THE HOT STAR NEWSLETTER

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An electronic publication dedicated to A, B, O, Of, LBV and Wolf-Rayet stars
and related phenomena in galaxies

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Call for Data

The multiplicity of 9 Sgr

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The non-thermal radio emission observed for a number of O and WR stars implies the presence of a small population of relativistic electrons in the winds of these objects. Electrons could be accelerated to relativistic velocities either in the shock region of a colliding wind binary (Eichler & Usov 1993, ApJ 402, 271) or in the shocks due to intrinsic wind instabilities of a single star (Chen & White 1994, Ap&SS 221, 259). Dougherty & Williams (2000, MNRAS 319, 1005) pointed out that 7 out of 9 WR stars with non-thermal radio emission are in fact binary systems. This result clearly supports the colliding wind scenario.

In the present issue of the Hot Star Newsletter, we announce the results of a multi-wavelength campaign on the O4 V star 9 Sgr (= HD 164794; see the abstract by Rauw et al.). 9 Sgr is a known non-thermal radio emitter and was usually considered a single star. However, our high-resolution ($R = 42000$) optical spectra of 9 Sgr reveal a velocity shift of 42 km s^{-1} compared to similar data gathered by Fullerton (1990, PhD thesis). This points towards 9 Sgr being a long-period (several decades?) spectroscopic binary. A comparison between the line profiles in Alex Fullerton's spectra and our own

data even suggests that 9 Sgr might be an SB2 system.
Since the star is rather bright ($m_V = 5.9$), it is very likely that many hot star astronomers have taken spectra of it. Therefore, if you have spectra of this star (ideally with a resolution of $R \geq 20000$ and in the optical wavelength range) in your personal archives, we would very much appreciate if you would share these data with us. Together with the spectra of our ongoing monitoring campaign, your data will hopefully allow us to establish whether 9 Sgr is a binary or not and will therefore lead to a better understanding of the radio and X-ray emission of this star.

Accepted Papers

Revised Stellar Temperatures for Magellanic Cloud O Supergiants from FUSE and VLT-UVES Spectroscopy

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We have undertaken quantitative analysis of four LMC and SMC O4–9.7 extreme supergiants using far-ultraviolet FUSE, ultraviolet IUE/HST and optical VLT UVES spectroscopy. Extended, non-LTE model atmospheres that allow for the consistent treatment of line blanketing (Hillier & Miller 1998) are used to analyse wind and photospheric spectral features simultaneously. Using Hα to constrain $\dot{M}$, He I-II photospheric lines reveal stellar temperatures which are systematically (5–7.5kK) and substantially (15–20%) lower than previously derived from unblanketed, plane-parallel, non-LTE photospheric studies. We have confidence in these revisions, since derived temperatures generally yield consistent fits across the entire $\lambda\lambda$912–7000Å observed spectral range. In particular, we are able to resolve the UV-optical temperature discrepancy identified for AzV232 (O7 Iaf$^+$) in the SMC by Fullerton et al. (2000).
The temperature and abundance sensitivity of far-UV, UV and optical lines is discussed. 'Of' classification criteria are directly linked to (strong) nitrogen enrichment (via N III λ4097) and (weak) carbon depletion (via C III $\lambda\lambda$4647-51), providing evidence for mixing of unprocessed and CNO processed material at their stellar surfaces. Oxygen abundances are more difficult to constrain, except via O II lines in the O9.7 supergiant for which it is also found to be somewhat depleted. Unfortunately, He/H is very difficult to determine in individual O supergiants, due to uncertainties in microturbulence and the atmospheric scale height. The effect of wind clumping is also investigated, for which P V $\lambda\lambda$1118–28 potentially provides a useful diagnostic in O-star winds, unless phosphorus can be independently demonstrated to be underabundant relative to other heavy elements. Revised stellar properties affect existing calibrations of (i) Lyman continuum photons – a factor of two lower for the O4 supergiant; and (ii) kinetic energy released into the ISM by O supergiants. Our results also have importance for the calibration of the wind momentum-luminosity relationship for OB stars, particularly since the stars studied here are amongst the visually brightest OB stars in external galaxies.

