COOLNEWS

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Stellar Abstracts

From Radio to X-ray: Flares on the dMe Flare Star EV Lacertae

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We present the results of a campaign to observe flares on the M dwarf flare star EV Lacertae over the course of two days in 2001 September, utilizing a combination of radio continuum, optical photometric and spectroscopic, ultraviolet spectroscopic, and X-ray spec troscopic observations, to characterize the multi-wavelength nature of flares from this ac tive, single late-type star. We find flares in every wavelength region in which we observed. A large radio flare from the star was observed at both 3.6 and 6 cm, and is the most luminous example of a gyrosynchrotron flare yet observed on a dMe flare star. The radio flare can be explained as encompassing a large magnetic volume, compar able to the stellar disk, and involving trapped electrons which decay over timescales of hours. Flux enhancements at 6 cm accompanied by highly negatively circularly polarized emission ($\pi_c \to -100\%$) imply that a coherent emission mechanism is operating in the corona of EV Lac. There are numerous optical white-light flares, and yet no signature of emission line response from the chromosphere appears. Two small ultraviolet enhancements differ in the amount of nonthermal broadening present. There are numerous X-ray flares occurring throughout the observation, and an analysis of undispersed photons and grating events reveals no evidence for abundance variations. Higher temperatures are present during some flares, however the maximum temperature achieved varies from flare to flare. There is no evidence for density variations during any flare intervals. In the multi-wavelength context, the start of the intense radio flare is coincident with an impulsive optical U-band flare, to within one minute, and yet there is no signature of an X-ray response. There are other intervals of time where optical flaring and UV flaring is occurring, but these cannot be related to the contemporaneous X-ray flaring: the time-integrated luminosities do not match the instantaneous X-ray flare luminosity, as one would expect for the Neupert effect. We investigate the probability of chance occurrences of flares from disparate wavelength regions producing temporal coincidences, but find that not all the flare associations can be explained by a superposition of flares due to a high flaring rate. We caution against making causal associations of multi-wavelength flares based solely on temporal correlations for high flaring rate stars like EV Lac.

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For preprints via ftp or WWW: http://arxiv.org/abs/astro-ph/0411236

Measuring Starspot Temperature from Line Depth Ratios II. Simultaneous Modeling of Light and Temperature Curves

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We present and apply to VY Ari, IM Peg and HK Lac a new method to determine spot temperatures ($T_{\rm sp}$) and areas ($A_{\rm rel}$) from the analysis of simultaneous light curves and temperature modulations deduced from line-depth ratios. A spot model, developed by us, has been applied to light and temperature curves. Grids of solutions with comparable χ-square have been found for a wide range of spot temperatures. The behavior of the solution grids for temperature and light curves in the $T_{\rm sp}$–$A_{\rm rel}$ plane is very different and a rather small and unique intersection area can be found. In our spot-model we used spectral energy distributions (SEDs) based on the Planck law and on model atmospheres to evaluate the flux ratio between spots and unspotted photosphere and we found higher spot temperatures with SEDs based on model atmospheres than on the Planck law.

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The Coronae of AB Dor and V471 Tau: Primordial Angular Momentum vs Tidal Spin-up

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The zero-age main-sequence star AB Dor and the K dwarf component of the V471 Tau close binary have essentially identical rotation rates and spectral types. An analysis of their high resolution *Chandra* X-ray spectra reveals remarkably similar coronal characteristics in terms of both temperature structure and element abundances. Both stars show depletions of low FIP elements by factors of ~ 3, with higher FIP elements showing more mild depletions. No evidence for enhancements of very low FIP (< 7 eV) elements, such as Na, Al and Ca, as compared to other low FIP elements was found. The abundance anomaly pattern for AB Dor and V471 Tau is similar to, though less extreme than, the abundance anomalies exhibited by active RS-CVn-type binaries. While we find statistically significant structure in the underlying differential emission measure distributions of these stars over narrow temperature intervals, this structure is strongly dependent on the lines used in the analysis and is probably spurious. Based on their X-ray similarities, we conclude that the exact evolutionary state of a star has little effect on coronal characteristics, and that the parameters that dominate coronal structure and composition are simply the rotation rate and spectral type.

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The Role of HeH^+ in Cool Helium Rich White Dwarfs.

