

2009 Epsilon Aurigae Eclipse

Campaign Newsletter #8

Fall 2008

Campaign Web Site
<http://www.hposoft.com/Campaign09.html>

Dear Colleagues,

The 2008/2009 observing season for epsilon Aurigae is well into action. Each month the star system rises by 2 hours. During October the system is fairly high in the East around midnight. During mid-October it is on the meridian around 4:00 AM local time. This means you have at least a hour after crossing the meridian to observe before twilight.

The hydrogen alpha ($H\alpha$) region of the spectrum of epsilon Aurigae is an area of interest. In particular the blue and red emissive horns also known as wings that bracket a large absorption line. Several of us have likened these horns to the horns of the $H\alpha$ lines in Be stars. There the horns are believed to be caused by a rotating gas ring around the Be star. While epsilon Aurigae is not a Be star, it may have a similar ring and one that is lumpy causing the horns to go up and down. But there are also other possible causes of the horns. There may be emission of $H\alpha$ radiation from the unknown secondary. One theory has a pair of stars sweeping out a hole in the middle of the secondary that allow for the mid-eclipse brightening. Could the horns be radiation from these stars? Possibly one test would be to have a good set of out-of-eclipse spectra and compare the horns with the in-eclipse horns. If the horns are due to the secondary, the horns should not be seen much different than the out-of-eclipse horns. If they are significantly reduced, then the gas ring theory becomes more likely. This is why we need good out-of-eclipse spectroscopy coverage. These are exciting times as during the last eclipse only a small handful of professional astronomers were taking few spectra. Now we have many smaller observatories doing the same and providing significantly more data. Oliver Thizy and Lothar Shane have been helpful with suggestions for archiving spectra of epsilon Aurigae. Other comments and suggestions are most welcome.

We are planning on setting up an archive for spectral images. More information is provided by Dr. Lothar Shanne in the Spectroscopy portion of this Newsletter. It is rumored the AAVSO will also be setting up a means for archiving star spectra early next year.

Photometry

Photometry Data Report Format

To submit photometric data for the Newsletter and publishing on the web site, please use the following format. Please submit data as a text only file:

Header

Report Date:

Observer Name:

Observatory Name:

Location:

Latitude/Longitude/Altitude (ASL):

Time Zone:

Telescope:

Filter Set:

Detector:

Observation Date: Double Date e.g., 21/22 August 2008

JD or HJD to 4 places: e.g., 2,455,345.1234

Note: Because this is a very long period variable, the above should be representative of all bands measured not a separate date and JD for each band. For short period variables this is important, but not epsilon Aurigae. Multiple sets of observations for one night can have separate dates and times for each set. For a given set of three observations the middle observation date and time should be used. Time to the nearest minute is sufficient.

Suggested sequence for single channel photometry is:

Comp V (3-10 sec reading)

Comp B (3-10 sec readings)

Comp U (3-10 sec readings)

sky U (1-10 sec reading,

sky B (1-10 sec reading)

sky V (1-10 sec reading)

Var V (3-10 sec reading)

Var B (3-10 sec readings)

Var U (3-10 sec readings)

sky U (1-10 sec reading,

sky B (1-10 sec reading)

sky V (1-10 sec reading)

Comp V (3-10 sec reading)

Comp B (3-10 sec readings)

Comp U (3-10 sec readings)

sky U (1-10 sec reading,

sky B (1-10 sec reading)

sky V (1-10 sec reading)

With a total of 3 sets of Var reading each bracketed by Comp readings. Readings should be taken as quickly as possible. The low the air mass of the observation the better the data will be.

Note: Please do not send raw data, only your reduced magnitudes. Please extinction and color correct data.

Report Reduced Data such as:

Filter Corrected magnitude # Measurements SD of the measurements, e.g.,
For single dates:

Data

Filter	Magnitude	# Obs	SD
U	3.8323	3	0.0012
B ...			
V ...			
R ...			
I ...			
J ...			
H ...			

Note: List magnitude and SD to 4 places. Also, this is in addition to the header data listed above.

Observation Note: Observation comments if any.