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Stellar and Wind Properties of LMC WC4 stars A metallicity dependence for Wolf-Rayet mass-loss rates

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We use ultraviolet space-based (*FUSE, HST*) and optical/IR ground-based (2.3m MSSSO, NTT) spectroscopy to determine the physical parameters of six WC4-type Wolf-Rayet stars in the Large Magellanic Cloud. Stellar parameters are revised significantly relative to Gräfener et al. (1998) based on improved observations and more sophisticated model atmosphere codes, which account for line blanketing and clumping. We find that stellar luminosities are revised upwards by up to 0.4 dex, with surface abundances spanning a lower range of 0.1$\leq$ C/He $\leq$ 0.35 (20–45% carbon by mass) and O/He$\leq$0.06 ($\leq$10% oxygen by mass).

Relative to Galactic WC5–8 stars at known distance analysed in a similar manner, LMC WC4 stars possess systematically higher stellar luminosities, $\sim$0.2 dex lower wind densities, yet a similar range of surface chemistries. We illustrate how the classification C III λ5696 line is extremely sensitive to wind density, such that this is the principal difference between the subtype distribution of LMC and Galactic early-type WC stars. Temperature differences do play a role, but carbon abundance do not affect WC spectral types. We illustrate the effect of varying temperature and mass-loss rate on the WC spectral type for HD 32257 (WC4, LMC) and HD 156385 (WC7, Galaxy) which possess similar abundances and luminosities.
We determine current stellar masses of LMC WC4 stars, taking account of the (minor) effect of wind darkening, once clumped winds are considered. Depending on the evolutionary model followed, pre-supernova masses 11–19 $M_{\odot}$ are anticipated, with 7–14 $M_{\odot}$ for Galactic WC stars with known distances. These values are consistent with pre-cursors of bright Type-Ic supernovae such as SN 1998bw (alias GRB 980425) for which a minimum total mass of C and O of 14$M_{\odot}$ has been independently derived.

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Predictions of variable mass loss for Luminous Blue Variables

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We present radiation-driven wind models for Luminous Blue Variables (LBVs) and predict their mass-loss rates. We study the effects of lower masses and modified abundances in comparison to the normal OB supergiants, and we find that the main difference in mass loss is due to the lower masses of LBVs. In addition, we find that the increase in helium abundance changes the mass-loss properties by small amounts (up to about 0.2 dex in log $\dot{M}$), while CNO processing is relatively unimportant for the mass-loss rate. A comparison between our mass loss predictions and the observations is performed

for four relatively well-studied LBVs. The comparison shows that (i) the winds of LBVs are driven by radiation pressure on spectral lines, (ii) the variable mass loss behaviour of LBVs during their S Doradus-type variation cycles is explained by changes in the line driving efficiency, notably due to the recombination/ionisation of Fe IV/III and Fe III/II, and finally, (iii) the winds of LBVs can be used to derive their masses, as exemplified by the case of AG Car, for which we derive a present-day mass of 35 Msun.

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The orbit of the double-lined Wolf-Rayet Binary HDE 318016 (= WR 98)

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We present the discovery of OB type absorption lines superimposed to the emission line spectrum and the first double-lined orbital elements for the massive Wolf-Rayet binary HDE 318016 (=WR 98), a spectroscopic binary in a circular orbit with a period of 47.825 days. The semiamplitudes of the orbital motion of the emission lines differ from line to line, indicating mass ratios between 1 and 1.7 for $\mathcal{M}_{\mathcal{WR}}/\mathcal{M}_{\mathcal{OB}}$.

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XMM-Newton and *VLA* Observations of the Variable Wolf-Rayet Star EZ CMa: Evidence for a Close Companion?

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We present new X-ray and radio observations of the Wolf-Rayet star EZ CMa (HD 50896) obtained with *XMM-Newton* and the *VLA*. This WN4 star exhibits optical and UV variability at a period of 3.765 d whose cause is unknown. Binarity may be responsible but the existence of a companion has not been proven. The radio spectral energy distribution of EZ CMa determined from *VLA* observations at five frequencies is in excellent agreement with predictions for free-free wind emission and the ionized mass-loss rate allowing for distance uncertainties is $\dot{\mathrm{M}} = 3.8\ (\pm 2.6) \times 10^{-5}\ \mathrm{M}_{\odot}\ \mathrm{yr}^{-1}$. The CCD X-ray spectra show prominent Si XIII and S XV emission lines and can be acceptably modeled as an absorbed multi-temperature optically thin plasma, confirming earlier *ASCA* results. Nonsolar abundances are inferred with Fe notably deficient. The X-ray emission is dominated by cooler plasma at a temperature $kT_{cool} \approx 0.6$ keV, but a harder component is also detected and the derived temperature is $kT_{hot} \approx 3.0$

- 4.2 keV if the emission is thermal. This is too high to be explained by radiative wind shock models and the X-ray luminosity of the hard component is three orders of magnitude lower than expected for accretion onto a neutron star companion. We show that the hard emission could be produced by the Wolf-Rayet wind shocking onto a normal (nondegenerate) stellar companion at close separation. Finally, using comparable data sets we demonstrate that the X-ray and radio properties of EZ CMa are strikingly similar to those of the WN5-6 star WR110. This similarity points to common X-ray and radio emission processes in WN stars and discredits the idea that EZ CMa is anomalous within its class.

