theoretical points of view, and only recent ground breaking advances in observational instrumentation - as will be discussed during this Symposium - and deeper theoretical understanding of magnetohydrodynamic processes in stars enable us to model stellar magnetic fields and winds – and the resulting influence on surrounding planets – in more and more detail. We have initiated a national and international research network (NPN): 'Pathways to Habitability - From Disks to Active Stars, Planets to Life', to address questions on the formation and habitability of environments in young, active stellar/planetary systems. In this talk, we will discuss the work we are carrying out within this project and then focus on how stellar magnetic fields, their winds and the relation to stellar rotation can be assessed observationally with relevant techniques such as Zeeman Doppler Imaging (ZDI), field extrapolation and wind simulations. Furthermore, we will present recent results of our theoretical and observational studies.

**Magalhães, Seriacopi, Alex Carciofi, Pereyra, Rodrigues**

**Circumstellar Polarimetry**

**Oral Session 8**

Optical and Near-infrared polarization is an important probe of the physical mechanisms that take place in and around the star, as well as a probe of the source's geometry. As the object does not have to be angularly resolved, polarimetry becomes an attractive technique. In this talk we will review mechanisms that polarize light in stellar envelopes and how the observations and modeling can be used to probe the circumstellar environment.

**Marsden, Petit, Jeffers, and the BCool project collaboration**

**The BCool project**

**Oral Session 1**

The BCool project is an international collaboration studying the magnetic activity of low-mass stars from pre-main sequence through to evolved objects and using spectropolarimetric observations to directly characterise the magnetic fields of cool stars using Zeeman Doppler imaging. Through such studies the BCool project aims to empirically study stellar dynamos and how stellar magnetic fields generate winds and the space weather relevant to the evolution of planetary systems. As part of the BCool project we are compiling the largest spectropolarimetric survey of the magnetic fields of solar-type stars yet undertaken, with over 170 solar-type stars observed from 2006 to the present. In this presentation I will give an overview of the BCool project as well as some of the latest results.
Martin, Stift, Leone, Scalia, Gangi, Giarrusso, Bagnulo
Polarimetric Observations of Beta CrB with the Catania Astrophysical Observatory Spectro-polarimeter
Oral Session 1
We present new data of Ap star Beta CrB obtained with the new fibre-fed white pupil echelle spectro-polarimeter, CAOS, attached at the Cassegrain focus of the 91cm telescope at Serra La Nave Observatory. We obtained Stokes IQUV at different rotational phases, and we compare them with those obtained with the ESPaDOnS spectro-polarimeter. Finally, we present a model of the observed Stokes IQUV profiles produced with the radiative transfer code COSSAM.

Martinez Gonzalez
Small-scale solar and stellar surface fields
Oral Session 1
We refer to the quiet Sun as those regions of the solar surface which are out of the active regions (more than 99% of the area). During the last 20 years, the quiet Sun has been observed in polarised light, revealing a magnetism at very small scales (10-1000 km), chaotic, and extremely dynamic. Understanding the quiet Sun is then interesting from a physical point of view but it is also interesting for stellar physics. A quiet magnetic component is known to be present in all stars but we can only study it in detail in the Sun. But the flow of information is in both directions, and much about global behaviour and stellar evolution can be learned only from stellar observations. In this talk I will review the present knowledge of the small-scale magnetism, in the Sun and in other stars, building a bridge between the knowledge gathered from solar quiet Sun observations and modelling, and the diversity of stars.

Martinez Pillet, Rimmeele, the DKIST team
Daniel K. Inouye Solar Telescope: Collaborations: A 4m aperture spectropolarimeter
Oral Session 6
The 4m Daniel K. Inouye Solar Telescope (DKIST) will be the largest solar facility ever built. Designed to meet the needs of critical high resolution and high sensitivity spectral and polarimetric observations of the sun, this facility will support key experiments for the study of solar magnetism and its influence on the solar wind, flares, coronal mass ejections and variability in solar output. Its coronagraphic capabilities will allow direct measurements of the coronal magnetic field with unprecedented sensitivity. The design allows the facility to operate over a broad wavelength range (0.35 to 28 microns). The state-of-the-art adaptive optics system provides diffraction limited imaging and the ability to resolve features approximately 20 km on the Sun. Five first light instruments will be available at the start of operations: Visible Broadband Imager (VBI; National Solar Observatory), Visible SpectroPolarimeter (ViSP; High Altitude Observatory), Visible Tunable Filter (VTF; Kiepenheuer Institute, Germany), Diffraction Limited NIR Spectropolarimeter (DL-NIRSP; University of Hawaii) and the Cryogenic NIR Spectropolarimeter (Cryo-NIRSP; University of Hawaii). Site construction on Haleakala, HI began in December 2012 and is progressing on schedule. Operations are scheduled to begin in 2019. We provide a brief update on the development and construction of the facility and discuss plans for operations, including the DKIST Data Center development.

Maund
Polarimetry of Supernovae
Oral Session 8
A number of different explosion mechanisms, with very different physics, have been proposed to explain the observed diversity of supernovae. A key discriminator between the various explosion models is their characteristic 3D geometries. Spectropolarimetry of supernovae is the only observing technique that can reveal the 3D structure of these events at early times and at large distances. I will present an overview of the latest results from our ongoing VLT FORS spectropolarimetric survey of nearby supernovae, which has revealed the complex structures of core-collapse supernovae, Type Ia supernovae, and the peculiar Type IIn supernovae.
Menard (no abstract received)

Miles-Páez, Pallé, Zapatero Osorio
Infering condensate structures in ultracool dwarfs using linear polarimetry
Oral Session 8
Condensates or “dusty particles” represent one relevant and yet poorly understood source of opacity in ultracool dwarfs. Since condensates polarize the dwarf's output flux by scattering, linear polarization arises as a useful tool to comprehend the complexity of ultracool atmospheres. In this talk, we present the results of our ongoing linear polarimetric monitoring in a sample of M9-L9.5 dwarfs. In particular, we present the short-time polarimetric monitoring of a M9 dwarf for which it is found a modulation of the polarization with the rotation of the object, suggesting different structures in the dwarf's surface. Also, we present a long-term monitoring of a L0 dwarf, which shows a time-evolution in both the degree of linear polarization and the polarization vibration angle that suggests a continuous evolution of the atmospheric condensates structures.

Miles-Páez, Pallé, Zapatero Osorio
Optical and near-infrared linear polarimetry of low mass stars, brown dwarfs
Poster A16
We present red optical and near-infrared linear polarization measurements of a sample of young and mature low-mass stars and brown dwarfs. Polarimetric variability appears to be common among late-type objects. Data suggest heterogeneous dust distributions and evolution of dusty patterns in cool atmospheres.