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HeH^+ is found to be the dominant positive ion over a wide range of temperatures and densities relevant to helium rich white dwarfs. The inclusion of HeH^+ in ionization equilibrium computations increases the abundance of free electrons by a significant factor. For temperatures below 8000 K, He^- free-free absorption is increased by up to a factor of 5, by the inclusion of HeH^+. Illustrative model atmospheres and spectral energy distributions are computed, which show that HeH^+ has a strong effect upon the density and pressure structure of helium rich white dwarfs with $T_{\rm eff}$<8000 K. The inclusion of HeH^+ significantly reddens spectral energy distributions and broad band color indices for models with $T_{\rm eff}$<5500 K. This has serious implications for existing model atmospheres, synthetic spectra and cooling curves for helium rich white dwarfs.

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http://www.journals.uchicago.edu/ ApJ/journal/issues/ApJL/v617n2/18978/brief/18978.abstract.html

Calculated Spectra for HeH^+ and Its Effect on the Opacity of Cool Metal Poor Stars

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The wavelength and Einstein A coefficient are calculated for all rotation-vibration transitions of $^4He^1H^+$, $^3He^1H^+$, $^4He^2H^+$ and $^3He^2H^+$, giving a complete line list and the partition function for $^4HeH^+$ and its isotopologues. This opacity is included in the calculation of the total opacity of low-metallicity stars and its effect is analysed for different conditions of temperature, density and hydrogen number fraction. For a low helium number fraction (as in the Sun), it is found that HeH^+ has a visible but small effect for very low densities ($\rho \leq 10^{-10}$g cm^{-3}), at temperatures around 3500 K. However, for high helium number fraction, the effect of HeH^+ becomes important for higher densities ($\rho \leq 10^{-6}$g cm^{-3}), its effect being most important for a temperature around 3500 K. Synthetic spectra for a variety of different conditions are presented.

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The Lithium Depletion Boundary in NGC 2547 as a Test of Pre-main-sequence Evolutionary Models

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Intermediate resolution spectroscopy from the ESO Very Large Telescope is analysed for 63 photometrically selected low-mass (0.08-0.30 $M_\odot$) candidates of the open cluster NGC 2547. We have confirmed membership for most of these stars using radial velocities, and found that lithium remains undepleted for cluster stars with $I > 17.54 \pm 0.14$ and $K_s > 14.86 \pm 0.12$. From these results, several pre-main-sequence evolutionary models give almost model independent ages of 34-36 Myr, with a precision of 10 per cent. These ages are only slightly larger than the ages of 25-35 ($\pm$5) Myr obtained using the same models to fit isochrones to higher mass stars descending towards the zero age main sequence (ZAMS), both in empirically calibrated and theoretical colour-magnitude diagrams. This agreement between age determinations in different mass ranges is an excellent test of the current generation of low-mass pre-main sequence stellar models and lends confidence to ages determined with either method between 30 and 120 Myr.

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Inferring Coronal Structure from X-ray Lightcurves and Doppler Shifts: A *Chandra* Study of AB Doradus

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The Chandra X-ray observatory monitored the single cool star, AB Doradus, continuously for a period lasting 88 ksec (1.98 $P_{\rm rot}$) in 2002 December with the LETG/HRC-S. The X-ray lightcurve shows rotational modulation, with three peaks that repeat in two consecutive rotation cycles. These peaks may indicate the presence of compact emitting regions in the quiescent corona. Centroid shifts as a function of phase in the strongest line profile, O VIII 18.97 Å, indicate Doppler rotational velocities with a semi-amplitude of 30 ± 10 km/s. By taking these diagnostics into account along with constraints on the rotational broadening of line profiles (provided by archival Chandra HETG Fe XVII and FUSE Fe XVIII profile) we can construct a simple model of the X-ray corona that requires two components. One of these components is responsible for 80% of the X-ray emission, and arises from the pole and/or a homogeneously distributed corona. The second component consists of two or three compact active regions that cause modulation in the lightcurve and contribute to the O VIII centroid shifts. These compact regions account for 16% of the emission and are located near the stellar surface with heights of less than 0.3R_*. At least one of the compact active regions is located in the partially obscured hemisphere of the inclined star, while one of the other active regions may be located at 40°. High quality X-ray data such as these can test the models of the coronal magnetic field configuration as inferred from magnetic Zeeman Doppler imaging.

