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THE M$^{\mathrm{A}}$S$^{\mathrm{S}}$I$^{\mathrm{V}}$E STAR NEWSLETTER

formely known as *the hot star newsletter*

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Contents of this newsletter

Accepted Papers

Puzzling X-rays from the new colliding wind binary WR65 (WC9d)

L. M. Oskinova & W. R. Hamann

University of Potsdam

We report the discovery of variability in the X-ray emission from the Wolf-Rayet type star WR 65. Using archival Chandra data spanning over 5 yr we detect changes of the X-ray flux by a factor of 3 accompanied by changes in the X-ray spectra. We believe that this X-ray emission originates from wind-wind collision in a massive binary system. The observed changes can be explained by the variations in the emission measure of the hot plasma, and by the different absorption column along the binary orbit. The X-ray spectra of WR 65 display prominent emission features at wavelengths corresponding to the lines of strongly ionized Fe, Ca, Ar, S, Si, and Mg. WR 65 is a carbon rich WC9d star that is a persistent dust maker. This is the first investigation of any X-ray spectrum for a star of this spectral type. There are indications that the dust and the complex geometry of the colliding wind region are pivotal in explaining the X-ray properties of WR 65.

Reference: MNRAS:Letters, in press

On the web at: arXiv:0809.2782

Preprints from: lida@astro.physik.uni-potsdam.de

Metallicity in the Galactic Center: The Quintuplet cluster

Francisco Najarro1, Don F. Figer2, D. John Hillier3, T. R. Geballe4, Rolf P. Kudritzki5

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We present a measurement of metallicity in the Galactic center Quintuplet Cluster made using quantitative spectral analysis of two Luminous Blue Variables (LBVs). The analysis employs line-blanketed NLTE wind/atmosphere models fit to high-resolution near-infrared spectra containing lines of H, HeI, SiII, MgII, and FeII. We are able to break the H/He ratio vs. mass-loss rate degeneracy found in other LBVs and to obtain robust estimates of the He content of both objects. Our results indicate solar iron abundance and roughly twice solar abundance in the alpha-elements. These results are discussed within the framework of recent measurements of oxygen and carbon composition in the nearby Arches Cluster and iron abundances in red giants and supergiants within the central 30 pc of the Galaxy. The relatively large enrichment of alpha-elements with respect to iron is consistent with a history of more nucleosynthesis in high mass stars than the Galactic disk.

Reference: ApJ

On the web at: `http://arxiv.org/abs/0809.3185`

Preprints from: `najarro@damir.iem.csic.es`

Towards an Accurate Determination of Parameters for Very Massive Stars: the Eclipsing Binary LMC-SC1-105

Alceste Z. Bonanos

Carnegie Institution of Washington, DTM

This paper presents a photometric and spectroscopic study of the bright blue eclipsing binary LMC-SC1-105, selected from the OGLE catalog as a candidate host of very massive stars (¿=30Mo). The system is found to be a double-lined spectroscopic binary, which indeed contains massive stars. The masses and radii of the components are M1= 30.9+/-1.0 Mo, M2= 13.0+/-0.7 Mo, and R1= 15.1+/-0.2 Ro, R2= 11.9+/-0.2 Ro, respectively. The less massive star is found to be filling its Roche lobe, indicating the system has undergone mass-transfer. The spectra of LMC-SC1-105 display the Struve-Sahade effect, with the HeI lines of the secondary appearing stronger when it is receding and causing the spectral types to change with phase (O8+O8 to O7+O8.5). This effect could be related to the mass-transfer in this system. To date, accurate (¡=10%) fundamental parameters have only been measured for 15 stars with masses greater than 30 Mo, with the reported measurements contributing valuable data on the fundamental parameters of very massive stars at low metallicity. The results of this work demonstrate that the strategy of targeting the brightest blue stars in eclipsing binaries is an effective way of studying very massive stars.