Miles-Páez, Pallé, Zapatero Osorio
Optical and near-infrared linear spectropolarimetry of the Earth
Poster B18
We present optical and near infrared spectropolarimetry of the Earthshine (Miles-Páez et al. 2014). We find the highest values of linear polarization (>10%) at the bluest wavelengths, which agrees with previous studies. Linear polarization intensity steadily decreases toward red wavelengths reaching a nearly flat value beyond 800 nm. Features due to water vapor and oxygen are detected with high levels of linear polarization at both optical and near infrared wavelengths, which may turn useful for future characterization of Earth-like exoplanets.

Milic, Faurobert
Inhomogeneity and velocity fields effects on scattering polarization in solar prominences
Oral Session 5
In interpretation (i.e. inversion) of spectropolarimetric observations of solar prominences, either single-scattering approximation or 1D slab model is used to infer the magnitude and the orientation of the magnetic field. The fitting procedure assumes that the generative model for observed polarized spectra is rather simple and in this contribution we explore the potential errors one makes when doing so. We study scattering polarization, in the framework of a two level atom, emerging from prominence toy-models which are two dimensional, highly inhomogeneous, and pervaded by different velocity fields. These effects, together with multidimensional (i.e. lateral) radiative transfer lead to complex profiles of scattering polarization which sometimes significantly differ from ones predicted by simple 1D slab model. We find important differences, such as the magnitude of Stokes U which, is now influenced not only by the magnetic field but also by radiative transfer effects. We also apply a simple inversion procedure to our synthetic data, in order to demonstrate the differences between the input magnetic field and the magnetic field inferred by the inversion procedure which assumes 1D slab geometry.
Mishchenko
Scattering Polarization from Macroscopic Particles
Oral Session 3
Electromagnetic scattering by a small particle or a collection of small particles can produce light with polarization characteristics different from those of the incident beam. If the incident beam is unpolarized then the scattered light generally has at least one nonzero Stokes parameter other than intensity; this phenomenon is often called “polarization.” When the incident beam is fully linearly or circularly polarized then the scattered light may become partially polarized or even totally unpolarized; this phenomenon is called “depolarization.” In this talk I use numerically exact computer solutions of the Maxwell equations for individual particles and multi-particle groups as well as of the vector radiative transfer equation in order to study the dependence of polarization and depolarization on such characteristics of the scattering particles as their size, refractive index, and shape. I also discuss various manifestations of the polarization and depolarization phenomena in passive and active remote sensing of Solar System objects.

Monin, Bohlender, Hardy, Saddlemeyer
The DAO liquid crystal spectropolarimeter dimaPol
Poster A17
The spectropolarimeter dimaPol measures circular polarization in spectral lines of stellar objects. The instrument is used to simultaneously detect polarization signals in the hydrogen Hbeta line as well as nearby metallic lines. A fast switching ferro-electric liquid crystal waveplate synchronized with charge shuffling on the CCD is employed to greatly reduce instrumental systematics. dimaPol has been in use on the DAO 1.8-m Plaskett telescope since 2007. In this presentation we show the capabilities of the instrument as well as some of the main results obtained with it to date.

Murillo Salazar, Fernández
An Equation for Uranus Zonal Wind
Poster B19
An equation for Uranus zonal wind was deduced using atmospheric phenomena such as, dark spots, bright spots, clouds and others. This equation is validated with data compiled from several missions since 1986 and provides a better representation of the zonal wind than other equations presented in previous works. The zonal component plays an important role in the dynamics of the giant planetary atmospheres and it is presented here as a sinusoidal type function, from which the zones with greater or lower wind shear can be deduced.

Nagendra
On the Importance of Partial Frequency Redistribution in Modeling the Scattering Polarization
Oral Session 10
It is well-known that partial frequency redistribution (PRD) is the basic physical mechanism to correctly describe radiative transfer in spectral lines. In the case of polarized line scattering, the PRD becomes particularly important to describe the line-wing polarization, instead of the well-known and simpler mechanism of complete redistribution (CRD). Historically, the two-level atom PRD scattering matrices for polarized line scattering were first derived in the 1970's, and later generalized to the case of arbitrary fields in 1997. The latter formulation of the PRD matrices have subsequently been used in the solution of line transfer equation to successfully model the non-magnetic (resonance scattering) and the magnetic (Hanle scattering) polarization observations. In recent years, using the Kramers-Heisenberg approach, we have formulated PRD matrices for various physical mechanisms like quantum interference involving fine- and hyperfine-structure states in a two-term atom. The effects of collisions are included in an approximate way. We have used these PRD matrices to model the observed linear polarization in several interesting lines of the Second Solar Spectrum. In this talk I present few results which highlight the importance of PRD in the interpretation of the polarized Stokes profiles.
Narayanamurthy, Nagendra, Smitha, Stenflo, Bianda, Sampoorna, Ramelli (Presenter: Nagrendra)

A revisit to model the Cr I triplet at 5204-5208 \AA\ and Ba II D$_2$ line at 4554 \AA\ in the Second Solar Spectrum

Poster A18

In our previous attempt to model the Stokes profiles of the Cr I triplet at 5204-5208 \AA, and Ba II D$_2$ at 4554 \AA, we found it necessary to slightly modify the standard FAL model atmospheres to fit the observed polarization profiles. In case of the Cr, this modification was done to reduce the theoretical continuum polarization, and in case of the Ba, it was needed to reproduce the central peak in $Q/I$. In this work, we revisit both these cases using different standard model atmospheres whose temperature structures closely resemble that of the modified FAL models, and explore the possibility of modeling without the need for small modifications of the model atmosphere.

Neiner, Mathis, Alecian, Grunhut, C. Emeriau, and the BinaMIcS and MiMeS collaborations

The origin of magnetic fields in hot stars

Oral Session 7

Observations of stable mainly dipolar magnetic fields in ~10% of single hot stars indicate that these fields are of fossil origin, i.e. they come from the seed fields in the molecular clouds from which the stars were formed. Recent results confirm this theory. First, observations by the BinaMIcS collaboration of hot stars in binary systems show that the fraction of those hosting detectable magnetic fields is much smaller than for single hot stars. This could be related to results obtained in simulations of massive star formation (e.g. Commerçon et al. 2011), which show that the stronger the magnetic field in the original molecular cloud, the more difficult it is to fragment massive cores to form several stars. In addition, recent theoretical calculations show that rapid rotation prevents stability of fossil fields. This would explain the lack of detection of magnetic fields in Be stars, which rotate close to their break-up velocity. Therefore, more and more arguments support the fossil field theory.

Orozco Suarez, Trujillo Bueno, Asensio Ramos

A two dimensional view of spicules from He 1083 nm triplet observations

Oral Session 7

Solar spicules are thin and very dynamic, jet-like chromospheric structures that can be clearly seen at the limb. Their rapid evolution makes the characterization of their magnetic properties extremely difficult. The main reason has to do with the long integration times needed for recording full Stokes measurements in suitable lines and the lack of spatial resolution and image stability during limb observations. In this talk I show He 1083 nm triplet spectropolarimetric data taken at the solar limb during excellent seeing conditions with the German VTT. It has been possible to infer the dependence of the magnetic field vector of spicules with height. We also detect the presence of radiative transfer effects in the Stokes profiles, meaning that spicules may be optically thick at the bottom of the chromosphere. Finally, we compare our results with previous investigations and models.