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An X-ray investigation of the NGC346 field in the SMC (1) : the LBV HD5980 and the NGC346 cluster

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We present results from a *Chandra* observation of the NGC346 cluster. This cluster contains numerous massive stars and is responsible for the ionization of N66, the most luminous HII region and the largest star formation region in the SMC. In this first paper, we will focus on the characteristics of the main objects of the field. The NGC346 cluster itself shows only relatively faint X-ray emission (with $L_X^{unabs} \sim 1.5 \times 10^{34}$ erg s^{-1}), tightly correlated with the core of the cluster. In the field also lies HD5980, a LBV star in a binary (or possibly a triple system) that is detected for the first time at X-ray energies. The star is X-ray bright, with an unabsorbed luminosity of $L_X^{unabs} \sim 1.7 \times 10^{34}$ erg s^{-1}, but needs to be monitored further to investigate its X-ray variability over a complete 19d orbital cycle. The high X-ray luminosity may be associated either with colliding winds in the binary system or with the 1994 eruption. HD5980 is surrounded by a region of diffuse X-ray emission, which is a supernova remnant. While it may be only a chance alignment with HD5980, such a spatial coincidence may indicate that the remnant is indeed related to this peculiar massive star.

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Deep Transient Optical Fading in the WC9 Star WR 106

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We discovered that the WR9-type star WR 106 (HDE 313643) underwent a deep episodic fading in 2000. The depth of the fading ($\Delta V \sim 2.9$ mag) surpassed those of all known similar "eclipse-like" fadings in WR stars. This fading episode was likely to be produced by a line-of-sight episodic dust formation rather than a periodic enhancement of dust production in the WR-star wind during the passage of the companion star though an elliptical orbit. The overall 2000 episode was composed of at least two distinct fadings. These individual fadings seem to more support that the initial dust formation triggered a second dust formation, or that the two independent dust formations occurred by the same triggering mechanism rather than a stepwise dust formation. We also discuss on phenomenological similarity of the present fading with the double fading of R CrB observed in 1999–2000.

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The Effective Temperatures of mid-O type stars

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We derived photospheric parameters, mass loss rates, and wind velocities of Galactic O6-O7 type stars by analysing high resolution spectra in the far-UV and UV ranges with line-blanketed, hydrodynamic, non-LTE spherical models. We combined spectra from the Far Ultraviolet Spectroscopic Explorer (FUSE) in the range 905-1187Å, and International Ultraviolet Explorer (IUE) archival spectra (1150-3250Å) and used the WM-BASIC code of Pauldrach et al. to compute model spectra.

Lines in the FUSE range include high ionization stages (e.g., O 6) and lower abundance non-CNO elements (e.g., P 5). Analysed in addition to the N 4, N 5, Si 4, and C 4 lines in the IUE range, these features play a crucial role in uniquely constraining the stellar parameters, assessing the presence of shocks in the wind, and quantifying the effects of the resulting soft X-rays on the wind ionization.

The effective temperatures derived from the consistent analysis of the far-UV and UV spectra are significantly ($\approx$ 6,000 K or 15% on average, or between 4,000 and 8,000 K) lower than most values previously derived for some of our targets, and than typical values assigned to their spectral types from different compilations. This result has great implications for our understanding the evolution of massive stars and the characterization of young stellar populations, as well as for energy balance calculations of H II regions.

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VLT Observations of Metal-Rich Extra Galactic HII Regions. I. Massive Star Populations and the Upper End of the IMF

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We have obtained high quality FORS1/VLT optical spectra of 85 disk HII regions in the nearby spiral galaxies NGC 3351, NGC 3521, NGC 4254, NGC 4303, and NGC 4321. Our sample of metal-rich H II regions with metallicities close to solar and higher reveal the presence of Wolf-Rayet (WR) stars in 27 objects from the blue WR bump ($\sim$ 4680 Å) and 15 additional candidate WR regions. This provides for the first time a large set of metal-rich WR regions.

