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SYMBIOTIC STARS: CONTINUALLY EMBARRASSING BINARIES

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Received: 2007 January 15

Abstract. This paper aims at presenting the state-of-the-art in understanding of symbiotic binaries. In particular, we discuss their basic parameters, the mechanisms of mass loss and accretion and the role of these processes in the observed activity of symbiotic systems.

Key words: stars: binaries: symbiotic – stars: fundamental parameters – stars: mass loss

ECLIPSE MAPPING OF SYMBIOTIC BINARIES

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Received: 2007 January 15

Abstract. We describe an ultraviolet eclipse mapping of the symbiotic binary EG And. Analysis of FUSE and HST/STIS observations at differing orbital phases probe different layers of the chromosphere and wind of the red giant in absorption. Whilst the primary aim of the study is to examine the thermal and dynamic conditions at the base of these winds, much is learnt about both the hot and cool material within the system. It is found that the behavior of the hot material associated with the dwarf is highly variable but the inner wind of the giant is relatively undisturbed due to the wind density and the low-luminosity of the dwarf.

Key words: stars: binaries: symbiotic – stars: mass loss – stars: individual (EG And)

CHEMICAL COMPOSITION AND SPECTROSCOPIC VARIABILITY OF CH CYG

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Abstract. We discuss some details of abundance analysis of the cool component of the symbiotic system CH Cyg. The depth variation of absorption lines is shown to correlate with the light curve in the infrared *M* passband.

Key words: stars: binaries: symbiotic – stars: abundances, variability – stars: individual (CH Cyg)

A CLEAR DETECTION OF THE EXTINGUISH POINT OF HYDROGEN BURNING IN THE RS OPH 2006 OUTBURST

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Abstract. I report a coordinated multi-band photometry of the RS Oph 2006 outburst and a theoretical light-curve fitting. Our emission-line free y -band photometry clearly shows a mid-plateau phase from day 40 to day 75, followed by a sharp drop of the final decline. We have calculated theoretical light curves based on the optically thick wind theory and have reproduced the observed light curves. We found that the mid-plateau phase is interpreted as a bright disk irradiated by the white dwarf, and that the final sharp decline corresponds to the epoch in which the steady hydrogen burning turned out. We strongly recommend the y filter observations of novae to detect both the presence of a disk and the hydrogen burning turn-off.

Key words: stars: binaries: symbiotic – stars: novae – stars: individual (RS Oph)
– white dwarfs

THE NON-STANDARD MULTIFREQUENCY BEHAVIOR OF AG DRA

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Abstract. We summarize the behavior of AG Dra during the last 25 years, characterized by a sequence of 5 active phases (with 14 light maxima). Cool and hot outbursts are discussed. In general, during bursts the X-ray flux weakens or vanishes, which should be mostly due to an increase of the high energy opacity of the envelope, rather than to a decrease of the source temperature. An explanation is suggested for the different behavior of the He II Zanstra temperature during the two burst types, and the possibility is considered that during all the burst events AG Dra first passes through a hot phase, and that only in the strongest bursts it evolves towards the cool burst phase.

Key words: stars: binaries: symbiotic – stars: individual (AG Dra) – accretion – X-rays: bursts

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V407 CYG AS A MEMBER OF A NEW SUBCLASS OF SYMBIOTIC STARS

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Abstract. We analyze the results of new multicolor *UBVRIJHKLM* photometric observations of the symbiotic Mira V407 Cyg, obtained on return to quiescence from its 1998 outburst.

Key words: stars: binaries: symbiotic – stars: Mira variables – stars: individual (V407 Cyg)

THE ORIGIN AND EVOLUTION OF SYMBIOTIC BINARIES

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Abstract. Symbiotic binaries form a diverse class of interacting binaries that can be used to constrain binary evolution theory. In this contribution we will review some of the major unsolved issues concerning symbiotic binaries, in particular the origin of the orbital-period distribution of S-type symbiotic binaries, their possible relation to a sub-class of Type Ia supernovae and the stability of mass transfer. We will then present some recent observations of Mira suggesting that even very wide symbiotic experience a new form of Roche-lobe overflow, “wind Roche-lobe overflow”. We will present preliminary hydrodynamical simulations of this type of mass transfer and discuss its implications for the shaping of (proto-)planetary nebulae, the origin of barium stars and potentially Type Ia supernova progenitors.

Key words: stars: binaries: symbiotic – stars: AGB and post-AGB, mass loss – supernovae: general – white dwarfs

CH CYGNI ON THE BACKGROUND OF HETEROGENEITY OF SYMBIOTIC STARS

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Abstract. With its cool component as a semiregular M6–M7 III variable of solar chemical composition, CH Cygni fits well into the classification schemes of symbiotic stars (S- and D-type). On the other hand, its activity behavior is different from most of the other symbiotic stars. We describe some aspects of recent spectroscopic variability of CH Cyg. An attempt is made to explain most of the peculiarities of CH Cyg as a consequence of extremely long orbital period (~ 5300 d) for an S-type symbiotic star.

Key words: stars: binaries: symbiotic – stars: individual (CH Cyg)

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SYMBIOTIC STARS IN MASSIVE PHOTOMETRIC SURVEYS

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Abstract. We identified 126 symbiotic stars in ASAS, OGLE and MACHO databases, and found good light curves for 74 of them. Here we present and discuss some results of our search for periodic changes in these objects.

Key words: stars: binaries: symbiotic

NEBULAR ABUNDANCES OF SOUTHERN SYMBIOTIC STARS

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Abstract. We present relative elemental abundances for a representative sample of 53 symbiotic stars in our Galaxy. We derive the He abundances taking into account self-absorption effects in Balmer lines. Our results for N/O, Ne/O, Ar/O and He/H show that symbiotic stars follow the same trend as other well-known tracers of Galactic chemical evolution such as planetary nebulae. The increasing number of suspected symbiotic stars being discovered in X-rays and optical wavelengths suggests that symbiotic stars may play a key role in diagnostics of the Galaxy evolution in advanced stages.