For multiple date:

JD/HJD	V Mag	SD	#	B Mag	SD	#	U Mag	SD	#
2454738.8593	3.0189	.0031	3	3.5779	.0031	3	3.6640	.007	3

News from our Campaign Members

23 August 2008

Gene Milone writes:

For the past two months we have been tweaking the 1.8-m and managed to get a single set of iz, iJ, iH, and iK observation of epsilon Aur sandwiched between observations of lambda Aur on Jul 31-Aug. 1, 2008. We picked up the pair while still under the pole, and had expected to follow it into the twilight sky but were thwarted by clouds forming in the northeast. We continue to be stymied by a myriad of equipment/software, and, more critically right now, sky problems. The system is definitely improving and the dewar has been kept cold for two and a half months now, so we do expect within the coming month to get many more differential observations of epsilon Aur. We also desire to observe many standards to check the zero points and test the integrity of the filters after so long a downtime.

- gene

E. F. Milone
Physics & Astronomy
University of Calgary

2008/2009 Season Photometry Data Summary

26 July 2008

David Daiku Trowbridge

Comp stars 1 Aur, 2 Aur and Omega in order to average results I had obtained using Eta and Zeta on July 21 (I have no images of Lambda yet).

B	3.319	+/-0.12
V	3.134	+/-0.042
R	2.374	+/-0.139
I	2.062	+/-0.195

4 September 2008

Brian E. McCandless

Telescope: CGE1400

Detector *(BVRI): SSP-3

Detector (JH): SSP-4 @ T= - 40C

Com = Lam Aur HD34411

B= 5.34 V= 4.71 R= 4.19 I= 3.88 J= 3.62 H= 3.33

Comment: Humid

01-Sep-08 Elkton, MD Temp= 60F RH= 55

JD	AM	B	Error	V	Error	Rc	Error	Ic	Error
2454710.86389	1.148								
2454710.86250	1.153								
2454710.83625	1.246							2.096	0.015
2454710.83250	1.260					2.473	0.015		
2454710.83042	1.270	3.544	0.01						
2454710.82625	1.292			2.977	0.012				
2454710.82083	1.409			2.962	0.012				

JD	AM	J	Error	H	Error
2454710.86389	1.148	1.624	0.04		
2454710.86250	1.153			1.860	0.05

12 September 2008

Dr. Tiziano Colombo

Median J.D.	UT	Avg. V mag	# meas.
2454698.604167	2:30	3.16	6
2454705.583333	2:00	3.17	5
2454712.567361	1:37	2.99	9
2454713.631944	3:10	3.21	7
2454719.607639	2:35	3.05	13
2454720.630556	2:42	3.25	6

They look like oscillating values although I used the same measurement conditions. I hope they are good and comparable with other observers values.

I send you now because next days won't be good for observing due to an atmospheric disturbance passing over Italy.

29 September 2009

Jeff Hopkins Hopkins Phoenix Observatory

Phoenix, Arizona USA

Latitude: 33.5017 North

Longitude: 112.2228 West

Altitude: 1097 feet ASL

Time Zone: MST (UT -7)

Telescope: C-8 8" SCT

Filter Set: UBV Standard

Detector: 1P21 PMT in Photon Counting Mode

HJD	V	SD	#	B	SD	#	U	SD	#
2454675.9621	2.9570	.0106	3	3.5088	.0099	3	3.5815	.010	3
2454676.9503	2.9709	.0128	3	3.5234	.0086	3	3.5577	.020	3
2454678.9551	2.9691	.0393	3	3.5190	.0373	3	3.5369	.070	3
2454689.9704	2.9289	.0219	3	3.4897	.0193	3	3.5766	.038	3
2454697.9634	3.0064	.0068	3	3.5519	.0016	3	3.6281	.013	3
2454700.9565	3.0080	.0009	3	3.5628	.0057	3	3.6348	.013	3
2454712.9454	3.0292	.0048	3	3.5941	.0050	3	3.6863	.013	3
2454714.9655	3.0362	.0012	3	3.5986	.0061	3	3.6935	.025	3
2454731.9002	3.0192	.0021	3	3.5794	.0044	3	3.6806	.011	3
2454738.8593	3.0189	.0031	3	3.5779	.0031	3	3.6640	.007	3

29 September 2008

Mid-IR Observations of Epsilon Aurigae

M.L. Sitko (University of Cincinnati & Space Science Institute), D.K. Lynch, R.W. Russell (The Aerospace Corporation)

