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Contents of this newsletter

From the editor

Due to problems with the internet connection here in Guanajuato, the mailing of this newsletter has been delayed. It is also possible that your abstract did not reach us. If this is the case, please send it again for inclusion in the December issue. Please accept our apologies.

Best wishes for a happy 2003!

Philippe

Accepted Papers

Line profile variability in the spectra of Oef stars: I. BD+60° 2522

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We report the analysis of a long term observing campaign designed to monitor the spectroscopic variability of the Oef star BD+60° 2522. We find that the double-peaked He II λ 4686 emission line undergoes strong profile variability on time scales of 2 – 3 days. However, the time scale as well as the pattern of these variations turn out to be epoch dependent and the phenomenon is thus most likely not ruled by a single stable clock. On the other hand, the absorption lines in the spectrum of BD+60° 2522 display line profile variability on time scales of a few hours that might be related to non-radial pulsations. We tentatively propose that the beating of several non-radial pulsation modes triggers transient large-scale density perturbations in a confined stellar wind that produce the 2 – 3 days time scale variability.

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Wolf-Rayet Binaries in the Magellanic Clouds and Implications for Massive-Star Evolution II. LMC

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We present in this second paper the results for the Large Magellanic Cloud (LMC) of our intensive spectroscopic campaign to search for binaries via periodic radial-velocity (RV) variations among Wolf-Rayet (WR) stars. We observed 61 nitrogen-rich WNE stars in the LMC. Along with the results of Bartzakos et al 2001 on the carbon/oxygen-rich WR stars, 2/3 of the WR population of the LMC (134 stars in total) has now been investigated for periodic RV variability. We have also retrieved time-dependent photometric data in the public domain from the OGLE and MACHO projects, as well as X-ray data from *ROSAT* and *Chandra* satellites, to provide additional constraints on the binary character. For each of our sample stars, we discuss its observational properties: RV variations, (periodic) photometric variability, X-ray luminosity, spectral classification, abundance of hydrogen, runaway status and line-profile variations (LPVs). For the binaries we discuss additional properties, like wind-wind collision (WWC) effects, and the orbital parameters. With this large sample, we discuss the global properties of the WNE population, which is expected to be the most sensitive to

binary evolution with respect to the influence of metallicity. To emphasize the relevance of the binary frequency test for the stellar evolution of massive stars in the LMC, we review their observational properties and provide new and meaningful evolutionary classes, which reconcile observational and theoretical definitions. Finally, we draw an overall evolutionary scheme for massive-star evolution, with respect to the three main ingredients of stellar evolution: mass, metallicity and rotation.

Submitted to MNRAS
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or on the web at http://www.astro.umontreal.ca/~foellmi/papers/

IUE Observations of β Cephei Stars – Paper 2: β Cephei

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Archival high-resolution IUE observations of β Cephei have been measured for radial velocity and colour variations. The velocity data have been combined with published optical radial velocities and subjected to comprehensive analysis. The results support the long-period binary hypothesis and confirm three periodicities found by Aerts et al. (*A & A*, **286**, 109, 1994). However, the mystery of the variable amplitude remains: certainly we can find no periodic variation in K above 2 km s^{-1}that might contribute to this. The colour variation confirms the 1000 K change of temperature recorded by previous studies.

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New Challenges for Wind Shock Models: The *CHANDRA* Spectrum of the Hot Star δ Orionis

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The *Chandra* spectrum of δ Ori A shows emission lines from hydrogen- and helium-like states of Si, Mg, Ne, and O, along with N VII Lyα and lines from ions in the range Fe XVII-Fe XXI. In contrast to the broad lines seen in ζ Pup and ζ Ori (850 $\pm$ 40 and 1000 $\pm$ 240 km s^{-1} half-width at half maximum [HWHM], respectively), these lines are broadened to only 430 $\pm$ 60 km s^{-1} HMHM. This is much lower than the measured wind terminal velocity of 2000 km s^{-1}. The forbidden, intercombination, and resonance (*fir*) lines from He-like ions indicate that the majority of the X-ray line emission does not originate at the base of the wind, in agreement with the standard wind shock models for these objects. However, in that model the X-ray emission is distributed throughout an expanding, X-ray-absorbing wind, and it is therefore surprising that the emission lines appear relatively narrow, unshifted, and symmetric. We compare the observed line profiles to recent detailed models for X-ray line profile

generation in hot stars, but none of them offers a fully satisfactory explanation for the observed line profiles. **Appeared in ApJ, vol. 577, p. 951**
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Ten Eclipsing Binaries in the Small Magellanic Cloud: Fundamental Parameters and SMC Distance