Approximately half (14) of the WR regions also show broad CIV λ5808 emission attributed to WR stars of the WC subtype. The simultaneous detection of CIII λ5696 emission in 8 of them allows us to determine an average late WC subtype compatible with expectations for high metallicities. Combined with literature data, the metallicity trends of WR features and the WC/WN number ratio are discussed.

The WR regions show quite clear trends between their observed WR features and the Hβ emission line. Detailed synthesis models are presented to understand/interpret these observations. In contrast with earlier studies of low metallicity WR galaxies, both W(WR) and I(WR)/$I(H\beta)$ are here found to be smaller than "standard" predictions from appropriate evolutionary synthesis models at corresponding metallicities.

Various possibilities which could explain this discrepancy are discussed. The most likely solution is found with an improved prescription to predict the line emission from WN stars in synthesis models.

The availability of a fairly large sample of metal-rich WR regions allows us to improve existing estimates of the upper mass cut-off of the IMF in a robust way and independently of detailed modeling: from the observed maximum Hβ equivalent width of the WR regions we derive a **lower limit for M_{up} of 60–90 $M_\odot$** in the case of a Salpeter slope and larger values for steeper IMF slopes. This constitutes a lower limit on M_{up} as all observational effects known to affect potentially the Hβ equivalent width can only reduce the observed W(Hβ).

From our direct probe of the massive star content we conclude that there is at present no evidence for systematic variations of the upper mass cut-off of the IMF in metal-rich environments, in contrast to some claims based on indirect nebular diagnostics.

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A multi-wavelength investigation of the non-thermal radio emitting O-star 9 Sgr

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We report the results of a multi-wavelength investigation of the O4 V star 9 Sgr (= HD 164794). Our data include observations in the X-ray domain with *XMM-Newton*, in the radio domain with the VLA as well as optical spectroscopy. 9 Sgr is one of a few presumably single OB stars that display non-thermal radio emission. This phenomenon is attributed to synchrotron emission by relativistic electrons accelerated in strong hydrodynamic shocks in the stellar wind. Given the enormous supply of photospheric UV photons in the wind of 9 Sgr, inverse Compton scattering by these relativistic electrons is a priori expected to generate a non-thermal power law tail in the X-ray spectrum. Our EPIC and RGS spectra of 9 Sgr reveal a more complex situation than expected from this simple theoretical picture. While the bulk of the thermal X-ray emission from 9 Sgr arises most probably in a plasma at temperature $\sim 3 \times 10^6$ K distributed throughout the wind, the nature of the hard emission in the X-ray spectrum is less clear. Assuming a non-thermal origin, our best fitting model yields a photon index of ≥ 2.9 for the power law component which would imply a low compression ratio of ≤ 1.79 for the shocks responsible for the electron acceleration. However, the hard emission can also be explained by a thermal plasma at a temperature $\geq 2 \times 10^7$ K. Our VLA data indicate that the radio emission of 9 Sgr was clearly non-thermal at the time of the *XMM-Newton* observation. Again, we derive a low compression ratio (1.7) for the shocks that accelerate the electrons responsible for the synchrotron radio emission. Finally, our optical spectra reveal long-term radial velocity variations suggesting that 9 Sgr could be a long-period spectroscopic binary.

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An *XMM-Newton* observation of the Lagoon Nebula and the very young open cluster NGC 6530

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We report the results of an *XMM-Newton* observation of the Lagoon Nebula (M 8). Our EPIC images of this region reveal a cluster of point sources, most of which have optical counterparts inside the very young open cluster NGC 6530. The bulk of these X-ray sources are probably associated with low and intermediate mass pre-main sequence stars. One of the sources experienced a flare-like increase of its X-ray flux making it the second brightest source in M 8 after the O4 star 9 Sgr. The X-ray spectra of most of the brightest sources can be fitted with thermal plasma models with temperatures of kT $\sim$ a few keV. Only a few of the X-ray selected PMS candidates are known to display Hα emission and

were previously classified as classical T Tauri stars. This suggests that most of the X-ray emitting PMS stars in NGC 6530 are weak-line T Tauri stars. In addition to 9 Sgr, our EPIC field of view contains also a few early-type stars. The X-ray emission from HD 164816 is found to be typical for an O9.5 III-IV star. At least one of the known Herbig Be stars in NGC 6530 (LkHα 115) exhibits a relatively strong X-ray emission, while most of the main sequence stars of spectral type B1 and later are not detected. We also detect (probably) diffuse X-ray emission from the Hourglass Region that might reveal a hot bubble blown by the stellar wind of Herschel 36, the ionizing star of the Hourglass Region.