Key words: stars: binaries: symbiotic – stars: abundances

THE YELLOW SYMBIOTIC STAR GH GEM

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Abstract. We have begun in 2005 a tight spectroscopic and $UBVR_CI_C$ photometric monitoring of the poorly known symbiotic star GH Gem. Its absorption continuum is that of a K3III metal poor, low reddening giant, showing only weak, low ionization emission lines, with strong profile modulation. The long-term photometric evolution in V band is dominated by a marked periodicity at 331.774 day and $\Delta V = 0.8$ mag amplitude, while a sinusoidal $\Delta B = 0.6$ mag and $P \approx 72.5$ variability modulate the brightness at shorter wavelengths.

Key words: stars: binaries: symbiotic – stars: individual (GH Gem)

THE 2006 OUTBURST OF THE RECURRENT NOVA RS OPH

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Abstract. We present the results of our intensive photometric (BVR_CI_C passbands) and spectroscopic monitoring (high and low resolution) throughout the 2006 outburst of the symbiotic star and recurrent nova RS Oph. Photometrically as well as spectroscopically the 2006 event closely followed the pattern already traced by the previous outbursts that occurred in 1898, 1933, 1958, 1967 and 1985. The decline time scales in the B band were $t_2 = 6.2$ and $t_3 = 17.1$ d. Coronal emission lines reached maximum intensity around day ~ 70 . A fast drop in brightness set in at day ~ 80 and brought the nova below quiescence mean level by day ~ 90 , where it is still now, varying widely both in brightness and color.

Key words: stars: binaries: symbiotic – stars: novae – stars: individual (RS Oph)

MODELING LIGHT CURVES OF SYMBIOTIC STARS

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Abstract. Near-infrared light curves of some well-studied symbiotic stars show a modulation with half-orbital period as expected for an ellipsoidal variability in the red giant. We present and discuss preliminary results of modeling of three symbiotic systems with such variability: RW Hya, SY Mus and AR Pav.

Key words: stars: binaries: symbiotic – stars: individual (RW Hya, SY Mus, AR Pav) – stars: infrared

A FRESH LOOK TO THE YELLOW SYMBIOTIC STAR V471 PER

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Abstract. The recent behavior of the yellow, low excitation symbiotic star V471 Per is investigated on the basis of absolute spectrophotometry, high resolution Echelle spectroscopy and $UBVR_CI_C$ CCD photometry. A photoionized modeling of the circumstellar nebula is presented.

Key words: stars: binaries: symbiotic – stars: individual (V471 Per)

**ABSOLUTE DIMENSIONS OF THE OUTBURSTING WD IN THE
SYMBIOTIC NOVA AS 338 FROM MAPPING OF THE
2005 ECLIPSE**

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Abstract. The total eclipse of the symbiotic nova AS 338 occurred during the summer of 2005 was monitored in detail in the $UBVR_CI_C$ passbands, resulting in accurate multicolor eclipse profiles. These eclipse profiles are modeled to derive absolute dimensions and properties of the inflated and outbursting WD component and to compare them with theoretical expectations.

Key words: stars: binaries: symbiotic – stars: individual (AS 338)

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IRAS 12316–6401: A NEW SYMBIOTIC MIRA?

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Abstract. Current observations indicate that IRAS 12316-6401 is a new addition to the rare class of resolved symbiotic Miras, however future observations are needed to confirm this.

Key words: stars: winds, outflows – stars: binaries: symbiotic – planetary nebulae: general – stars: individual (IRAS 12316–6401)

HIGH-RESOLUTION SPECTROSCOPY OF RS OPH DURING THE QUIESCENCE BEFORE THE 2006 OUTBURST

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Abstract. We present preliminary analysis of six high-resolution spectra of RS Oph obtained 1–2 years before the last outburst in 2006. New radial velocities of the M giant’s neutral metal absorptions and double-component Ti II absorptions were measured and used here to study the orbital motions.

Key words: stars: binaries: symbiotic, novae, cataclysmic variables – stars: individual (RS Oph)

NEW INSIGHTS INTO THE DYNAMICS AND EXPANSION PARALLAX OF NEBULAE AROUND SYMBIOTIC STARS

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Abstract. Currently, there are a dozen known spatially resolved nebulae around symbiotic stars. We summarize their properties, focusing on their dynamical ones. Then, new results about the determination of the expansion in the plane of the sky of the nebulae around Hen 2-104 and Hen 2-147, which allows us to gain important information about their dynamics and to discuss their distance via the expansion parallax method, will be described. Finally, the discussion will be extended to bipolar nebulae presently classified as planetary nebulae, but which might instead host a symbiotic star, and in particular to the remarkable cases of Mz 3 and M 2-9.

Key words: stars: binaries: symbiotic – stars: individual (Hen 2-104, Hen 2-147) – planetary nebulae: individual (Mz 3, M 2-9) – interstellar medium: kinematics and dynamics

A SEARCH FOR SYMBIOTIC STARS IN THE MILKY WAY

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Abstract. We present the search for symbiotic stars in the Northern Galactic Plane within the IPHAS imaging survey. The criterion used to select this class of objects is a combination of the IPHAS r -H α vs. r - i color-color diagram with the 2MASS J - H vs. H - K diagram. This allows us to distinguish symbiotic stars from other classes of H α -emitting evolved stars and nebulae. Confusion with young stars in star-forming regions can be also limited by a careful selection of the regions of the Milky Way to be investigated. In this way, more than a thousand new candidate symbiotic stars have been selected so far, and a spectroscopic campaign to determine their real nature is in progress.

