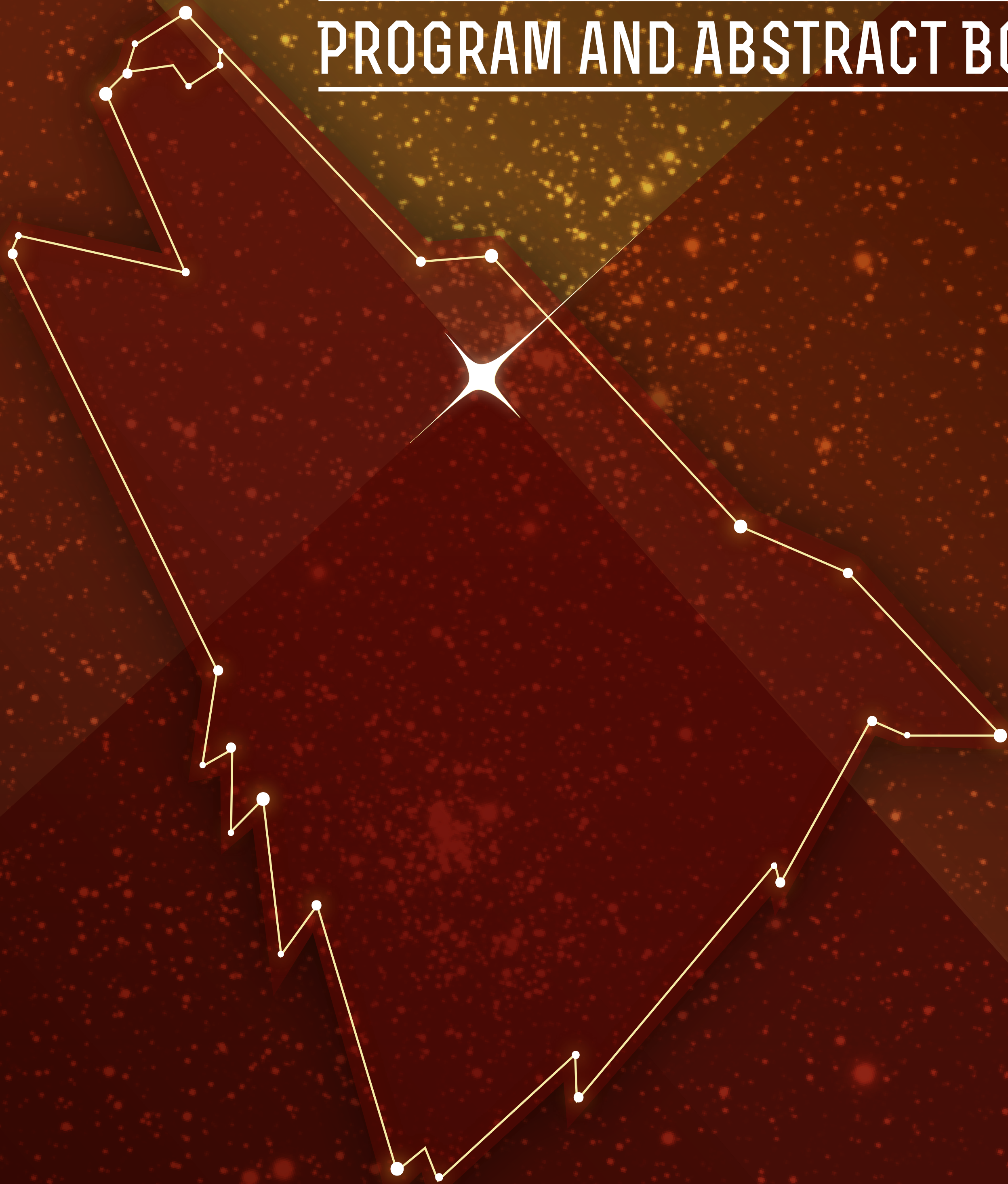
PROGRAM AND ABSTRACT BOOK



COOL STARS 18

JUNE 9-13, 2014 · FLAGSTAFF, ARIZONA - USA

18th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun

LOWELL OBSERVATORY

coolstars18.net

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NORTHERN ARIZONA UNIVERSITY

NExScI
NASA Exoplanet Science Institute

NSO

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COOL STARS 18

SCHEDULE

SUNDAY, JUNE 8

7:00pm-9:00pm **Evening: Opening Reception**

Day One | MONDAY, JUNE 9 - Cool Star formation, Structure, and Evolution

Morning: Opening Plenary Session

7:30am **Breakfast**

8:30am **Opening and Logistics**

8:45am Laurent Gizon | *MPS Goettingen* **(Invited)**
- Helioseismology In a Stellar Context: From SDO to PLATO

9:25am Adam Kraus | *UT-Austin* **(Invited)**
- The Fundamental Properties of Cool Stars

10:05am Ruth Angus | *University of Texas at Austin* **(Contributed)**
- Calibrating Gryochronology using Kepler Asteroseismic Targets

10:25am **Coffee Break**

11:10am Daniel Huber | *NASA Ames* **(Invited)**
- Asteroseismology of Cool Stars

11:50am Trent Dupuy | University of Texas at Austin **(Contributed)**
- Testing Models of Substellar Evolution with Dynamical Masses

12:10pm Ilaria Pascucci | *LPL/University of Arizona* **(Contributed)**
- The EUV Luminosity from Young Cool Stars: Implications for the Dispersal of Protoplanetary Material

12:30pm **Lunch & Poster Session**

Afternoon: Splinter Sessions

Cool Cloudy Atmospheres: Theory and Observations **- 1899 Ballroom**
Cool Stars and Space Weather - **HCCC**
Touchstone Stars: Empirically Determined Parameters of Cool Stars - **Prochnow Auditorium**

2:00pm **Splinters Begin**
3:30pm **Coffee Break**
4:15pm **Splinter Second Halves**

5:30pm **End of Day**

Day Two | TUESDAY, JUNE 10 - Cool Stars as Dynamic Objects

Morning: Plenary Session

7:30am **Breakfast**

8:30am **Opening and Logistics**

8:45am Jeffrey Hall | *Lowell Observatory* **(Invited)**
- Sixty Years (and Counting) of Stargazing: Synoptic Observations of Sun-Like Stars

9:25am Bart De Pontieu | *Lockheed-Martin Solar & Astrophysics Laboratory* **(Invited)**
- The Solar Chromosphere and Transition Region as Viewed by the Interface Region Imaging Spectrograph (IRIS)

10:05am Daniel Apai | *University of Arizona* **(Contributed)**
- The Physics and Chemistry of Brown Dwarf Clouds: Results from HST and Spitzer Phase Mapping Programs

10:25am **Coffee Break**

11:10am Moira Jardine | *University of St Andrews* **(Invited)**
- The Long and Short of It: Timescales for Stellar Activity

11:50am Kyle Augustson | *High Altitude Observatory-NCAR* **(Contributed)**
- *Simulations of Cyclical Dynamos and Grand Minima in Sun-like Stars*

12:10pm A.A. Pevtsov | *National Solar Observatory* **(Contributed)**
- *SOLIS: Reconciling Disk-Integrated and Disk-Resolved Spectra from the Sun*

12:30pm Lunch & Poster Session

Afternoon: Splinter Sessions

Galactic Archaeology with Cool Stars **- 1899 Ballroom**
Magnetic Fields, Dynamos, and Aurorae from Brown Dwarfs to Exoplanets **- Prochnow Auditorium**
Stellar Surfaces with High Spatial and Temporal Resolution **- HCCC**

2:00pm Splinters Begin
3:30pm Coffee Break
4:15pm Splinter Second Halves

5:30pm End of Day

Day Three | **WEDNESDAY, JUNE 11** - Cool Stars Abundances

Morning: Plenary Session

7:30am Breakfast

8:30am Opening and Logistics

8:40am Natalie R. Hinkel | *San Francisco State University* **(Contributed)**
- *Variations in the Composition of Cool Stars*

9:00am Michael Line | *UCSC* **(Contributed)**
- *Determination of Temperatures and Abundances in Brown Dwarf Atmospheres*

9:20am Andrew West | *Boston University* **(Contributed)**
- *Wide Stellar Binaries and a Photometric (griz) Metallicity Calibration for Cool Stars*

10:20am Martin Asplund | *ANU* and Marc Pinsonneault | *OSU* **(Invited)**
- ***The Cool Stars 18 Debate:*** *"The Ins and Outs of Solar Abundances" (Invited)*

11:40am End of Day

Afternoon: Free Time

12:00pm Tours to Grand Canyon, DCT/Anderson Mesa, Sedona, and Walnut Canyon

Evening: Public Lecture - Prochnow Auditorium

7:00pm Lucianne Walkowicz | *Princeton*
- "*Kepler and the Exoplanet Revolution" -* Sponsored by the Barringer Crater Company

Day Four | **THURSDAY, JUNE 12** - Cool Stars as Planet Hosts

Morning: Plenary Session

7:30am Breakfast

8:30am Opening and Logistics

8:45am Kaitlin Kratter | *University of Arizona* **(Invited)**
- *Planet (or Binary?) Formation Around Cool Stars*

9:25am Nuccio Lanza | *INAF-Osservatorio Astrofisico di Catania* **(Invited)**
- *Star-Planet Interactions*

10:05am Megan Ansdell | *Institute for Astronomy, University of Hawaii* **(Contributed)**
- *The Intrinsic UV Luminosity Distribution of M Dwarf Stars*

10:25am Coffee Break

11:10am Guillam Anglada-Escude | *Queen Mary University of London* **(Invited)**
- Planetary Systems Around Cool Stars: a Window Towards Characterization of Small Planets

11:50am Antoine Strugarek | *Université de Montréal* **(Contributed)**
- Close-in Planets and Magnetic Torques: What Impact on Stellar Evolution?

12:10pm James Davenport | *University of Washington* **(Contributed)**
- Using Transiting Planets to Model Starspot Evolution

12:30pm Lunch & Poster Session

Afternoon: Splinter Sessions

The Accretion Process in Young Stars - **1899 Ballroom**
Portraying the Hosts: Stellar Science from Planet Searches - **Prochnow Auditorium**
Upgrading the Solar-Stellar Connection: News About Activity in Cool Stars - **HCCC**

2:00pm Splinters Begin
3:30pm Coffee Break
4:15pm Splinter Second Halves

5:30pm End of Day

Evening: Conference Banquet

5:30pm First Buses Depart HCCC for Arizona Snowbowl
- At HCCC: Poster Session, Cocktail Hour

6:10pm Cocktail Hour at Snowbowl Begins for First Bus Arrivals

6:50pm Second Buses Depart HCCC for Arizona Snowbowl

7:30pm Dinner

10:00pm First Buses Depart Snowbowl

11:20pm Second Buses Depart Snowbowl

Day Five | **FRIDAY, JUNE 13** - Observational Frontiers

Morning: Closing Plenary Session

7:30am Breakfast

8:30am Opening and Logistics

8:45am Sofia Randich | *INAF - Osservatorio de Arcetri* **(Invited)**
- The Gaia-ESO Survey

9:25am Fabienne Bastien | *Vanderbilt* **(Invited)**
- Observing Convection in Cool Stars through Light Flicker

10:05am Tabetha Boyajian | *Yale* **(Contributed)**
- Size Matters

10:25am Coffee Break

11:10am Carsten Denker | *Leibniz-Institut für Astrophysik Potsdam* **(Invited)**
- Progress in High Resolution Solar Physics

11:50am Jacqueline Faherty | *Carnegie Institution of Washington* **(Contributed)**
- Young Brown Dwarfs at the Exoplanet Mass Boundary

12:10pm Viki Joergens | *Max Planck Institute for Astronomy* **(Contributed)**
- The Coolest 'Stars' are Free-Floating Planets

12:30pm Closing

Afternoon: Closing Reception at Lowell Observatory

1:00pm Barbecue outside the Trustee's Residence

ABSTRACTS

Day 1 | MONDAY, JUNE 9 - Cool Star Formation, Structure, and Evolution

Abstract #1 - Helioseismology in a Stellar Context: from SDO to PLATO

Laurent Gizon | *Max Planck Institute for Solar System Research and University of Goettingen, Germany*

Full-disk observations of solar oscillations by the Solar Dynamics Observatory have led to renewed efforts to probe the complex internal dynamics of the solar convection zone. Besides differential rotation, I will review other important dynamo ingredients that are now being inferred by helioseismology, such as meridional circulation, convective motions, or subsurface emerging magnetic flux. Reliable helioseismic inferences will be key to understanding the origin of solar activity. A plausible dynamo model must be accurate enough to satisfy the Sun's constraints and it must be general enough to fit a sample of sufficiently diverse stars. Solar results complement observational advances in stellar physics, including asteroseismic measurements of internal rotation with CoRoT and Kepler. Well-defined relationships between stellar activity and stellar internal properties ought to be revealed by the recently-selected mission PLATO, which will enable the asteroseismology of 85000 cool dwarfs. **(Invited, 40 min)**

Abstract #2 - The Fundamental Properties of Cool Stars

Adam Kraus | *UT-Austin*

Low-mass stars and brown dwarfs are the most numerous component in the Milky Way's stellar population and are rapidly growing in importance as exoplanet hosts. However, due to their intrinsic faintness and complex spectra, the properties of cool dwarfs are not calibrated to the same extent as their solar-mass brethren. I will review the current understanding of the fundamental properties of cool stars, beginning with relations between the most influential bulk properties (mass, radius, luminosity, temperature, age), and then touching on other parameters that modify or result from these properties (metallicity, rotation, activity, and detailed atmospheric features). Finally, I will conclude with a prospective look ahead at the cutting-edge results expected in the rest of this conference and beyond. **(Invited, 40 min)**

Abstract #3 - Calibrating Gyrochronology using Kepler Asteroseismic targets

Ruth Angus | *University of Oxford*

Measuring ages for intermediate and low mass stars on the main sequence is challenging, but important for a wide range of studies, from Galactic dynamics to stellar and planetary evolution. The most commonly used dating methods are extremely model dependent and often provide age estimates with uncertainties of order 100% or more. Among the available methods, gyrochronology is a powerful one, because it requires knowledge of only the star's mass (or suitable proxy) and rotation period. However, it is not well calibrated at late ages. The continuous, high precision light curves obtained by Kepler mission are ideally suited to measuring photometric rotation periods and, for a few hundred bright Kepler targets, asteroseismology also provides relatively precise ages. We measured surface rotation periods for 144 Kepler targets with asteroseismic age estimates, which should in principle enable us to test the uniqueness and improve the calibration of the gyrochronology relation at late ages. We use advanced statistical methods to model the relationship between rotation period, age, and mass (or color or effective temperature) while accounting for measurement uncertainties in all three quantities. Our sample includes both main sequence stars and subgiants, and straddles the Kraft break (only main sequence stars cooler than the Kraft break are expected to follow gyrochronology relations); and this must be taken into account when modeling the data. Once our method is applied to the extended sample of published rotation periods for stars with reliable mass and age estimates, it should enable us to estimate ages for any star with a measured period and mass (or temperature), along with associated uncertainties that reflect both measurement errors and the intrinsic scatter in the gyrochronology relations. **(Contributed, 20 min)**

Abstract #4 - Asteroseismology of Cool Stars

Daniel Huber | *NASA Ames Research Center*

The measurement of oscillations excited by surface convection is a powerful method to study the structure and evolution of cool stars. CoRoT and Kepler have initiated a revolution in asteroseismology by detecting oscillations in thousands of stars reaching from the main-sequence to the red-giant branch, including more than one hundred exoplanet host stars. In this talk I will review recent asteroseismic results, focusing in particular on ensemble determinations of fundamental properties (radii, masses and ages) of dwarfs and red giants, and their synergy with photometric and spectroscopic follow-up observations. I will furthermore discuss the impact of asteroseismology on the characterization of exoplanets, including measurements of stellar spin-orbit inclinations and their implications for hot-Jupiter formation theories. Finally, I will give a brief outlook on future prospects for asteroseismic observations of cool stars with ground and space-based facilities. **(Invited, 40 min)**