Little is known about the composition of the disk in Epsilon Aurigae, in particular the size distribution and mineralogical composition of any dust that might be present. Backman et al. (1984) and Backman & Gillett (1985) observed Epsilon Aurigae between 1 μ m and 20 μ m, supplemented with IRAS broad-band photometry, and found that the eclipse could be modeled using an opacity that was wavelength-independent and removed 48% of the light from the primary, plus a cool emitter with a temperature of 500(50 K that was visible throughout the eclipse, and presumably coming from the disk itself. However, all of these data were obtained with standard broad-band filters, so the resolution was insufficient to detect the presence of any weak silicate band, which would lie entirely within the 10 μ m N filter. IR technology has improved significantly since 1985, and higher spectral resolution observations with great sensitivity are possible today. Furthermore, recent out of eclipse Spitzer IRS and MIPS data do not seem to confirm the IR excess reported by Backman during the last eclipse (R. Stencel 2006, in Proc. IAU, 2, 202). The next eclipse may be very

different from the preceding one. †Confirmation of the disk signature during eclipse with improved IR technology is a key experiment as part of the 2009 eclipse campaign. New observations of the eclipse with modern detector technology are needed to properly characterize this system.

In preparation for the upcoming eclipse, new Mid-IR observations have been obtained using The Aerospace Corporation's Broad-band Array Spectrograph (BASS), which covers the entire 3-13 (m wavelength region accessible from the ground. The star was observed on two epochs, 11 Dec 2006 (observers: M.L. Sitko, R.W. Russell, D.K.,Lynch, D. Kim, and S.M. Brafford) and 3 Sept. 2008 (observers: M.L. Sitko, H.B. Hammel, R.W. Russell, D.K.,Lynch, and B. Kaneshiro). The observations will help define the baseline flux in the mid-IR, to which eclipse data can be compared.

This work was supported in part by the Independent Research and Development program at The Aerospace Corporation (Russell & Lynch) and by NASA's Astrophysics Data Program (Sitko).

REFERENCES

Backman, D.E., Becklin, E.E., Cruikshank, D.P., Joyce, R.R., Simon, T., & Tokunaga, A. 1984, ApJ, 284, 799.

Backman, D.E., & Gillett, F.C. 1985, ApJ, 299, L99.

Spectroscopy

Spectroscopy Tutorial/Paper

On 6 September 2008 I gave a paper at a meeting in Dewey, Arizona USA on methods to do wavelength calibration of a hydrogen alpha spectrum profile. The following is the paper abstract.

Hydrogen Alpha Wavelength Calibration

Jeff Hopkins

Hopkins Phoenix Observatory

6 September 2008

Abstract

To provide useful spectral wavelength information, a stellar spectrum must be wavelength calibrated. This paper will discuss ways to use VSpec software to wavelength calibrate a high resolution (2,400 lines/mm) stellar hydrogen alpha spectrum. The paper will discuss using neon spectral lines to provide a linear calibration. The use of atmospheric water absorption lines to create a non-linear calibration is also discussed. Finally the use of a heliocentric calibration is discussed. The resulting wavelength calibrated spectrum can be used to determine radial velocities to a high degree of accuracy.

A pdf (~ 2MB) of the paper can be downloaded at
<http://www.hposoft.com/HaCalibration.pdf>

I plan to have other documents available in the near future for using VSpec for continuum calibration and determination of Equivalent Widths.

Areas of the Spectrum of Interest:

The entire "blue region" i.e. 4000-4500A is apparently a rich region studied by Ferluga, showing many changes through eclipse. High resolution and good signal to noise are important. Elizabeth Griffin from DAO just communicated that a pair of spectra in that region from 2002 and 2007 show absorption excesses present at +50km/sec. I've asked her if we can include that info in the next newsletter. In addition, if anyone can measure the K I lines at 7699A, those show interesting behavior at and after mid-eclipse.

What do you think about using a lower resolution grating? The Lhires III has a set that goes to 150 lines/mm. The high resolution would be best for specific areas of the spectrum.

What I would like to see is a list of spectrum regions of interest, why they are of interest, past observations and changes, what to look for, what type of processing

should be done on the spectra, what resolution is suggested and tips or comments regarding that band. I know this would help me and I am sure others.