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Coronal Evolution of the Sun in Time: High-Resolution X-Ray Spectroscopy of Solar Analogs with Different Ages

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We investigate the long-term evolution of X-ray coronae of solar analogs based on high-resolution X-ray spectroscopy and photometry with *XMM-Newton*. Six nearby main-sequence G stars with ages between ≈ 0.1 Gyr and ≈ 1.6 Gyr and rotation periods between ≈ 1 d and 12.4 d have been observed. We use the X-ray spectra to derive coronal element abundances of C, N, O, Ne, Mg, Si, S, and Fe and the coronal emission measure distribution (EMD). We find that the abundances change from an inverse-First Ionization Potential (FIP) distribution in stars with ages around 0.1 Gyr to a solar-type FIP distribution in stars at ages of 0.3 Gyr and beyond. This transformation is coincident with a steep decline of non-thermal radio emission. The results are in qualitative agreement with a simple model in which the stream of electrons in magnetic fields suppresses diffusion of low-FIP ions from the chromosphere into the corona. The coronal emission measure distributions show shapes characterized by power laws on each side of the EMD peak. The latter shifts from temperatures of about 10 MK in the most rapidly rotating, young stars to temperatures around 4 MK in the oldest target considered here. The power-law index on the cooler side of the EMD exceeds expected slopes for static loops, with typical values being 1.5–3. We interpret this slope with a model in which the coronal emission is due to a superposition of stochastically occurring flares, with an occurrence rate that is distributed in radiated energy E as a power-law, $dN/dE \propto E^{-\alpha}$, as previously found for solar and stellar flares. We obtain the relevant power-law index α from the slope of the high-temperature tail of the EMD. Our EMDs indicate $\alpha \approx 2.2 - 2.8$, in excellent agreement with values previously derived from light curves of magnetically active stars. Modulation with

time scales reminiscent of flares is found in the light curves of all our targets. Several strong flares are also observed. We use our α values to simulate light curves and compare them with the observed light curves. We thus derive the range of flare energies required to explain the light-curve modulation. More active stars require a larger range of flare energies than less active stars within the framework of this simplistic model. In an overall scenario, we propose that flaring activity plays a larger role in more active stars. In this model, the higher flare rate is responsible both for the higher average coronal temperature and the high coronal X-ray luminosity, two parameters that are indeed found to be correlated.

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Solar Abstracts

RESIK: A Bent Crystal X-ray Spectrometer for Studies of Solar Coronal Plasma Composition

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We describe the RESIK (REntgenovsky Spektrometr s Izognutymi Kristalami) instrument, consisting of two double-channel X-ray spectrometers, designed to observe solar active region and flare plasmas. RESIK is one of the instruments making up the scientific payload of the Russian *CORONAS-F* solar mission. The uncollimated spectrometer uses two silicon and two quartz bent crystals observing flare, active region and coronal spectra in four wavelength bands with a resolving power ($\lambda/\Delta\lambda$) of $\sim$1000. The wavelength coverage, 3.3 Å - 6.1 Å, includes emission lines of Si, S, Cl, Ar, and K and in third diffraction orders, the wavelength range includes He-like Fe lines (1.85 Å) and Ni lines (1.55 Å) with dielectronic satellites, emitted during intense, hot flares. The instrument is believed to be the best calibrated space-borne crystal spectrometer flown to date. The spectrometer dynamically adjusts the data gathering intervals from 1 s to 5 minutes, depending on the level of solar X-ray emission at the time of observation. The principal aims of RESIK are the measurement of relative and absolute element abundances in the emitting plasma and the temperature distribution of plasma (differential emission measure) over the temperature interval 3 MK and 50 MK. This paper summarizes the scientific objectives of RESIK and describes the design, characteristics, and performance of the instrument.

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ADAS Analysis of the Differential Emission Measure Structure of the Inner Solar Corona. II. A study of the 'Quiet Sun' Inhomogeneities from SOHO CDS-NIS Spectra