Abstract #5 - Testing Models of Substellar Evolution with Dynamical Masses

Trent Dupuy | *University of Texas at Austin*

Evolutionary models of stars at the bottom of the main sequence and into the substellar regime are widely used, but many of their basic predictions remain essentially untested by direct measurement. We present a large sample of high precision dynamical masses for very low-mass stars and brown dwarfs via binary orbit monitoring with HST and Keck laser guide star adaptive optics. Our results more than double the number of visual binaries with dynamical masses and represents an order of magnitude increase in the sample since the beginning of our program 9 years ago. This sample of 26 binaries is now sufficiently populous to begin breaking down objects as a function of spectral type and determining the typical mass of a mid-L or early-T dwarf, for example. We also derive precise system ages from substellar evolutionary models by combining our masses with component luminosities determined from our resolved multi-band photometry. This ensemble of brown dwarf “clocks” provides a quantitative and unique record of the star formation history of low-mass objects in the solar neighborhood. In the rare cases where our brown dwarf binaries are companions to solar-type stars, we find that the substellar clocks disagree with stellar age--activity--rotation relations. We speculate that updating substellar evolutionary models to account for patchy clouds/weather could resolve this discrepancy by making brown dwarfs systematically more luminous at a given mass and age. **(Contributed, 20 min)**

Abstract #6 - The EUV Luminosity from Young Cool Stars: Implications for the Dispersal of Protoplanetary Material

Ilaria Pascucci | *LPL/University of Arizona*

We present a new method to estimate the maximum ionizing (13.6-100eV) luminosity reaching the surface of protoplanetary disks around Cool Stars. In Pascucci et al. (2012) we demonstrated that free-free emission from a fully or partially ionized disk surface is detectable with current instruments and appears as emission in excess to the dust thermal emission at centimeter wavelengths. We now apply this method to 14 stars with ages between a few to ~10Myr for which we have acquired the needed millimeter and centimeter interferometric data to measure the free-free disk emission. We show that the EUV luminosity reaching the disk is below the range of inferred stellar EUV luminosities, by more than an order of magnitude for the older sources in our sample. We discuss our results in the context of the time evolution of stellar EUV luminosities and point out the main implications for the dispersal of protoplanetary material. **(Contributed, 20 min)**

SPLINTER SESSIONS

COOL CLOUDY ATMOSPHERES: THEORY AND OBSERVATION (1899 Ballroom)

Conveners: Daniel Apai (University of Arizona), Adam Burgasser (UC San Diego), Michael Gillon (U. Leige), Mark Marley (NASA Ames), Caroline Morley (UC Santa Cruz), Jacqueline Radigan (STScI)

Session 1 - Variability & Weather

Abstract #7 - As The Dust Settles: Using Time-Domain Observations to Reveal Cloud Structure at the L/T Transition

Jacqueline Radigan | *STScI*

The combination of condensate clouds and rapid rotation has long motivated searches for weather phenomena in ultracool (late-M, L and T) dwarf (UCD) atmospheres. Pioneering work in this field dating back as early as 1999 suggested that variability is quite common for UCDs. Yet these early studies were ambiguous: detections were often low-amplitude and/or lacking periodicity, and the mechanisms responsible remained unclear. Observations made in the past 5 years, utilizing continuous monitoring strategies, better instruments, and larger telescopes have demonstrated conclusive and surprisingly large near-infrared variability for a subset of brown dwarfs at the transition between L and T spectral types, suggesting a patchy distribution of silicate clouds in their atmospheres. Brightness variations as large as 25% on readily observable rotational timescales allow light curves of exquisite precision, worthy of detailed analysis, to be obtained from both ground and space based facilities. I will provide a brief review of previous work, and described the chromatic and temporal properties of variability at the L/T transition based on observations from ground and space based facilities interpretations based on current dynamical and spectral models of brown dwarf atmospheres. **(Review, 12+3 min)**

Abstract #8 - Atmospheric Dynamics of Brown Dwarfs

Adam Showman | *University of Arizona*

A variety of observations now provide evidence for vigorous motion in the atmospheres of brown dwarfs and directly imaged giant planets; these observations include spectral evidence for clouds, disequilibrium chemistry, lightcurve variability, and maps of surface patchiness. I here survey the dynamical regime of brown-dwarf atmospheres with an eye toward explaining these observations. Brown dwarfs rotate rapidly, and for plausible wind speeds, the flow at large scales will be rotationally dominated, exhibiting geostrophic balance between pressure gradient and Coriolis forces. I will present 2D and 3D numerical simulations of the atmosphere and interior dynamics on brown dwarfs that illustrate the dynamical regime and provide a context for explaining the observations. The interaction of convection with the overlying, stably stratified atmosphere will generate a wealth of atmospheric waves, and I argue that, just as in the stratospheres of planets in the solar system, the interaction of these waves with the mean flow will lead to a significant atmospheric circulation at regional to global scales. This circulation will comprise turbulence, vortices and possibly zonal (east-west) jet streams, accompanied by a vertical (overturning) circulation that should generate large-scale cloud patchiness analogous to that inferred in the observations. **(Review, 12+3 min)**

Abstract #9 - Patchy Atmospheres Beyond the L/T Transition: Spectral Variability of Mid-T Dwarfs

Esther Buenzli | *Max Planck Institute for Astronomy, Heidelberg*

The occurrence of patchy clouds has been invoked to explain the near-IR variability of several brown dwarfs. Large amplitude variables (>3%) are predominantly found at the L/T transition, where the silicate cloud cover is thought to break up. However, variable brown dwarfs are also found beyond the L/T transition, where the silicate clouds have disappeared below the photosphere. A particularly interesting object is the T6.5 dwarf 2MASSJ2228-43, a very fast rotator with a 1.4 hr period. We discuss spectral variability observations with HST and simultaneous Spitzer photometry that show an increasing phase lag for light curves at wavelengths probing decreasing pressure levels. We discuss potential scenarios for this complex 3D structure. We also present variability trends for two other mid-T dwarfs that appear to be variable predominantly within absorption bands. We show that the characteristics of spectral variability for mid-T dwarfs appear to be distinctly different than at the L/T transition. **(Contributed, 8+2 min)**

Abstract #10 - Weather on the Nearest Brown Dwarfs: Resolved Simultaneous Multi-wavelength Variability Monitoring of Luhman 16AB

Beth Biller | *University of Edinburgh*

We present multiple epochs of MPG/ESO 2.2 m GROND simultaneous six-band (r'i'z' JHK) photometric monitoring of the closest known L/T transition brown dwarf binary Luhman 16AB (including new epochs taken in February 2014). We report here the first resolved variability monitoring of both the T0.5 and L7.5 components. We note a number of robust trends in our light curves from April 2013. The r' and i' light curves appear to be anti-correlated with z' and H for the T0.5 component and in the unresolved light curve. In the defocused dataset, J appears correlated with z' and H and anti-correlated with r' and i', while in the focused dataset we measure no variability for J at the level of our photometric precision, likely due to evolving weather phenomena. In our focused T0.5 component light curve, the K band light curve displays a significant phase offset relative to both H and z'. We argue that the measured phase offsets are correlated with atmospheric pressure probed at each band, as estimated from one-dimensional atmospheric models. We also report low-amplitude variability in i' and z' intrinsic to the L7.5 component. **(Contributed, 8+2 min)**

Abstract #11 - Atmospheric Circulation of Brown Dwarfs: Jets, Vortices, and Time Variability

Xi Zhang | *University of Arizona*

Under the conditions of fast rotation, strong radiative dissipation and no external stellar flux, brown dwarfs occupy a unique corner of the parameter space of atmospheric dynamics theories. Here we ask: do the atmospheres of the brown dwarfs exhibit east-west jets pattern as exist on both the gas giants in our solar system and the close-in extra-solar giant planets, or are they dominated by isotropic turbulence and vortices instead? The answer is crucial for the interpretation of observed time variability of L/T dwarfs as well as being of fundamental theoretical interest. We used a global two-dimensional (2D) shallow-water model to investigate the dominant atmospheric features during the continuous transition from gas giants to brown dwarfs. We show that the existence and properties of the jets crucially depend on several key parameters including the energy injection rate and radiative damping timescale. Under conditions of strong internal heat flux and weak radiative dissipation, east-west jets spontaneously emerge from the interaction of atmospheric turbulence with the planetary rotation. When the internal heat flux is weak and/or radiative dissipation is strong, turbulence injected into the atmosphere damps before it can self-organize into jets, leading to a flow dominated by isotropic turbulence and vortices instead. We present a scaling law as a quantitative criterion for the emergence of jets versus vortices on gas giants and brown dwarfs. The long-time integration of the shallow water system provides a new tool to understand the effect of atmospheric dynamics on the observed light curve variations in both short and long timescales. Our simulated light curves capture the important features in recent infrared observations, such as an amplitude variation of a few percent and multi-peak shapes. **(Contributed, 8+2min)**

Abstract #12 - Space-Based Variability Studies Indicate that Spots are Ubiquitous on Brown Dwarfs

Stan Metchev | *University of Western Ontario*

I will overview results from recent highly precise campaigns to monitor brown dwarfs for cloud-induced variability using space-borne telescopes. I will focus on results from the "Weather on Other Worlds" Spitzer program: the most comprehensive of these precision studies. The Weather on Other Worlds program reveals that 45% of L3-T8 (2000 K - 700 K) dwarfs are variable, with amplitudes between 0.2%-5% at 3.6 and 4.5 micron observing wavelengths. Based on spin-axis and spot viewing geometry considerations, our findings indicate that cloud-induced variability is present on virtually all L3-T8 dwarfs. If the detected variations are caused by single large spots, rather than by multiple smaller ones, the measured amplitudes and temperature contrasts indicate that these features cover between 4%-20% of the visible disks of brown dwarfs. That is, atmospheric spots with sizes between approximately half to twice that of the Great Red Spot on Jupiter are ubiquitous on 700-2000 K brown dwarfs. **(Invited, 12+3 min)**

Session 2 - Characterizing Clouds

Abstract #13 - Cloud Models: Where Do We Go From Here?

Mark Marley | *NASA Ames*

The first wave of brown dwarf cloud models that arrived in the early 2000s attempted to account for the colors and spectral shape of the L dwarfs and the transition from L to T type dwarfs. These early models either parameterized the cloud or attempted to calculate cloud profiles from the underlying atmospheric physics. Fits of these models to actual data ranged from poor to excellent, with many cases of what might be termed 'adequate but unsatisfying'. Later modeling efforts added parameterized atmospheric mixing and cloud holes to try and improve the fits. While the improvements have been promising, comparisons of multiple models to a single dataset have been sparse, and tests against benchmark objects with known masses or effective temperatures even sparser. For these reasons no single model has emerged as the de facto standard. Rather each theory group continues to use their own cloud approach. Partly for this reason model-derived effective temperatures and gravities for specific objects have an air of uncertainty as the results are not easily reproduced. In my presentation I will briefly discuss this history and then focus on suggestions for improving the current situation. While further model refinements are definitely needed, inversions methods which derive the atmospheric thermal profile, gravity, and cloud properties directly from all available data are truly required. While such approaches have their own uncertainties, they will provide a cross check for forward models and will regularize the reporting of derived brown dwarf properties. The combination of inverse methods and forward models applies to benchmark systems with highly constrained properties is almost certainly the best path forward. **(Review, 15 min)**

Abstract #14 - Constraining the Properties of the Dust Haze in the Atmospheres of Young Brown Dwarfs

Kay Hiranaka | *Hunter College/AMNH*

Brown dwarfs and exoplanets share physical properties: they both have radii similar to Jupiter and cool temperatures. Warm, young brown dwarfs (~2000K, <100 Myr) have thick clouds that affect emergent spectra and their clouds are likely to be similar to those of young gas giant planets. A better understanding of the role of clouds in brown dwarfs will inform our understanding of the thick clouds observed in directly imaged planets. It is thought that redder spectral energy distribution might indicate thick clouds, bluer spectral energy distribution might be thin or patchy clouds.
The goal of this project is to combine observations and theory to make inroads on the process of disentangling the observed effects of the clouds. In order to tackle the problem of dust and clouds in young brown dwarfs, we are using Mie theory to find the combination of dust properties that best reproduce the effects seen in the spectra of young brown dwarfs. In particular, we are trying to constrain the grain size distribution and the grain composition in young, warm brown dwarf clouds. The combination of Mg_2SiO_4 and the Hansen distribution with mean particle size of 0.1 - 0.3 micron fits the data best. This result suggests that young brown dwarfs may have silicate dust hazes with mean grain sizes much smaller than the regular cloud grains (~10 microns). **(Contributed, 10 min)**

Abstract #15 - Building a Volume-Limited Sample of L/T Transition Dwarfs with Pan-STARRS and WISE

Will Best | *IfA/Hawaii*

The current census of L/T transition brown dwarfs (spectral types ~L6-T5) is a compilation of magnitude-limited surveys with varying sensitivity, spatial coverage, and spectral completeness. While ~90 L/T dwarfs within 25 pc have been found, and several individual objects have been studied in detail, many fundamental properties of the L/T transition remain poorly understood. We are building a complete, volume-limited sample of L/T transition dwarfs within 25 pc. We have searched 30,000 deg^2 in the Pan-STARRS1 3pi and WISE all-sky surveys for brown dwarfs spanning the L/T transition. We have spectroscopically confirmed a total of 117 new L and T dwarfs (an 82% success rate); 80 of these are L/T transition dwarfs, 30 of which have photometric distances within 25 pc. Our discoveries help to form a well-defined, robust sample of L/T dwarfs that can constrain atmospheric models and improve our understanding of the progression from dusty and cloudy L dwarfs to clear T dwarf photospheres, and better characterize the handful of extremely red late-L dwarfs that have been discovered. Our sample also provides more targets for variability searches, and for high-resolution imaging and spectral decomposition to identify L+T binaries whose colors mimic those of single L/T transition objects. **(Contributed, 10 min)**

Abstract #16 - Clouds and Variability in Cool Brown Dwarfs

Caroline Morley | *UC Santa Cruz*

There is growing evidence that heterogeneous clouds cover the photospheres of brown dwarfs of many spectral types, causing photometric variability as cloudier hemispheres rotate in and out of view. We present a new grid of model atmospheres for objects from 200-450 K including water ice clouds; we find that they become optically thick in Y dwarfs cooler than 350 K and strongly influence mid-infrared spectra, with some potentially observable spectral features in the near- and mid-infrared. While the most dramatically variable brown dwarfs are found at the L/T transition, later T and Y dwarfs exhibit variability as well. To understand this variability, an initial approach is to disentangle the effects caused by heterogeneous clouds and hot spots. We present models where we predict the spectral dependence of variability caused by each of these effects, and find that these two processes have quite different spectral dependence. Broad-wavelength spectral observational campaigns should be able to disentangle these processes and give insight into the 3D temperature and cloud structures of brown dwarfs. **(Invited, 10 min)**

Session 3 - Exoplanets & New Opportunities

Abstract #17 - Clouds and Hazes in Hot Jupiter Atmospheres: Results from a Large HST Program

David Sing | *University of Exeter*

Clouds and hazes have become an emerging and ever-growing important topic for highly-irradiated hot-Jupiter exoplanets. These aerosol species can be effectively probed with transmission spectroscopy in addition to albedo measurements for transiting planets. Here I will present the various evidence for upper atmospheric haze in the canonical hot Jupiter HD189733b, and comment on the possible links to brown dwarf atmospheres. In addition, I will present evidence for similar clouds and hazes in other hot Jupiters, new results which are now emerging from a large Hubble Space Telescope program covering eight planets. **(Invited, 15 min)**

Abstract #18 - Ground-Based Instrumentation for Long-Term Monitoring

Michael Gillon | *U. Liege*

(Review, 15 min)

COOL STARS AND SPACE WEATHER (HCCC)

Conveners: Aline Vidotto (Geneva) and Moira Jardine (St Andrews)

Session 1

Abstract #19 - Setting the Stage: "Issues of Habitability"

Andrew C. Cameron | *University of St Andrews*

TBD **(Invited, 25 min)**

Abstract #20 - Exploring a Threat to Foreign Worlds: Detecting Coronal Mass Ejections on Nearby Stars