Key words: stars: binaries: symbiotic – Galaxy: stellar content

MODELING OF DUST AROUND RR TEL

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Abstract. We present a model of the inner dust regions around the cool Mira component of the symbiotic nova RR Tel, based on observations in the near IR from 1975 to 2002. The *JHKL* magnitudes taken at the South African Astronomical Observatory and corrected for Mira pulsations were modeled by DUSTY code. The code solves radiative transfer by assuming a spherical temperature distribution in the innermost regions around the Mira component. The dust temperature, grain size, density distribution and optical depth during the intervals with and without obscuration have been obtained.

Key words: stars: binaries: symbiotic – stars: circumstellar matter – stars: AGB and post-AGB – infrared: stars – radiative transfer

BINARY CENTRAL STARS OF PLANETARY NEBULAE

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Abstract. This paper reviews our knowledge on binary central stars of planetary nebulae and presents some personal opinions regarding their evolution. Three types of interactions are distinguished: type I, where the binary companion induces the mass loss; type II, where it shapes the mass loss but does not enhance it; type III, where a wide orbit causes the center of mass to move, leading to a spiral embedded in the wind. Surveys for binary central stars are discussed, and the separations are compared to the distribution for binary post-AGB stars. The effect of close binary evolution on nebular morphology is discussed. Post-common-envelope binaries are surrounded by thin, expanding disks, expelled in the orbital plane. Wider binaries give rise to much thicker expanding torii. Type I binary evolution predicts a wide distribution of masses of central stars, skewed towards low masses. Comparison with observed mass distributions suggests that this is unlikely to be the only channel leading to the formation of a planetary nebula. A new sample of compact Bulge nebulae shows about 40% of nebulae with binary-induced morphologies.

Key words: stars: AGB and post-AGB – stars: binaries: close – stars: mass-loss – planetary nebulae: general

COMPACT CIRCUMSTELLAR DISK IN A POST-AGB STAR OH 231.8+4.2

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Abstract. We have observed a bipolar post-AGB star OH 231.8+4.2, using the mid-infrared interferometer MIDI and the infrared camera with an adaptive optics system NACO on VLT. An unresolved core (<200 mas in FWHM), found at the center of the OH 231.8+4.2 in the $3.8 \mu\text{m}$ image, is resolved with the interferometer. The fringes from the four baselines consistently show the presence of a compact circumstellar shell with an inner radius of 30–40 mas, which is equivalent to 40–50 AU at 1.3 kpc. The measured size of the circumstellar feature is consistent with the size of disks calculated by hydrodynamic models, implying the circumstellar feature may have a disk configuration. The mid-infrared size of the circumstellar dust shell or disk among AGB and post-AGB stars seems to be correlated with the effective temperature of the central star.

Key words: stars: AGB and post-AGB – stars: mass loss – ISM: dust, extinction – infrared: stars

EFFICIENT RADIATIVE TRANSFER IN A CIRCUMSTELLAR DISK ENVIRONMENT

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Abstract. We present SKIRT, an efficient 3D Monte Carlo radiative transfer code, designed to treat continuum radiative transfer problems in dusty systems. In particular, we are using SKIRT to investigate the geometry, composition and formation of circumbinary dust disks around post-AGB stars. The main novelty in SKIRT is the use of partly polychromatic photon packages, which allow a very efficient radiative transfer algorithm. We test the accuracy and the numerical requirements of the SKIRT code by comparing its results with recent 1D and 2D benchmark calculations. We demonstrate that the common belief that Monte Carlo radiative transfer is slow, is not valid for state-of-the-art Monte Carlo codes where modern optimization techniques are included. Moreover, the very limited memory requirements of Monte Carlo radiative transfer make high-resolution three-dimensional radiative transfer simulations possible, while this might be more challenging for traditional grid-based codes.

Key words: radiative transfer – stars: circumstellar matter

FLUORESCENCE FE II LINES AS TRACES OF FAST OUTFLOWS OF WHITE DWARF WINDS

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Abstract. A set of equations are put into a code forming a procedure to derive intensities of fluorescence lines based on both physical properties of the fluorescent plasma and its location relative to the origin of the pumping emission. In a first test, the code is applied to symbiotic stars, and effort is made to explain the circumstances under which the two known Fe II channels pumped by CIV are activated. For the channel at 1548.204 Å, which is most frequently observed to be active, there is a good agreement between the results of the calculations and the observed Fe II line strengths. Fluorescence lines resulting from pumping through the other channel at 1548.411 Å can occur, according to the results of the calculations, only in the systems where a fast outflow from the white dwarf wind is present. The evidences of the white dwarf winds are found in the literature for all the symbiotic systems in which observation of the Fe II fluorescence lines from the $w^2D_{3/2}$ level is reported.

Key words: stars: white dwarfs – stars: winds, outflows

CIRCUMSTELLAR DUST IN SYMBIOTIC MIRAS DURING OBSCURATION EVENTS

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Abstract. We present a study of circumstellar dust properties in the symbiotic Miras RX Pup, V835 Cen, RR Tel and R Aqr, which show obscuration events during the observed time intervals. The obscuration events, as seen from the light curves corrected for Mira pulsations, have been investigated in view of the change of colors caused by the circumstellar dust. Assuming a spherical temperature distribution of the dust in the close neighborhood of the Mira, the DUSTY code was used to solve the radiative transfer in order to determine the dust temperature and its properties in each particular case. The preliminary results of this study provide information on the nature of the dust during the obscuration events.