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We present a study of the differential emission measure (DEM) of a 'quiet Sun' area observed in the extreme ultraviolet at normal incidence by the Coronal Diagnostic Spectrometer (CDS) on the SOHO spacecraft. The data used for this work were taken using the NISAT_S observing sequence. This takes the full wavelength ranges from both the NIS channels (308-381 Å and 513-633 Å) with the 2 arcsec by 240 arcsec slit, which is the narrowest slit available, yielding the best spectral resolution. In this work we contrast the DEM from subregions of 2×80 arcsec^2 with that obtained from the mean spectrum of the whole raster (20×240 arcsec^2). We find that the DEM maintains essentially the same shape in the subregions, differing by a constant factor between 0.5 and 2 from the mean DEM, except in areas were the electron density is below 2×10^7 cm^{-3} and downflow velocities of 50 km s^{-1} are found in the transition region. Such areas are likely to contain plasma departing from ionisation equilibrium, violating the basic assumptions underlying the DEM method. The comparison between lines of Li-like and Be-like ions may provide further evidence of departure from ionisation equilibrium. We find also that line intensities tend to be lower where velocities of the order of 30 km s^{-1} or higher are measured in transition region lines. The DEM analysis is also exploited to improve the line identification performed by Brooks et al (1999) and to investigate possible elemental abundance variations from region to region. We find that the plasma has composition close to photospheric in all the subregions examined.

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Observational Evidence of the Primary Role Played by Photospheric Motions on Magnetic Helicity Transport Before a Filament Eruption

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Many filament eruptions can be suitably described in the framework of the kink instability model, although it is not always easy to discriminate whether the helical flux rope writhes due to new emerging flux or to photospheric horizontal motions. In order to give a contribution to this question, in this paper we provide observational evidence of the important role which can be played by horizontal motions in filament instability and eruption. More precisely, we describe the analysis of the eruption of an S-reverse shape filament associated with a flare of class M6.3, occurred on 15 June, 2001 in the active region NOAA 9502. Using TRACE 195 Å images we studied the morphological evolution of the EUV filament channel, while using 1 minute cadence MDI full-disc longitudinal magnetograms we analyzed the magnetic evolution of the entire active region. The geometrical parameters of the EUV filament channel and the horizontal velocities in the areas corresponding to the filament footpoints were determined and resulted in agreement with the kink instability. Moreover, the analysis of MDI magnetograms showed that a sudden and strong increase in the magnetic helicity transport rate to the corona preceded and accompanied the filament eruption. During the same time interval, on the one hand the emergence of magnetic flux in both polarities became negligible, but on the other hand the velocity pattern at the filament ends showed horizontal, counterclockwise motions, which could provide a significant contribution to the transformation, from twist to writhe, of the magnetic helicity accumulated along the filament before its eruption. This result seems to indicate that in this event the transport of magnetic helicity exceeding the limit for the kink instability is primarily due to photospheric motions, while the contribution, due to the emerging flux, is negligible.

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Helium Line Formation and Abundance in a Solar Active Region

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An observing campaign (SOHO JOP 139), coordinated between ground based and SOHO instruments, has been planned to obtain simultaneous spectroheliograms of the same active region in several spectral lines. The chromospheric lines Ca II K, Hα and Na I D as well as He I 10830, 5876, 584 and He II 304 Å lines have been observed. The EUV radiation in the range $\lambda < 500$ Å and in the range $260 < \lambda < 340$ Å has also been measured at the same time. These simultaneous observations allow us to build semi-empirical models of the chromosphere and low transition region of an active region, taking into account the estimated total number of photoionizing photons impinging on the target active region and their spectral distribution. We obtained a model that matches very well all the observed line profiles, using a standard value for the He abundance ([He]=0.1) and a modified distribution of microturbulence. For this model we study the influence of the coronal radiation on the computed helium lines. We find that, even in an active region, the incident coronal radiation has a limited effect on the UV He lines, while it results of fundamental importance for the D_3 and 10830 lines. Finally we build two more models assuming values of He abundance [He]= 0.07 and 1.5, only in the region where temperatures are larger than $1. \times 10^4$ K. This region, between the chromosphere and transition region, has been indicated as a good candidate for processes that might be responsible for strong variations of [He]. The set of our observables can still be well reproduced in both cases changing the atmospheric structure mainly in the low transition region. This implies that, to choose between different values of [He], it is necessary to constrain the transition region with different observables, independent on the He lines.