Jackie Villadsen | *Caltech, Department of Astronomy*

Coronal mass ejections (CMEs) likely play a significant role in the mass loss from active stars, and may significantly affect exoplanetary magnetospheres and atmospheres. However, there have been no definitive detections of CMEs outside our own solar system. Broadband dynamic spectroscopy has long been used to study coherent radio emission associated with solar CMEs (known as Type II bursts), but such emission has not been detected from other stars. Type II bursts sweep downwards in frequency on timescales of tens of minutes, tracing the motion of a CME outwards through the stellar atmosphere into progressively lower plasma densities. I will present JVLA observations of UV Ceti showing two Type II-like radio bursts, which sweep upwards in frequency. We interpret these bursts as either bulk plasma motion downwards in the stellar atmosphere or polar radiation modulated by rotation. I will also present plans for the Starburst program, a 3-year nightly observing program using two 27-meter telescopes at the Owens Valley Radio Observatory (the equivalent of a JVLA baseline). The Starburst program will survey stellar coherent radio bursts in order to characterize the rate and energetics of CMEs on nearby stars, combined with complementary observations to image and characterize the detected CMEs. **(Contributed, 15 min)**

Abstract #21 - Rates of Strong Flares in Kepler Clusters NGC 6811 (1 Gyr) and NGC 6819 (2.5 Gyr)

Steven Saar | *Harvard*

We present flare rates in Kepler open clusters NGC 6811 (1 Gyr old) and NGC 6819 (2.5 Gyr old) over a range of masses. We use the results to estimate the rate of strong flares for the Sun, and explore the evolution of flare rates with stellar mass and age. Implications for mass loss (via associated CMEs) and planetary environments are briefly explored. **(Contributed, 15 min)**

Abstract #22 - Setting the State: "Cool Stars Magnetic Fields"

Julien Morin | *University of Montpellier*

Magnetic fields, their generation by dynamo effect and the activity phenomena they induce are central to the physics of cool stars and their planetary systems throughout their evolution. During the past few years, magnetic fields have been detected and studied on stars throughout the Hertzsprung-Russell diagram – in particular through ambitious spectropolarimetric observing programs such as Bcool, MaPP, MaTYSSE and TOUPIES – and trends are starting to emerge. In this talk I will briefly summarize the theoretical puzzles we want to address in the field of stellar magnetism, the basics of magnetic field measurements, and I will present a selection of the main results obtained so far which can help us to understand space weather of cool stars other than the Sun. **(Invited, 25 min)**

Abstract #23 - Magnetic Fields in Planet-Hosting G-Type Stars

Julian Alvarado | *ESO, Garching*

We present large scale magnetic field maps and activity diagnostics of two planet hosting Sun-like stars, HD 1237 and HD 147513, from a time-series of spectro-polarimetric data. We have tested some of the basic assumptions behind LSD techniques and confirm the robustness of similar published maps. We place our results in context of the Sun in time and other systems that have been studied so far. With the aid of Doppler Imaging (DI) and Zeeman Doppler Imaging (ZDI) techniques, we also refined the inclination angle and rotation period for both stars, essential parameters to understand the stellar environment around young planet forming systems. The next step will include these surface magnetic field maps as initial inputs for a 3D MHD code (BATS-R-US), to model the large-scale topology and wind structure of the two stars. This will used to predict the mass and angular momentum loss rates due to stellar winds and compare these with previous studies on more active stars. This comparison will enable us to refine our models further and get a better understanding on the physics of planet hosting systems such as these. **(Contributed, Student Talk 5 min)**

Session 2

Abstract #24 - Magnetospheric Structure and Atmospheric Joule Heating of Planets Orbiting in the Habitable Zone of Active M-dwarfs

Ofer Cohen | *Harvard-Smithsonian Center for Astrophysics*

We study the magnetospheric structure and the ionospheric Joule Heating of habitable planets orbiting M-dwarf stars using a set of magnetohydrodynamic (MHD) models. The stellar wind solution is obtained using an MHD model for the stellar corona. We then extract the stellar wind parameters at particular locations along the planetary orbit to drive an MHD model for the planetary magnetosphere, which is coupled with a model for the planetary ionosphere. The solutions from these models provide the magnetospheric structure and the Joule Heating of the upper atmosphere as a result of the interaction with the stellar wind. Our simulations reveal that the space environment around close-in habitable planets is extreme, with the stellar wind dynamic pressure, magnetic field, and temperature being 10 to 1000 times stronger than that at 1~AU. The stellar wind plasma conditions change from sub- to super-Alfv\'enic along the planetary orbit. As a result, the magnetospheric structure changes dramatically. In a way, the transitioning between the plasma sectors mimics a Coronal Mass Ejection (CME) heating the planet. A significant amount of Joule Heating is provided at the top of the atmosphere as a result of the planetary interaction with the stellar wind. For the steady-state solution, the heating is about 0.1-3\% of the total incoming stellar irradiation, and it is enhanced by 50\% for the time-dependent case. The significant Joule Heating obtained here should be considered in models for the atmospheres of habitable planets in terms of the thickness of atmosphere, the top-side temperature and density, the boundary conditions for the atmospheric pressure, and particle radiation and transport. **(Contributed, 15 min)**

Abstract #25 - Joint Magnetospheres of Star-Planet Systems

Volkmar Holzwarth | *Kiepenheuer-Institute for Solar Physics*

Among the increasing number of detected extrasolar planets is a considerable number of hot Jupiters, which revolve around their host star in close orbits allowing for tidal and magnetic interactions. One signature of such interactions can be the observed phase shift between the location of enhanced chromospheric emission and the orbital phase of the exoplanet. We investigate the magnetic interaction of a hot Jupiter with its magnetically active host star in the framework of a potential magnetic field approximation. The focus of the work is on the structure of the joint magnetosphere of the system, in particular the original locations of inter-connecting magnetic field flux. For the host star, reconstructed magnetic maps of slow and fast rotators will be used, whereas the planetary field structure will be taken to be dipolar and quadrupolar, with different angles of inclination. The dependence of the results on surface magnetic field distributions and system parameters, such as orbit radius, dipole strengths and field orientation are investigated and discussed. **(Contributed, 15 min)**

Abstract #26 - A Tale of Two Exoplanets: The Inflated Atmospheres of the Hot Jupiters HD 189733 b and CoRoT-2 b

Katja Poppenhaeger | *Harvard*

Planets in close orbits around their host stars are subject to strong irradiation. High-energy irradiation, originating from the stellar corona and chromosphere, is mainly responsible for the evaporation of exoplanetary atmospheres. We have conducted multiple X-ray observations of transiting exoplanets in short orbits to determine the extent and heating of their outer planetary atmospheres. In the case of HD 189733 b, we find a surprisingly deep transit profile in X-rays, indicating an atmosphere extending out to 1.75 optical planetary radii. The X-ray opacity of those high-altitude layers points towards large densities or high metallicity. We will also report on observations of the Hot Jupiter CoRoT-2 b from our Large Program with XMM-Newton, which was conducted recently **(Contributed, 15 min)**

Abstract #27 - Planet-Star Interaction

Sandra Jeffers | *Georg-August-Universität*

Planet-star interaction is defined as the impact a planet has on the evolution of its host star. For close-in planets, their tidal interaction will have important consequences for the rotational evolution of the host star and consequently its activity levels. In this talk we focus on the activity levels of several well known exoplanetary systems to quantify the large-scale tidal interaction of a close-in planet that is orbiting a low mass star. We discuss the results in a broader evolutionary context. **(Contributed, 15 min)**

TOUCHSTONE STARS: EMPIRICALLY DETERMINED PARAMETERS OF COOL STARS

(Prochnow Auditorium)

Conveners: Andrew Mann (University of Texas at Austin), Eric Gaidos (University of Hawaii at Manoa), Adam Kraus (University of Texas at Austin), Tabetha Boyajian (Yale)

Abstract #28 - Radii of Transiting Planet Hosts from Interferometry

Kaspar von Braun | *Max Planck Institute for Astronomy*

(20 min)

Abstract #29 - Constraining The Early Stages Of Binary Star Evolution

Ed Gillen | *University of Oxford*

There are only a handful of known low-mass, pre-main sequence eclipsing binaries (PMS EBs) with well-determined masses and radii. Detecting and characterizing a sample of low-mass EBs sharing the same age and composition, yet spanning a wide range of masses, was one of the key motivations for CoRoT to observe the 3 Myr old NGC 2264 star forming region for 23 days in 2008. We identified 37 EBs among the possible cluster members and have performed an intensive program of ground-based follow-up observations to confirm their membership and determine their parameters. Furthermore, CoRoT observed the cluster again for 40 days in Dec 2011 - Jan 2012, as part of a coordinated campaign with Spitzer, Chandra, and a number of ground-based facilities including VLT/FLAMES, providing a unique simultaneous multi-band photometric and spectroscopic dataset. I will present the sample of confirmed and candidate cluster members, detailing our innovative methods to determine their fundamental parameters using Gaussian process regression, before comparing our results to different models of stellar evolution. **(15 min)**

Abstract #30 - Asteroseismic Properties of Kepler targets from AMP

Travis Metcalfe | *Space Science Institute*

Recently the number of main-sequence and subgiant stars exhibiting solar-like oscillations that are resolved into individual mode frequencies has increased dramatically. While only a few such data sets were available for detailed modeling just a decade ago, the Kepler mission has produced suitable observations for hundreds of new targets. This rapid expansion in observational capacity has been accompanied by a shift in analysis and modeling strategies to yield uniform sets of derived stellar properties more quickly and easily. I have developed a stellar model-fitting pipeline for solar-like oscillations, which is available through the Asteroseismic Modeling Portal (AMP, http://amp.phys.au.dk/). Taking the individual oscillation frequencies and other observational constraints as input, the pipeline uses a parallel genetic algorithm to derive the optimal stellar radius, mass, age and composition. I will provide an overview of the method and present the initial results from applying AMP to two large samples of Kepler targets. **(15 min)**

Abstract #31 - Temperatures, Radii, and Metallicities of Low-Mass Dwarf Stars from Near-Infrared Spectra

Elisabeth Newton | *Harvard*

We present estimates of the temperatures, radii and metallicities for M dwarfs targeted by the MEarth and Kepler transiting planet surveys. The fundamental properties of M dwarfs are difficult to constrain by direct measurement, and we instead use empirically-derived relationships that are based on the strengths of near infrared spectral features. We establish our relationships for radius and temperature using cool dwarfs with interferometric measurements. Our calibrations use the equivalent widths of H-band spectral features as tracers of these parameters and have an accuracy of 0.03 solar radii and 60 K for late K to mid M dwarfs. We validate our method by comparing our inferred stellar parameters to absolute magnitudes and also identify candidate over-luminous objects within our sample, which may be binaries or young stars. Our metallicity relation is calibrated using M dwarfs in wide binaries with a higher mass star, where the primary has a measured metallicity. It has an accuracy of 0.12 dex inferred from the scatter between the metallicities of the primaries and the estimated metallicities of the secondaries. Our relation is valid for NIR spectral types from M1V to M5V and for -1.0 dex < [Fe/H] < $+0.35$ dex. **(15 min)**

Abstract #32 - Confronting Predictions of Stellar Evolution Theory with Touchstone Stars

Gregory Feiden | *Uppsala University*

We are in an age of precision stellar astrophysics. It is possible to determine stellar fundamental properties---mass, radius, effective temperature, luminosity---with a precision better than 2%. These “touchstone” stars provide strict constraints with which to confront basic predictions of stellar evolution theory, such as the mass-radius and radius-luminosity relationships. In this talk, I will highlight key results of such confrontations that reveal disagreements between theory and observation. Incomplete physics is often cited as an explanation of the disagreements, with particular emphasis on the role of magnetic fields and magnetic activity. Discussion of efforts aimed at testing this and other hypotheses with touchstone stars will be addressed. **(20 min)**

Abstract #33 - Kepler’s Low Hanging Grapefruit: Mass-Radius Relations from Low-Mass Eclipsing Binaries

Jonathan Swift | *Caltech*

The Kepler Space Mission has provided and extraordinary dataset with scientific value that extends well beyond the field of exoplanets. In addition to more than 100 planets orbiting low mass stars, Kepler has also discovered tens of low-mass stellar eclipsing systems spanning a wide period range that provide an accurate, model-independent means of measuring the fundamental properties of low-mass stars. For this study, we concentrate on the detached systems with periods > 2 days that fill in a large gap in parameter space for low-mass eclipsing binaries. We will present results from Kepler photometry supplemented with data from a suite of ongoing observational follow up programs that facilitate a direct comparison between measured masses, radii, effective temperatures and metallicities to stellar evolution models in the context of several other measured properties including rotational periods and activity levels. Lastly, we will take a look ahead to the near future as we approach the peak observing season for the Kepler field. **(20 min)**

Abstract #34 - Dating Middle-Aged Stars

Jason Curtis | *Penn State*

Ruprecht 147 is the oldest nearby star cluster, with an age of 3 Gyr at 300 pc, which allows R147 to serve as a sorely needed intermediate-aged benchmark. Stellar ages are difficult to infer for main sequence stars, but age can reveal itself through the spin down of stars via magnetic braking, which also causes magnetic activity to wane with time. We will present results from our studies of the magnetic activity and rotation of FGK stars. We also hope to have newly identified M dwarf members by the time of this meeting, and will discuss their activity, manifested in chromospheric H-alpha emission. **(15 min)**

Abstract #35 - Photometric Calibration for Determining M Dwarf Metallicity

Neda Hejazi | *York University*

Based on a carefully collected sample of dwarf stars, we present a new photometric calibration to estimate the metallicity of late-type K and early- to mid-type M dwarfs. The calibration sample includes some touchstone stars whose metallicities are accurately determined based on high-resolution spectra. This sample also contains other dwarfs which are selected according to the locations of touchstone stars on a color-color diagram and their metallicities are obtained by empirically spectroscopic calibrations of moderate-resolution spectra. Our method is then applied to a large sample of stars from the Sloan Digital Sky Survey (SDSS) and the Two-Micron All Sky Survey (2MASS) and the resulting metallicity distribution is compared to several distributions of M and FGK dwarfs from other studies. In this work, we also test the “Simple Closed Box Model” of Galactic chemical evolution. Finally, we suggest ways to improve future analyses. **(15 min)**

Abstract #36 - Expanded SEDs and Bolometric Luminosities as Direct Measures of Substellar Touchstones

Joe Filippazzo | *City University of New York*

For very low mass stars and brown dwarfs, there is precious little we can measure to identify touchstone objects in the absence of direct observations such as asteroseismology, interferometry and eclipsing binaries. One of the most direct measurements we can make for substellar touchstones is the bolometric luminosity. Combining optical and near-infrared spectra with optical, NIR and MIR photometry, we construct detailed spectral energy distributions for a sample of 120 brown dwarfs across effective temperatures of 700-2800K for both field age (3-5 Gyr) and young (10-150 Myr) objects. Model atmospheres are used to fill gaps in the spectra and parallaxes provide precise measurement of bolometric luminosities while minimizing assumptions about the source. This technique will improve our understanding of the effects of physical parameters such as effective temperature, surface gravity and clouds on brown dwarf spectra and greatly expand the number of touchstones we have to characterize the atmospheres and evolution of substellar objects. **(15 min)**

Abstract #37 - Benchmark Companions to Nearby Stars from Pan-STARRS 1

Niall Deacon | *Max Planck Institute for Astronomy*

We present the largest sample of benchmark ultracool dwarf companions to stars to date. Pan-STARRS1 with its large sky coverage (30,000 sq.deg.), red-sensitive detectors and multiple epochs provides the ideal tool for discovering wide, common proper motion systems. We have used these data to identify 48 wide, ultracool (M7-T5) companions to nearby stars. This represents a doubling of the number of late M dwarf companions wider than 300 AU and an 80% increase in the number of L companions in the same separation range. We examine the population

of ultracool companions as a whole and highlight interesting benchmark systems which can be used to constrain the properties of ultracool atmospheres. **(15 min)**