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We present the first results of an observational programme to measure the fundamental parameters of over 100 eclipsing binaries in the Small Magellanic Cloud (SMC). The spectroscopic data were obtained by using the 2dF multi-object spectrograph on the 3.9-m Anglo-Australian Telescope, and are used in conjunction with photometry from the OGLE database of SMC eclipsing binaries. Ten systems are discussed in this first paper. Three are detached early-B binaries, six are in a semi-detached configuration, and one is in a marginal contact state. We conclude that the semi-detached systems are undergoing the slow mass-transfer phase of case-A binary evolution, in which the mass donor has reached its Roche lobe while still on the main sequence. Each system provides a primary distance indicator. By constructing a new calibration between spectral type and temperature for O and early B stars, we find a mean distance modulus to the SMC of 18.89 ± 0.04 (statistical) ± 0.10 (systematic). This value represents one of the most precise determinations to date of the distance to the SMC.

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Variability and pulsations in the Be star 66 Ophiuchi

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66 Oph is a Be star seen under a moderate inclination angle that shows strong variability from UV to IR wavelengths. A concise review of long-term variability history is given. High resolution, high S/N spectroscopic observations obtained in 1997, 1998 and 2001 and spectropolarimetric observations

obtained in 2000 are presented. These observations occurred during a long-term decrease of Hα intensity. Fundamental parameters of the star have been revisited from Barbier-Chalonge-Divan (BCD) calibrations. New $V \sin i$ values are obtained using Fourier transforms applied to observed helium lines and a rotational frequency $f_{rot} = 1.29\ c\,d^{-1}$ is determined. Time series analysis and Fourier Doppler Imaging (FDI) of He I lines (4713, 4921, 5876 and 6678 Å) lead for the first time to the detection of multi-periodicity in 66 Oph. The two main frequencies found are $f = 2.22\ c\,d^{-1}$ and $f = 4.05\ c\,d^{-1}$. They are attributed to non-radial pulsations and can be associated with mode degree $\ell = 2$ and $\ell = 3$, respectively. Inspection of Stokes V profiles suggests the presence of a weak Zeeman signature but further observations are needed to confirm the detection of a magnetic field in 66 Oph.

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Preprints from michele.floquet@obspm.fr

High-resolution X-ray spectroscopy of τ Scorpii (B0.2V) with XMM-Newton

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We report the analysis of the first high-resolution X-ray spectrum of the B0.2V star τ Scorpii obtained with the Reflection Grating Spectrometers (RGS) and the EPIC-MOS CCD spectrometers on board *XMM-Newton*. The spectrum exhibits bright emission lines of the H- and He-like ions of C, N, O, Ne, Mg, and Si, as well as Fe XVII & Fe XVIII lines. Line fluxes have been determined. Simultaneous fits to the RGS and EPIC spectra were used to obtain four plasma temperatures, emission measures, and the overall elemental abundances. This multi-temperature fitting yielded temperatures of 1.6, 5.2, 8.2, and $\gtrsim$20 MK. These temperatures are confirmed by DEM modelling. The nitrogen lines are relatively strong: the N/O abundance ratio is about 3× solar. No indication of a solar-type "FIP effect" was found for the other elements. According to the derived models the X-ray luminosity in the energy range 0.3–10 keV is $L_x = 3.2 \times 10^{31}\,erg\,s^{-1}$ at a distance of 132 pc. The sensitivity of the He-like forbidden and intercombination lines to a strong ultraviolet radiation field is used to derive upper limits to the radial distances at which lines of Mg XI, Ne IX, O VII, and N VI originate. The results suggest that the soft X-rays ($\lesssim$ 8 MK) originate from shocks low in the wind that are produced by the common mechanism of radiation line-driven instabilities. This is consistent with the observed emission line profiles that are much narrower ($\lesssim$ 500 km/s) than the broad lines (up to 1500 km/s) observed high up in the wind of ζ Puppis. The hot ($\sim$ 20-40 MK) component may be explained by a model involving dense clumps embedded in a wind which sweeps past them at high relative velocity ($\sim$ 1400–1700 km/s). Such an interaction would produce the strong shocks required.