Palacios, Cid, Guerrero, Saiz, Cerrato

Flux emergence event beneath an eruptive filament

Oral Session 7

Flux emergence phenomena are relevant for many solar scales. We have studied a supergranular-sized flux emergence region beneath a filament. This filament lifted off smoothly, and the associated CME reached Earth. In this study we investigate the flux emergence and size, growth rates, and the possible implications on the filament lift-off. In particular, the observed flux emergence reached hectogauss values. The flux emergence extent appeared just beneath the filament. The emergence acquired a size of 33" in 12 h. The LOS-unsigned magnetic flux is around $10^{20}$ Mx. The transverse field is also analysed. We have also studied the filament eruption speed, size and dynamics, under the torus instability hypothesis.
Palacios, Balmaceda, Vieira, Rempel, Chian, Marcela Rodríguez
Magnetic field configuration in a flaring active region: emerging and shear regions
Poster A19
The Helioseismic and Magnetic Imager (HMI) on board the Solar Dynamics Observatory (SDO) provides continuous monitoring of the Sun vector magnetic field through full-disk photospheric data with both high cadence and high spatial resolution. Here we investigate the evolution of the AR 11249 from March 6 to March 7, 2012. We make use of HMI Stokes imaging, SDO/HARPS HMI line-of-sight (LOS) and transverse components of the magnetic field as well as LOS-velocity maps in order to detect regions with significant flux emergence and/or cancellation. To this purpose, we apply the Local Correlation Tracking (LCT) to the total, transverse and signed magnetic flux data and derive maps of horizontal velocity. From this analysis, we were able to pinpoint localized shear regions (and a shear channel) where penumbrae and pore formation areas, with strong linear polarization signal, are stretched and squeezed/compressed showing also important downflows and upflows. The aforementioned shear channel seems to correspond well with the X-class flare main channel on March 7 2012, as observed in AIA/SDO 171, 304 and 1600 Å. In order to characterize the turbulent flows in the active region, we aim to detect the Lagrangian Coherent Structures (LCS) based on LCT, which divide regions with different dynamics. From our analysis, the identified LCS regions seem to act as barriers (or saddle points) and are related to the evolution of the flare channel. We speculate that these flow dynamics properties could be employed to identify precursors of flare activity.

Palle, Miles-Paez, Zapatero-Osorio, Pirola, Berdyugin, Berdyugina
Polarimetric detection of gas in the candidate disintegrating planet KIC12557548b
Oral Session 10
KIC 12557548b is one of the two known short-period (less than a day) low-mass exoplanets with irregular transit depth and shapes. Discovered by the Kepler satellite, it is thought to lose greats amounts of mass through a comet-like tail while orbiting main sequence mid-K stars. This hypothesis however, remains unconfirmed. The dusty tail should cause linear polarization of the parent star light with an intensity that varies with the planets' orbital phase, the size of the dust grains, and the dust density of the tails. Here we present simultaneous measurements in B, V and R bands of this planet+star systems, and we show our first results indicating a positive detection of polarization varying with the planet's orbital phase.

Pastor Yabar, Martínez González, Collados Vera
Polar faculae magnetism
Oral Session 7
The Quiet Sun (QS) has been largely studied both in infrared and visible spectral ranges. Thus, from works like [Keller et al. 1994, Lin 1995, Grossmann-Doerth et al. 1996, Sigwarth et al. 1999, Lin & Rimmele 1999, Sánchez Almeida & Lites 2000, Socas-Navarro & Sánchez Almeida 2002, Dominguez Cerdeña et al. 2003, Khomenko et al. 2003, Socas-Navarro et al. 2004, Martinez González et al. 2007], one get the conclusion that all the magnetic fields are ubiquitous over all the solar surface, even in QS. So, one can expect the QS to have an important role in the solar energetics. Unlike QS, the study of Solar Poles has been scarce. Thus the main works has been those of [Okunev & Kneer 2004, Blanco Rodríguez et al. 2007, Tsuneta et al. 2008, Ito et al. 2010 and Shiota et al. 2012]. From these works, the general scenario of the solar poles magnetism is the following: as Quiet Sun, it has two different components. One is characterise by strong (~kG) vertical magnetic fields and the second one by weak fields (~hG) homogeneously distributed both, spatially and in magnetic field inclination. In this contribution we pretend to show a comparative study of the magnetic structure of the polar faculae. To do so, we have used data from visible (FeI 6173Å) and infrared (15648Å) obtained at the SST (CRISP [Scharmer et al. 2008]) and VTT (TIP-II [Collados, M et al. 2007]) respectively. The visible data was taken in 14th April 2014 for a field of view at lower latitudes than -80º while the infrared data was taken in 14th September 2013 at latitudes above 75º. The full Stokes vector was recorded in order to retrieve the complete magnetic vector. This step was made inverting the data with various strategies allowed by SIR code [Ruiz Cobo & del Toro Iniesta 1992] obtaining the different thermodynamical and magnetic stratification along the atmosphere. Additionally we have solved the 180º ambiguity assuming the most smooth magnetic azimuth configuration that leads us to two possible solutions. We decide between this two by taking the solution in which the magnetic structure is more vertical when changing the magnetic field vector from LOS frame to local system frame. The results presented will be additionally corrected from projection effects.
Pertenais, Neiner, Parès, Petit, Snik, van Harten
Preliminary Design of the Full-Stokes UV and Visible Spectropolarimeter for UVMag
Oral Session 4
The UVMag consortium will propose a space mission project to ESA at its M4 call, dedicated to the study of the dynamic 3D environment of stars and planets. This space mission will be equipped with a high-resolution spectropolarimeter working from 117 to 870 nm. A preliminary optical design of the whole instrument has been prepared and will be presented in this talk. The design consists of the telescope, the instrument itself and the focusing optics. Considering not only the scientific requirements but also the cost and size constraints to fit a M-size mission, the telescope has a 1.3 m diameter primary mirror and is a classical Cassegrain type telescope that allows a polarization-free focus. The polarimeter is placed at this Cassegrain-focus. This is the key element of the mission and the most challenging to be designed. The main difficulty is to deal with the huge spectral range offered by the instrument; the polarimeter has to deliver the full-Stokes vector with a high precision from the FUV (117 nm) to the NIR (870 nm). The polarimeter module is then followed by a high-resolution echelle-spectrometer achieving a resolution of 35000 in the visible range and 25000 in the UV. The two channels are separated after the echelle grating, allowing a specific cross-dispersion and focusing optics for the UV and visible range. Considering the large field of view and the high numerical aperture, the focusing optic for the UV and also for the visible channel is a Three-Mirror-Anastigmat (TMA), in order to focus all the various wavelengths and orders onto the detectors.