Day 2 | TUESDAY, JUNE 10 - Cool Stars as Dynamic Objects

Abstract #38 - Sixty Years (and Counting) of Stargazing: Synoptic Observations of Sun-Like Stars

Jeffrey Hall | *Lowell Observatory*

The Mount Wilson Observatory (MWO) HK Project ran from 1966 to 2003 and is the landmark data set that revealed the ensemble of variations, cyclic and otherwise, in cool stars. The Lowell Observatory Solar-Stellar Spectrograph (SSS) project has operated since 1994; it includes some MWO stars but also the Sun itself and all solar analogs to V ~7.5. Decades of comparable solar observations have been accumulated at the NSO. Long-term photometric monitoring of Sun-like stars, including many of the MWO and SSS stars, continues today at the Fairborn Observatory south of Tucson. Numerous other synoptic programs have been carried out from the ground and in space. I will review the advantages (and perils) of carrying out the same observations for decades, key results, promising lines of work for the future, and the insights and benefit to the community of a full combination of the data sets – this having been done to some extent but not comprehensively. **(Invited, 40 min)**

Abstract #39 - The Solar Chromosphere and Transition Region as Viewed by the Interface Region Imaging Spectrograph (IRIS)

Bart De Pontieu | *Lockheed-Martin Solar & Astrophysics Laboratory*

The Interface Region Imaging Spectrograph (IRIS) was launched in June 2013 and has been obtaining high-resolution (0.33 arcsec) spectra and images of the chromosphere and transition region since end of July 2013. I will describe the IRIS instrument and its diagnostics, which include strong lines in the far-ultraviolet (e.g., C II 1335, Si IV 1402) and near-ultraviolet (Mg II k 2796 and Mg II h 2803). I will present an overview of recent results based on IRIS observations, including: 1. Detection of small-scale and dynamic transition region loops that were previously unresolved but whose existence had been hypothesized to explain the excess brightness in the transition region (so-called "unresolved fine structure"), 2. The pervasiveness of twist on very small scales in the chromosphere and transition region on a variety of different dynamic features and associated heating to transition region temperatures, 3. Exploiting observations of the chromospheric response to coronal energy deposition to help constrain the coronal heating mechanism, 4. Spatio-temporal characterization of the dominant heating mechanism in the chromosphere and its connection to that of the corona. Numerical simulations form an integral part of the IRIS science investigation. I will provide a comparison of IRIS observations with advanced radiative MHD simulations, which include the effects of ion-neutral interactions, and describe how such comparisons lead to new insights into the dynamics and energetics of the low solar atmosphere. **(Invited, 40 min)**

Abstract #40 - The Physics and Chemistry of Brown Dwarf Clouds: Results from HST and Spitzer Phase Mapping Programs

Daniel Apai | *University of Arizona*

Condensate clouds play important roles in setting the physical and thermal structures of photospheres of brown dwarfs, directly imaged exoplanets, and hot transiting exoplanets. Rotational phase mapping of brown dwarfs provides exciting new insights into the physical and chemical properties of condensate clouds in ultracool atmospheres. Here I will show new results from ongoing HST and Spitzer rotational mapping projects, which provide very high quality spectrally and temporally resolved data of rotating brown dwarfs, obtained simultaneously at multiple atmospheric depths. I will summarize results from several studies that address the nature and properties of brown

dwarf clouds as a function of spectral type and other properties. Finally, I will show first results from the Spitzer Cycle-9 Exploration Science program Extrasolar Storms that uses multi-epoch observations of complete rotations to study the evolution of cloud coverage in brown dwarf photospheres, thus providing detailed views of atmospheric dynamics in these ultracool atmospheres. **(Contributed, 20 min)**

Abstract #41 - The Long and the Short of It: Timescales for Stellar Activity

Moira Jardine | *University of St Andrews*

Stellar activity varies on a range of timescales, from the long-term decrease due to stellar spindown, through the shorter timescales of magnetic cycles and the rapid fluctuations of flares and coronal mass ejections. All of these are influenced by the mass of the star. This governs the nature of the dynamo that generates magnetic field in the stellar interior and determines the observed large-scale magnetic structure. Stellar mass also governs the processes (such as differential rotation) that transport flux across stellar surfaces and drive coronal evolution and dynamics. In this talk I will review recent progress in these areas and consider the impact that stellar activity on all these timescales may have on exoplanetary systems. **(Invited, 40 min)**

Abstract #42 - The Physics and Chemistry of Brown Dwarf Clouds: Results from HST and Spitzer Phase Mapping Programs

Kyle Augustson | *High Altitude Observatory-NCAR*

Many Sun-like stars exhibit cyclical magnetic activity. There is also some evidence for stochastic variations in these cycle's amplitudes, as well as evidence for organized, large-scale patterns of magnetic structures. Results of recent global-scale 3-D dynamo simulations that show some aspects of these phenomena are presented, where regular cycles, equatorward propagation of magnetic structures, and grand minima are among the salient features of these simulations. The mechanisms resulting in the cyclical nature of the achieved dynamo action within these simulations and their relevant time-scales are shown, along with an analysis of the conditions preceding and following the protracted minima in magnetic energy. **(Contributed, 20 min)**

Abstract #43 - SOLIS: Reconciling Disk-Integrated and Disk-Resolved Spectra from the Sun

A.A. Pevtsov | *National Solar Observatory*

Unlike other stars, the surface of the Sun can be spatially resolved to a high degree of detail. But the Sun can also be observed as if it was a distant star. The availability of solar disk-resolved and disk-integrated spectra offers an opportunity to devise methods to derive information about spatial distribution of solar features from sun-as-a-star measurements. This talk will present an update on work done at the National Solar Observatory to reconcile disk-integrated and disk-resolved solar spectra from the Solar Optical Long-term Investigations of the Sun (SOLIS) station. We will also present the results of numerical simulations of the evolution of surface features, which are used to interpret the disk-integrated spectra. The results of this work will lead to a new approach to infer the information about the spatial distribution of features on other stars, from the overall filling factor of active regions to possibly the latitude/longitude distribution of features. **(Contributed, 20 min)**

SPLINTER SESSIONS

GALACTIC ARCHAEOLOGY WITH COOL STARS **(1899 Ballroom)**

Conveners: Luca Casagrande (Australian National University), Remo Collet (Australian National University), Aaron Dotter (Australian National University), Katharine Schlesinger (Research School of Astronomy and Astrophysics)

Survey Panel

Session Leaders: L. Casagrande, K. Schlesigner

Featured Panelists: Bárbara Rojas-Ayala (Centro de Astrofísica da Universidade do Porto), Mario Juric (Large Synoptic Survey Telescope), Sarah Schmidt (Ohio State University)

Some Selected Topics: TBD

Theory Panel

Session Leaders: R. Collet, A. Dotter

Featured Panelists: Ed Baron (University of Oklahoma), Andrea Dupree (Harvard-Smithsonian Center for Astrophysics), Arunas Kucinskas (Vilnius University), Chris Sneden (University of Texas)

Some Selected Topics: TBD

MAGNETIC FIELDS, DYNAMOS AND AURORAE: FROM BROWN DWARFS TO EXOPLANETS (Prochnow Auditorium)

Conveners: Gregg Hallinan (Caltech), Joseph Lazio (Caltech JPL), Evgenya Shkolnik (Lowell Observatory)

Session 1

Abstract #44 - Fully Convective Dynamos

Matt Browning | *University of Exeter*

(Invited, 20+5 min)

Abstract #45 - Magnetic Fields on Brown Dwarfs

Oleksii Kuzmychov | *KIS Freiburg Germany*

(10+2 min)

Abstract #46 - Auroral Radio Emission on Planets and Exoplanets

Jean-Mathias Greissmeir | *Netherlands Institute for Astronomy*

(Invited, 20+5 min)

Abstract #47 - Modeling Exoplanetary Radio Emissions Using a Realistic Magnetic Field Geometry

Victor See | *University of St. Andrews*

(10+2 min)

Abstract #48 - Magnetic Fields and Planetary Outflows

Fred Adams | *University of Michigan*

(10+2 min)

Session 2

Abstract #49 - Evolution in Activity and Rotation at the Bottom of the Main Sequence
Subhanjoy Mohanty | *Imperial College London*
(Invited, 20+5 min)

Abstract #50 - Chromospheric Activity on L Dwarfs
Sarah Jane Schmidt | *Ohio State University*
(10+2 min)

Abstract #51 - A Survey of Auroral Emission from Ultracool Dwarfs
J. Sebastian Pineda | *Caltech*
(10+2 min)

Abstract #52 - Auroral Radio Emission from Late L and T Dwarfs: A New Constraint on Dynamo Theory in the Substellar Regime
Melodie Kao | *Caltech*
(10+2 min)

Abstract #53 - Pushing the Limits of Auroral Radio Emission: New Results from the T6.5 Dwarf 2MASS 1047+21
Peter Williams | *Harvard*
(10+2 min)

STELLAR SURFACES WITH HIGH SPATIAL AND TEMPORAL RESOLUTION (HCCC)

Conveners: Heidi Korhonen (FINCA, Turku University), Alex Brown (University of Colorado), John Monnier (University of Michigan), Matthew Muterspaugh (Tennessee State University)

Abstract #54 - Testing the Detectability of Rotation and Differential Rotation Signals in Kepler Light Curves
Joe Llama | *University of St Andrews*
(Invited, 25 min)

Abstract #55 - Imaging Stellar Surfaces and Magnetic Fields
Stephen Marsden | *University of Southern Queensland*
(Invited, 25 min)

Abstract #56 - Pushing the (Convective) Envelope: Imaging Spotted Stellar Surfaces with Optical Interferometry
Rachael Roettenbacher | *University of Michigan*
(Invited, 25 min)

Abstract #57 - Cycles and Rapid Variations on Solar-Like Stars: The Magnetic Surface Structure Revealed by ZDI
Thorsten Carroll | *Leibniz Institute for Astrophysics Potsdam*
(Contributed, 12 min)

Abstract #58 - The Evolution Of Surface Magnetic Fields In Young Solar-Type Stars

Colin Folsom | *IRAP*

(Contributed, 12 min)

Abstract #59 - Active Longitudes And Azimuthal Dynamo Waves In Models And Observations

Jyri Lehtinen | *University of Helsinki*

(Contributed, 12 min)

Abstract #60 - Determining Stellar Properties From Planetary Transits

Adriana Valio | *Mackenzie University*

(Contributed, 12 min)

Abstract #61 - Stellar Spectroscopy During Exoplanet Transits: Dissecting Fine Structure Across Stellar Surfaces

Dainis Dravins | *Lund Observatory*

(Contributed, 12 min)

Abstract #62 - Spontaneous Formation of Cool Polar-Spots in Global Numerical Simulations

Rakesh Yadev | *Max Planck Institute for Solar System Research*

(Contributed, 12 min)

Day 3 | **WEDNESDAY, JUNE 11** - Cool Star Abundances

Abstract #63 - Variations in the Composition of Cool Stars

Natalie R. Hinkel | *San Francisco State University*

Understanding the chemical composition of cool stars in the solar neighborhood is vital to answering key formation and evolutionary questions for not only our local universe, but also for planets orbiting those stars. However, over the last few decades, abundance measurement techniques have changed – such as line lists, atmospheric models, and adopted solar abundances, introducing systematic and stochastic differences between data sets. These differences make comparisons between data sets, let alone stars, very difficult to quantize. I will discuss abundance data from a homogenized compilation of literature sources for ~3000 stars found within 150pc of the Sun, as part of the Hypatia Catalog. This large collection of chemical abundances allows for a more copacetic understanding of stellar compositions, without bias towards a given group or technique. I will also present abundance results from a collaboration with multiple, international groups who analyzed the same high-resolution spectra using a variety of techniques. Our conclusions from their analysis, as it pertains to the field, suggests that while there are many discrepancies between groups, a standard method of measuring abundances may be in order. With help from the community, the stellar abundance issues may be disentangled to provide an accurate portrayal of the compositions of nearby stars. **(Contributed, 20 min)**

Abstract #64 - Determination of Temperatures and Abundances in Brown Dwarf Atmospheres

Michael Line | *UCSC*

Brown dwarf spectra contain a wealth of information about the temperature structure and molecular abundances. The standard approach to interpreting brown dwarf spectra has been through the use of self-consistent stellar grid models that attempt to fit basic stellar parameters such as the effective temperature and surface gravity and occasionally eddy diffusivity. We present a novel inverse approach based upon earth and solar system atmosphere remote sensing techniques to determine the detailed temperature profile, molecular gas abundances, surface gravity, and photometric radius (if distance is known) free from many of the underlying assumptions present in current grid-modeling. We apply our inverse approach to well studied cloud-free benchmark brown dwarf spectra (like Gl570D) and present retrieved abundances for H2O, CH4, CO, CO2, and NH3. From these abundance determinations it is possible to address the importance of vertical mixing as well as a determination of the elemental C/O ratio, which is indicative of the formation environment. Time permitting we will also present preliminary retrieval results on the high-resolution spectrum of Luhman 16A. **(Contributed, 20 min)**

Abstract #65 - Wide Stellar Binaries and a Photometric (griz) Metallicity Calibration for Cool Stars

Andrew West | *Boston University*

I will present a summary of recent highlights from studies identifying and capitalizing on the powerful laboratories that are low-mass, wide stellar binaries. Using large surveys such as (but not limited to) SDSS, UKIDSS and Kepler we have identified thousands of systems, many of which have spectroscopic observations (for both components) and rich photometric light curves. I will briefly discuss some of our results that exploit the coeval nature of these systems to constrain models of stellar angular momentum and magnetic activity evolution. I will particularly focus on wide pairs as tools for estimating and constraining the metal content of cool stars from their spectra and broad band colors. Specifically, I will present results from work that optimizes the Mann et al. M dwarf metallicity calibrations (derived using wide binaries) for the optical regime covered by SDSS spectra. I will demonstrate the robustness of the new calibrations using a sample of wide, low-mass binaries for which both components have an SDSS spectrum. Using these new spectroscopic metallicity calibrations, we derived relations between the metallicities (from optical spectra) and the Sloan colors derived using more than 20,000 M dwarfs in the SDSS DR7 spectroscopic catalog. I will present these relations, which have important ramifications for studies of Galactic chemical evolution, the search for exoplanets and subdwarfs, and are essential for surveys such as Pan-STARRS and LSST, which use griz photometry but have no spectroscopic component. **(Contributed, 20 min)**

Abstract #66 - The Cool Stars Debate: "The Ins and Outs of Solar Abundances"

Martin Asplund and Marc Pinsonneault | *ANU and OSU*

Abstract #67 - Kepler and the Exoplanet Revolution (Prochnow Auditorium)

Lucianne Walkowicz - *Princeton University*

Until just a few decades ago, our knowledge of planetary systems was limited to our own Earth and the neighboring planets of our solar system. Over the past several years, however, thousands of planets have been discovered orbiting stars beyond our sun, allowing us to study our own Earth in the context of other worlds for the first time in history. Dr. Walkowicz will discuss NASA's Kepler Mission, the space telescope responsible for many of these new discoveries, and how it has changed our knowledge of planetary systems forever. Kepler's findings set the stage not only for understanding planetary systems in general, but also for the possibility of finding life beyond planet Earth.

The Cool Stars 18 Public Lecture is sponsored by The Barringer Crater Company, owners since 1903 of The Barringer Meteorite Crater more commonly known as Meteor Crater, Earth's first proven and best preserved impact site. For more than 70 years the company has supported research and education in the broad field of meteorites and planetary science and it is please to sponsor this important lecture.