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On the optical–infra-red continuum emission from equatorial discs of supergiant B[e] stars

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Two models of the circumstellar disc around supergiant B[e] stars are discussed: an equatorial wind model produced by wind bi-stability, and a Keplerian viscous disc model. Both models are successful in providing a site for dust formation once they have cooled sufficiently. However, the optical–infra-red continuum is calculated and it is found that both models have significant trouble in accounting for observations. In particular the optical–near-IR emission is accounted for, but the dust emission is underestimated by at least an order of magnitude. Variations in the structure of the models (the temperature variation with radius, the density structure and the dust opacity) are investigated to assess how (in)appropriate the standard models are for supergiant B[e] star discs. Changing the temperature structure, and making simple dust opacity changes within the disc has little effect on the resultant continuum emission. By altering the density structure of the discs, the continuum may be accounted for by both models: the equatorial wind model requires a very flat density profile which is impossible to explain with any accelerating wind, and the viscous disc model's density structure is required to fall off less steeply with radius than would have been expected, although this may be explained from consideration of viscous processes in the disc. It is recognised that both theoretical interpretations have difficulties and unsolved problems.

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An HI interstellar bubble linked to the O-type stars BD+24° 3866 and BD+25° 3952

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We investigate the ISM in the vicinity of the O-type stars BD+24° 3866 (O8.5II(f)), BD+24°r 3881 (O6.5III(f)) and BD+24° 3952 (O8) based on radio continuum and HI line data obtained with the Synthesis Telescope of the Dominion Radio Astrophysical Observatory (DRAO) with synthesized beams of 1.5 arcmin and 7.0 arcmin at 1420 and 408 MHz, respectively. High angular resolution *IRAS* data (*HIRES*) are also analyzed. BD+24° 3866 is found to be located close to the inner border of a slowly expanding shell. The evolved HII region Sh2-88, which is excited by BD+25° 3952, appears to be interacting with neutral material in the approaching part of this shell. The whole structure is at a distance of 2.4 kpc and is about 23×15 pc in radius. The total swept up mass is 1300 $M_{\odot}$. The stellar winds of BD+24° 3866 and BD+25° 3952, are mainly responsible for shaping the HI structure. An HI expanding shell was also found to be related to the HII region G61.7+0.9. At a kinematic distance of 2.4 kpc, this feature is 10 pc in radius and has neutral and ionized masses of 200 and 135

$M_\odot$, respectively. The present observational data do not allow us to identify a definite interstellar HI feature associated with BD+24° 3881. We consider different explanations for this fact.

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First far–UV observations of KQ Puppis with FUSE

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We report the first far–ultraviolet spectrum of the emission line spectroscopic binary KQ Pup (M2Iab + B0Ve), obtained with FUSE shortly after conjunction at orbital phase Φ=0.13. The spectrum presents a sharp flux cutoff at 1040 Å; longwards, it is dominated by a large amount of resonant and low excitation transitions of neutral and singly ionized species, probably mostly of circumsystem origin, and by the Lyman absorption bands of H_2, whose strength corresponds to an interstellar H_2 column density of $\sim 2\times10^{20}$ cm^{-2}, indicating a fraction of molecular hydrogen $2N(H_2)/[N(H\ I)+2N(H_2)]$ of $\sim$0.4. An $N(H\ I)/E_{B-V}$ ratio of 4.3×10^{21} is derived from the IUE spectra. The long–term UV monitoring of KQ Pup with IUE, HST and FUSE reveals a large decrease of the far–UV flux since orbital phase 0.82 and occupying more than 0.3 of orbital phase. This 'shell' episode is attributed to line absorption and to Lyα Rayleigh scattering due to an extended dense cool envelope in the line of sight of the B star.