Petit
Polarimetric tomography of stellar surfaces
Oral Session 1
The analysis of polarized signatures recorded in spectral lines of stars provides a powerful method to detect their atmospheric magnetic fields. But beyond simple field detections, crucial information about the origin and impact of stellar magnetism is contained in the spatial distribution and temporal evolution of the magnetic field vector over stellar surface. Extracting this information constitutes a tough technical challenge for spatially unresolved stellar sources, and Zeeman-Doppler Imaging is a tomographic method tackling this question by using a series of polarized measurements collected at various phases across stellar rotation to reconstruct the surface magnetic geometry of a star. Over the years, this technique was successfully employed to model magnetic fields of stars throughout most of the Hertzsprung-Russell diagram. I describe here the basis of this method, as well as its main assets and limitations. I then highlight a number of results obtained so far for various classes of stars, from cool active stars to massive stars and from pre-main sequence objects to evolved giants.

Pignata
Probing the geometry of Type II-Plateau Supernovae explosions
Poster B20
Spectropolarimetry offers a direct probe of early-time Supernova (SN) geometry since a hot, young SN atmosphere is dominated by electron scattering, which by its nature is highly polarizing. Any asymmetry in the distribution of the scattering electrons, or of absorbing material overlying the electron-scattering atmosphere produces a net polarization. Type II-Plateau (IIP) SN are the canonical core-collapse events that arise from isolated red supergiant stars. The precise nature of the mechanism responsible for the stellar explosion, however, remains the subject of debate. One key diagnostic is the explosion geometry. I will present preliminary results of a project aimed to study the geometry of SN IIP explosion through spectropolarimetric observation of their expanding photosphere.

Plowman, Judge
Intensity and Linear Polarization of Fe XIII 10747 and 10798 in the Corona
Oral Session 8
We analyze IQU data for both the 10747 (J=1 to J=0) and 10798 (J=2 to J=1) lines of the ground term (3P) of Silicon like Fe XIII measured from the CoMP instrument and compare these with computations. These data show remarkable quantitative agreement with the model, suggesting that the coronal emission is compatible with the idea that density homogeneity is not extreme. We also compare our work against EUV and white light analyses.
Rangaswamy, Luna, Carrasco, Mayya
A near infrared imaging polarimeter: POLICAN
Oral Session 4
POLICAN is a near infrared (J,H,K) imaging polarimeter developed for the Cananea near infrared camera (CANICA) at the 2.1m Guillermo Haro Astrophysical Observatory (OAGH) located at Cananea, Sonora, Mexico. The camera has a 1024 x 1024 HgCdTe detector (HAWAII array) with a plate scale of 0.32 arcsec/pixel providing a field of view of 5.5 arcmin. POLICAN is mounted externally to the camera and is being used for narrow-field (F/12) linear polarimetric observations. It consists of a rotatable super achromatic (1-2.7µm) half waveplate and a fixed wire-grid polarizer as analyzer. Observations are carried out with modulating the half waveplate at different angles (0º, 22º.5, 45º and 67º.5) to successfully obtain the Stokes parameters (I, Q and U). Image reduction and removal of instrumental polarization consist of dark noise subtraction, polarimetric flat fielding and background sky subtraction. Polarimetric calibration is performed by observing polarization standards published in MIMIR and Whittet et al. Astrometry is performed by matching common stars with Two Micron All Sky Survey. POLICAN achieves polarimetric sensitivity about less than 0.5% and polarization angle uncertainties within 3º with limiting magnitudes of J=17.5, H=17.2 and K=16.0 at S/N =10. Preliminary observations are being carried out towards molecular clouds in the galactic plane in order to study their magnetic properties and understand the star formation process.

Rojas, Taliashvili, Gutiérrez, Carboni
Multi-wavelength Comparative study of oscillations of sunspot and filament
Poster B21
We study oscillations of an equatorial sunspot and the filament located near the sunspot and an additional quiescent equatorial filament, far from the sunspot, based on SDO/AIA, SDO/HMI and GONG multi-wavelength data. In order to identify the inter-correlation between the sunspot’s and the filament’s oscillations, as well as the independent oscillations of each of them and the associated phenomenon; we analyze the evolution of the filament and sunspot’s oscillations just prior to the filament eruption and onset of subsequent Coronal Mass Ejections (CMEs). We select several small regions of the filament body, compute the average intensities inside each region and get the relative oscillation with respect to the Savitzky–Golay filter. Additionally, Morlet wavelet power spectrum is obtained in order to deduce the frequencies of these oscillations. The same process is applied to the sunspot. Preliminary results of this comparative study, allows us a better understanding of the implication of sunspot’s and filaments’ oscillation at the filament dynamic evolution and the associated CME.

Rosén, Kochukhov, Wade
Zeeman Doppler imaging of a cool star using all four Stokes parameters for the first time
Poster B22
Magnetic fields in cool stars are ubiquitous but can still be challenging to characterize due to their complexity and relatively low strength. The polarization signatures are proportional to the field strength, and current studies of cool star magnetic fields are using circular polarization only since linear polarization is even weaker. However, circular polarization is only sensitive to the line-of-sight component of the magnetic field, meaning that a lot of structural features are not recovered or misinterpreted when only circular polarization is used for reconstruction of stellar magnetic topologies. Linear polarization, on the other hand, is sensitive to the transverse component of the magnetic field and would provide a more complete picture of the magnetic field topology if combined with circular polarization. We have identified the first target, RS CVn star II Peg, suitable for full Stokes vector analysis. Using current instrumentation, we have succeeded in systematically detecting its linear polarization signatures with the precision and rotational phase coverage sufficient for magnetic mapping. Here we present the very first temperature and magnetic field maps reconstructed for a cool star using all four Stokes parameter spectra.
Sabin, Zhang, Zijlstra, Hull, Patel, Plambeck, Wade, Lèbre, Vázquez, Zauderer, Navarro, Contreras, Guillén

Detection of magnetic fields in evolved low-intermediate mass stars
Oral Session 1

The role of magnetic fields in late type stars, such as Asymptotic Giant Branch stars (AGBs), Post-AGBs and Planetary Nebulae (PNe), is poorly known from an observational point of view. Magnetic fields are however believed to have a non-negligible influence on the dynamics (via mass loss control, outflows shaping) and even on the chemistry (e.g. extra mixing) of these stellar objects. We are therefore presenting different investigations which aim at filling the gap between the observations on the one hand and the theoretical predictions on the other hand. First, in order to trace the geometry of the magnetic field based on dust grain alignment, we performed single-dish and interferometric sub-millimeter and millimeter polarimetric observations of a sample of PAGBs and PNe to establish the field's configuration. And then, we recently conducted a high resolution spectropolarimetric analysis of a group of Post-AGB stars to unveil for the first time surface magnetic fields. These new discoveries (combined to MHD modelling) are a first step for a better understanding of the influence of magnetic fields in these evolved stars.