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Massive Stars in the Arches Cluster

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We present and use new spectra and narrow-band images, along with previously published broad-band images, of stars in the Arches cluster to extract photometry, astrometry, equivalent width, and velocity information. The data are interpreted with a wind/atmosphere code to determine stellar temperatures, luminosities, mass-loss rates, and abundances. We have doubled the number of known emission-line stars, and we have also made the first spectroscopic identification of the main sequence for any population in the Galactic Center. We conclude that the most massive stars are bona-fide Wolf-Rayet (WR) stars and are some of the most massive stars known, $\dot{M} > 10^{-5}\ M_\odot\ yr^{-1}$, that are enriched with helium and nitrogen; with these identifications, the Arches cluster contains about 5% of all known WR stars in the Galaxy. We find an upper limit to the velocity dispersion of 22 km s^{-1}, implying an upper limit to the cluster mass of $7(10^4)\ M_\odot$ within a radius of 0.23 pc; we also estimate the bulk heliocentric velocity of the cluster to be $v_{\mathrm{cluster},\odot} \approx +95$ km s^{-1}. Taken together, these results suggest that the Arches cluster was formed in a short, but massive, burst of star formation about 2.5±0.5 *Myr* ago, from a molecular cloud which is no longer present. The cluster happens to be approaching and ionizing the surface of a background molecular cloud, thus producing the Thermal Arched Filaments. We estimate that the cluster produces $4(10^{51})$ ionizing photons s^{-1}, more than enough to account for the observed thermal radio flux from the nearby cloud, $3(10^{49})$ ionizing photons s^{-1}. Commensurately, it produces $10^{7.8}\ L_\odot$ in total luminosity, providing the heating source for the nearby molecular cloud, $L_{\mathrm{cloud}} \approx 10^7\ L_\odot$. These interactions between a cluster of hot stars and a wayward molecular cloud are similar to those seen in the "Quintuplet/Sickle" region. The small spread of formation times for the known young clusters in the Galactic Center, and the relative lack of intermediate-age stars ($\tau_{\mathrm{age}}=10^{7.0}$ to $10^{7.3}$ yrs), suggest that the Galactic Center has recently been

host to a burst of star formation. Finally, we have made new identifications of near-infrared sources that are counterparts to recently identified x-ray and radio sources.

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Submitted Papers

The Spectrum of the Mass Donor Star in SS 433

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We present results from a short series of blue, moderate resolution spectra of the microquasar binary, SS 433. The observations were made at a time optimized to find the spectrum of the donor star, i.e., when the donor was in the foreground and well above the plane of the obscuring disk. In addition to the well-known stationary and jet emission lines, we find evidence of a weak absorption spectrum that resembles that of an A-type evolved star. These lines display radial velocity shifts opposite to those associated with the disk surrounding the compact star, and they appear strongest when the disk is maximally eclipsed. All these properties suggest that these absorption lines form in the atmosphere of the hitherto unseen mass donor star in SS 433. The radial velocity shifts observed are consistent with a mass ratio $M_X/M_O = 0.57 \pm 0.11$ and masses of $M_O = (19 \pm 7)\ M_\odot$ and $M_X = (11 \pm 5)\ M_\odot$. These results indicate that the system consists of an evolved, massive donor and a black hole mass gainer.

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Wolf-Rayet Binaries in the Magellanic Clouds and Implications for Massive-Star Evolution I. SMC

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We have carried out an intensive spectroscopic campaign to search for binaries via periodic radial-velocity (RV) variations among all the nitrogen-rich WN Wolf-Rayet stars in the Small Magellanic Clouds (SMC), and all WNE stars in the Large Magellanic Cloud (LMC). We present in this first paper the results for the SMC. Along with the results of Bartzakos, Moffat & Niemela (2001) on the only carbon/oxygen-rich WR star (AB8, WO4+O4), the whole WR population of the SMC (11 stars) has now been investigated intensively 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 the *ROSAT* and *Chandra* archives, to provide additional constraints on the binary character. Contrary to theoretical expectations which predict a virtually 100% binary frequency in the SMC,

we find a normal ($\sim 40\%$) WR binary frequency in this galaxy. We discuss the possible reasons and implications of this for stellar evolution of massive stars in such a low-metallicity environment, e.g. the influence of rotation versus the necessity of very high initial mass of the progenitors for single stars, and the possible past occurrence of Roche-lobe overflow for binaries.