Key words: stars: binaries: symbiotic – stars: circumstellar matter – stars: AGB and post-AGB – infrared: stars – radiative transfer

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3D DUST RADIATIVE TRANSFER SIMULATIONS IN THE INHOMOGENEOUS CIRCUMSTELLAR MEDIUM

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Abstract. Circumstellar dusty disks seem to be a ubiquitous feature around stars in different phases of their evolution, including post-AGB stars. We present 3D radiative transfer simulations of circumstellar disks with an inhomogeneous dust distribution to investigate the effect of a clumpy medium on the dust temperature distribution. Our initial results indicate that the structure of the dust temperature distribution is rather insensitive to the structure of the ISM, but nevertheless we find a systematic dependence on the parameters describing the structure of the clumpiness of the dust medium.

Key words: radiative transfer – stars: circumstellar matter

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BINARY LIFE AFTER THE AGB – TOWARDS A UNIFIED PICTURE

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Abstract. We attempt to construct a unified evolutionary scheme that includes post-AGB systems, barium stars, symbiotics and related systems, explaining their similarities as well as their differences. Special attention is given to the comparison of the barium pollution and symbiotic phenomena. Finally, we outline a ‘transient torus’ evolutionary scenario that makes use of the various observational and theoretical hints and aims at explaining the observed characteristics of the relevant systems.

Key words: stars: AGB and post-AGB, stars: binaries

POST-AGB BINARIES

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Abstract. The specific characteristic of the SED of serendipitously discovered post-AGB binaries, allowed us to launch a very extensive multi-wavelength study of evolved objects, selected on the basis of very specific selection criteria. Those criteria were tuned to discover more stars with circumstellar dusty disks. The observational study includes radial velocity monitoring, high spectral resolution optical studies, infrared spectral dust studies, sub-mm bolometric observations and high spatial resolution interferometric experiments with the VLTI. In this contribution, we will review the preliminary results of this program showing that the binary rate is indeed very high. We argue that the formation of a stable circumbinary disk must play a lead role in the evolution of the systems.

Key words: stars: AGB and post-AGB – stars: binaries : spectroscopic – stars: evolution – stars: circumstellar matter

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DYNAMICS OF STELLAR OUTFLOWS

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Abstract. Processes of radiative transfer are quite important when one discusses the dynamics of stellar outflows. Radiation pressure causes force on dust grains and the latter drag the dust along. We present a better procedure for solution of the outflow dynamics in late-type stars, which is applicable for quite a wide range of parameters.

Key words: stars: winds, outflows

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MILLIMETER WAVE SURVEY OF THE PROTOPLANETARY NEBULA CRL 618 AND ITS COMPLETE MODEL

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Abstract. This contribution presents a survey of the emission from the C-rich protoplanetary nebula CRL 618, performed with the IRAM 30 m radiotelescope from 80.25 GHz to 275.25 GHz. The analysis of the data has resulted in a complete picture of the structure of the source, its physical conditions and the chemical abundances in different gas regions. More than 3000 molecular lines have been successfully labeled and modeled and only 74 features in the spectrum remain unidentified.

Key words: stars: protoplanetary nebulae – line: identification – surveys

MOLECULES IN (PROTO)PLANETARY NEBULAE

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Abstract. This contribution reviews results on the structure and dynamics of planetary and protoplanetary nebulae from observations of molecular line emission. Molecular line data have been particularly useful to study the very fast evolution of these nebulae. Our knowledge on the molecular content of these objects, i.e., the molecule abundances, is also summarized.

Key words: stars: AGB and post-AGB – planetary nebulae

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MIXED CHEMISTRY PHENOMENON DURING LATE STAGES OF STELLAR EVOLUTION

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Abstract. We discuss phenomenon of simultaneous presence of O- and C-based material in the surroundings of evolutionary advanced stars. We concentrate on silicate carbon stars and present observations that directly confirm for them the binary model scenario. We discuss also the class of C-stars with OH emission detected, to which some [WR] planetary nebulae do belong.

Key words: stars: AGB and post AGB – stars: carbon – stars: abundances – stars: individual (V778 Cyg, IRAS 04496–6859, IRAS 06238+0904, M 2-43) – planetary nebulae

AGB STAR INTERSHELL ABUNDANCES INFERRED FROM EXTREMELY HOT H-DEFICIENT POST-AGB STARS

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Abstract. The hydrogen-deficiency in extremely hot post-AGB stars of spectral class PG1159 is probably caused by a (very) late helium-shell flash or a AGB final thermal pulse that consumes the hydrogen envelope, exposing the usually-hidden intershell region. Thus, the photospheric elemental abundances of these stars allow us to draw conclusions about details of nuclear burning and mixing processes in the precursor AGB stars. We compare the observed and predicted elemental abundances. Good qualitative and quantitative agreement is found for many species (He, C, N, O, Ne, F, Si) but discrepancies for others (P, S, Fe) point at shortcomings in stellar evolution models for AGB stars.

Key words: stars: AGB and post-AGB – stars: abundances – stars: atmospheres – stars: evolution – nuclear reactions, nucleosynthesis, abundances

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RESOLVING THE COMPACT DUSTY DISKS AROUND BINARY POST-AGB STARS USING THE VLTI/MIDI INTERFEROMETER

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Abstract. Although the presence of circumbinary disks around binary post-AGB stars is now well established, their actual structure, formation, stability and evolution remain largely unknown. We therefore used the MIDI interferometer to observe the disks around a sample of nine post-AGB binaries. These measurements show the very compact nature of the circumstellar environment and confirm the disk interpretation of their spectral energy distribution. In addition, a large diversity is observed in the radial distribution of the crystallinity over the N -band. While some objects show a homogeneous distribution of the crystallinity, for some objects the crystallinity is confined to the innermost regions. Whether this is a result of the formation process or due to annealing during the long storage time in the disk is not clear.