Sainz Dalda, Kleint

How to analyze millions of spectral profiles of an X1.0 flare efficiently and still feel good afterward
Oral Session 5

Machine learning techniques have been successfully applied to the analysis and interpretation of large datasets in different fields, such as social media (facebook, Google, Amazon, etc.), Economics, and Science (neuroscience, genetics, biology, astronomy, etc.). The same techniques can be applied to a very large amount of spectra to classify them very fast, according to a given science goal. Machine learning techniques are most useful when the amount of data is very large and most other techniques would be too slow or computationally too demanding. We observed an X1.0 flare on 29 March 2014 with an unprecedented number of instruments and thus we have more than 1 million spectra every minute in the spectral lines Ca II 8542 Å, Fe I 6302 Å, H-alpha 6563 Å, He I 10830 Å, and Mg II h & k, including polarimetric information for some of them. While it is desirable to analyze all these spectral lines together for maximum information about the physics, this obviously cannot be done manually. We will present a rather simple technique, which allows us to more easily analyze such a wealth of data. Using k-means clustering, we identify the spatial locations of similar spectra and thus we can provide a simple, spatially and temporally coherent interpretation of the magnetic and thermodynamic conditions. This information is an extremely fast way to get a good proxy to determine when and how to use properly more advanced techniques, e.g.: when to apply multi-gaussian fits in Intensity profiles, how well the bisector method will work, and how important it is to use a multi-component atmosphere during inversions, etc. We will present an example classification of Stokes profiles during the flare to explain how to easily analyze changes in the magnetic structure.

Sampoorna, Nagendra

PRD effects on polarized lines formed in moving media in the presence of a weak magnetic field
Oral Session 10

It is well-known that the macroscopic velocity fields in the solar atmosphere significantly affect the shapes of the emergent Stokes profiles. Although the velocities and their gradients are small, the inextricable coupling between the angle and frequency variables becomes more complex in a moving media when compared to a static media. In this paper we use an exact theory of partial frequency redistribution (PRD) in line scattering on a two-level atom in the presence of an external weak field. For simplicity we consider empirical velocity laws to represent motion of the atmospheric layers. Further, we also show that there exists significant differences between the Stokes profiles computed using the angle-averaged and angle-dependent versions of the PRD. It is shown that angle-dependent PRD effects are more important in magnetized scattering in comparison with non-magnetic scattering. The results are presented for simple atmospheric models. They are expected to be of relevance to polarized line formation in slowly expanding chromospheric layers.
Schmieder, Levens, Lopez Ariste, Labrosse
Polarimetric measurements in prominences observed by THEMIS
Oral Session 8
Since 2012 coordinated campaigns with the THEMIS spectropolarimeter in Tenerife and other instruments (spatial: Hinode/SOT, IRIS or ground based: Sac Peak, Meudon) are organized to track prominences. THEMIS is observing the He D3 line depolarisation and we used the CPA method to derive the field strength, inclination and azimuth. Among the large number of observed prominences we can distinguish different kinds of prominences even all of them are quiescent because stable as filaments since three days and not eruptive. Nevertheless they present dynamical characteristics: transverse waves or high velocities reaching 100 km/s. Commonly we have observed horizontal magnetic field lines in all of them except in some of them presenting a thin shape and apparent rotation. The field strength is between 5 to 15 Gauss. We tested the possibility of an additional turbulence field component. The model is compatible with the polarimetric observations in some of them.

Shchukina
The impact of surface dynamo magnetic fields on the chemical abundance determination
Oral Session 10
The solar abundances of iron and of the CNO elements play an important role in addressing a number of important issues such as the formation, structure, and evolution of the Sun and the solar system, the origin of the chemical elements, and the evolution of stars and galaxies. Despite the large number of papers published on this issue, strong debates about the abundances of such solar chemical elements continue. Most abundance studies ignore the fact that the solar photosphere is significantly magnetized, due to the ubiquitous presence of an unresolved, tangled magnetic field at subresolution scales, and whose mean strength is thought to be of the order of 100 gauss. The aim of the present investigation is to quantify the impact of such significant small-scale magnetization on the determination of the solar chemical abundances. To this end, we used two 3D snapshot models of the “quiet” solar photosphere taken from state-of-the-art radiative magneto-hydrodynamical simulations with small-scale dynamo action. One of the 3D models used has a negligible magnetization, while the other is characterized by a surface mean field strength of 160 gauss. Using such 3D models we have carried out spectral synthesis for a large set of FeI, Cl, Ni, and OI lines, in order to derive abundance corrections caused by the following effects: (1) the magnetic, Zeeman broadening of the intensity profiles (direct effect), and (2) the magnetically induced changes of the photospheric temperature structure (indirect effect). We find that if the magnetism of the quiet solar photosphere (B~100 gauss) is mainly produced by a small-scale dynamo, then its impact on the determination of the abundances of iron, carbon, nitrogen and oxygen is negligible.

Shibasaki (Presenter: Ichimoto)
Probing Coronal and Chromospheric Magnetic Field with Radio Imaging Polarimetry
Oral Session 8
Circularly polarized radio waves interact with gyrating electrons in the magnetic field due to the Lorentz force. Emissivity and absorption coefficients of right-hand-circular polarization (RCP) and that of left-hand- circular polarization (LCP) are different. This is the essence of magnetic field measurements with radio technique. Inversion procedure to get magnetic field strength from measured signal is rather simple because these processes can be treated by classical theory of electromagnetism and mechanics. In thermal plasma, emissivity and absorption coefficient of radio waves are strongly coupled and their ratio is approximated by the Rayleigh-Jeans formula. Optical depths (line-of-sight integrated absorption coefficient) of RCP and LCP differ in the presence of magnetic field. The radio intensity difference between RCP and LCP (Stokes parameter V) can be used to measure line-of-sight magnetic field strength. Measurement of magnetic field strength in the corona is rather simple due to small optical depth. Even in optically thick chromosphere, we can estimate magnetic field strength due to steep temperature gradient. Examples of magnetic field distribution in the solar corona and in the chromosphere observed by the Nobeyama Radioheliograph will be presented. There are other methods to estimate magnetic field strength using radio techniques in the solar atmosphere and also in the interplanetary space. These methods will also be reviewed.
Soam, Maheswar, Chang, Sami, Bhatt, Tamura
Magnetic field structure around cores with very low luminosity objects
Oral Session 8
We carried out optical polarimetry of five dense cores namely, IRAM 04191, L1521F, L328, L673-7 and L1014 which are found to harbour very low luminosity objects (VeLLOs; Lint < 0.1L). This study was conducted mainly to understand the role played by the magnetic field in the formation of very low and sub-stellar mass range objects. Light from the stars while passing through the dust grains that are aligned with their short axis parallel to an external magnetic field becomes linearly polarised. The polarisation position angles measured for the stars can provide the plane of the sky magnetic field orientation. Because the light in the optical wavelength range is most efficiently polarized by the dust grains typically found at the outer layers of the molecular clouds, optical polarimetry mostly traces the magnetic field orientation of the core envelope. The polarisation observations of stars projected on IRAM 04191, L328, L673-7 and L1014 were obtained in R-band and those of L1521F were obtained in the V-band. The angular offsets between the envelope magnetic field direction (inferred from optical polarization measurements) and the outflow position angles from the VeLLOs in IRAM 04191, L1521F, L328, L673-7 and L1014 are shown. The results obtained from our study on the limited sample of five cores with VeLLOs show that the outflows in three of them tend to nearly align with the envelope magnetic field.