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Low-Mass and Substellar Abstracts

Dust in the Photospheric Environment III. A Fundamental Element in the Characterization of Ultracool Dwarfs

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Recent photometry of L and T dwarfs revealed that the infrared colors show a large variation at a given $T_{\rm eff}$ and, within the framework of our Unified Cloudy Model (UCM), this result can be interpreted as due to a variation of the critical temperature ($T_{\rm cr}$) which is essentially a measure of the thickness of the dust cloud. It appears that the transition from L to T types takes place at $T_{\rm eff} \approx 1400 \pm 100\,$K, where $T_{\rm cr}$ shows a particularly large change. Thus the L/T transition is associated with the drastic change of the thickness of the dust cloud at $T_{\rm eff} \approx 1400\,$K, but the reason for this change is unknown. Once we allow $T_{\rm cr}$ to vary at given $T_{\rm eff}$ and $\log g$ in our UCMs, the two-color and color-magnitude diagrams can be well explained as the effect of $T_{\rm eff}$, $\log g$, and $T_{\rm cr}$, but not by the effect of $T_{\rm eff}$ and $\log g$ alone. In general, the effects of $T_{\rm eff}$ and $T_{\rm cr}$ on individual spectra are difficult to discriminate, since the dust column density in the photosphere depends on $T_{\rm eff}$ as well as on $T_{\rm cr}$. This degeneracy of $T_{\rm eff}$ and $T_{\rm cr}$ can be removed to some extent by the analysis of the SED on an absolute scale. The reanalysis of a selected sample of spectra revealed that the L-T spectral sequence may not necessarily be a sequence of $T_{\rm eff}$, at least partly, but may reflect a change of the thickness of the dust cloud, represented by $T_{\rm cr}$ in our UCM. Also, an odd 'brightening' of the absolute J magnitudes plotted against the L-T spectral types may also be a manifestation that the L-T spectral sequence is not necessarily a temperature sequence, since $M_{\rm bol}$ also shows a similar 'brightening'. Then, the 'J-brightening' may not be due to any atmospheric effect and hence should not be a problem to be solved by model atmospheres including the UCMs. Thus, almost all the available observed data are reasonably well interpreted with the UCMs in which the cloud

thickness varies, and the problem now is how to understand why the cloud thickness (or T_{cr}) changes independently of T_{eff} and $\log g$. At present, the UCM is a semi-empirical model in that T_{cr} is an empirical parameter to be inferred from observations and not derived from any particular model of cloud formation which is not well understood yet.

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Ph.D. Thesis Abstracts

The Rotation of Very Low Mass Objects

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Ph.D degree awarded: October 2004

This dissertation contains an investigation of the rotation of very low mass objects, i.e. Brown Dwarfs and stars with masses $\leq 0.4\,M_{\odot}$. Today, it is well-established that there are large populations of such VLM objects in open clusters and in the field, but our knowledge about their physical properties and evolution is still very limited. Contrary to their solar-mass siblings, VLM objects are fully convective throughout their evolution. Thus, they are not able to form a large-scale magnetic field like for example the sun. The magnetic field, in turn, is crucial for the regulation of rotation: Magnetic interaction between star and circumstellar disk ("'disk-locking"') and angular momentum losses through stellar winds have dominant influence on the rotational evolution. Thus, we can expect major differences in the rotational behaviour of VLM objects and solar-mass stars.

The best method to investigate stellar rotation is to measure rotation periods. If a star exhibits surface features which are asymmetrically distributed, its brightness may be modulated with the rotation period. Thus, this dissertation is based on the analysis of photometric time series. Open clusters are an ideal environment for such a project, since they enable one to follow many objects at the same time. Additionally, they allow one to investigate the age and mass dependence of rotation, because distance and age of the clusters are known in good approximation. For this thesis, five open clusters were observed, which span an age range from 3 to 750 Myr. In three of them (σOri, ϵOri, IC4665), VLM objects were identified by means of colour magnitude diagrams. The candidate lists for these three regions comprise at least 100 objects, for which photometry in at least three wavelength bands is available. About a fifth to a third of these candidates could be contaminating field stars in the fore- or background of the clusters. For the remaining two clusters (Pleiades and Praesepe), objects from the literature were selected as targets for the variability study. Masses for all these candidates were estimated by comparing the photometry with stellar evolutionary tracks.

For each of the clusters, at least one photometric monitoring campaign was carried out; three of them were observed twice. Subsequently, the magnitudes of the VLM objects were measured relative to non-variable stars in the same fields. The difference image analysis procedure was used to improve the precision for two time series. That way, a photometric precision between 5 and 20 mmag was reached for the brightest stars. A comparison of several period search techniques showed that periodogram analysis delivers by far the best results for the available time series data. Beside the Scargle and CLEAN periodogram, the period search includes several independent and robust control

procedures, to assure the reliability of the results. Additionally, a test to identify even non-periodic variability was implemented.