Reference: ApJ, in press

On the web at: `http://arxiv.org/abs/0807.3742`

Preprints from: `bonanos@stsci.edu`

The Quintuplet Cluster I. A K-band spectral catalog of stellar sources

A. Liermann, W.-R. Hamann, L. M. Oskinova

University of Potsdam

Three very massive clusters are known to reside in the Galactic Center region, the Arches cluster, the Quintuplet cluster and the Central parsec cluster. We obtained spectroscopic observations of the Quintuplet cluster with the Integral Field Spectrograph SINFONI-SPIFFI at the ESO-VLT. The spectral range comprises the near-IR K-band from 1.94 to 2.45 micrometer. The 3D data cubes of the individual fields were flux-calibrated and combined to one contiguous cube, from which the spectra of all detectable point sources were extracted. We present a catalog of 160 stellar sources in the inner part of the Quintuplet cluster.

Reference: A&A

On the web at: `arXiv:0809.5199`

Preprints from: `adriane@astro.physik.uni-potsdam.de`

The Exciting Star of the Berkeley 59/Cepheus OB4 Complex and Other Chance Variable Star Discoveries

Daniel J. Majaess, David G. Turner, David J. Lane, Kathleen K. Moncrieff

Saint Mary's University, Halifax, NS, Canada

A study is presented regarding the nature of several variable stars sampled during a campaign of photometric monitoring from the Abbey Ridge Observatory: 3 eclipsing binaries, 2 semiregulars, a luminous Be star, and a star of uncertain classification. For one of the eclipsing systems, BD+66 1673, spectroscopic observations reveal it to be an O5 V((f))n star and the probable ionizing star of the Berkeley 59/Cep OB4 complex. An analysis of spectroscopic observations and BV photometry for Berkeley 59 members in conjunction with published observations imply a cluster age of 2 Myr, a distance of d = 883+-43 pc, and a reddening of E(B-V) =1.38+-0.02. Two of the eclipsing systems are Algol-type, but one appears to be a cataclysmic variable associated with an X-ray source. ALS 10588, a B3 IVn star associated with the Cepheid SV Vul, is of uncertain classification, although consideration is given to it being a slowly pulsating B star. The environmental context of the variables is examined using spectroscopic parallax, 2MASS photometry, and proper motion data, the latter to evaluate the membership of the variable B2 Iabe star HDE 229059 in Berkeley 87, an open cluster that could offer a unique opportunity to constrain empirically the evolutionary lineage of young massive stars. Also presented are our null results for observations of a sample of northern stars listed as Cepheid candidates in the New Catalogue of Suspected Variable Stars.

Reference: JAAVSO, in press. (rev. August 2008)

On the web at: `http://www.ap.smu.ca/ smuaps/projects/vs.pdf`

Preprints from: `dmajaess@ap.smu.ca`

A consistent solution for the velocity field and mass-loss rate of massive stars

Patrick E. Mueller (1), Jorick S. Vink (2)

(1) Keele University, UK (2) Armagh Observatory, Northern Ireland, UK

Stellar winds are an important aspect of our understanding of the evolution of massive stars and their input into the interstellar medium. Here we present solutions for the velocity field and mass-loss rates for stellar outflows as well as for the case of mass accretion through the use of the so-called Lambert W-function. For the case of a radiation-driven wind, the velocity field is obtained analytically using a parameterised description for the line acceleration that only depends on radius, which we obtain from Monte-Carlo multi- line radiative transfer calculations. In our form of the equation of motion the critical point is the sonic point. We also derive an approximate analytical solution for the supersonic flow which closely resembles our exact solution. For the simultaneous solution of the mass-loss rate and velocity field, we describe a new iterative method. We apply our theoretical expressions and our iterative method to the stellar wind from a typical O5-V main sequence star, and find good agreement with empirical values. Our computations represent the first self-consistent mass-loss calculations including the effect of multi-line scattering for an O-type star, opening up the possibility of applying Monte Carlo mass-loss calculations in regions of the Universe for which empirical constraints cannot be readily obtained.

Reference: A&A, in press

On the web at: `http://arXiv.org/abs/0810.1901`

Preprints from: `pmueller@astro.keele.ac.uk`

Mass loss from hot massive stars

Joachim Puls, Jorick S. Vink, & Francisco Najarro

University Observatory Munich, Germany; Armagh Observatory, Armagh, Northern Ireland; Instituto de Estructura de la Materia, CSIC, Madrid, Spain

Mass loss is a key process in the evolution of massive stars, and must be understood *quantitatively* if it is to be successfully included in broader astrophysical applications such as galactic and cosmic evolution and ionization. In this review, we discuss various aspects of radiation driven mass loss, both from the theoretical and the observational side. We focus on developments in the past decade, concentrating on the winds from OB-stars, with some excursions to the winds from Luminous Blue Variables (including super-Eddington, continuum-driven winds), winds from Wolf-Rayet stars, A-supergiants and Central Stars of Planetary Nebulae.