Solanki, del Toro Iniesta, Woch, Gandorfer, Hirzberger, Schmidt, Appourchaux, the SO/PHI team
The Polarimetric and Helioseismic Imager on Solar Orbiter
Oral Session 2
The Solar Orbiter is the next solar physics mission of the European Space Agency, ESA, in collaboration with NASA, with a launch planned in 2017. The spacecraft is designed to approach the Sun to within 0.28 AU at perihelion of a highly eccentric orbit. The proximity with the Sun will also allow the Sun to be observed at uniformly high resolution at EUV and visible wavelengths. Such observations are central for learning more about the magnetic coupling of the solar atmosphere. At a later phase in the mission the spacecraft will leave the ecliptic and study the enigmatic poles of the Sun from a heliographic latitude of up to 33.5 degrees. A central instrument of Solar Orbiter is the Polarimetric and Helioseismic Imager, SO/PHI. It will do full Stokes imaging in the Lande g=2.5 Fe I 617.3 nm line. It is composed of 2 telescopes, a full-disk telescope and a high-resolution telescope, that will allow observations at a resolution as high as 200 km on the solar surface. SO/PHI will also be the first solar polarimeter to leave the Sun-Earth line, opening up new possibilities, such as stereoscopic polarimetry (besides stereoscopic imaging of the photosphere and stereoscopic helioseismology). Finally, SO/PHI will have a unique view of the solar poles, allowing not just more precise and exact measurements of the polar field than possible so far, but also enabling us to follow the dynamics of individual magnetic features at high latitudes and to determine solar surface and sub-surface flows right up to the poles. In this presentation an introduction to the science goals and the capabilities of SO/PHI will be given, as well as a brief overview of the instrument and of the current status of its development.

Stam (no abstract received)

Stenflo
Resolution of the D1 enigma: Physics of polarized scattering at multi-level systems
Oral Session 3
The extensive literature on the physics of polarized scattering may give the impression that we have a solid theoretical foundation for the interpretation of spectro-polarimetric data. This theoretical framework has however not been sufficiently tested by experimental data obtained under controlled conditions. While the solar atmosphere may be viewed as a physics laboratory, the observed solar polarization depends on too many environmental factors that are beyond our control. The existence of a symmetric polarization peak at the core of the solar Na D1 line has remained an enigma for two decades, in spite of persistent efforts to explain it with available quantum theory. A decade ago a laboratory experiment was set up to determine whether this was a problem for solar physics or quantum physics. The experiment revealed a rich polarization structure of D1 scattering, although available quantum theory predicted zero results. After many years of work it has finally been possible to formulate a well-defined and self-consistent theory of quantum scattering that can quantitatively reproduce in great detail all the rich polarization structure revealed by the laboratory experiment. Here we describe the various physical ingredients of the new theory, with focus on the aspects that have been missing in the previous theoretical framework.
Stepan
Three-dimensional simulations of scattering polarization and the Hanle Effect in MHD chromospheric models
Oral Session 10
Scattering line polarization and the Hanle effect are among the most important mechanisms for diagnostics of the solar and stellar atmospheres. The fact that the real atmospheres are horizontally inhomogeneous makes the spectral synthesis and interpretation very challenging because the effect of thermodynamic fluctuations on spectral line polarization is entangled with the action of magnetic fields. This applies to the spatially resolved as well as to the averaged spectra. The necessary step towards interpretation of such spectra is to study the line formation in sufficiently realistic 3D MHD models and comparison of the synthetic spectra with observations. In this talk, I will discuss the recent progress in the field of 3D non-LTE synthesis of polarized spectral lines and I will show some of the new results obtained with the radiative transfer code PORTA.

Sterzik, Bagnulo
Polarization Bio-signatures of Planet Earth
Oral Session 9
Polarimetry is routinely used as a diagnostic tool to characterise the surfaces of bodies in our solar system. In the near future, polarization measurements of the starlight reflected by exoplanets will become a common tool to characterise the atmospheres and the surfaces of other worlds. If extra-terrestrial life has similar signatures as the life we know, then astronomical observations of planet Earth represent the best benchmark case to probe bio-signatures on other planets. In fact, linear polarisation spectra of Earthshine (the sunlight that has been first reflected by Earth and then reflected back to Earth by the Moon), allow us to detect the presence of oxygen, ozone, and water in the atmosphere of our planet. It allows us also to measure surface properties such as fractional contributions of clouds and ocean, as well as vegetation. Ultimately, Earthshine observations provide strong observational constraints on model predictions for Earth-like exoplanets. In this talk, we will review the current status and prospect of observations of Earthshine through polarimetry, and will critically discuss applications to exoplanet observations.

Strachan, Ko, Moses, Laming, Auchere, Casini, Fineschi, Gibson, Knoelker, Korendyke, McIntosh, Romoli, Rybak, Socker, Tomczyk, Vourlidas, Wu
Waves and Magnetism in the Solar Atmosphere (WAMIS)
Poster A20
Magnetic fields in the solar atmosphere provide the energy for most varieties of solar activity, including high-energy electromagnetic radiation, solar energetic particles, flares, and coronal mass ejections, as well as powering the solar wind. Despite the fundamental role of magnetic fields in solar and heliospheric physics, there exists only very limited measurements of the field above the base of the corona. What is needed are direct measurements of not only the strength and orientation of the magnetic field but also the signatures of wave motions in order to better understand coronal structure, solar activity and the role of MHD waves in heating and accelerating the solar wind. Fortunately, the remote sensing instrumentation used to make magnetic field measurements is also well suited to measuring the Doppler signature of waves in the solar structures. With this in mind, we developed a mission concept—within the constraints of the NASA Low Cost Access to Space program—entitled WAMIS (Waves and Magnetism in the Solar Atmosphere). WAMIS will take advantage of greatly improved infrared (IR) detectors, forward models, advanced diagnostic tools and inversion codes to obtain a breakthrough in the measurement of coronal magnetic fields and in the understanding of the interaction of these fields with space plasmas. This will be achieved with a high altitude balloon borne payload consisting of a coronagraph with an IR spectro-polarimeter focal plane assembly. The balloon platform provides minimum atmospheric absorption and scattering at the IR wavelengths in which these observations are made. Additionally, a NASA long duration balloon flight mission from the Antarctic can achieve continuous observations over most of a solar rotation, covering all of the key time scales for the evolution of coronal magnetic fields.
Sylwester, Stęślicki, Szaforz, Bąkala, Kowaliński, Ścisłowski, Gburek, Siarkowski, Płocieniak, Kuzin