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A large Wolf-Rayet population in NGC 300 uncovered by VLT-FORS2

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We have detected 58 Wolf-Rayet candidates in the central region of the nearby spiral galaxy NGC 300, based on deep VLT-FORS2 narrow-band imaging. Our survey is close to complete except for heavily reddened WR stars. Of the objects in our list, 16 stars were already spectroscopically confirmed as WR stars by Schild & Testor and Breysacher et al., to which 4 stars are added using low resolution FORS2 datasets. The WR population of NGC 300 now totals 60, a threefold increase over previous surveys, with WC/WN$\geq$1/3, in reasonable agreement with Local Group galaxies for a moderately sub-solar metallicity. We also discuss the WR surface density in the central region of NGC 300. Finally, analyses are presented for two apparently single WC stars – #29 (alias WR3, WC5) and #48 (alias

WR13, WC4) located close to the nucleus, and at a deprojected radius of 2.5 kpc, respectively. These are among the first models of WR stars in galaxies beyond the Local Group, and are compared with early WC stars in our Galaxy and LMC.

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Wolf-Rayet Stars and Black Holes in Close Binary Systems

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The paper is devoted to the analysis of evolutionary state of close binary systems including black holes and Wolf-Rayet stars (WR) as components. Observational estimates of masses and orbital periods of WR-star binaries allow the reason of formation of WR-stars in such systems to be revealed. WR-stars can be formed due to stellar wind from a massive ($M_{OB} \geq 50 M_\odot$) OB-star or conservative mass exchange between components with close initial masses and the loss of a common envelope by a system having a high (up to ~ 25) initial mass ratio of the components. The role of observational selection effects for compilation of the catalogue of binary systems with black holes and Wolf-Rayet stars as components was demonstrated. To explain the observed ratio of members of WN and WC stars in the Galaxy the mass loss rate by WR-stars has to be equal: $\dot{M}_{WR}(M_{\odot/yr} \cong 5 \cdot 10^{-7}(M_{WR}/M_\odot)^{1.3}$.

The minimal mass of a main sequence star, a progenitor of a WR-star or a black hole, is about $25 M_\odot$. The mass loss during supernova explosion, forming a black hole, amounts to several solar masses as it follows from observed space velocities of binaries with black holes as components. The frequency of formation of rapidly rotating Kerr black holes in the Galaxy is $\sim 3 \cdot 10^{-6} yr^{-1}$. The formation of these black holes is accompanied by a burst of gamma radiation, that is, may account for the origin of gamma bursters. The initial distribution of close binary stars over component mass ratio, $dN \sim dq = dM_2/M_1$, is valid in the interval $0,04 \leq q_0 \leq 1$ what is an evidence of the common scenario of their formation.

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The dynamics of the nebula M1-67 around the run-away Wolf-Rayet star WR 124

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A new point of view on the dynamics of the circumstellar nebula M1-67 around the run-away Wolf-Rayet (WR) star WR 124 is presented. We simulated the outbursts of nebulae with different morphologies, to compare the results to the observed dynamical spectra of M1-67. We found that it has been interacting with the surrounding ISM and has formed a bowshock due to its high velocity of about 180 km s^{-1} relative to the local ISM. The star is about 1.3 parsec away from the front of