Day 4 | THURSDAY, JUNE 12 - Cool Stars as Planet Hosts

Abstract #68 - Helioseismology in a Stellar Context: From SDO to PLATO

Kaitlin Kratter | *University of Arizona*

The distinction between planetary systems and binary systems is especially fraught for the lowest mass primaries. In this talk I will review the current population of ambiguous systems and describe how both binary and planet formation models are modified to accommodate cool stars and brown dwarfs as hosts. I will focus on the role of pre-stellar cores and star forming environments in the star and planet formation process. **(Invited, 40 min)**

Abstract #69 - Star-Planet Interactions

Nuccio Lanza | *INAF-Osservatorio Astrofisico di Catania*

Stars interact with their planets through gravitation, radiation, and magnetic fields. I shall focus on the interaction between late-type stars with an outer convection zone and close-in planets, i.e., with an orbital semimajor axis smaller than 0.15 AU. In particular, I shall review the roles of tides and magnetic fields considering some key observations and discussing theoretical scenarios for their interpretation with an emphasis on open questions. Tides in systems consisting of close-in planets and late-type stars occur in a regime far from synchronization and with extreme values of the mass ratios of the two bodies. This is challenging for current tidal theories based on the observations of binary systems consisting of stars with similar masses and synchronized rotation and orbital motion. Many close-in planets orbit inside the Alfven radii of their host stars leading to magnetic interactions remarkably different than in the case of Solar System where the planets are in the region where the solar wind is streaming in a super-alfvenic regime. The energy dissipated by magnetic reconnection events involving stellar and planetary fields can reach the star producing transient coronal and chromospheric emissions, but can also increase the evaporation rate of the planet's atmosphere and induce a remarkable time variability in it. Moreover, the stellar magnetized wind can be modified by a close-in planet, changing the angular momentum loss rate and the evolution of stellar rotation. Recent observations, both from the ground and with the space telescopes Kepler and CoRoT, open new interesting perspectives in these fields, in particular for the study of stellar rotation and the effects of tides and magnetic interactions on the evolution of stellar angular momentum. Moreover, the new opportunities opened by the recently selected ESA space mission PLATO will be briefly considered. **(Invited, 40 min)**

Abstract #70 - The Intrinsic UV Luminosity Distribution of M Dwarf Stars

Megan Ansdell - *Institute for Astronomy, University of Hawaii*

M dwarfs exhibit strong magnetic activity that may create intense ultraviolet (UV) radiation environments in their circumstellar habitable zones. Quantifying their intrinsic UV luminosity distribution as a function of spectral subtype and age is therefore critical to understanding the potential of M dwarfs as habitable planet hosts. To this end, we have characterized a population of ~5,000 M dwarfs in UV luminosity vs. V-J color space by cross-correlating the Lepine & Gaidos (2011) catalog of nearby late-type stars with the GALEX all-sky catalog of near-UV (1770-2730Å) sources. We find a primary locus of UV-dim M dwarfs (presumably the inactive stars dominated by low-level photospheric emission) as well as a separate population of ~1,000 UV-bright M dwarfs (presumably the active stars dominated by stronger chromospheric emission). The UV-dim locus has an intrinsic width in excess of measurement errors of ~0.5 mags; this spread could be due to metallicity effects or may suggest that M dwarfs exhibit base levels of activity throughout their lifetimes. We measured Hα equivalent widths and searched for wide binaries (~10^3 AU) using moderate-resolution integral-field spectra for ~500 UV-bright M dwarfs in order to confirm activity. We vetted both populations for false-positive UV detections resulting from interacting binaries or unrelated background sources. The intrinsic UV-luminosity distribution, corrected for false-positives and photospheric emission, features a ~1/L_UV shape that indicates a smooth transition between inactive and active epochs. We also combine this intrinsic UV luminosity distribution with local star-formation rates to constrain possible age-activity relations. **(Contributed, 20 min)**

Abstract #71 - Planetary Systems Around Cool Stars : A Window Towards Characterization of Small Planets

Guillem Anglada-Escude | *Queen Mary University of London*

Due to their favorable mass-radius ratios, current technical means enable characterization of the bulk properties of small planets around low-mass stars efficiently. I will review the current techniques to detect them and the unique opportunities they offer for follow-up. This includes Doppler spectroscopy, photometric transits, gravitational microlensing, direct imaging and astrometry. The same way as hot-Jupiters paved the road on the first years of exoplanet discoveries, dedicated programs to detect and characterize hot Earths and super-Earths are the natural step towards (near) future characterization of potentially habitable worlds. These studies show that detailed knowledge of the stars and their physics is needed to correctly interpret exoplanet observations, even at their most basic level (Doppler, photometric and spectroscopic observables). An explosion of detections using the last two techniques (imaging and astrometry) is expected in the next few years opening up a new region of the parameter space for exploration. I will end-up with an overview of new instruments coming on-line, and present what trends in the exoplanet populations are suggested by recent studies. **(Invited, 40 min)**

Abstract #72 - Close-in Planets and Magnetic Torques: What Impact on Stellar Evolution?

Antoine Strugarek | *Université de Montréal*

The diversity of masses, sizes and orbits of known exoplanets has prompted recent efforts in the scientific community to explore the broad range of interactions that can exist between planets and their host stars. In particular, planets orbiting inside the stellar wind Alfvén radius can magnetically influence their host star and sometimes influence the angular momentum evolution of the system. Among the numerous star-planet interaction (SPI) models that have been developed, magnetohydrodynamic (MHD) simulations combine state of the art numerical models of cool star magnetospheres with simplified models of planets. The advantage of these global, dynamical models is the ability to assess the effects of SPI on both the planet and host star, in a self-consistent way. We will present our study of global magnetic SPI using the PLUTO code. We first give an overview of different types of interactions, depending on the stellar wind and orbital properties. Planets can magnetically influence host star angular momenta in two ways: (1) via a direct magnetic connection between the star and planet, and (2) by significantly modifying the stellar wind. We explore these mechanisms for cases of both magnetized and unmagnetized planets, in order to characterize the potential influence on the rotational history of the star, as well as the planetary orbital migration. We show that the key factors for the interaction are the relative magnetic field strengths and topologies of the two bodies, as well as the strength of the stellar wind. In some cases, the planet transfers an amount of angular momentum to the star that is comparable to the amount being removed by the wind, which can have a significant impact on the evolution of the star. **(Contributed, 20 min)**

Abstract #73 - Using Transiting Planets to Model Starspot Evolution

James Davenport | *University of Washington*

Photometry from Kepler has revealed the presence of cool starspots on the surfaces of thousands of stars, presenting a wide range of spot morphologies and lifetimes. Understanding the lifetime and evolution of starspots across the main sequence reveals critical information about the strength and nature of stellar dynamos. We probe the dynamo by modeling starspot properties using Kepler light curves. In particular, we use planetary systems like Kepler 17 that show in-transit starspot crossing features. Spot-occulting transits probe smaller-scale starspot features on the stellar surface along a fixed latitude region. Our approach is novel in modeling both the in- and out-of transit light curve features, allowing us to break fundamental degeneracies between spot size, latitude, and contrast. With continuous monitoring from Kepler we are able to observe small changes in the positions and sizes of spots from many transits, spanning 4 years of data. Additionally, for stars without transiting planets like GJ 1243, we are able to recover subtle, long term changes in spot sizes and longitudes, leading to some of the slowest differential rotation rates yet measured. These studies constrain key physical parameters including rotation period, differential rotation, and diffusion timescales, and open the door to ensemble studies of detailed spot evolution in the future. **(Contributed, 20 min)**

SPLINTER SESSIONS

THE ACCRETION PROCESS IN YOUNG STARS (1899 Ballroom)

Conveners: Rosaria (Sara) Bonito and Costanza Argiroffi (Dip. di Fisica e Chimica, University of Palermo)

Session 1

Abstract #74 - Observations of Young Clusters with the Gaia-ESO Survey

G. Germano Sacco

The Gaia-ESO Survey is observing about 40 young open clusters (1-100 Myr) with the multi-object optical spectrograph FLAMES at the VLT. We are deriving very precise radial velocities (error ~0.3 km/s), projected rotational velocities, stellar parameters, accretion rates and chemical abundances, using homogeneous methods for all the clusters. In this talk, I will present results from the first observations of the youngest clusters in the sample, which include a high fraction of actively accreting stars and I will outline the scientific goals for the future observations. **(20 min)**

Abstract #75 - Accretion and Photoevaporation Diagnostics: Comparison Between Disk Dispersal Mechanisms

E. Rigliaco, I. Pascucci, J.M. Alcalá et al. | *University of Arizona/LPL*

The physical mechanisms that disperse circumstellar disks around young stars dictate the timescale over which disk material is cleared out, and giant planets have to be formed. In this talk I will review the spectroscopic diagnostics of the two most efficient disk dispersal mechanisms: viscous accretion and photoevaporation. I will discuss the reliability of several accretion indicators and I will discuss the state of the art of the photoevaporative wind diagnostics, showing few cases where both these diagnostics have been observed simultaneously. **(20 min)**

Abstract #76 - Accretion in Young Stellar Objects: A Complete View with the VLT/X-Shooter Spectrograph

Carlo Felice Manara | *European Southern Observatory*

The evolution of protoplanetary disks is regulated by its interaction with the central forming star. This interaction happens mainly through accretion of matter from the disk onto the star, and its most significant signatures are the continuum excess in the UV part of the spectrum and the presence of various emission lines. With the advent of the VLT/X-Shooter, the excess emission in the UV is being studied simultaneously with the signatures in the visible and in the near-infrared, finally giving a complete view of this phenomenon. In this talk I will present my work and that of the italian X-Shooter GTO team, which focuses on the study of the accretion of matter from the circumstellar disk onto the central young stellar object with X-Shooter spectra. I will explain the methodology of my spectroscopic analysis, which is based on fitting the UV-excess and the broadband spectrum to derive simultaneously stellar and accretion properties of the target, and explain its application to different key aspects of disk evolution. In particular, I will report on the results obtained by our team studying various young star forming regions, such as Lupus, rho-Ophiucus, and TWA, to derive the dependence of accretion on the stellar mass and the age. Moreover, I will discuss some interesting results on the accretion properties derived on a sample of transitional disk observed with X-Shooter. I will discuss how accretion helps constraining the properties of the inner region of such disks, where planet formation is thought to be already happening. **(10 min)**

Abstract #77 - Magnetic Fields and Magnetospheric Accretion in T Tauri Stars

Gaitee Hussain | *ESO*

Magnetic fields in T Tauri stars can be detected and analyzed using both intensity and circularly polarized spectra. The magnetic fields have been measured and mapped in over a dozen young stars using the technique of Zeeman Doppler imaging. These imaging studies, combined with measurements of the mean magnetic field strengths obtained from complementary techniques, enable us to characterize the range of magnetic field properties in these systems as well as to test some basic tenets of magnetospheric accretion. I will present an overview of magnetism in T Tauri stars, focusing on systems that are still accreting. I will also show results from coordinated multi-wavelength campaigns of individual T Tauri systems. These latter campaigns are particularly effective probes of the magnetospheric accretion environment. **(20 min)**

Abstract #78 - Coordinated Synoptic Investigation of NGC 2264

Ann Marie Cody | *IPAC*

(10 min)

Session 2

Abstract #79 - MHD Simulations of Magnetospheric Accretion, Waves in the Disk and Associated Variability

Marina Romanova | *Cornell University*

I will discuss results of the global 3D MHD simulations of accretion onto young magnetized stars with a dipole or more complex magnetic fields and will describe properties of the funnel streams and shapes of the hot spots. In the case of a dipole field, the simulations show that magnetized stars may accrete either in a stable regime, where matter flows towards a star in two ordered funnel streams, or in an unstable regime, where matter accretes either in several chaotic “tongues” (which form chaotic spots on the surface of the star), or in 1-2 ordered tongues which rotate with the angular frequency of the inner disk, and therefore their frequency varies with the accretion rate. These regimes of accretion determine the variability patterns of young stars, which range from periodic in the stable regime, to chaotic or quasi-periodic in the unstable regime. A star with a tilted dipole magnetic field excites density and bending waves in the inner disk. The density waves produce density enhancements in the inner disk and may determine position of the funnel streams and unstable tongues. On the other hand, bending waves may be responsible for obscuration of stellar light and AA Tau type light-curves. **(20 min)**

Abstract #80 - TW Hya: Insights from Time-Domain Multi-Wavelength Spectroscopy

A. K. Dupree, N. S. Brickhouse, and S. R. Cranmer | *Harvard Smithsonian Center for Astrophysics*

High resolution ultraviolet, optical, and near-infrared spectra of TW Hya, the nearest accreting T Tauri star, cover a decade and reveal substantial changes in accretion and wind properties in one star. Stable absorption features in H-alpha, appear caused by an accreting column silhouetted in the stellar wind. Measurements of dynamics from the line profiles support a dipole accretion model: the free-fall velocity of material correlates inversely with the strength of the post-shock emission. Terminal outflow velocities appear to be directly related to the amount of post-shock emission, giving evidence for an accretion-driven stellar wind. Line-profiles when compared to existing models suggest that 3 elements are needed: (1) a turbulent post-shock region producing chromospheric emission; (2) an accretion-driven stellar wind; (3) infalling material. **(20 min)**

Abstract #81 - X-Rays from the Accretion Shocks in Young Stars

Nancy S. Brickhouse | *Harvard-Smithsonian Center for Astrophysics*

Young stars are prolific producers of X-ray emission, as we know from Chandra and XMM-Newton surveys of star forming regions sampling several thousand stars. This X-ray emission is predominantly coronal in nature. Accreting stars are also expected to show X-ray emission from the shock produced near the surface of the star. High resolution X-ray grating spectra are required to distinguish this shock emission from the corona, using diagnostic line ratios to determine the electron temperature, electron density, and absorption characteristics. We are building a self-consistent model of the accretion shock constrained by grating data, for which understanding the absorption is key. I will also discuss new insights into the physics of the post-shock environment. **(20 min)**

Abstract #82 - Magnetic Activity and Accretion in Three Nearby, Nearly Edge-on Pre-MS Star-disk Systems

David Principe | *Rochester Institute of Technology*

We investigate, via contemporaneous X-ray and optical/IR observations, the nearby, pre-main sequence star/disk systems T Chamaeleontis (T Cha; D ~ 110 pc, age 3-5 Myr) and TWA 30A and 30B (D ~ 40 pc; age ~ 8 Myr). All three of these systems present opportunities to probe pre-main sequence (pre-MS) star-disk interactions during late-stage circumstellar disk evolution. The classical T Tauri star T Cha is the closest known example of a nearly edge-on, actively accreting, solar-mass star/disk system; furthermore, T Cha may be orbited by a low-mass companion or massive planet that has cleared an inner hole in its disk. We analyze near-simultaneous Chandra high-resolution X-ray and optical H-alpha spectroscopy observations of T Cha to search for correlations between X-ray and optical emission signatures of accretion, and to infer the X-ray absorbing properties of the T Cha circumstellar disk. We also present contemporaneous XMM-Newton X-ray and optical/IR spectroscopic observations of the nearby, actively accreting, very low-mass (mid-M) pre-MS star/disk/jet systems TWA 30A and 30B. Like T Cha, each component of this wide binary is viewed through a nearly edge-on circumstellar disk. Both TWA 30A and 30B display large near-IR variability, suggestive of (respectively) variable obscuration of the stellar photosphere and a possible disk-rim warp. The proximity and edge-on viewing geometries of the TWA 30 pair afford a unique opportunity to investigate the composition of circumstellar disks orbiting pre-MS stars near the H-burning limit. We investigate potential X-ray accretion signatures, and compare the levels of magnetic activity in TWA 30A and 30B to those of other nearby, low-mass pre-MS stars. **(10 min)**

Abstract #83 - Modeling The Accretion Shocks In Classical T Tauri Stars

Rosaria Bonito & Costanza Argiroffi | *Dip. di Fisica e Chimica, University of Palermo*

(10 min)

PORTRAYING THE HOSTS: STELLAR SCIENCE FROM PLANET SEARCHES
(Prochnow Auditorium)

Conveners: Bárbara Rojas-Ayala (CAUP), Isabelle Boisse (Laboratoire d'Astrophysique de Marseille), Philip Muirhead (Boston University)

Abstract #84 - Stellar Activity Features Seen From Planet Search Data

Isabelle Boisse | *LAM*

Most of the exoplanet science is dependent on the stellar knowledge. One of them that has to be understood is the magnetic activity when we search for planets with radial velocity or photometry measurements. The main shape of stellar activity and spots properties have to be understood, for example, to choose the best targets to search for low-mass planets in the habitable zone or to derive the accurate parameters of a planetary system. With that aim, we will try to review in this presentation how these studies lead to give clues on several activity features that were not

previously observable on Sun-like stars. **(20 min)**

Abstract #85 - Measuring 34,030 Rotation Periods of Kepler Field Stars with a New Autocorrelation Method and the Planet Connection

Tsevi Mazeh | *TAU-Wise Observatory*

The long-baseline, high precision light curves from the Kepler space mission are revolutionizing the study of stellar rotation. However, standard approaches used to measure periodicity based on Fourier decomposition, are not well suited to signals that evolve in phase and amplitude, and may be affected by instrumental systematics. We have therefore developed an alternative algorithm, based on the autocorrelation function (ACF) of the light curve. Because the ACF measures only the degree of self-similarity of the light curve at a given time lag, the period remains detectable even when the rotational modulation evolves significantly, and when systematic effects and long term trends are present.