SolpeX: the soft X-ray flare polarimeter under construction for ISS

Oral Session 6

We present an innovative soft X-ray polarimeter and spectrometer SolpeX. The instrument will be mounted aboard the ISS within the Russian science complex KORTES. The SolpeX instrument is composed of three individual measuring units: the soft X-ray polarimeter with 1-2% linear polarization detection limit, fast-rotating drum Bragg X-ray spectrometer with very high time resolution (0.1s) and a simple pin-hole soft X-ray spectral imager - with moderate spatial (∼20arcsec), spectral (0.5 keV) and high time resolution (0.1s). This combination of measuring units will provide new opportunity to reliably measure possible X-ray polarization, thus contributing towards better understanding of particle acceleration mechanism(s) in solar flares, in particular during the impulsive phase. Polarized Bremsstrahlung and line emission due to presence of particle beams will be detected as well as the hot plasma evaporation velocities will be simultaneously measured. We discuss details of the construction of the instrument as well as its operation scenarios and electronic/telemetry solutions adopted. Delivery of SolpeX to ISS is expected in 2017/2018.

Taliashvili, Mouradian, Gutiérrez, Sánchez

Long-Term Evolution of Filaments Associated with Emerging Magnetic Flux

Poster B25

We present the results of a long-term study of filaments, considering the Ha and EUV daily images, magnetograms and synoptic/magnetic maps. We identify the regions characterized by preferential recurrent concentration of filaments that we found related with emerging new magnetic flux regions and to high solar activity. We consider small-scale as well as large-scale emerging flux regions and include the quiescent as well as active prominences. The correlation between these emerging magnetic regions, general solar activity, especially prominence instabilities and the associated Coronal Mass Ejections are discussed.

Tarr, Leka, Judge

Inferring magnetic and plasma properties at multiple heights in the Sun's atmosphere with IBIS data

Poster A21

The purpose of this work is to use multiple lines formed at different heights in the solar atmosphere to determine the local plasma and magnetic field parameters governing the formation of each line. Using multiple lines allows us to relate the variation of the magnetic field with height to the local plasma parameters. We focus on the photospheric 6302Å FeI and chromospheric 5896Å NaI spectral lines. Stokes (I, Q, U, V) for each line were measured using the IBIS instrument, an imaging spectropolarimeter with a Fabry-Perot type interferometer at the Dunn Solar Telescope. The measured profiles are then matched to the theoretical lines using the method of Jefferies, Lites, and Skumanich (JLS, 1989). The data were taken on September 25th, 2011, and cover a field of view of 40x80 arcseconds, centered on the small active region, NOAA 11304, and include regions of plage, pores, and emerging flux, as well as quiet sun.

Thonhofer, Bellot Rubio, Utz, Hanslmeier, Jurcak, Plantschitsch, Lemmerer

Parallelization of the SIR code for the investigation of small-scale magnetic features in the solar photosphere

Poster A22

One of the most important driver for the highly dynamic processes in the lower solar atmosphere (photosphere) are magnetic fields. Apart from large-scale magnetic phenomena, such as sunspots, also exists smaller magnetic flux concentrations. These structures, e.g. single magnetic flux tubes seen as Magnetic Bright Points (MBPs), can today be investigated in more detail due to the enhanced observational possibilities. The most common method to deduce magnetic field properties from observations is the inverson of spectropolarimetric data. For our work we used the SIR code, a well-established tool that can not only derive the magnetic field vector and other plasma parameters (e.g. temperature, line-of-sight velocity), but also their stratifications with height, which enables us to retrieve a 3-dimensional model of the photosphere. In order to enhance the runtime performance of the SIR code and its usability we parallelized the existing code and extended it by the possibility of standardized in/output. We applied the enhanced code to a timeseries of high-resolution data. The presented results show the interaction of magnetic features with convectional pattern (granulation).
Tichý, Štěpán, Trujillo Bueno, Kubát
Formation of polarized spectral lines in atmospheres with horizontal inhomogeneities
Poster B23
We study the problem of the generation and transfer of spectral line polarization in models of stellar atmospheres with horizontal plasma inhomogeneities. We solve the non-LTE radiative transfer problem in full 3D geometry taking into account resonant scattering polarization and its modification by magnetic fields via the Hanle effect. We show that horizontal fluctuations of the thermodynamical conditions of stellar atmospheres can have a significant impact on the intensity and linear polarization of the emergent spectral line radiation and on their center-to-limb variation.

Tomczyk
A Large Coronagraph for Solar Coronal Magnetic Field Studies
Oral Session 2
Measurements of solar coronal magnetic fields are required to advance our understanding of the processes responsible for coronal heating, coronal dynamics, and the generation of space weather that have severe societal consequences. Recent advances have shown that observation of the Zeeman effect in IR coronal emission lines holds promise for the measurement of coronal magnetic fields. These measurements are very difficult due to the low photon flux of the corona and the small magnetic fields present there. We are proposing to build a 1.5-m aperture refracting coronagraph to routinely measure the strength and direction of magnetic fields in the solar corona, as part of the Coronal Solar Magnetism Observatory (COSMO). The science drivers of a coronal magnetograph will be presented along with derived instrument requirements. A coronagraph design that meets these requirements will be presented along with engineering studies that demonstrate the feasibility of constructing this coronagraph.

Trinidad
High-velocity Wind from IRS 1 in the NGC 2071IR
Poster B24
We report the results of simultaneous radio continuum and water maser observations toward the NGC 2071IR star-forming region, carried out with the VLA in its A configuration. We detect continuum emission toward the infrared sources IRS 1 and IRS 3 at 1.3 and 3.6 cm. In particular, IRS 1 breaks up into three continuum peaks (IRS 1E, 1C, and 1W), aligned in the east–west direction, being IRS 1 is the central source. The morphology of the condensation IRS 1W is very interesting, which has an elongated structure and shows a significant curvature towards the north. We suggest that this morphology could be explained as the impact of a high-velocity wind or jetlike outflow from IRS 1 on a close companion or other obstruction, which also explains the strong water maser emission observed toward IRS 1W.