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In Proceedings

Wolf-Rayet star parameters from spectral analyses

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The Potsdam Non-LTE code for expanding atmospheres, which accounts for clumping and iron-line blanketing, has been used to establish a grid of model atmospheres for WC stars. A parameter degeneracy is discovered for early-type WC models which do not depend on the "stellar temperature". 15 galactic WC4–7 stars are analyzed, showing a very uniform carbon abundance (He:C=55:40) with only few exceptions.

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ftp.astro.physik.uni-potsdam.de/pub/wrhamann/lanzarote.ps[.gz]
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X-ray line profiles from structured stellar winds

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Absorbing material compressed in a number of thin shells is effectively less opaque for X-rays than smoothly distributed gas. The calculated X-ray emission line profiles are red-shifted if the emission arises from the starward side of the shells.

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ftp.astro.physik.uni-potsdam.de/pub/oskinova/lanzarote.ps[.gz]
or on the web at www.astro.physik.uni-potsdam.de

Radio observations of interstellar bubbles surrounding massive stars

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We show radio continuum observations of the WR ring nebulae around WR 101 and WR 113 obtained using the VLA and HI 21cm line data of the interstellar bubble around the O type stars BD+24° 3866 and BD+25° 3952 obtained with the DRAO Synthesis Telescope. We review previous radio continuum and HI line results toward WR and O-type stars.

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or by anonymous ftp to `lilen.fcaglp.unlp.edu.ar, in /pub/ccappa`

Gamma-ray bursts: the most powerful cosmic explosions

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With the detection of gamma-ray burst (GRB) afterglows, the cosmological origin of GRBs has been firmly established. Recent observations suggest that (long-duration) GRBs are due to the collapse of a massive star forming a black hole. Besides theoretical arguments, observational evidence supporting this hypothesis comes from the coincidence of several GRBs with a supernova. Also, all accurately located GRBs are contained in the optical (restframe UV) extent of distant, blue galaxies. Some of these host galaxies show relatively high star-formation rates, which is expected when massive stars and GRBs are physically linked. Alternatively, GRBs can be produced by the merging of a binary neutron star system, such as the Hulse-Taylor binary pulsar. Very likely GRBs trace the massive-star populations in distant galaxies. With their enormous brightness, GRBs are powerful probes of the early universe, providing information on the properties of their host galaxies, the cosmic star-formation history, and potentially the first generations of massive stars.

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Eta Carinae: The physical structure of the outer ejecta and the strings

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The outer ejecta is part of the nebula around η Carinae. They are filamentary, shaped irregularly and larger than the Homunculus, the central bipolar nebula. While the Homuculus is mainly a reflection

nebula, the outer ejecta is an emission structure. However, we showed with kinematic analysis that the outer ejecta (as the Homunculus) expands bi-directional despite of its complex morphology. Radial velocities in the outer ejecta reach up to 2000 km/s and give rise to X-ray emission. An analysis showing the distribution of the soft X-ray emission and its comparison to the optical emitting gas is presented here. X-ray maxima are found in areas in which the expansion velocities are highest. The temperature of 0.65 keV determined with the CHANDRA/ACIS data and thermal equilibrium models indicates post-shock velocities of 750 km/s , about what was found in the spectra. In addition analysis of the new HST-STIS data from the Strings—long, highly collimated structures in the outer ejecta—are presented. The data show that the electron density of the Strings is of the order of 10^4 cm^{-3}. The same value was detected for other structures in the outer ejecta. With this density String 1 has a mass of about 3 10^{-4} $M_\odot$ and the total ejecta could be as massive as 0.5 $M_\odot$.

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Preprints from kweis@mpifr-bonn.mpg.de
or on the web at http://www.mpifr-bonn.mpg.de/staff/kweis/publications.html or http://www.astro.washington.edu/balick/eta_conf/eta_talks_posters.html

Massive Stars and the Creation of our Galactic Center

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Our Galactic Center hosts over 10% of the known massive stars in the Galaxy. The majority of these stars are located in three particularly massive clusters that formed within the past 5 Myr. While these clusters are extraordinary, their formation repesents about half of the total inferred star formation rate in the Galactic Center. There is mounting evidence that the clusters are just present-day examples of the hundreds of such similar clusters that must have been created in the past, and whose stars now comprise the bulk of all stars seen in the region. I discuss the massive stellar content in the Galactic Center and present a new analysis that suggests that effects of continuous star formation in the Galactic Center can be seen in the observed luminosity functions newly-obtained HST/NICMOS and Gemini AO data.

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