We analyzed three years of data from the Kepler space mission to derive rotation periods of main-sequence stars. Our automated autocorrelation-based method detected rotation periods between 0.2 and 70 days for 34,030 (25.6%) of the 133,030 main-sequence Kepler targets (excluding known eclipsing binaries and Kepler Objects of Interest), making this the largest sample of stellar rotation periods to date. The upper envelope of the period distribution is broadly consistent with a gyrochronological age of 4.5 Gyr, based on the published isochrones. We examined the amplitude of periodic variability for the stars with detected rotation periods, and found typically higher amplitudes for shorter periods and lower effective temperatures.

We also analyzed the light curves of the Kepler planet-host candidates (KOI) and derived stellar rotation periods for ~1500 of them. The comparison between the orbital and rotational periods reveals a striking lack of close-in planets around fast rotators. We further compared the rotational amplitudes of the KOIs with those corresponding to single stars, and found that only the KOIs with hot temperature show lower rotational amplitudes than the stars without transits. This is probably due to the non-alignment of the rotational and orbital axes of hot stars. **(20 min)**

Abstract #86 - Discovering Brown Dwarfs with Microlens Parallax

Jennifer Yee | *Harvard-Smithsonian Center for Astrophysics*

Although microlensing surveys are primarily conducted for the purpose of finding planets, they are also a means to probe the population of old, isolated brown dwarfs, especially brown dwarf binaries. I will discuss how the microlensing parallax effect has been used to discover brown dwarfs, including some of the lowest mass brown-dwarf--brown-dwarf binaries. In the future, the WFIRST satellite will provide the opportunity to discover many more such objects. **(20 min)**

Abstract #87 - Trigonometric Parallaxes and the Inferred Properties for 1507 mid-to-late M-dwarfs from the MEarth Planet Survey

Jason Dittmann | *Harvard-Smithsonian Center for Astrophysics*

The MEarth survey has been actively searching for small rocky planets around the smallest, nearest stars to the Sun. Over this time we have taken more than two million images of approximately 1700 mid-to-late M dwarf stars in the northern hemisphere. Prior to our results, most of our stars were characterized solely with data from photographic plates. The data provided by the MEarth survey has allowed us to discover and characterize eclipsing binary systems, measure short and long term rotation periods of stars, and directly measure the distances to these stars via trigonometric parallaxes. In this talk, I will discuss the MEarth Observatory, how it operates, and then discuss MEarth's recent contributions to our understanding of low mass stars. Specifically, I will describe the astrometric pipeline we have developed to measure the trigonometric parallaxes to 1507 systems with a typical accuracy of 4 milliarcseconds and how we have used these results to more reliably estimate the stellar mass and stellar radii for these stars. I will further discuss recent work in calibrating the MEarth photometric system with nightly standard field

observations and our progress in obtaining precise broadband optical magnitudes for these stars. We use these results to derive new photometric estimates of distance and metallicities. Finally, I will outline our future plans for the MEarth Observatory and the newly online MEarth South observatory at CTIO. **(10 min)**

Abstract #88 - SPIRou is a near-Infrared (nIR) Spectropolarimeter and High-Precision Velocimeter for the Canada-France-Hawaii Telescope (CFHT)

Jean-François Donati | *IRAP-Toulouse*

SPIRou aims at becoming world-leader on two high-impact science topics, (i) the quest for habitable Earth-like planets around low-mass stars, and (ii) the study of low-mass star and planet formation in the presence of magnetic fields. In addition to these two main goals, SPIRou will be able to tackle many more key programs, from weather patterns of brown dwarfs to Solar-system-planet and exoplanet atmospheres, dynamo processes in fully-convective bodies, planet habitability and massive star formation. The science programs that SPIRou proposes to tackle are forefront, ambitious and timely - ideally phased in particular with complementary space missions like TESS and JWST.

SPIRou is designed to carry out its science mission with maximum efficiency and optimum precision. More specifically, SPIRou will be able to cover a wide simultaneous nIR spectral domain (0.98-2.35 μm), including the K band, at a resolving power of 73.5K and to provide polarimetric capabilities, with a 15% average throughput and a radial velocity (RV) precision of 1 m/s. Both the K band and the polarimetric capabilities are key assets for the two main science goals. Supported and funded by a large international team, SPIRou is presently in construction - with first light at CFHT planned for early 2017. **(20 min)**

Abstract #89 - Solar like activity of the TrES-2 host star?

Stefanie Raetz | *ESTEC-ESA*

TrES-2 is one of few exoplanets, which offer the matchless possibility to combine long-term ground-based observations with continuous satellite data. Because of the nearly continuous observations of the Kepler space telescopes for a duration of 4 years, TrES-2 is one of the photometrically best studied transiting exoplanets. We analyzed seven years of ground based observations along with data of 18 observation quarters (Q0- Q17) of the Kepler space telescope. Altogether 491 individual transit mid-times were obtained. The long observation period allowed a very precise redetermination of the transit ephemeris . Owing to unprecedented precision of Kepler we determined the system parameters independently for each of the 436 Kepler transits and searched for any variations . We found no statistically significant change in the orbital inclination i and the transit duration D, but the radius ratio rPl/rS, hence the transit depth, shows a slight increase which is significant with 3σ. This finding could be an indication of an increasing stellar activity. The translation from the increasing transit depth to a change in spot coverage yielded a value of 0.44% which seems to be plausible compared to the solar cycle. Hence, we probably found, for the first time, solar like activity on a transiting planet host star by analyzing transit events. **(10 min)**

Abstract #90 - MASCARA, the Multi-site All-Sky CAmeRA

Anna-Lea Lesage | *Leiden Observatory*

MASCARA, the Multi-site All-Sky CameRa, is a new ground-based transit survey project. Its main scientific goal is to find exoplanets transiting the brightest stars, in the V=4 to 8 magnitude range. This magnitude range is currently probed by neither space- nor ground-based surveys. The target population for MASCARA consists mostly of hot Jupiters, for which the average transit depth is around 1%. This immediately sets the signal-to noise requirement of at least 100 in less than one hour for the faint end of our magnitude range. As part of the survey we'll be observing and characterizing all stars in this magnitude range with unprecedented high temporal cadence and nearly continuously. We expect to be able to detect stellar flares, and to monitor stellar spot evolution for several months consecutively. Furthermore, we will be sensitive to large stellar oscillations occurring at very short periods, for example like those currently observed in delta-Scuti stars and white dwarfs. In order to provide a nearly continuous coverage of the night sky, MASCARA will consist of several stations world wide. Each station is equipped with five fixed, wide-angle cameras which each take an image every 6.4 seconds. This allows for monitoring the near-entire sky down to magnitude 8 at that location. The first station is currently being integrated and will, after an initial test period in the Netherlands, be commissioned on La Palma early summer of this year. **(10 min)**

Abstract #91 - A New Kinematically Unbiased Search for Young, Nearby Stars

Alex Binks | *Keele University*

Samples of coeval stars in nearby, young groups offer a unique opportunity to further our observational constraints on the physics of stellar evolution on the pre-main-sequence. To date at least nine such groups have been unveiled, hosting several hundred stars. Low-mass stars in these groups are particularly interesting as they provide the best conditions for directly detecting sub-stellar companions and can act as a probe for surrounding disk material. The majority of recent search mechanisms to observe low-mass counterparts in these groups have focused on proper-motion selected surveys. These have been successful in terms of finding new members of known groups, but inherently preclude the discovery of new moving groups.

In this talk I present an alternative method, capable of identifying not only members of known moving groups, but also new groups themselves. By cross-correlating objects observed to have short rotation periods in the SuperWASP All Sky Survey with highly active X-ray sources in the ROSAT catalog, optical spectra of a sub-sample of 168 candidates were obtained to assess their youth and kinematics. Using lithium as the primary youth indicator, further strengthened by gyrochronology, H-alpha and rotation, 26 stars of spectral type FGK were measured to have ages younger than 100 Myr. Radial velocities and photometric parallaxes for these objects reveal a sub-sample of 11 targets which are tentatively close in their kinematics to the recently identified Octans-Near group. Whether these are members of Octans-Near or not, there nevertheless exists a sub-grouping of several stars with no connection to any previously determined nearby young moving group. **(10 min)**

UPGRADING THE SOLAR-STELLAR CONNECTION: NEWS ABOUT ACTIVITY IN COOL STARS (HCCC)

Conveners: Moritz Günther, Katja Poppenhaeger, Paola Testa (Harvard-Smithsonian Center for Astrophysics)

Abstract #92 - Bright Hot Impacts by Erupted Fragments Falling Back on the Sun: A Template for Stellar Accretion

Paola Testa | *Harvard-Smithsonian Center for Astrophysics*

Impacts of falling fragments observed after the eruption of a filament in a solar flare on 7 June 2011 are similar to those inferred for accretion flows on young stellar objects. As imaged in the ultraviolet (UV)-extreme UV range by the Atmospheric Imaging Assembly onboard the Solar Dynamics Observatory, many impacts of dark, dense matter display uncommonly intense, compact brightenings. High-resolution hydrodynamic simulations show that such bright spots, with plasma temperatures increasing from ~104 to ~106 kelvin, occur when high-density plasma (>>1010 particles per cubic centimeter) hits the solar surface at several hundred kilometers per second, producing high-energy emission as in stellar accretion. The high-energy emission comes from the original fragment material and is heavily absorbed by optically thick plasma, possibly explaining the lower mass accretion rates inferred from x-rays relative to UV-optical-near infrared observations of young stars. **(14 min)**

Abstract #93 - The Variability of Sun-Like Stars: Reproducing Observed Photometric Trends

A. I. Shapiro | *PMOD/WRC*

The Sun and stars with low magnetic activity levels become photometrically brighter when their activity increases. Magnetically more active stars display the opposite behavior and get fainter when their activity increases. We reproduce the observed photometric trends in stellar variations with a model that attributes the variability of the stellar radiative energy flux to the imbalance between the contributions from dark starspots and bright faculae. Our approach allows us to model the stellar photometric variability vs. activity dependence and reproduce the transition from faculae-dominated variability and direct activity brightness correlation to spot- dominated variability and inverse activity brightness correlation with increasing chromospheric activity level. The general success of the model in reproducing the behavior of Sun-like stars is a clear indication that the photometric variability of more active stars has the same basic causes as the Sun's. **(14 min)**

Abstract #94 - A Deep Rapid Archival Flare Transient Search in the Galactic Bulge

Adam Kowalski | *University of Washington*

Due to their high flare rates and energies combined with a large contrast against the background quiescent emission, the low-mass M dwarfs are the primary target for studying flare rates in the Galaxy. However, high-precision monitoring from Kepler and the Hubble Space Telescope have recently revealed important information on the flare rates of earlier-type, more massive stars. In this talk, I will focus on the properties of flares and flare stars in the optical as revealed by a Hubble Space Telescope/ACS planet search of the Galactic Bulge. We discovered ~100 flare stars, which are likely old (10 Gyr) binary systems with sustained flare activity from tidal spin-up. We will discuss the implications for flare rates in future time-domain surveys and compare to rates and energetics of flares on much younger M dwarf flare stars. **(14 min)**

Abstract #95 - HAZMAT I: The Evolution of Ultraviolet Emission from Early M Stars

Evgenya Shkolnik | *Lowell Observatory*

With the recent discoveries of several super-earths orbiting M dwarfs well within their habitable zones (0.1 to 0.4 AU), and with many more such planets to come, it is critical to assess the evolution of the high-energy radiation environment of these systems. We have begun the HAZMAT (HAbitable Zones and M dwarf Activity across Time) program by first measuring the drop in near-UV and far-UV flux in early M stars from 10 Myr to several Gyr using photometry from NASA's Galaxy Evolution Explorer (GALEX). We focus this study on the confirmed low-mass members of nearby young moving groups, the Hyades cluster, and old field stars. We show a relatively slow decline in UV flux up until at least 650 Myr with a sharper drop in the old M dwarfs. Yet without confirmed M dwarfs in nearby star clusters with ages of 1-2 Gyr, mapping the precise evolution at these older ages is not currently possible. The UV data also provide much-needed constraints to M dwarf upper-atmosphere models, which are currently insufficient for predicting UV emission from M dwarfs. Our analysis will aid empirically motivated upper-atmospheric modeling for the young and old M stars, which can then be used to predict the extreme-UV fluxes most critical to the evolution of a planetary atmosphere. The HAZMAT program is the first comprehensive study of the UV history of M stars. **(14 min)**

Abstract #96 - Magnetic Modulation of Stellar Angular Momentum Loss

Cecilia Garraffo | *Harvard-Smithsonian Center for Astrophysics*

Angular Momentum Loss (AML) is important for understanding astrophysical phenomena such as stellar rotation and magnetic activity, close binaries, and cataclysmic variables. Magnetic breaking is the dominant mechanism in the spin down of young late-type stars. We have studied AML as a function of stellar magnetic activity. We argue that the complexity of the field and its latitudinal distribution are crucial for the AML rates. In this talk I will discuss how AML is modulated by magnetic cycles and stellar spin down is not just a simple function of large scale magnetic field strength. **(14 min)**

Abstract #97 - Convection and Dynamo Action in Sun-Like Stars or the New Concept of Spot-Dynamos

Sacha Brun | *University of Colorado Boulder*

We will present recent advances made in understanding dynamo action in the Sun and solar-like stars. We will discuss how large scale flows are established, how they vary with rotation rate and how this impact dynamo action in stars. We will also discuss the new concept of spot-dynamo, e.g. non linear dynamo generating self consistently rising omega-loop, that, we believe, will be key to interpret ever growing observations of stellar magnetism. **(14 min)**

Abstract #98 - A Fully Parametrized Model of the Activity Pattern of a Solar-Like Star

Simon Borgniet | *IPAG*

Future high-resolution spectrographs are expected to push back the radial velocity detection limits at the level of a few cm/s, giving theoretically access to low planetary masses such as Earth-like planets. However, according to many studies, stellar magnetic activity will induce radial velocity jitter at the level of the m/s, ie far over the expected performances of the future spectrographs, even in the case of a low activity star. It will thus seriously undermine the possibility of detecting an Earth twin in the habitable zone of its host star, unless precise correction can be done. In the context of the modeling of such stellar jitter, we present a fully parametrized model of the activity pattern of a Solar-like star and of its impact on radial velocity jitter. The model includes dark spots, bright faculae and the attenuation of the convective blueshift. It has been compared to the Solar pattern over a full Solar cycle for validation. Being fully parametrized, it is straightforward to transfer to other spectral types and stellar properties (this is a work in progress). It will allow to predict the radial velocity signature for a wide range of stars and activity levels. It also opens new perspectives in terms of correcting the activity radial velocity signature. **(14 min)**

Abstract #99 - Understanding Astrophysical Noise from Stellar Surface Magneto-Convection