Key words: stars: AGB and post-AGB – stars: circumstellar matter – techniques: interferometry

THE INFRARED SPECTRA OF DISKS AROUND BINARY POST-AGB STARS

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Received: 2007 January 15

Abstract. The number of binary post-AGB stars known in the Galaxy is significant, yet their evolutionary status is far from understood. Evidence is growing that all these evolved binaries are surrounded by circumbinary Keplerian dusty disks. We present the first results of our 2D-SED-modeling and detailed study of the mineralogy using Spitzer-IRS and TIMMI2 spectra. Our analyses show that the spectra indicate a very high degree of processing of the dust grains, both with respect to grain size and crystallinity. Whether this processing is the result of the long storage time in the disk and/or due to a special thermal history at formation is not yet clear.

Key words: stars: AGB and post-AGB - stars: binaries - stars: evolution - stars: circumstellar matter

**DUST DISTRIBUTION IN [WR] PLANETARY NEBULAE:
A CASE OF M2-43**

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Abstract. Simultaneous presence of O- and C-rich molecules and/or dust is commonly known as mixed or dual chemistry. C-rich [WR] central stars show at the same time the presence of polycyclic aromatic hydrocarbons (PAHs) and crystalline silicates in their nebulae. We perform radiative transfer modeling of ISO spectrum for M2-43 to determine spatial location of PAHs and crystalline silicates inside the nebula. This allows us to discuss the origin of mixed chemistry in [WR] planetary nebulae.

Key words: planetary nebulae: individual (M2-43)

**THE CANONICAL POST-AGB STAR HD 56126: THE FIRST
HIGH-RESOLUTION SPECTRAL ATLAS WITHIN 401–879 NM**

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Abstract. We present an atlas of the optical spectrum of the well known post-AGB star HD 56126 associated with the IR-source IRAS 07134+1005, in comparison to a standard supergiant α Per. The high resolution spectra in the range from 401 to 879 nm were obtained with two Echelle spectrographs on the 6 m telescope. We have identified 1700 spectral lines, molecular features and diffuse interstellar bands (DIBs). Specific behavior of selected lines ($H\alpha$, $H\beta$ and spectral features identified with Fe II (42), C_2 , CN, DIBs) is studied. The pattern of differential motions is revealed. Both the atlas and the table with line identification are available on the web at <http://www.sao.ru/hq/ssl/Atlas/Atlas.html>.

Key words: stars: post-AGB – stars; atmospheres – stars: individual
(HD 56126 = IRAS 07134+1005)

MACHO 82.8405.15: THE FIRST EXTRAGALACTIC DEPLETED RV TAURI STAR

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Abstract. RV Tauri stars are a heterogeneous subclass of the Population II Cepheids, probably in the post-AGB stage of evolution. Many RV Tauri stars show some degree of depletion in their photospheres, which is caused by a gas-dust separation in the circumstellar environment and a subsequent gas accretion, making the photosphere devoid of refractory elements. The most favorable circumstance for this process to occur is when the circumstellar dust is trapped in a disk. The presence of a disk in evolved objects is likely related to binarity. In this contribution, we present the results of our abundance study of the first depleted RV Tauri star in the Large Magellanic Cloud, MACHO 82.8405.15, based on high-resolution VLT-UVES spectra. While our analysis of other LMC RV Tauri stars is still in progress, it is clear that, also in the LMC, depletion seems to be quite common amongst RV Tauri objects.

Key words: stars: AGB and post-AGB – stars: abundances – stars: individual (MACHO 82.8405.15) – Magellanic Clouds

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SUMMARY OF THE CONFERENCE

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Received: 2007 January 15

Abstract. After showing how ideas about the nature of symbiotic binaries and their relation with other classes of objects, also examined at this meeting, have become more precise, personally selected highlights of the conference are mentioned. A few lessons for the future are drawn.

Key words: planetary nebulae: general – stars: AGB and post-AGB – stars: binaries: symbiotic – stars: individual (AS 338, R Aqr, o Ceti, RT Cru, CH Cyg, AG Dra, RS Oph, AG Peg) – stars: winds, outflows

YOUNG STARS IN THE CAMELOPARDALIS DUST AND MOLECULAR CLOUDS. I. THE CAM OB1 ASSOCIATION

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Received 2007 April 5; accepted 2007 April 20

Abstract. The distribution of dust and molecular clouds in the direction of Galactic longitudes $132\text{--}158^\circ$ and latitudes $\pm 12^\circ$ is investigated. The maps of dust distribution in the area were plotted from the following surveys: the star counts in the DSS I database by Dobashi et al. (2005), the survey of the average infrared color excesses by Froebrich et al. (2007) and the thermal dust emission survey at $100\ \mu\text{m}$ by Schlegel et al. (1998). The distribution of molecular clouds was taken from the whole sky CO survey by Dame et al. (2001). All these surveys show very similar cloud patterns in the area. Using the radial velocities of CO, the distances to separate clouds are estimated. A revised list of the Cam OB1 association members contains 43 stars and the open cluster NGC 1502. 18 young irregular variable and $\text{H}\alpha$ emission stars are identified in the area. All this proves that the star forming process in the Camelopardalis clouds is still in progress.

Key words: ISM: clouds, dust, extinction – stars: formation – Galaxy: structure – Galaxy: open clusters and associations: individual (Cam OB1, NGC 1502)

ON CHEMICAL ABUNDANCES OF AM AND NORMAL A-TYPE STARS

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Abstract. As the chemical abundance values of normal A stars overlap those of incipient and moderate Am stars, we examine the abundance anomalies of the Am and superficially normal A stars together. We study the results of 17 consistently performed studies by Adelman and his associates who used Dominion Astrophysical Observatory long camera spectra obtained using Reticon and CCD detectors. A linear correlation analysis of the abundance anomalies of 12 elements derived in all 17 cohort stars shows many of these anomalies are correlated with one another especially those of the Fe-peak elements, Sr, Y, Zr and Ba. This most likely reflects hydrodynamic processes such as radiative diffusion and gravitation acting within the stellar atmospheres and envelopes.