this bowshock. The outbursts that are responsible for the nebula are assumed to be discrete LBV-outbursts, that occurred inside this bowshock. The ejecta collide with this bowshock shortly after the outburst. After the collision, they are be dragged away by the pressure of the ISM, along the surface of the shock. The shock is oriented in such way that we are looking from the rear into this paraboloid, almost along the main axis. Evidence for this is given firstly by the fact that the far hemisphere is much brighter than the near hemisphere, secondly by the fact that there is hardly any emission found with radial velocities higher than the star's velocity, thirdly by the fact that the star looks to be in the center of the nebula, as seen from Earth, and finally by the overall velocity distribution of the nebula, which indicates higher radial velocities in the center of the nebula, and lower velocities near the edges. We find evidence for at least two discrete outbursts that occurred inside this bow shock. For these outbursts, we find expansion velocities of $v_{\rm exp} \simeq 150$ km s^{-1} and dynamical timescales of about 0.8 and 2×10^4 yr, which are typical for LBV outbursts. We therefore conclude that M1-67 originates from several outbursts that occurred inside the bow shock around WR 124, during an LBV phase that preceded the current WR phase of the star.

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Constraints on the Ionization Balance of Hot-Star Winds from *FUSE* Observations of O Stars in the Large Magellanic Cloud

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We present Far Ultraviolet Spectroscopic Explorer (*FUSE*) spectra for 25 O stars in the Large Magellanic Cloud (LMC). We analyze wind profiles for the resonance lines from C III, N III, S IV, P V, S VI, and O VI in the *FUSE* range using a Sobolev with Exact Integration (SEI) method. In addition, the available data from either *IUE* or *HST* for the resonance lines of Si IV, C IV, and N V are also modeled. Because several of the *FUSE* wind lines are unsaturated, the analysis provides meaningful optical depths (or, equivalently, mass loss rate times ionization fractions, $\dot{M}q$), as a function of normalized velocity, $w = v/v_\infty$. Ratios of $\dot{M}q$ (which are independent of $\dot{M}$) determine the behavior of the relative ionization as a function of w. The results demonstrate that, with the exception of O VI in all stars and S VI in the later stars, the ionization in the winds shifts toward lower ionization stages at higher w (contrary to the expectations of the nebular approximation). This result implies that the dominant production mechanism for O VI and S VI in the late O stars differs from the other ions.

Using the Vink et al. (2001) relationship between stellar parameters and mass-loss rate, we convert the measurements into mean ionization fractions for each ion, $\langle q_i \rangle$. Because the derived ion fractions never exceed unity, we conclude that the derived values of $\dot{M}$ are not too small. However, q(P V), which is expected to be the dominant stage of ionization in some of these winds, is never greater than 0.20. This implies that either the calculated values of $\dot{M}$ are too large, the assumed abundance of phosphorus is too large or the winds are strongly clumped. The implications of each possibility are discussed. Correlations between the mean ion fractions and physical parameters such as $T_{\rm eff}$, v_∞ and the mean wind density, $\langle \rho \rangle$, are examined. Two clear relationships emerge. First, as expected, the

mean ionization fraction of the lower ions (C III, N III, Si IV, S IV) decreases with increasing $T_{\rm eff}$. Second, the mean ion fraction of S VI in the latest stars and O VI in all stars increases with increasing v_∞. This re-affirms the notion, first introduced by Cassinelli and Olson (1979), that O VI is produced non-radiatively.

Finally, we discuss specific characteristics of three stars, BI 272, BI 208, and Sk -67°166. For BI 272, the ionic species present in its wind suggest it is much hotter than its available (uncertain) spectral type of O7: II-III:. In the case of BI 208, our inability to fit its observed profiles suggests that its wind is not spherically symmetric. For Sk -67°166, quantitative measurements of its line strengths confirm the suggestion by Walborn et al. (1995) that it is a nitrogen rich O star.

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An outflow from the nebula around the LBV candidate S 119

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We present an analysis of the kinematic and morphological structure of the nebula around the LMC LBV candidate S 119. On HST images, we find a predominantly spherical nebula which, however, seems to be much better confined in its eastern hemisphere than in the western one. The filamentary western part of the nebula is indicative of matter flowing out of the nebula's main body. This outflow is even more evidenced by our long-slit echelle spectra. They show that, while most of the nebula has an expansion velocity of 25.5 km s^{-1}, the outflowing material reaches velocities of almost 140 km s^{-1}, relative to the systemic one. A ROSAT HRI image shows no trace of S 119 and thus no indications of hot or shocked material.