For 87 candidates, a photometric rotation period was determined, 80 of these objects have masses $\leq 0.4\,M_{\odot}$. Thus, this work increases the number of known VLM rotation periods in the age range between 3 and 750 Myr by a factor of 14. Altogether, about 30-50% of the candidates are variable. In the two youngest clusters, several objects show variability with very high amplitudes between 0.2 and 1.1 mag. Their lightcurves contain in the most cases a periodic component, but additionally irregular brightness variations. For two VLM stars, a flare event was detected.

The origin of the periodic variability is surface features co-rotating with the objects. In most cases, these surface features are cool magnetically induced spots. From the lightcurves, it can be concluded that the spot properties change on timescales of at most two or three weeks. The amplitudes of the lightcurves are in the VLM regime by a factor of 2.4 smaller than for solar-mass stars, indicating a change of the spot properties with mass. The best explanation for this phenomenon is a more symmetric spot distribution on VLM objects. Additionally, it is probable that the contrast between spots and photospheric environment is smaller than for more massive stars.

The lightcurves of the highly variable objects in the youngest clusters cannot be understood only with cool spots. This kind of variability resembles very much the photometric behaviour of classical T Tauri stars, i.e. stars which accrete matter from a circumstellar disk. Thus, it is likely that the highly variable VLM objects possess accretion disks as well. This interpretation is confirmed by near-infrared photometry and optical spectroscopy. For VLM objects in the σOri cluster, a disk frequency of 6-14% was estimated. From this value and the age of σOri it follows that VLM objects loose their disk on shorter timescales than solar-mass stars, which could be an indication for a formation through ejection from a multiple system. This result, however, needs confirmation, since the derived disk frequency should only be considered as a lower limit.

The majority of the periodic variable objects rotate with periods < 2 d. Slow rotators, with periods longer than 2 d, are rare, in contrast to solar-mass stars. For $M < 0.3\,M_{\odot}$, a tendency of faster rotation with decreasing object mass is observed. The origin of this tendency lies very probably in the earliest phases of the rotational evolution. The lower limit of the periods is, within the statistical uncertainties, nearly independent of age and ranges from three to six hours. On the other hand, the upper period limit clearly evolves with time. Between ages of 3 and 100 Myr, it declines from at least ten days to about two days. Afterwards, it increases again up to at least four days. To investigate this behaviour in more detail, simple models were constructed which simulate the basic mechanisms of angular momentum regulation. It turns out that the basic aspects of the rotational evolution can be understood if one takes into account the contraction of the objects and exponential rotational braking through stellar winds. On the contrary, for solar-mass stars the angular momentum losses through stellar winds can be described with the Skumanich law, which predicts a period increase proportional to the squareroot of time. This Skumanich law is not applicable in the VLM regime. Moreover, in the considered age range, the influence of "'disk-locking"' is negligible.

Many of these results can be understood by taking into account the fact that VLM objects are fully convective and cannot possess a large-scale magnetic field. This basic physical property could be responsible for the fast rotation, the breakdown of the Skumanich law, the exponential braking of the rotation, and a more symmetric spot distribution. Thus, main results of this thesis can be ascribed to the internal structure of VLM objects.

Thesis-related Publications: A&A, 419, 249; A&A 421, 259

Announcement

Ph.D. Program
Univ. of Heidelberg (Germany)

Dear Colleagues:

The recently founded

International Max-Planck Research School for Astronomy and Cosmic Physics (IMPRS) at the University of Heidelberg

invites applications for its Ph.D. program.

The school is located in Heidelberg (Germany) which is one of the most beautiful old university towns in Europe. We offer outstanding research and training opportunities with excellent instrumental, observational, and theoretical research facilities at five first-rate institutes, namely

- the Max-Planck Institute for Astronomy (MPIA), - the Max-Planck Institute for Nuclear Physics (MPIK), - the Institute for Theoretical Astrophysics (ITA), - the Astronomisches Recheninstitut (I.f. Astronomical Computing, ARI), - the Landessternwarte (State Observatory) Heidelberg (LSW).