Key words: stars: abundances – stars: chemically peculiar

OPTICAL SPECTROMETRY OF THE POST-AGB STAR HD 161796

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Received 2007 February 21; accepted 2007 May 15

Abstract. The high-resolution spectrum of the post-AGB star HD 161796 is analyzed. The derived atmospheric parameters are: $T_{\text{eff}} = 7250 \pm 200$ K, $\log g = 0.5 \pm 0.3$ and $\xi_t = 4.5 \pm 0.5$ km s⁻¹. The star is found to be mildly metal deficient with $[\text{Fe}/\text{H}] = -0.30$. The C, N, O and Na – S abundances are enhanced. The abundances of iron peak elements follow those of Fe. The elements produced in s-process are considerably underabundant and the r-process elements slightly underabundant. The star is found to be more luminous ($M_V < -6$ mag) and more distant ($d > 3.6$ kpc) than was considered earlier.

Key words: stars: atmospheres – stars: AGB and post AGB – stars: individual: HD 161796

SEVEN-COLOR VILNIUS PHOTOMETRY OF THE OPEN CLUSTER NGC 752

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Received 2006 December 18; revised and accepted 2007 June 1

Abstract. New photoelectric seven-color observations in the *Vilnius* system are presented for 65 stars in the region of the open cluster NGC 752. Based on individual stars with accurate photometric classifications, we determine the apparent distance modulus $(m-M)_V = 8.38 \pm 0.14$ and the mean reddening to the cluster $E_{Y-V} = 0.027 \pm 0.010$, or $E_{B-V} = 0.034 \pm 0.013$ (the errors given are the standard deviations for one star). The mean photometric metallicity for the main-sequence stars, $[\text{Fe}/\text{H}] = -0.14 \pm 0.03$, is found to be slightly lower than that derived for the red clump giants, $[\text{Fe}/\text{H}] = -0.08 \pm 0.09$. This difference suggests that red giants in later evolutionary phases may not have zero-age surface values of $[\text{Fe}/\text{H}]$. We made use of the least-squares minimization techniques to fit the Padova theoretical isochrones to the CMD, when the binary star population is taken into account. By varying the distance modulus, metallicity and age, the best match has been found between the seven magnitudes and colors of the observed stars and those of model binaries, which gives the distance modulus by 0.2 mag smaller than that derived from individual stars, i.e., $(m-M)_V = 8.18$, a closely similar metallicity ($[\text{Fe}/\text{H}] = -0.12$), and age of 1.6 Gyr. With these results, the fraction of photometric binaries among the main-sequence stars is $\geq 40\%$.

MASS LOSS PARAMETERS OF WNE STARS: DEPENDENCE ON METALLICITY

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Received 2007 April 26; accepted 2007 June 12

Abstract. Mass-loss rates and luminosities of single WNE (WN2–WN5) stars in the LMC and SMC were determined by using empirically scaled formulae. The comparison with the Galactic WNE stars allows one to conclude that the mass-loss rates of WNE stars depend on the initial metallicity Z to about the first power, but this dependence may be much weaker if the flux enhancement due to clumping is weaker at smaller initial metallicities. The terminal velocities of WNE-star winds are somewhat smaller at lower initial metallicity, but this dependence is quite weak.

Key words: stars: Wolf-Rayet – stars: mass loss – Magellanic Clouds

ESTIMATION OF TIME DELAYS FROM TWO BLENDED LIGHT CURVES OF GRAVITATIONAL LENSES

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Received 2007 March 28; accepted 2007 June 14

Abstract. Long time photometric monitoring programs of gravitational lens systems are often carried on using modest equipment. The resolution of such observations is limited and some of the images may remain unresolved. It may be still possible to find a full set of time delays from such a blended data. We discuss here a particular but interesting case when we have two light curves that both are blends. A suitable computational algorithm is developed and tested to work with computer-generated model light curves. Our method combines both blended sequences using the hypothetical time delays between the initial components of the light curves as free input parameters. The combined curves are then compared using statistical distance estimation. It occurs that using an assumption of equal magnification ratios between the components of the blends, we can indeed recover the whole set of time delays.

Key words: cosmology: observations – gravitational lensing – methods: statistical

X-RAY PROFILES IN SYMMETRIC AND ASYMMETRIC SUPERNOVA REMNANTS

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Received 2006 September 5; revised and accepted 2007 January 5

Abstract. The nonthermal X-rays from the SNR 1006 NE rim present characteristic scale lengths that are interpreted in the context of diffusion of a relativistic electron. The adopted theoretical framework is the mathematical diffusion in 3D, 1D and 1D with drift as well as the Monte Carlo random walk in 1D with drift. The asymmetric random walk with diffusion from a plane can explain the scale widths of 0.04 pc upstream and 0.2 pc downstream in the nonthermal intensity of X-ray emission in SNR 1006. A mathematical image of the nonthermal X-flux from a supernova remnant as well as profiles function of the distance from the center can be simulated. This model provides a reasonable description of both the limbs and the central region of SNR 1006. A new method to deduce the magnetic field in supernova remnants is suggested.