Trujillo Bueno
Atomic Scattering Polarization: Observations, Modeling, Predictions
Oral Session 6
The future of “measuring” magnetic fields by interpreting the spectral line polarization produced by optically pumped atoms in the solar atmosphere cannot be bright unless we are able to model spectropolarimetric observations with a very high level of confidence. Although much remains to be done, this lecture reviews very recent advances on the identification of new polarizing mechanisms which turn out to be key for understanding some of the most enigmatic Q/I patterns of the linearly-polarized solar visible spectrum. In addition, it shows some radiative transfer predictions on the expected scattering polarization in FUV and EUV lines, with the hope that one day a space telescope will observe them in order to explore the magnetism of the chromosphere-corona transition region via the Hanle effect.
van Noort
Spatially coupled inversion of spectro-polarimetric data
Oral Session 5
Spectro-polarimetric data are uniquely suitable for the determination of the atmospheric parameters of the solar atmosphere. Although, traditionally, only the degradation of the data in the spectral dimension has been considered, the spatial degradation of the data also has a significant effect on the spectra. The spatially coupled version of the SPINOR inversion code takes this spatial degradation explicitly into account by inverting an extended field-of-view, while considering explicitly the spatial degradation in the Levenberg-Marquardt minimization of the merit function. The inversion results of Hinode SP spectra, fully recover the spatial resolution permitted by the Hinode SOT aperture and the noise statistics of the data, while eliminating the need for an additional "stray-light" contribution in the inversion.

Vieira (Presenter: Nagendra), de Gonzalez, Dal Lago, Wrasse; Echer, Reis Cardoso, Guerrero, Rezende Costa, Palacios, Balmaceda, Ribeiro Alves, da Silva, Antunes Vieira, Sampaio, Rabello Soares, Barbosa, Domingues, Rigozo, Mendes Jr., Jauer, Dallaqua, Stekel, Gonzalez, Kabata
Spectrograph for the Brazilian Solar Telescope
Poster A23
The solar electromagnetic and corpuscular emissions are strongly modulated by the evolution of the magnetic structure of the solar atmosphere, which is imprinted in the solar surface. The evolution of the magnetic structure leads to gradual changes of the solar activity (space climate) as well as violent events (space weather) that affect the whole heliosphere. The solar magnetism is driven by the energy transport from the inner layers of the solar structure to the solar atmosphere. Although systematic observations of the solar surface magnetic field have revealed several features related to the evolution of the solar activity, there is not a complete explanation of the physical processes that lead to the solar activity cyclic variability and its long-term changes. Here we describe to develop a magnetograph and visible-light imager instrument to study the solar dynamo processes through observations of the solar surface magnetic field distribution. The instrument will provide measurements of the vector magnetic field and of the line-of-sight velocity in the solar photosphere. The HELIOSIS-SP will consist of a German-equatorial mount Ritchey-Chrétien telescope, with a diameter of 50 cm and f8, that may reach a theoretical diffraction-limited resolution of 0\textquotesingle 2, with a FOV (before the polarimetric suite, it is 69\textquotesingle x69\textquotesingle , 2\textquotesingle /px). With a tuning system consisting of an etalon, it will work in the visible range (FeI of 525 or 630. nm lines) and two sCMOS cameras for orthogonal polarimetry. We present a comparison of the expected data products from this instrument with those of a telescope with equal diameter currently operating from space (HINODE). In order to match the observations conditions from ground, we have degraded, spatially and spectroscopically, Hinode LOS-magnetograms and Stokes profiles. We have also estimated the expected signal-to-noise ratio. The proposed instrument will be designed to operate from ground, but flexible enough to be adapted to operate on balloon and space-based platforms. In this way, our main aim is acquiring progressively know-how to build state-of-art solar vector magnetograph and visible-light imagers for space-based platforms to contribute to the efforts of the solar-terrestrial physics community to address the main unanswered question on how our nearby Star works.

Vink
Linear line spectropolarimetry and circumstellar structures
Oral Session 8
We discuss the role of linear polarimetry in a wide set of environments, involving the accretion disks around young pre-main sequence stars, to the aspherical outflows from several groups of O stars, luminous blue variables (LBVs) and Wolf-Rayet stars, just prior to explosion as a supernova or a gamma-ray burst (GRB). We predict subtle QU line signatures, such as single/double QU loops for un/disrupted disks. Whilst there is plenty of evidence for single QU loops, suggesting the presence of disrupted disks around young stars, current sensitivity (at S/N of order 1000) is typically not yet sufficient to allow for quantitative comparison between our 3D Monte Carlo models and existing linear spectropolarimetry data. However, we show that the detection of such signatures will become entirely feasible with the massive improvement in sensitivity of 30m mirrors.
**Wang, Sun, Deng, Zhang, Sun, Hou, Zhang**  
**Performance Measurement of LCVR From Meadowlark Company**  
**Poster A24**  
Liquid Crystal Variable Retarder (LCVR) is widely used in solar, planetary, and extrasolar polarimetric instruments recently. A Lyot Hα filter based on LCVRs is being developed at Huairou Station, NAOC for chromospheric velocities. Six LCVRs from Meadowlark Company will be used in this filter for adjusting wavelength. Their performance of uniformity and stability in retardance and fast axis was measured precisely in laborotary. The results will be given in this paper.

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**Wisniewski, the SEEDS/HiCIAO/AO188 Team**  
**The SEEDS High-Contrast Imaging Polarimetry Survey of Protoplanetary Disks**  
**Oral Session 8**  
The Strategic Exploration of Exoplanets and Disks with Subaru (SEEDS) is a H-band survey of ~500 nearby stars using the HiCIAO coronagraph and AO-188 system at the Subaru telescope whose goal is to spatially resolve nearby circumstellar disks and planetary systems. The survey, led by PI M. Tamura, has been prolific at spatially resolving nearby protoplanetary, pre-transitional, and transitional disks in polarized scattered light, revealing a diverse array of morphological structures (spiral arms, gaps, inner holes and gaps), some of which might be caused by gravitational interactions with newly formed planetary bodies in these systems. The survey has also helped to confirm and quantify the location of small dust grains in gapped pre-transitional and transitional disks. I will review the major results from polarimetric imaging of the survey's disk sample.

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**Wolfe, Stencel, Cole**  
**Commissioning Results of a New Polarimeter, DUSTPol**  
**Poster A25**  
The Denver University Small Telescope Polarimeter (DUSTPol) was built to promote the study of linear polarimetry in the optical regime with smaller telescopes. DUSTPol utilizes rotator housing a half wave plate to provide polarimetric modulation, which is followed by a Savart plate, serving as a polarizing beam splitter, which produced a doubled image on an CCD camera. DUSTPol’s performance has demonstrated low instrumental polarization at 0.05 +/- 0.02%. This poster presents commissioning results as well as early science observations, and describes software used for data reduction. Additionally, recent polarimetric results of RS CVn systems and Wolf-Rayet stars, discussed herein, indicate shape and interaction parameters. By promoting the development of similar polarimeters at other institutions, DUSTPol will serve to establish new joint-study surveys of cool active stars, as well as systems showing evidence of containing complex stellar environments.