After recapitulating the 1-D, stationary *standard model* of line-driven winds, extensions accounting for rotation and magnetic fields are discussed. Stationary wind models are presented that provide theoretical predictions for the mass-loss rates as a function of spectral type, metallicity, and the proximity to the Eddington limit. The relevance of the so-called bi-stability jump is outlined.

We summarize diagnostical methods to infer wind properties from observations, and compare the results from corresponding campaigns (including the VLT-FLAMES survey of massive stars) with theoretical predictions, featuring the mass loss-metallicity dependence.

Subsequently, we concentrate on two urgent problems, *weak winds* and *wind-clumping*, that have been identified from various diagnostics and that challenge our present understanding of radiation driven winds. We discuss the problems of "measuring" mass-loss rates from weak winds and the potential of the NIR Br_α-line as a tool to enable a more precise quantification, and comment on physical explanations for mass-loss rates that are much lower than predicted by the standard model. Wind-clumping, conventionally interpreted as the consequence of a strong instability inherent to radiative line-driving, has severe implications for the interpretation of observational diagnostics, since derived mass-loss rates are usually overestimated when clumping is present but ignored in the analyses. Depending on the specific diagnostics, such overestimates can amount to factors of 2 to 10, and we describe ongoing attempts to allow for more uniform results. We point out that independent arguments from stellar evolution favor a moderate reduction of present-day mass-loss rates.

We also consider larger scale wind structure, interpreted in terms of co-rotating interacting regions, and complete this review with a discussion of recent progress on the X-ray *line* emission from massive stars. Such emission is thought to originate both from magnetically confined winds and from non-magnetic winds, in the latter case related to the line-driven instability and/or clump-clump collisions. We highlight as to how far the analysis of such X-ray line emission can give further clues regarding an adequate description of wind clumping.

Reference: A&ARv, Springer
Comments: Review

On the web at: `http://www.usm.uni-muenchen.de/people/puls/papers/review_mdot.pdf`

Preprints from: `uh101aw@usm.uni-muenchen.de`

Early-type objects in NGC 6611 and the Eagle Nebula

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An important question about Be stars is whether they are born as such or whether they have become Be stars during their evolution. It is necessary to observe young clusters to answer this question. To this end, observations of stars in NGC 6611 and the star-formation region of Eagle Nebula were carried out with the ESO-WFI in slitless spectroscopic mode and at the VLT-GIRAFFE (R ≃ 6400-17 000). The targets for the GIRAFFE observations were pre-selected from the literature and our catalogue of emission-line stars based on the WFI study. GIRAFFE observations allowed us to study the population of the early-type stars accurately both with and without emission lines. For this study, we determined the fundamental parameters of OBA stars thanks to the GIRFIT code. We also studied the status of the objects (main sequence or pre-main sequence stars) by using IR data, membership probabilities, and location in HR diagrams. The nature of the early-type stars with emission-line stars in NGC 6611 and its surrounding environment is derived. The slitless observations with the WFI

clearly indicate a small number of emission-line stars in M16. We observed with GIRAFFE 101 OBA stars, among them 9 are emission-line stars with circumstellar emission in Halpha. We found that W080 could be a new He-strong star, like W601. W301 is a possible classical Be star, W503 is a mass-transfer eclipsing binary with an accretion disk, and the other ones are possible Herbig Ae/Be stars. We also found that the rotational velocities of main sequence B stars are 18% lower than those of pre-main sequence B stars, in good agreement with theory about the evolution of rotational velocities. Combining adaptive optics, IR data, spectroscopy, and radial velocity indications, we found that 27% of the B-type stars are binaries. We also redetermined the age of NGC 6611 found equal to 1.2-1.8 Myears, in good agreement with the most recent determinations.