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Submitted Papers

The Remarkable Alternating Spectra of the Of?p Star HD 191612

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The spectrum of HD 191612 has been found to display large, recurrent variations between two highly reproducible, peculiar states; at least four transformations have occurred since 1950. In one state, the spectral type is O6-O7, with C III λ4650 emission comparable to N III λ4640 (the definition of the Of?p category) and P Cygni profiles at He II λ4686 and Hα. In the other state, the spectral type is O8, with the C III emission absent, very strong N III λ4097 absorption, broad He II λ4686 absorption with narrow central emission (a profile that may be unprecedented in this line among known O-type spectra), and a broad asymmetrical absorption at Hα. One observing sequence over several consecutive nights shows no spectral variations, practically ruling out a short-period, interacting binary as the origin of the phenomenon; moreover, no significant radial-velocity variations have been found. Although the sporadic observational record prior to the discovery of the variations in early 2001 precludes definite conclusions, it is possible that a given state is maintained for a decade or longer, but one transformation occurred within 13 months, and the data obtained during 2002 suggest an event with a shorter timescale.

The Of?p category currently contains only five members, three in the Galaxy and two in the Small Magellanic Cloud. The other two Galactic members also display bizarre and unexplained phenomena, in the case of HD 108 strikingly similar to those described here. Because of their relatively high X-ray luminosities, all three Galactic objects have been suggested to have collapsed companions. If the spectral variations of HD 108 and HD 191612 are due to binary interactions, they are likely multi-year, eccentric systems like WR 140 and η Carinae. The axisymmetric shell ejections of HD 148937 could have a similar origin. Alternatively, these stars may be rapid rotators or in an unstable evolutionary transitional stage. Further intensive spectroscopic monitoring is required to reveal their nature.

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The Zeeman Effect in the Sobolev Approximation: Applications to Spherical Stellar Winds

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Modern spectropolarimeters are capable of detecting the Zeeman effect from sub-kiloGauss fields in line profiles from the *static* photosphere, but supersonic Doppler broadening makes it more difficult to detect the Zeeman effect in the *wind* lines of hot stars. Nevertheless, the recent advances in observational capability motivate a reassessment of the potential for detecting the magnetic fields threading

such winds. We incorporate the weak-field longitudinal Zeeman effect in the Sobolev approximation to yield integral expressions for the flux of circularly polarized emission. To illustrate the results, two specific wind flows are considered: (1) spherical constant expansion with $v(r) = v_\infty$, and (2) homologous expansion with $v(r) \propto r$. Axial and split monopole magnetic fields are used to schematically illustrate the polarized profiles. For constant expansion, optically thin lines yield the well-known "flat-topped" total intensity emission profiles and an antisymmetric circularly polarized profile. For homologous expansion, we include occultation and wind absorption to provide a more realistic observational comparison, and find that occultation severely reduces the circularly polarized flux in the redshifted component. For the blueshifted component, the polarization is reduced by partially offsetting emission and absorption components. We find that for a surface field of about 100 G, the largest polarizations result for thin but strong recombination emission lines, with peak values on the order of 0.05%. Although somewhat small, this polarization should be observable.

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In Proceedings

The winds of O-type stars: ionization structure and revised stellar parameters from far-UV spectra

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We derived consistent photospheric and wind parameters of O-type stars, by analysing high resolution spectra in the range 905-3250Å with line-blanketed, hydrodynamic, non-LTE spherical models. We find significantly lower T_{eff} and luminosities than previously assigned to these spectral types.

To appear in: " Winds, Bubbles and Explosions", RMxAA Conf. Proceedings, in press
Preprints from `bianchi@pha.jhu.edu`
or on the web at `http://dolomiti.pha.jhu.edu/publgoto.html`

The outer evolution of structure in radiatively driven stellar winds

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We present a new method to study the evolution of instability-generated structure in the outer winds of hot stars. We coin this method a pseudo-planar moving periodic box technique. It makes use of the fact that the outer evolution of structure can be simplified to a pure gasdynamical problem. It follows a box moving out at a constant speed, containing a representative portion of the structure generated by a radiatively driven model. The method allows us to follow structure out to more than a thousand stellar radii, at relatively low computational cost. We have used a less artificial line-strength cut-off than previous models. We also make a first attempt at improving the treatment of the energy balance in the wind.