Heather Cegla | *Queen's University Belfast*

Cool, low mass stars with a convective envelope have bubbles of hot, bright plasma rising to the surface where they eventually cool, darken and sink. The motions of these plasma bubbles induce stellar line asymmetries since the radial velocity (RV) shift induced from the uprising granules does not completely cancel the shift from the sinking intergranular lanes. Furthermore, these line asymmetries are constantly changing as the ratio of granular to intergranular lane material continues to change due to magnetic field interplay. The net result for Sun-like stars is shifts in the line profiles on the order of several tens of cm/s. Hence an understanding of magneto-convection and its effects is paramount in any high precision RV study. One particular area impacted is the RV confirmation of Earth-analogs; the astrophysical noise from the host star stellar surface magneto-convection completely swamps the 10 cm/s signal induced from the planet. We aim to understand the physical processes involved here so that we may disentangle the effects of magneto-convection from observed stellar lines. To do so, we start with a state-of-the-art 3D magnetohydrodynamic simulation of the solar surface. Motivated by computational constraints and a desire to breakdown the physics, we parameterize the granulation signal from these simulations. This parameterization is then used to construct model Sun-as-a-star observations with a RV precision far beyond current instrumentation. This parameterization across the stellar disc, for a variety of magnetic field strengths, is presented here, alongside the current results from the model star observations. We find several line characteristics to be correlated with the induced RV shifts. Particularly high correlations were found for the velocity asymmetry (comparing the spectral information content of the blue wing to the red wing) and brightness measurements (approximated by integrating under the model observation profiles), allowing significant granulation noise reduction. The results of this campaign can feed directly into future high precision RV studies, such as the search for habitable, rocky worlds, with the forthcoming ESPRESSO and HIRES spectrographs. **(14 min)**

Abstract #100 - HAZMAT I: Magnetism in Cool Stars: Empirical Trends with Age and Rotation

A.A. Vidotto | *University of Geneva*

We investigate how the large-scale surface magnetic fields of cool dwarf stars, reconstructed using the Zeeman-Doppler Imaging technique, vary with age, rotation period, Rossby number and X-ray emission. Our sample consists of 104 magnetic maps of 76 stars, from accreting pre-main sequence to main-sequence objects, spanning ages from ~1 Myr to ~10 Gyr. For non-accreting dwarfs we empirically find that the unsigned average large-scale surface magnetic field relates to age as age-0.655± 0.045. This relation has a similar power dependency to that identified in the seminal work of Skumanich (1972). We also find in our data evidence for a linear-type dynamo, in which the surface field is linearly dependent on the rotation rate. The trends we find for large-scale stellar magnetism from ZDI studies are consistent with the trends found from Zeeman broadening measurements, which are sensitive to the unsigned large- and small-scale magnetic field. These similarities indicate that the fields recovered from both techniques are coupled to each other, suggesting that small- and large-scale fields could share the same dynamo field generation processes. Our results are relevant for investigations of rotational evolution of low-mass stars and give important observational constraints for stellar dynamo studies. **(14 min)**

Abstract #101 - Radius Variability Induced by Dynamo Magnetic Fields: The Sun vs. Low-Mass Stars

Frederico Spada | *AID Potsdam*

We investigate the impact of the magnetic fields associated with the dynamo on the internal structure and the global parameters (i.e., radius, luminosity, effective temperature) of the Sun and of solar-like stars. Although magnetic fields are usually not taken into account in standard stellar evolutionary codes, they have both direct effects (by contributing to the total pressure) and indirect effects (by inhibiting or suppressing convection), which can alter the internal equilibrium structure. Many theoretical studies have shown that magnetic fields are a promising mechanism to explain the so-called radius discrepancy in low-mass stars - i.e., the discrepancies between observed and modeled stellar radii and effective temperatures for young, active stars, usually reported at the ~10% and ~5% levels, respectively. More recently, radius variations have been reported for the Sun, based on the measurements by the Solar Disk Sextant (SDS) experiment, with an amplitude of up to 0.02% over the whole solar cycle. The possibility to reconcile both the solar and the stellar observations within the framework of a unique theoretical picture will be discussed. **(14 min)**

Day 5 | **FRIDAY, JUNE 13** - Observational Frontiers

Abstract #102 - The Gaia-ESO Survey

Sofia Randich | *INAF-Osservatorio Astrofisico di Arcetri*

The Gaia-ESO Survey is an ESO large public spectroscopic survey to which 300 nights have been allocated with FLAMES on VLT/UT2. The Survey aims to obtain high resolution spectra of some 100,000 Milky Way stars, systematically covering all Galactic populations, from ancient halo stars, to young star forming regions, providing a homogeneous overview of the distributions of kinematics and elemental abundances. The Survey has completed about 2.5 years of observations and several thousand spectra have been processed and analyzed. In the talk, the project overview and progress will be presented, as well as several scientific highlights, with emphasis on the results obtained for open clusters and cool stars. **(Invited, 40 min)**

Abstract #103 - Observing Convection in Cool Stars through Light Flicker

Fabienne Bastien | *Vanderbilt University*

As a result of the high precision and cadence of surveys like MOST, CoRoT, and Kepler, we may now directly observe the very low-level light variations arising from stellar granulation in cool stars. In this talk, we discuss how this enables us to more accurately determine the physical properties of Sun-like stars, to understand the nature of surface convection and its connection to activity, and to better determine the properties of planets around cool stars. Indeed, such sensitive photometric "flicker" variations are now within reach for thousands of stars, and we estimate that upcoming missions like TESS will enable such measurements for ~100 000 stars. We present recent results that tie "flicker" to granulation and enable a simple measurement of stellar surface gravity with a precision of 0.1 dex. We use this, together and solely with two other simple ways of characterizing the stellar photometric variations in a high quality light curve, to construct an evolutionary diagram for Sun-like stars from the Main Sequence on towards the red giant branch. We discuss further work that correlates “flicker” with stellar density, allowing the application of astrodensity profiling techniques used in exoplanet characterization to many more stars. We also present results suggesting that the granulation of F stars must be magnetically suppressed in order to fit observations. Finally, we show that we may quantitatively predict a star’s RV jitter using our evolutionary diagram, permitting the use of discovery light curves to help prioritize follow-up observations of transiting exoplanets. **(Invited, 40 min)**

Abstract #104 - Size Matters

Tabetha Boyajian | *Yale*

This presentation will review the status of our survey to measure the fundamental properties of nearby, main-sequence, K- and M- type stars. Our method exploits high angular resolution observations available from long baseline optical/infrared interferometry to precisely measure angular sizes. This data, combined with parallaxes and flux-calibrated photometry, are used to determine stellar luminosities, linear radii, and effective temperatures. We demonstrate how the data are used to calibrate less-direct methods in determining fundamental stellar properties. The data are also used to identify weaknesses in stellar atmosphere and evolutionary modeling, where observed discrepancies with models compared to observations have implications for the characterization of exoplanet systems. **(Contributed 20 min)**

Abstract #105 - Progress in High-Resolution Solar Physics

Carsten Denker | *Leibniz Institute for Astrophysics Potsdam (AIP)*

A new generation of solar telescopes (NST and GREGOR) has risen above the 1-meter aperture limit of traditional evacuated telescopes and now delivers first science data. The quest for higher resolution is in full swing with even larger, 4-meter aperture solar telescopes (ATST and EST) on the horizon. The term “high-resolution” implies, however, more than just resolving the solar surface in ever finer details. The dynamics of solar processes can be captured on shorter time scales, and the improved light-gathering capacity of the new telescopes allows us to extract more information from spectral lines with higher fidelity and accuracy, especially with respect to magnetic field measurements. Naturally, high spatial, spectral, and temporal resolution as well as a high polarimetric sensitivity cannot be achieved at the same time. High-resolution observations are presented based on direct imaging, two-dimensional spectropolarimetry with Fabry-Pérot interferometers, and scanning long-slit spectrographs to introduce some of the science cases for high-resolution solar physics: (1) statistical properties of flows in and around pores and sunspots, (2) chromospheric dynamics associated with newly emerging flux, and (3) flare diagnostics from near-infrared spectropolarimetry. In addition, data analysis techniques and instrument concepts are critically assessed so that high-resolution data can serve as a benchmark for numerical simulations of granulation and sunspots. **(Invited, 40 min)**

Abstract #106 - Young Brown Dwarfs at the Exoplanet Mass Boundary

Jacqueline Faherty | *Carnegie Institution of Washington*

The observable properties of the current collection of directly imaged exoplanets and juvenile age (10-150 Myr) brown dwarfs show striking similarities. From triangular shaped H band to extremely red infrared colors and peculiar luminosity trends, there is useful overlap between the physical properties of the populations. All evidence to date implies that they should be studied in concert. In this talk I will present the photometric, luminosity and spectral sequences of the brown dwarf and exoplanet members of nearby young moving groups (Beta Pictoris--~20Myr--, Tucana Horlogium--~30Myr--, and AB Doradus--~100 Myr-- specifically). I will discuss the diversity among objects of the same age and spectral type, focusing on those that approach or exceed the classic exoplanet mass boundary. I will discuss how the red extent of the near and mid-infrared colors, the variations in the behavior of spectral features and the scatter in bolometric luminosity within each group indicate critical differences in atmosphere conditions and temperatures of newly assigned members. I will also discuss the potential of differentiating formation mechanisms for brown dwarfs and exoplanets by examining the mass functions of

individual groups. **(Contributed 20 min)**

Abstract #107 - The Coolest ‘Stars’ are Free-Floating Planets

Viki Joergens | *Max Planck Institut for Astronomy*

We show that the coolest known object that is formed in a star-like mode is a free-floating planet. We discovered recently that the free-floating planetary mass object OTS44 (M9.5, ~12 Jupiter masses, age ~2 Myr) has significant accretion and a substantial disk. This demonstrates that the processes that characterize the canonical star-like mode of formation apply to isolated objects down to a few Jupiter masses. We detected in VLT/SINFONI spectra that OTS44 has strong, broad, and variable Paschen beta emission. This is the first evidence for active accretion of a free-floating planet. The object allows us to study accretion and disk physics at the extreme and can be seen as free-floating analog of accreting planets that orbit stars. Our analysis of OTS44 shows that the mass-accretion rate decreases continuously from stars of several solar masses down to free-floating planets. We determined, furthermore, the disk mass (30 Earth masses) and further disk properties of OTS44 through SED modeling based on far-IR Herschel data. We find that objects between 14 solar masses and 0.01 solar masses have the same ratio of the disk-to-central-mass of about 0.01. Our results indicate that OTS44 is formed like a star and suggest that the increasing number of young free-floating planets and ultra-cool field T and Y dwarfs are the low-mass extension of the stellar population. **(Contributed 20 min)**

POSTERS

Abstract #108 - High-Resolution Spectroscopy of Herbig Ae/Be Stars
Alicia Aarnio | *University of Michigan*

Abstract #109 - On the Origin of Stars With and Without Planets. Tc Trends and Clues to Galactic Evolution
Vardan Adibekyan | *Centro de Astrofísica, Universidade do Porto (CAUP)*

Abstract #110 - Toward Self Consistent MHD Model of Chromospheres of Late Type Evolved Stars
Vladimir Airapetian | *NASA*

Abstract #111 - Magnetic Interaction of a Super-CME with the Earth's Magnetosphere: Implications for the 770 AD Solar Energetic Particle Event
Vladimir Airapetian | *NASA/GSFC*

Abstract #112 - The Low Mass Population of the Nearby, Large Young Cluster Cep OB3b
Thomas Allen | *University of Toledo*

Abstract #113 - Searching for the Elusive Substellar Members of Young Moving Groups with Pan-STARRS
Kimberly M. Aller | *IfA/Hawaii*

Abstract #114 - Confirming the Age of a Free-Floating Exoplanet Analog
Katelyn Allers | *Bucknell University*

Abstract #115 - Preparation of the CARMENES Input Catalogue. Low-Resolution Spectroscopy of M dwarfs
F. J. Alonso-Floriano | *Universidad Complutense de Madrid*

Abstract #116 - Herschel Survey of Brown Dwarf Disks in rho Ophiuchi
Catarina Alves de Oliveira | *European Space Agency*

Abstract #117 - Searching for Extrasolar Planets with the Owens Valley LWA
Marin M. Anderson | *Caltech*

Abstract #118 - HI Lines in Young Stellar Objects: A Probe of Accretion and Circumstellar Properties
Simone Antoniucci | *INAF-Osservatorio Astronomico di Roma*

Abstract #119 - Low-Resolution Optical Spectra of Ultracool Dwarfs with OSIRIS/GTC
Antoaneta Antonova | *Department of Astronomy, St. Kl. Ohridski University of Sofia*

Abstract #120 - Activity-Rotation Relation in the Young Cluster h Per
Costanza Argiroffi | *Dip. di Fisica e Chimica, University of Palermo*

Abstract #121 - Exploring Deconvolution Techniques of M-Dwarf Spectra
Pamela Arriagada | *DTM, Carnegie Institution of Washington*

Abstract #122 - Multiplicity of Planets Among the Kepler M Dwarfs

Sarah Ballard | *University of Washington*

Abstract #123 - Bridging the Gap on Tight Seperation Brown Dwarf Binaries

Daniella C. Bardalez-Gagliuffi | *UCSD*

Abstract #124 - A Unified Model for Rotation, Coupling, Desaturation, and Angular Momentum Loss from Cool Stars

Sydney A. Barnes | *Leibniz Institute for Astrophysics*

Abstract #125 - Nearby Low Mass Stars and Brown Dwarfs with the VVV Survey

Juan Carlos Beamin | *P. Universidad Catolica de Chile-ESO*

Abstract #126 - MHD Simulations of Near-Surface Convection in Cool Main-Sequence Stars

Benjamin Beeck | *Max Planck Institute for Solar System Research*

Abstract #127 - Ultra-Cool Dwarfs in the VISTA Hemisphere Survey

V. J. S. Béjar, A. Pérez-Garrido, N. Lodieu, B. Gauza, R. Rebolo, H. Harrison, R. McMahon | *Instituto de Astrofísica de Canarias*

Abstract #128 - The AstraLux M Dwarf Survey Part 2: The Multiplicity of Mid-to-Late-Type M Dwarfs

Carolina Bergfors | *University College London*

Abstract #129 - Treatment of Molecules in 3D NLTE Radiative Transfer

Alexander Berkner | *University of Hamburg*

Abstract #130 - Solar Cycle Dependency of Sun-as-a-Star Photospheric Spectral Line Profiles

Luca Bertello, Alexei A. Pevtsov, Mark S. Giampapa, Andrew R. Marble | *National Solar Observatory*

Abstract #131 - Building a Volume-Limited Sample of L/T Transition Dwarfs with Pan-STARRS and WISE

William Best | *Institute for Astronomy/University of Hawaii*

Abstract #132 - The Binary Fraction of the Very Coolest Brown Dwarfs

Beth Biller | *University of Edinburgh*

Abstract #133 - The Most Distant Stars in the Milky Way: Confirmation of an M Giant Near the Galaxy's Virial Radius

John Bochanski | *Haverford College/Rider University*

Abstract #134 - Modeling the Accretion Shocks in Classical T Tauri Stars: The Role of Local Absorption on the X-Ray Emission

Rosaria Bonito | *UNIPA-INAF-OAPA*

Abstract #135 - Variablility of the Large-Scale Magnetic Field of Young Sun HN Peg

Brendan Bowler | *Caltech*

Abstract #136 - The Low-Mass Pre-Main Sequence Population of the Orion OB1 Association
Cesar Briceño | *Cerro Tololo Interamerican Observatory*

Abstract #137 - X-ray Emission from Young Stars in the TW Hya Association
Alexander Brown | *CASA, University of Colorado*

Abstract #138 - Spectral Variability Observations of the Very Nearby Brown Dwarf Binary Luhman 16AB with HST
Esther Buenzli | *Max Planck Institute for Astronomy, Heidelberg*

Abstract #139 - The SpeX Prism Library 2.0: Science, Education and Art from 1000 M, L and T Dwarf Spectra
Adam Burgasser | *UC San Diego*

Abstract #140 - Prominence Activity, Flare and Post-Flare Loops on the RS CVn-Type Binary SZ Psc
Dongtao Cao and Shenghong Gu | *Yunnan Observatories, Chinese Academy of Sciences*

Abstract #141 - Lithium Inventory of 2 M_sun Red Clump Stars: Is Li Created During the He Flash?
Joleen Carlberg | *Carnegie Institution of Washington*