Reference: published by A&A under the reference: 2008, A&A, 489, 459

On the web at: `http://cdsads.u-strasbg.fr/abs/2008A%26A...489..459M`

Preprints from: `martayan@oma.be`

The Physical Properties and Effective Temperature Scale of O-type Stars as a Function of Metallicity. III. More Results from the Magellanic Clouds

Philip Massey (1), Amanda M. Zangari (1,2), Nidia I. Morrell (3), Joachim Puls (4), Kathleen DeGioia-Eastwood (5), Fabio Bresolin (6), and Rolf-Peter Kudritzki (6)

(1) Lowell Observatory; (2) MIT; (3) Las Campanas Observatory; (4) Universitats-Sternwarte Munchen, Germany; (5) Northern Arizona University; (6) Institute for Astronomy, University of Hawaii

In order to better determine the physical properties of hot, massive stars as a function of metallicity, we obtained very high SNR optical spectra of 26 O and early B stars in the Magellanic Clouds. These allow accurate modeling even in cases where the He I 4471 line has an equivalent width of only a few tens of mA. The spectra were modeled with FASTWIND, with good fits obtained for 18 stars; the remainder show signatures of being binaries. We include stars in common to recent studies to investigate possible systematic differences. The "automatic" FASTWIND modeling method of Mokiem and collaborators produced temperatures 1100 K hotter on the average, presumably due to the different emphasis given to various temperature-sensitive lines. More significant, however, is that the automatic method always produced some "best" answer, even for stars we identify as composite (binaries). The temperatures found by the TLUSTY/CMFGEN modeling of Bouret, Heap, and collaborators yielded temperatures 1000 K cooler than ours, on average. Significant outliers were due either to real differences in the data (some of the Bouret/Heap data were contaminated by moonlight continua) or the fact we could detect the He I line needed to better constrain the temperature. Our new data agrees well with the effective temperature scale we presented previously. We confirm that the "Of" emission-lines do not track luminosity classes in the exact same manner as in Milky Way stars. We revisit the the issue of the "mass discrepancy", finding that some of the stars in our sample do have spectroscopic masses that are significantly smaller than those derived from stellar evolutionary models. We do not find that the size of the mass discrepancy is simply related to either effective temperature or surface gravity.

Reference: ApJ, in press

On the web at: `http://www.lowell.edu/users/massey/o2uv.pdf.gz`

Preprints from: `phil.massey@lowell.edu`

Outliers from the mainstream: how a massive star can produce a gamma-ray burst

S. Campana[1], N. Panagia[2,3,4], D. Lazzati[5], A.P. Beardmore[6], G. Cusumano[7], O. Godet[6], G. Chincarini[8,1], S. Covino[1], M. Della Valle[9,10,11], C. Guidorzi[8,1], D. Malesani[12], A. Moretti[1], R. Perna[5], P. Romano[8,1], and G. Tagliaferri[1]

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It is now recognized that long-duration gamma-ray Bursts (GRBs) are linked to the collapse of massive stars, based on the association between (low redshift) GRBs and (Type Ic) core-collapse supernovae (SNe). The census of massive stars and GRBs reveals, however, that not all massive stars produce a GRB. Only $\sim$1% of core-collapse SNe are able to produce a highly relativistic collimated outflow, and hence a GRB. The extra crucial parameter has long been suspected to be metallicity and/or rotation. We find observational evidence strongly supporting that both ingredients are necessary in order to make a GRB out of a core-collapsing star. A detailed study of the absorption pattern in the X-ray spectrum of GRB 060218 reveals evidence of material highly enriched in low-atomic-number metals ejected before the SN/GRB explosion. We find that, within the current scenarios of stellar evolution, only a progenitor star characterized by a fast stellar rotation and subsolar initial metallicity could produce such a metal enrichment in its close surrounding.