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For preprints, contact `Mark.Runacres@oma.be`

Theses

Observational Studies of Wind and Photospheric Variability in Three Early Type Stars

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Analyses of extensive time-series optical spectroscopy of three early-type stars, HD 64760 (B0.5 Ia), HD 151804 (O8 Iaf), and HD 152408 (O8: Iafpe) are presented. Observations of the two O stars are based primarily on a time-series data set of high resolution echelle spectra spanning 21 nights. These datasets are supplemented by older observations with a longer time span, but poorer temporal and spectral coverage. The observations of HD 64760 are based principally on a 6-night longslit time-series data set from Mount Stromlo, and are supplemented with echelle spectra from the AAT and ESO.

The optical data sets allow the photosphere and innermost wind region to be probed, to look for a possible 'photospheric connection' to wind variability. In HD 64760, the well known 1.2 and 2.4 d periods found in the UV wind lines (Prinja *et al.,*} 1995; Fullerton *et al.,*} 1997) are detected in the photospheric spectra. The results presented here indicate that stellar surface structure is maintained in the wind transition zone, and into the main wind region sampled by UV data. The discovery of shorter periods at 20.0 h and 13.7 h are also reported. These are attributed to non-radial pulsation in the modes $l = -m = 3$, and $l = -m = 4$ respectively.

The investigation of the two Of stars focuses on the wind lines of the Balmer series and He I, and the weak metal absorption and emission lines (e. g. He II λ4542, O III λ5592, & C III λ5696) which probe the near-photosphere region. Greyscale plots of the time-series spectra demonstrate substantial organised structure in the inner wind region. The wind activity is characterised by localised absorption and emission features that evolve blueward and redward over ~ 4 days. Interestingly, the acceleration and maximum velocity reached by the red-ward features is approximately half that of the blueward features. The discrepancy between the maximum velocities reached arises from cancellation effects, whilst the difference between the acceleration of the blue and red features (if interpreted in the context of CIR models) may indicate different velocity fields at the leading and trailing edge of the CIR. The repetitive nature of the wind activity is suggestive of rotational modulation of the wind, although it is difficult to uniquely establish a link to stellar rotation given the average values of $v_e \sin i$ of the O stars. Analysis of the weak metal lines reveals significant radial velocity shifts. In the metal emission lines, the radial velocity shifts sometimes betray the start of a strong wind event, whilst Fourier analysis of the metal absorption lines reveals periodic radial velocity shifts (P=1.5, 1.9 d) that may result from pulsation in the radial fundamental mode.

Thesis defended at UCL, 2002 September 20

Jobs

Postdoctoral Research Position - Massive Stars
Georgia State University

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Attention: Douglas R. Gies, Professor

Applications are invited for a postdoctoral research position in the Center for High Angular Resolution Astronomy (CHARA) and Department of Physics and Astronomy at Georgia State University. The successful applicant will work with Dr. Douglas Gies and collaborators on observational and computational studies of massive stars. Current projects include spectroscopic studies of massive binaries, Be stars, and X-ray binaries, plus interferometric observations of binaries and rapidly rotating stars. Observational and/or computational experience in these areas would be useful. Research facilities include two 0.4-m and one 1.0-m equivalent aperture telescopes at the University's Hard Labor Creek Observatory located 50 miles east of Atlanta. CHARA operates the CHARA Array, an optical/IR interferometer consisting of six 1.0-m telescopes, located at Mount Wilson, California. The initial appointment is for one year, renewable to a total of three years. Curriculum vitae, a bibliography, a one-page summary of research interests, and names of three references (plus contact information) should be sent to Prof. Gies at the above address. The deadline for receipt of these materials is 31 January 2003. AAE/EEO.

http://www.chara.gsu.edu/∼gies