Abstract #142 - The HST Treasury "Advanced Spectral Library (ASTRAL)" Programs
K.G. Carpenter and T.R. Ayres for the ASTRAL Science Team | *NASA's GSFC*

Abstract #143 - Zeeman Doppler Imaging Of The Surface Activity And Magnetic Fields Of Young Solar-Type Stars
Brad Carter, Stephen Marsden and Ian Waite | *University of Southern Queensland*

Abstract #144 - Asteroseismology for Galactic Archaeology
Luca Casagrande | *Australian National University*

Abstract #145 - Herbig Ae/Be vs T Tauri Stars: Accretion and Outflows with 1-Micron Spectroscopy
Paul Wilson Cauley | *Rice University*

Abstract #146 - Understanding Astrophysical Noise from Stellar Surface Magneto-Convection
Heather Cegla | *Queen's University Belfast*

Abstract #147 - New Age-Rotation Constraints at Old Ages from Wide Binaries
Julio Chaname | *Universidad Católica de Chile*

Abstract #148 - The Coordinated Synoptic Investigation of NGC 2264
Ann Marie Cody | *IPAC*

Abstract #149 - New Age-Rotation Constraints at Old Ages from Wide Binaries
Ofer Cohen | *Harvard-Smithsonian Center for Astrophysics*

Abstract #150 - A Method for Identifying M Dwarfs with Ultra Cool Companions in 2MASS and WISE
Neil Cook | *University of Hertfordshire*

Abstract #151 - Short-term Activity in Young Solar Analogs

Christopher Corbally, Richard Gray, Jon Saken | *Vatican Observatory, Appalachian State University, Marshall University*

Abstract #152 - Preparation of the CARMENES Input Catalogue. Multiplicity of M Dwarfs from Tenths of Arcseconds to Hundreds of Arcminutes

Miriam Cortés Contreras | *Universidad Complutense de Madrid*

Abstract #153 - A Kinematic Survey of the Perseus Molecular Cloud: Results from the APOGEE Infrared Survey of Young Nebulous Clusters (IN-SYNC)

Kevin Covey | *Lowell Observatory*

Abstract #154 - TRENDS Discovery of a Benchmark T-dwarf Companion

Justin R. Crepp | *Notre Dame*

Abstract #155 - Global, Spatially-Resolved Meteorology of Cloudy Brown Dwarfs

Ian Crossfield | *Max Planck Institute for Astronomy*

Abstract #156 - Reliability of Spectral Diagnostics of Temperature and Youth for 5–50 M_Jupiter Mass Objects

Kelle Cruz | *Hunter College, CUNY & AMNH*

Abstract #157 - Dating Middle-Aged Stars

Jason Curtis | *Penn State*

Abstract #158 - Disk Evolution in T Tauri Binary Systems

Sebastian Daemgen | *University of Toronto*

Abstract #159 - Parallaxes for Cool Subdwarfs

Conard Dahn and Hugh Harris | *U. S. Naval Observatory*

Abstract #160 - Accretion Discs as Regulators of Stellar Angular Momentum Evolution in the ONC and Taurus

Claire Davies | *The University of St Andrews*

Abstract #161 - Rotational Velocities of Nearby Mid M-Dwarfs

Cassy Davison | *Georgia State University*

Abstract #162 - Cool Companions to Nearby Stars - Detection And Characterisation With Adaptive Optics Observations

Robert De Rosa | *ASU/University of Exeter*

Abstract #163 - Benchmark Companions to Nearby Stars from Pan-STARRS 1

Niall Deacon | *Max Planck Institute for Astronomy*

Abstract #164 - Measuring Magnetic Fields in Young Stars

Casey Deen | *Max Planck Institute for Astronomy*

Abstract #165 - Li Depletion in Fg Stars: Planets and Rotation
Elisa Delgado Mena | *CAUP*

Abstract #166 - Ground-Based Transmission Spectrum of WASP-80 b, a Gas Giant Transiting an M-Dwarf
Laetitia Delrez | *University of Liège*

Abstract #167 - How Typical is the Sun's Magnetic Cycle Lengths?
José Dias do Nascimento Jr. | *Harvard-Smithsonian Center for Astrophysics*

Abstract #168 - Rotation and Ages of Solar Analogs Revealed by the Kepler Mission
José Dias do Nascimento Jr | *Harvard-Smithsonian Center for Astrophysics*

Abstract #169 - Monitoring the Variability of Newly-Discovered Symbiotic Stars: A Progress Report
Caitlin Doughty | *University of Washington*

Abstract #170 - When Good Fits Go Wrong: Determining Realistic Best Fits and Uncertainties on L Dwarf Physical Parameters
Stephanie Douglas | *Columbia University/American Museum of Natural History*

Abstract #171 - HCO+ in LkCa 15 Transitional Disk
Emily Drabek-Maunder | *Imperial College London*

Abstract #172 - Stellar Spectroscopy During Exoplanet Transits: Dissecting Fine Structure Across Stellar Surfaces
Dainis Dravins | *Lund Observatory*

Abstract #173 - Activity of Quiet Stars Reveals Their Inclination
Xavier Dumusque | *Harvard Smithsonian Center for Astrophysics*

Abstract #174 - Airborne Transit Observations of Cool Stars
Edward Dunham | *Lowell Observatory*

Abstract #175 - TW Hya: Insights from Time-Domain Multi-Wavelength Spectroscopy
Andrea Dupree, N. S. Brickhouse, S. R. Cranmer | *Harvard-Smithsonian Center for Astrophysics*

Abstract #176 - Permitted Emission Line Profiles in T Tauri Stars
Suzan Edwards | *Smith College*

Abstract #177 - Current Results of the Living with a Red Dwarf Program: Activity-Rotation-Age Relationships for M-dwarfs
Scott G. Engle | *Villanova University*

Abstract #178 - Searching for Brown Dwarfs in Chamaeleon
Taran Esplin | *Penn State*

Abstract #179 - Little Imbalance in Gravitational Pressure of Sun Causing Deadly Climate Change on Earth
Ahmad Reza Estakhr | *Researcher*

Abstract #180 - The Influence of Magnetic Fields on the Structure of Low-Mass Stars
Gregory Feiden | *Uppsala University*

Abstract #181 - Updating the Dartmouth Stellar Evolution Model Grid: Pre-Main-Sequence Models & Magnetic Fields
Gregory Feiden | *Uppsala University*

Abstract #182 - A Progress Report on New Spectroscopic Orbits of Potential Interferometric Binaries
Francis C. Fekel, Michael H. Williamson, Matthew W. Muterspaugh, Jocelyn Tomkin | *Tennessee State University*

Abstract #183 - On the Gas Content of Transitional Disks: A VLT/X-Shooter Study of Accretion and Winds
Carlo Felice Manara | *European Southern Observatory*

Abstract #184 - Expanded SEDs and Bolometric Luminosities as Direct Measures of Brown Dwarf Physical Parameters
Joe Filippazzo | *City University of New York*

Abstract #185 - X-Ray Activity and Proto-Planetary Disks - New Insights from the Coordinated Synoptic Investigation of NGC2264 (CSI NGC2264)
Ettore Flaccomio | *INA -Osservatorio Astronomico di Palermo*

Abstract #186 - Near-Infrared Radial Velocities of Hundreds of Kepler Eclipsing Binaries With APOGEE
Scott Fleming | *STScI*

Abstract #187 - The Evolution of Surface Magnetic Fields in Young Solar-Type Stars
Colin Folsom | *Institut de Recherche en Astrophysique et Planétologie*

Abstract #188 - Brown Dwarfs in Young Moving Groups
Jonathan Gagné | *Université de Montréal*

Abstract #189 - Young Brown Dwarfs in Nearby Moving Groups
Jonathan Gagné | *Université de Montréal/Caltech*

Abstract #190 - A Map for the World: An All-Sky Catalog of the Nearest, Brightest M Dwarf Stars
Eric Gaidos | *University of Hawaii at Manoa*

Abstract #191 - Chemical Abundance Analysis of the Symbiotic Red Giants
Cezary Gałan | *Nicolaus Copernicus Astronomical Center of the PAS*

Abstract #192 - Extreme High-Spatial Resolution Imaging of the Lowest Mass Pleiades
Eugenio Victor Garcia | *Lowell Observatory*

Abstract #193 - The Gran Telescopio CANARIAS Variable Star One-Shot Project
David Garcia-Alvarez | *Instituto de Astrofísica de Canarias*

Abstract #194 - Magnetic Modulation of Stellar Angular Momentum Loss
Cecilia Garraffo | *Harvard-Smithsonian Center for Astrophysics*

Abstract #195 - A Mid-IR Imaging Search for Substellar Companions of the Nearest Stars
Bartosz Gauza | *Instituto de Astrofísica de Canarias*

Abstract #196 - Characterization of WD 0806-661B Using Spitzer and Hubble Space Telescope Photometry
Christopher R. Gelino | *NASA Exoplanet and Science Institute*

Abstract #197 - On the Spectroscopic Properties of the Retired A Star HD 185351
Luan Ghezzi | *Harvard-Smithsonian Center for Astrophysics*

Abstract #198 - The Variability of Photospheric Line Bisectors in the Sun-as-a-Star
Mark Giampapa | *National Solar Observatory*

Abstract #199 - Investigating the Coronal Dynamics of High Differential Rotation Stars
Gordon Gibb | *University of St Andrews*

Abstract #200 - The First Low-Mass, Pre-Main Sequence Eclipsing Binary with Evidence of a Circumbinary Disk
Ed Gillen | *University of Oxford*

Abstract #201 - The Nature of Variability in Early L Dwarfs
John Gizis | *University of Delaware*

Abstract #202 - The Transition Between X-Ray Emission Regimes in the M34 Open Cluster
P. Gondoin | *European Space Agency*

Abstract #203 - Lithium Abundance and Rotation in the Pleiades and M34 Open Clusters
P. Gondoin | *European Space Agency*

Abstract #204 - The Young Solar Analogs Project
Richard Gray, Christopher Corbally, Jon Saken | *Appalachian State University*

Abstract #205 - HST FUV Monitoring of TW Hya
Hans Moritz Guenther | *Harvard-Smithsonian Center for Astrophysics*

Abstract #206 - Revising the Wilson-Bappu Effect
Cecilia Maria Guerra Olvera | *Universidad de Guanajuato*

Abstract #207 - A Search for Disk-Born Stellar Companions
Kevin Gullikson | *University of Texas*

Abstract #208 - The Radio and Optical Aurorae of Brown Dwarfs
Gregg Hallinan | *Caltech*

Abstract #209 - Photometric Variability of Y Dwarfs
Kevin Hardegree-Ullman | *University of Toledo*

Abstract #210 - Astrometric Orbits and Masses for Three Low-Mass Binaries
Hugh Harris, Conard Dahn, Trent Dupuy | *U.S. Naval Observatory, Flagstaff*

Abstract #211 - The Kepler View of Flares on Low Mass Stars
Suzanne Hawley | *University of Washington*

Abstract #212 - Understanding the Sun's Activity to Improve Exoplanet Radial-Velocity Detections
Raphaelle D. Haywood | *University of St Andrews*

Abstract #213 - Precise Fundamental Properties of a Surprisingly Hot, Low Metallicity, 0.2 Msun M Dwarf
Leslie Hebb | *Hobart and William Smith Colleges*

Abstract #214 - Brown Dwarfs with Dynamic, Rapidly Changing Clouds
Aren Heinze | *Stony Brook University*

Abstract #215 - M Dwarf Metallicity Distribution and Galactic Chemical Evolution
Neda Hejazi | *York University*

Abstract #216 - SEEDS - Direct Imaging Survey for Exoplanets
Krzysztof Helminiak | *Subaru Telescope; NCAC Torun*

Abstract #217 - Optical Photospheric and Accretion Properties of Nearby T Tauri Stars
Gregory Herczeg | *KIAA/Peking University*

Abstract #218 - Empirical Limits on Radial Velocity Planet Detection for Stars Younger than the Sun
Lynne Hillenbrand | *Caltech*

Abstract #219 - Magnetic Field Extrapolation in Binary and Star-Planet Systems
Volkmar Holzwarth, Scott Gregory, and the BinaMIcS collaboration | *Kiepenheuer-Institute for Solar Physics, Freiburg i.Br., Germany*

Abstract #220 - The Lyon-Exeter Grid of (Sub)Stellar Evolution Models
Derek Homeier | *CRAL/ENS-Lyon*

Abstract #221 - Probing Rotational Dynamo Extremes: X-Ray and Optical Spectroscopy of the 0.5 Day Period Eclipsing Binary, HD 79826.
David Huenemoerder | *MIT Kavli Institute*

Abstract #222 - NGC 3201: Population Studies from Photometric Metallicities
Joanne Hughes | *Seattle University*

Abstract #223 - Observational Constraints to the Magnetospheric Structure of T Tauri Stars
Ana Inés Gómez de Castro | *AEGORA Research Team, Universidad Complutense de Madrid*

Abstract #224 - Observational Constraints to the Physics of the Jets of TTSs from UV Observations
Ana Inés Gómez de Castro | *AEGORA Research Team, Universidad Complutense de Madrid*

Abstract #225 - Observational Constraints to the Atmospheric Structure and the Accretion Shocks
Ana Inés Gómez de Castro | *AEGORA Research Team, Universidad Complutense de Madrid*

Abstract #226 - Monitoring the Behavior of Spots Using Photometric Data
Panos Ioannidis | *Hamburger Sternwarte*

Abstract #227 - The MEarth-North and MEarth-South Transit Surveys: Searching for Habitable Super-Earth Exoplanets Around Nearby M-Dwarfs
Jonathan Irwin | *Smithsonian Astrophysical Observatory*

Abstract #228 - Anchoring the Age-Rotation Relation with the ZAMS Cluster Alpha Per
David Jaimes | *Department of Astronomy, Columbia University*

Abstract #229 - The Bcool Magnetic Snapshot Survey of Solar-Type Stars
Sandra Jeffers | *Goettingen University*

Abstract #230 - Detecting Planets Around Enigmatic Stars
Sandra Jeffers | *Goettingen University*

Abstract #231 - Preparation of the CARMENES Input Catalogue. High-Resolution Spectroscopy of M Dwarfs
Sandra Jeffers | *IAG, Goettingen*

Abstract #232 - Are Planetary Orbits Aligned with Binary Orbits?
Eric Jensen | *Swarthmore College*

Abstract #233 - The HST-FGS Parallax of XO-3 and Implications for its Hot Jupiter
Christopher M. Johns-Krull | *Rice University*

Abstract #234 - Update on the Stellar Surface Imaging Project at NPOI
Anders M. Jorgensen | *New Mexico Tech*

Abstract #235 - Auroral Radio Emission from Late L and T Dwarfs: A New Constraint on Dynamo Theory in the Substellar Regime
Melodie Kao | *Caltech*

Abstract #236 - Maps of Brown Dwarf Atmospheres
T. Karalidi | *Steward Observatory, University of Arizona*

Abstract #237 - V4046 Sgr: Touchstone to Investigate Spectral Type Discrepancies for Pre-main Sequence Stars
Joel Kastner | *Rochester Institute of Technology*

Abstract #238 - New Brown Dwarf Companion to a Young, Low Mass Star
Kendra Kellogg | *Western University*

Abstract #239 - Gyrochronology of Low-Mass Stars - Age-Rotation-Activity Relations for Young M Dwarfs
Benjamin Kidder | *University of Redlands*

Abstract #240 - High-Resolution Spectroscopy of Hipparcos Cool Dwarfs
Bokyoung Kim | *Ewha Womans University*

Abstract #241 - Rotation Period - X-Ray Activity Relations Based on ASAS and ROSAT Data
Marcin Kiraga | *Warsaw University Observatory*

Abstract #242 - Dynamical Masses of Pre-Main-Sequence Binary Systems
Rainer Koehler | *MPI for Astronomy*

Abstract #243 - CO Fluorescence and 2D Atmospheric Models of Two Cool Stars
Rachel Koncewicz | *Oxford*

Abstract #244 - The Metallicities of Arcturus and Mu Leo from Z-, Y-, and J-Bands Spectra with the High Resolution Spectrograph, WINERED
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