Reference: ApJ, 683: L9L12

On the web at: `http://babbage.sissa.it/abs/0805.4698`

Preprints from: `sergio.campana@brera.inaf.it`

A Cosmic Abundance Standard: Chemical Homogeneity of the Solar Neighbourhood and the ISM Dust-Phase Composition

Norbert Przybilla (1), Maria-Fernanda Nieva (1,2), Keith Butler (3)

(1) Dr. Remeis-Observatory Bamberg, (2) MPI for Astrophysics Garching, (3) University Observatory Munich

A representative sample of unevolved early B-type stars in nearby OB associations and the field is analysed to unprecedented precision using NLTE techniques. The resulting chemical composition is found to be more metal-rich and much more homogeneous than indicated by previous work. A rms scatter of 10% in abundances is found for the six stars (and confirmed by six evolved stars), the same as reported for ISM gas-phase abundances. A cosmic abundance standard for the present-day solar

neighbourhood is proposed, implying mass fractions for hydrogen, helium and metals of X=0.715, Y=0.271 and Z=0.014. Good agreement with solar photospheric abundances as reported from recent 3D radiative-hydrodynamical simulations of the solar atmosphere is obtained. As a first application we use the cosmic abundance standard as a proxy for the determination of the local ISM dust-phase composition, putting tight observational constraints on dust models.

Reference: ApJ Letters, in press

On the web at: `http://arxiv.org/abs/0809.2403`

Preprints from: `przybilla@sternwarte.uni-erlangen.de`

Proceedings

The evolution of massive and very massive stars in clusters

D. Vanbeveren

Astrophysical Institute, Vrije Universiteit Brussel

The present paper reviews massive star (initial mass less than or equal to 120 Mo) and very massive star (initial mass larger than 120 Mo) evolution. I will focus on evolutionary facts and questions that may critically affect predictions of population and spectral synthesis of starburst regions. We discuss the ever-lasting factor 2 or more uncertainty in the stellar wind mass loss rates. We may ask ourselves if stellar rotation is one of the keys to understand the universe, why so many massive stars are binary components and why binaries are ignored or are considered as the poor cousins by some people? And finally, do ultra luminous X-ray sources harbor an intermediate mass black hole with a mass of the order of 1000 Mo?

Reference: Rev. talk presented at the conference: From Taurus to the Antennae; Sheffield 4-8th August 2008

On the web at: `arXiv: 0810.4781`

Preprints from: `dvbevere@vub.ac.be`

The Properties of Early-type Stars in the Magellanic Clouds

Christopher J. Evans

UK Astronomy Technology Centre, Edinburgh

The past decade has witnessed impressive progress in our understanding of the physical properties of massive stars in the Magellanic Clouds, and how they compare to their cousins in the Galaxy. I summarise new results in this field, including evidence for reduced mass-loss rates and faster stellar rotational velocities in the Clouds, and their present-day compositions. I also discuss the stellar temperature scale, emphasizing its dependence on metallicity across the entire upper-part of the Hertzsprung-Russell diagram.

Reference: Invited review at IAU Symposium 256

On the web at: `http://arxiv.org/abs/0809.0852`

Preprints from: `cje@roe.ac.uk`

Jobs

Postdoctoral Research Fellow, HII Regions

Sally Oey
University of Michigan Department of Astronomy 830 Dennison Building Ann Arbor, MI 48109-1042 USA

Applications are invited for a postdoctoral position at at the University of Michigan to work with Prof. Sally Oey on projects related to galactic chemical evolution and starbursts, as revealed by HII regions and photoionized gas. There will also be broad opportunity in the area of galactic and cosmic evolution with respect to general massive star feedback effects. The successful candidate will have access to the University of Michigan telescope facilities, including the twin 6.5-m Magellan Telescopes at Las Campanas, and the MDM 2.4-m and 1.3-m telescopes at Kitt Peak. This position is available for two years, with possible extension for a third. The start date is flexible, to begin as soon as possible. Applicants should have a Ph.D. and experience with HII region spectroscopy. Experience with integral field spectroscopy is desireable.

To apply, please submit curriculum vitae, statement of research interests, and contact details for three references to Sally Oey at the given address. Applications may be submitted by email in PDF format, or by hardcopy. Please also include your available start date. The position will remain open until filled, but applications received by 15 November 2008 will receive first consideration. Inquiries may be directed to Sally Oey (msoey@umich.edu). The University of Michigan is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

Email contact: `msoey@umich.edu`

Closing date: 15 November 2008, or until filled

Post-doctoral position in astrophysics at the Université de Montréal

Pierre Bergeron
Departement de physique Univ. de Montreal C.P. 6128, Succ. Centre-Ville Montreal, QC, H3C 3J7 Canada

Post-doctoral position in astrophysics at the Université de Montréal

The Centre for Research in Astrophysics of Québec (CRAQ) is opening a post-doctoral position at the Université de Montréal (Québec, Canada). The CRAQ is a collaborative research centre whose members include astrophysicists from Université de Montréal, Université Laval, and McGill

University. The candidates are expected to carry out original research in astrophysics under the general supervision of the permanent faculty at the Université de Montréal whose interests include stellar astrophysics, extragalactic astronomy, solar physics, and astronomical instrumentation (see http//www.craq-astro.ca for further information). A Ph.D. in physics or astronomy is required.