The main research topics at these five institutions are: Planet and star formation - extrasolar planets and substellar objects - astrometry - formation, evolution and dynamics of galaxies - active galactic nuclei and massive black holes - gravitational lensing - cosmology and structure formation - high energy astrophysics, cosmic rays and the search for non-baryonic dark matter - state-of-the-art instrumentation for astronomy and astroparticle physics.

IMPRS for Astronomy and Cosmic Physics at the University of Heidelberg has established a comprehensive curriculum including regular lectures, seminars, invited guest lectures, and advanced summer schools. Ph.D. research projects will be defined and supervised by scientists at one of the participating institutes.

IMPRS Heidelberg is open for students from all countries and offers several 3-year Ph.D. fellowships for both international and national students. Interested students are invited to apply by 15 January 2005 for the academic year starting in September 2005. In general, applicants should have a Masters or Diploma in Physics or Astronomy (or equivalent) including a corresponding thesis. Successful applicants will receive financial support through a PhD fellowship.

For further details on IMPRS Heidelberg and the application procedure, we refer to our web-site at http://www.mpia-hd.mpg.de/imprs-hd/

Under /poster2.html you will also find a poster of IMPRS Heidelberg. We would be happy if you further distribute it among other colleagues and interested students. Thank you in advance for your support.

With kind regards,

Christian Fendt

Coordinating Scientist, International Max Planck School for Astronomy and Cosmic Physics at the University of Heidelberg

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Announcement

New Book on Star Formation

Dear Colleague:

Francesco Palla and I are pleased to announce the publication of **The Formation of Stars** (Wiley-VCH). We are hoping our book will fill the longstanding need for a comprehensive, graduate-level text in this exciting field. The book should also serve as a reference for established researchers.

With best wishes, Steven Stahler

Publisher's Description: This book is a comprehensive treatment of star formation, one of the most active fields of modern astronomy. The reader is guided through the subject in a logically compelling manner. Starting from a general description of stars and interstellar clouds, the authors delineate the earliest phases of stellar evolution. They discuss formation activity not only in the Milky Way, but also in other galaxies, both now and in the remote past. Theory and observation are thoroughly integrated, with the aid of numerous figures and images. In summary this volume is an invaluable resource, both as a text for physics and astronomy graduate students and as a reference for professional scientists.

Additional Info:

Title: The Formation of Stars
Authors: Steven W. Stahler and Francesco Palla
Publisher: John Wiley & Sons
ISBN: 3527405593
List Price: $U.S. 89.95 (paperback, 865 pages)
Availability: Not yet released in U.S. Expected to be released in Jan. - Feb. 2005.
Pre-orders: book may be pre-ordered at amazon.com
Display copies: this new book will be on display at AAS/San Diego.

Abstract Guidelines

Abstracts for *COOLNEWS* are solicited for papers that have been recently accepted by or submitted to refereed journals, and for recent Ph.D. theses. Abstracts for conference proceedings articles are *not* posted in *COOLNEWS*. The subject matter should pertain directly to cool stars (spectral types F,G,K,M or L), substellar objects, or the sun. Both theoretical and observational abstracts are appropriate.

Abstracts dealing with cool pre-main-sequence (PMS) stars will generally not be included in *COOLNEWS*, since they are already covered by the *Star Formation Newsletter*. Exceptions to this rule will be considered if the subject matter is truly cross-disciplinary. If you wish to submit a cross-disciplinary abstract on PMS stars, then first submit it to the *Star Formation Newsletter*. After doing so, submit the abstract to *COOLNEWS* accompanied by a short e-mail stating that it has already been submitted to the *Star Formation Newsletter*, and summarizing why it will be of interest to the cool star/solar community at large.

A monthly call for abstracts will be issued and abstracts received by the last day of the month will usually appear in the following month's newsletter. Announcements of general interest to the cool star and solar communities may also be submitted for posting in the newsletter. These might include (but are not restricted to) the following: (i) *Job Openings* directed toward cool star or solar researchers, (ii) announcements of *Upcoming Meetings*, (iii) announcements of *Upcoming Observing Campaigns* for which participation is solicited from the community at large, (iv) reviews of *New Books*, and (v) *General Announcements* that provide or request research-related information. Please send all correspondence to the editor at coolnews@jila.colorado.edu. Abstract templates and back issues can be obtained from the COOLNEWS Web-page at

`http://casa.colorado.edu/~skinners/coolnews.html` .

*** Please send abstracts in the body of the message and *not* as attachments.***