Key words: ISM: supernova remnants: individual (SNR 1006) – X-rays:
general

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THE ABCD FORMULA OF PHASE DEFINITION IN OPTICAL INTERFEROMETRY: COMBINED EFFECT OF AIR DISPERSION AND BROAD PASSBAND

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Received 2006 October 3; revised 2007 February 1; accepted 2007 March 1

Abstract. Long-baseline interferometry detects fringes created by superposition of two beams of light collected by two telescopes pointing into a common direction. The external path difference is commonly compensated by adding a variable optical path length (delay) through air for one beam such that the optical path difference between the beams remains close to zero near the detector. The ABCD formula assigns a (wrapped) phase to the signals A to D of an interference pattern shifted by multiples of 90 degrees in phase. We study the interplay between a broad spectral passband of the optics and the dispersion of the air in the compensating delay, which leads to small deviations between the ABCD phase and the reduced, monochromatic group-delay representation of the wave packets. This adds dispersion to the effects that have been discussed for evacuated interferometers before (Milman 2005).

Key words: instrumentation: interferometers – techniques: high angular resolution
– techniques: interferometric

STRÖMGREN PHOTOMETRY OF THE SUPERGIANTS HD 4841 (B5 Ia) AND HD 194279 (B2 Ia)

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Abstract. We investigated the variability of the B Ia supergiants HD 4841 and HD 194279 using Strömgren photometry obtained with the Four College Automated Photoelectric Telescope, Arizona and the 0.4-m telescope of TÜBİTAK National Observatory (TUG), Turkey. Both stars are definitely variable with amplitudes of order 0.10 mag in u , v , b and y . The Turkish photometry with several observations per night suggests a more rapid variability than the once per night American photometry. The periods of variability are likely to be of the order of one day.

Key words: stars: supergiants – variable: general – stars: individual: HD 4841 and HD 194279

YOUNG STARS IN THE CAMELOPARDALIS DUST AND MOLECULAR CLOUDS. II. INFRARED OBJECTS

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Received 2007 August 10; accepted 2007 September 20

Abstract. Using infrared photometric data extracted from the 2MASS, IRAS and MSX databases, 142 suspected young stellar objects (YSOs) are selected from about 2 million stars in the Camelopardalis segment of the Milky Way limited by Galactic coordinates $\ell, b = 132\text{--}158$ degr, ± 12 degr. According to the radial velocities of the associated CO clouds, the objects are attributed to three molecular and dust cloud layers at 150–300 pc, ~ 900 pc and 2.2 kpc distances from the Sun. These objects concentrate into dust and molecular clouds and exhibit extremely large reddenings (A_V up to 25 mag) which can be caused by the dust in foreground clouds and circumstellar envelopes or disks. In the $J\text{--}H$ vs. $H\text{--}K$ diagram these objects lie above the intrinsic line of T Tauri variables, roughly along the black-body line. Among the identified objects, some already known YSOs are present, including the well investigated massive object GL 490. The spectral energy distributions between 700 nm and 100 μm suggest that the objects may be YSOs of classes I, II and III. However, we do not exclude the possibility that a small fraction of the objects, especially those without IRAS and MSX photometry, may be unrecognized heavily reddened OB-stars, late-type AGB stars or even galaxies.

Key words: stars: formation – stars: pre-main-sequence – infrared: stars – ISM: dust, extinction, clouds

**CCD PHOTOMETRY AND CLASSIFICATION OF STARS IN THE
NORTH AMERICA AND PELICAN NEBULAE REGION.
IV. THE REGION OF A SUPPOSED CLUSTER COLLINDER 428**

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Abstract. Magnitudes and color indices of 860 stars down to $V = 16.7$ mag in the seven-color *Vilnius* photometric system were obtained in the area of the suspected open cluster Collinder 428 in the North America Nebula. Spectral types, interstellar color excesses, extinctions and distances of stars were determined for 290 stars from the photometric data. The plot of extinction vs. distance gives the front edge of the dust cloud at 540 pc. We conclude that Collinder 428 is not a real star cluster.

Key words: stars: fundamental parameters, classification – ISM: dust, extinction, clouds, individual objects (LDN 935) – open clusters: individual objects (Collinder 428, NGC 6997)

OPTICAL SPECTROSCOPY OF RU CAM, A PULSATING CARBON STAR

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Abstract. We have analyzed high-resolution spectra of RU Cam classified as a carbon-rich W Vir type star. The atmospheric parameters estimated for this star are $T_{\text{eff}} = 5250$ K and $\log g = 1.0$. Our analysis does not confirm hydrogen deficiency. The iron abundance, $[\text{Fe}/\text{H}] = -0.37$, appears to be close to solar. Abundances of most other elements are also close to normal. We found a considerable excess of carbon and nitrogen, $[\text{C}/\text{Fe}] = +0.98$ and $[\text{N}/\text{Fe}] = +0.60$ with the carbon-to-oxygen ratio $\text{C}/\text{O} > 1$. The carbon isotopic abundance ratio is $^{12}\text{C}/^{13}\text{C} = 4.5$. For sodium a moderate overabundance, $[\text{Na}/\text{Fe}] = +0.55$, is obtained. For two moments of observations we found heliocentric velocity values of $v_r = -21.7 \pm 0.8$ and -23.1 ± 1.0 km/s. Both spectra contain a peculiar feature – an emission component of Na I doublet whose location agrees with the radial velocity from the bulk of metallic lines. For our two observing moments we found no dependence of radial velocities on the formation depth or on excitation energy for metallic lines.

Key words: stars: atmospheres – stars: carbon – stars: W Vir type – stars: individual: RU Cam

**A SURVEY OF COMPACT STAR CLUSTERS IN THE S-W
FIELD OF THE M 31 DISK. STRUCTURAL PARAMETERS. II**

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Abstract. The King and the EFF (Elson, Fall & Freeman 1987) analytical models are employed to determine the structural parameters of star clusters using an 1-D surface brightness profile fitting method. The structural parameters are derived and a catalogue is provided for 51 star cluster candidates from the survey of compact star clusters in the South-West field of the M 31 disk performed by Kodaira et al. (2004).