Potential candidates with the required expertise are encouraged to apply. Please send CV, research proposal, cover letter and contact details of two referees (including email addresses) to Dr. Pierre Bergeron (bergeron@astro.umontreal.ca). The position is open from as early as January 1st, 2009 and no later than June 1st, 2009 for two years with a possible extension of one year.

Attention/Comments: Please send a copy of your application also to moffat@astro.umontreal.ca and stlouis@astro.umontreal.ca

Weblink: `http://craq-astro.ca`

Email contact: `bergeron@astro.umontreal.ca`

Closing date: Best to apply asap before January 1st, 2009

Postdoctoral Position at Royal Observatory of Belgium

Ronny Blomme
Royal Observatory of Belgium Ringlaan 3 B-1180 Brussel Belgium

Applications are invited for a postdoctoral research position at the Royal Observatory of Belgium. The successful applicant will start on 2009 January 1, or as soon as possible thereafter.

The successful candidate will work with Dr. Ronny Blomme on the subject of colliding winds in massive binary systems. He/she will interpret available optical spectra, as well as X-ray and radio data. He/she will theoretically model the spectra, and the X-ray and radio data, as well as their variation as a function of orbital phase. Applicants should have experience in at least some of the subjects relevant to this project (i.e. binaries, analysis of spectra, radiative transfer, high-energy physics, hydrodynamics, ...).

Applicants must have, or be about to obtain, a PhD in astrophysics. The position is for a duration of 2 years, with a possible extension of a further 2 years.

The position will remain open until filled, but applications received by November 30 will receive first consideration. Applicants should send a full curriculum vitae, statement of research interest and complete bibliography to: Ronny Blomme, Royal Observatory of Belgium, Ringlaan 3, B-1180 Brussel, Belgium. The contact details of two possible referees should be added.

Attention/Comments: For further information: contact R. Blomme at the above address, or via: Tel: +32 2 3730284; Fax: +32 2 3749822; E-mail: Ronny.Blomme@oma.be

Weblink:

Email contact: `Ronny.Blomme@oma.be`

Closing date: 30 November 2008, or until filled

Meetings

The Interferometric View on Hot Star

March 2-6, 2009
Via del Mar, Chile

The meeting aims at bringing together hot star and interferometry expertise, both observationally and theoretical, to review the progress made, as well as to outline current problems in hot star research that are expected to benefit most from interferometric observations.

PROGRAM Oral sessions during the meeting will be held on: - High angular resolution techniques - The stars (including Cepheids) - Stellar winds - Circumstellar disks - Hot binaries - Explosive stars

The Thursday and Friday before the Meeting we will hold an interferometry primer, mainly intended for students, but open to all participants as long as there is space. The scope of the primer is to enable attendants without experience in interferometry first steps to understand and assess the results presented and to develop project ideas for discussion during the meeting. This session will take place on ESO's premises in Vitacura, Santiago.

Weblink: `http://www.eso.org/sci/meetings/IHOT09/`

Email contact: `ihot09@eso.org`

Hot And Cool: Bridging Gaps in Massive Star Evolution

November 10-12, 2008; Registration closes on October 3!
Caltech, Pasadena

This meeting aims to bridge the gap between researchers studying stars in the upper blue and red sections of the Hertzsprung-Russell diagram (HRD). While morphologically separated, stars occupying these extremes of the HRD are intimately related via evolution, as well as both having atmospheric properties affected by extension and stellar wind outflow. At cosmological scales, like in distant starburst galaxies, the historical distinction between blue and red stellar populations becomes obsolete, and understanding the complex relation between the red and blue parts of the HRD is mandatory.

Weblink: `http://www.ipac.caltech.edu/hotandcool/`

Email contact: `leitherer@stsci.edu`