Key words: galaxies: individual (M 31) – galaxies: spiral – galaxies: star clusters – globular clusters: general – open clusters: general

PHOTOMETRY OF STAR CLUSTERS IN THE M 31 GALAXY. APERTURE SIZE EFFECTS

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Abstract. A study of aperture size effects on star cluster photometry in crowded fields is presented. Tests were performed on a sample of 285 star cluster candidates in the South-West field of the M 31 galaxy disk, measured in the Local Group Galaxy Survey mosaic images (Massey et al. 2006). In the majority of cases the derived UBVR photometry errors represent the accuracy of cluster colors well, however, for faint objects, residing in crowded environments, uncertainties of colors could be underestimated. Therefore, prior to deriving cluster parameters via a comparison of measured colors with SSP models, biases of colors, arising due to background crowding, must be taken into account. A comparison of our photometry data with Hubble Space Telescope observations of the clusters by Krienke and Hodge (2007) is provided.

Key words: galaxies: individual (M 31) – galaxies: star clusters – galaxies: photometry

ACCURACY OF STAR CLUSTER PARAMETERS FROM INTEGRATED UBVRI PHOTOMETRY

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Abstract. We study the capability of the UBVRI photometric system to quantify star clusters in terms of age, metallicity, and color excess by their integrated photometry. The well known age-metallicity-extinction degeneracy was analyzed for various parameter combinations, assuming different levels of photometric accuracy. We conclude that the UBVRI photometric system enables us to estimate star cluster parameters over a wide range, if the overall photometric accuracy is better than ~ 0.03 mag.

Key words: techniques: photometric methods – galaxies: star clusters

BVRIH α PHOTOMETRIC EVOLUTION OF NOVA 2007 IN M 33

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Abstract. The BVR_CI_C and H α light curves of Nova 2007, located in the galaxy M 33, are presented. They display the fastest decline ever observed for a nova in this galaxy ($\Delta B = 0.40 \pm 0.01$ mag/day). Color indices of the nova match those of its counterparts in the Galaxy. The nova was discovered when it was already two magnitudes down from maximum (estimated to have occurred on September 13 at $B = 15.5$ mag).

Key words: stars: novae – galaxies: individual (M 33)

ORBITS OF FIVE VISUAL BINARY STARS

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Abstract. We present the orbital parameters for five visual binary stars, calculated by using the new method which we name Sector Grid Search. The orbital parameters were obtained for the following stars: WDS 00152+2722 = ADS 195, WDS 02202+2949 = ADS 1780, WDS 11550–5606 = HIP 58106, WDS 16256–2327 = ADS 10049 and WDS 16256–2327 = ADS 10045. In addition, their masses, dynamical parallaxes and ephemerides were also calculated.

Key words: stars: binaries: visual – methods: numerical

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ON THE ACCURACY OF GALILEO'S OBSERVATIONS

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Received 2007 September 11; accepted 2007 September 30

Abstract. Galileo Galilei had sufficient skill as an observer and instrument builder to be able to measure the positions and apparent sizes of objects seen through his telescopes to an accuracy of 2 arcsec or better. However, Galileo had no knowledge of wave optics, so when he was measuring stellar apparent sizes he was producing very accurate measurements of diffraction artifacts and not physical bodies.

Key words: history of astronomy: Galileo Galilei

THE STRÖMVIL PHOTOMETRIC SYSTEM: 1996 TO 2006

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Abstract. The *Strömvil* seven-color photometric system, a combination of the four filters of the *Strömgren* system and three filters of the *Vilnius* system, is described. The system is able to determine the temperature, gravity and interstellar reddening of stars from photometric measures alone. The main observational programs underway during the decade are: (1) Setting up the primary *Strömvil* standards; (2) precise photometry of the open cluster M67 and several globular clusters at the VATT telescope, Arizona; (3) photometry of southern globular clusters at CASLEO, Argentina. On the data reduction side the CommandLog code has been written which automates the process of data reduction. In August–September of 2006 a workshop on the *Strömvil* system was held at the Moletai Observatory, Lithuania. Some papers presented in the workshop are being published in this issue of *Baltic Astronomy*.

Key words: techniques: photometric – stars: fundamental parameters – history of astronomy

A METHOD TO CORRECT CCD FLATFIELDS FOR PRECISE STELLAR PHOTOMETRY

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Abstract. When accurate CCD stellar photometry is required for classifying stars, correct flatfielding calibration is most important. The method of reshaping the surface of an initial flatfield by use of differential photometry of offset exposures of a well-populated starfield is valid if done carefully. However, more appealing for its efficiency and success is the method described here of matching new observations to an accurate catalog of many CCD standard stars populating practically the whole field while reshaping the flatfield during the photometric calibration.

Key words: techniques: photometric

**THE COMMANDPHOT, AN ORGANIZED AND AUTOMATED
METHOD FOR PROCESSING CCD STELLAR OBSERVATIONS**

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Abstract. A method for organized and automated reduction of CCD photometric observations of stars is described. The CommandPhot software, based on this method, extends the CommandLog used for processing CCD frames from the VATT telescope (Mt. Graham, Arizona). The CommandPhot with macros is available on a personal request.

Key words: techniques: photometric – methods: data analysis

A PHOTOMETRIC SYSTEM FOR GALACTIC SURVEYS

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Abstract. A medium-band multicolor photometric system for the classification of stars in the general Galactic field is proposed. The system classifies a mixture of stars containing samples of different temperatures, luminosities, metallicities and interstellar reddenings. Many types of peculiar stars are also recognizable. The full system consists of 10 passbands covering the spectral range from 300 to 1000 nm. Various combinations of passbands are possible, depending on the stellar population in the field and on the presence or absence of interstellar reddening.

Key words: techniques: photometric – stars: fundamental parameters, classification