The following graphic says it all - from Lambert/Sawyer 1986. Note the velocity variation (asymmetric too) due to rotation of the disk as it passes our line of sight.

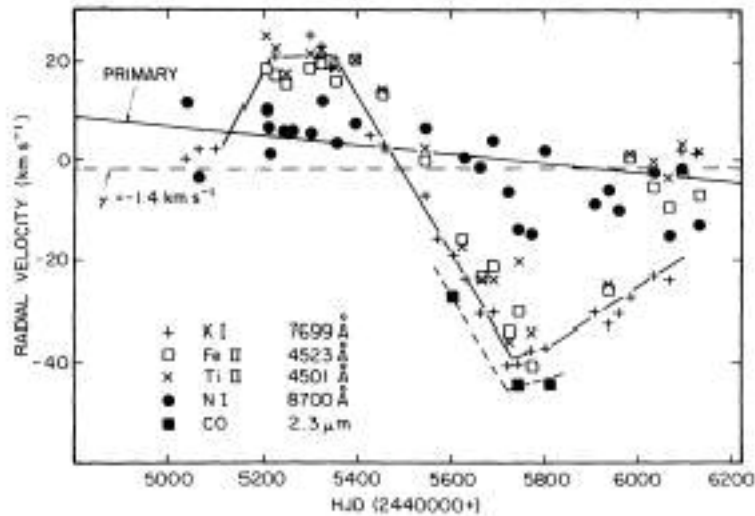


FIG. 2—Radial velocities for selected lines from before ingress to beyond egress. The systemic velocity (-1.4 km s^{-1}) and the predicted orbital velocity of the primary are drawn from elements by Batten *et al.* (1978). Velocities are given for the photosphere of the primary (N I lines near 8690 \AA), and the secondary's disk (K I 7699 \AA , Fe II 4523 \AA , Ti II 4501 \AA , and the CO $2.3 \mu\text{m}$ lines).

Lambert & Sawyer 1986 PASP 98: 389

Now is the time to obtain at least one full wavelength coverage, well calibrated, set of epsilon Aurigae spectra, from as far blue to as far red as your spectrograph can detect.

Then, one can focus on the regions highlighted in the graphic to watch for changes: blue 4000-4500A region, as detailed by Ferluga (see below) plus 7699A K I if reachable.

Fig. 2. The extracted shell spectra in linear-intensity scale (spectra 5, 8, 14, 15 are not yet optimized). The upper tracing is the reference stellar spectrum F_0 . At bottom the uncertainty band is reported. One may note: *i*) the sharpness of the shell lines with respect to stellar ones; *ii*) the enhancement of H_δ in totality; *iii*) the increase of metallic lines at egress; *iv*) the presence of the shell lines in post-eclipse phases; *v*) the shift of the shell lines from red to violet during the eclipse. Ferluga, S. 1991 A&A

To submit summary spectroscopic data for the Newsletter and publishing on the web site, please use the following format:

Newsletter Spectroscopy Data Report Format

Report Date:
Observer Name:
Observatory Name:
Location:
Latitude/Longitude:
Altitude (ASL Specify Meters or Feet):
Time Zone:
Universal Time (Mid-Observation Time):
Observation Date: Double Date e.g., 21/22 August 2008
JD or HJD to 4 places: e.g., 2,455,345.1234
Telescope (aperture, focal length):
Spectrograph:
Resolution:
Band (e.g., H α , Na, K):
Spectrum start and stop λ 's:
Lines of Interest:
Detector:
Profile Calibration Performed:
EW (define and specify λ 's):
Radial velocities (km/Sec):
Image(s) in jpg format:
Observation Notes:

Note: Please use Ångstroms (Å) for wavelengths. Profiles can be sent (jpg) and will be published in the Newsletter and on the web site.

2008/2009 Season Spectroscopy Summary

On 04 Sep 2008

Brian E. McCandless wrote:

I will review the spectral submission recommendations overnight and send comments to you tomorrow.

I was able to grab a 600-sec spectrum of Eps Aur in the H-alpha region last night, BUT my SGS (which was put away all summer) was not very well focused. It's a small adjustment, just not one I could perform at the telescope at 3:30 AM! New photometry and spectrum are attached.

Best wishes,

Brian.

Brian E. McCandless

Associate Scientist

Institute of Energy Conversion

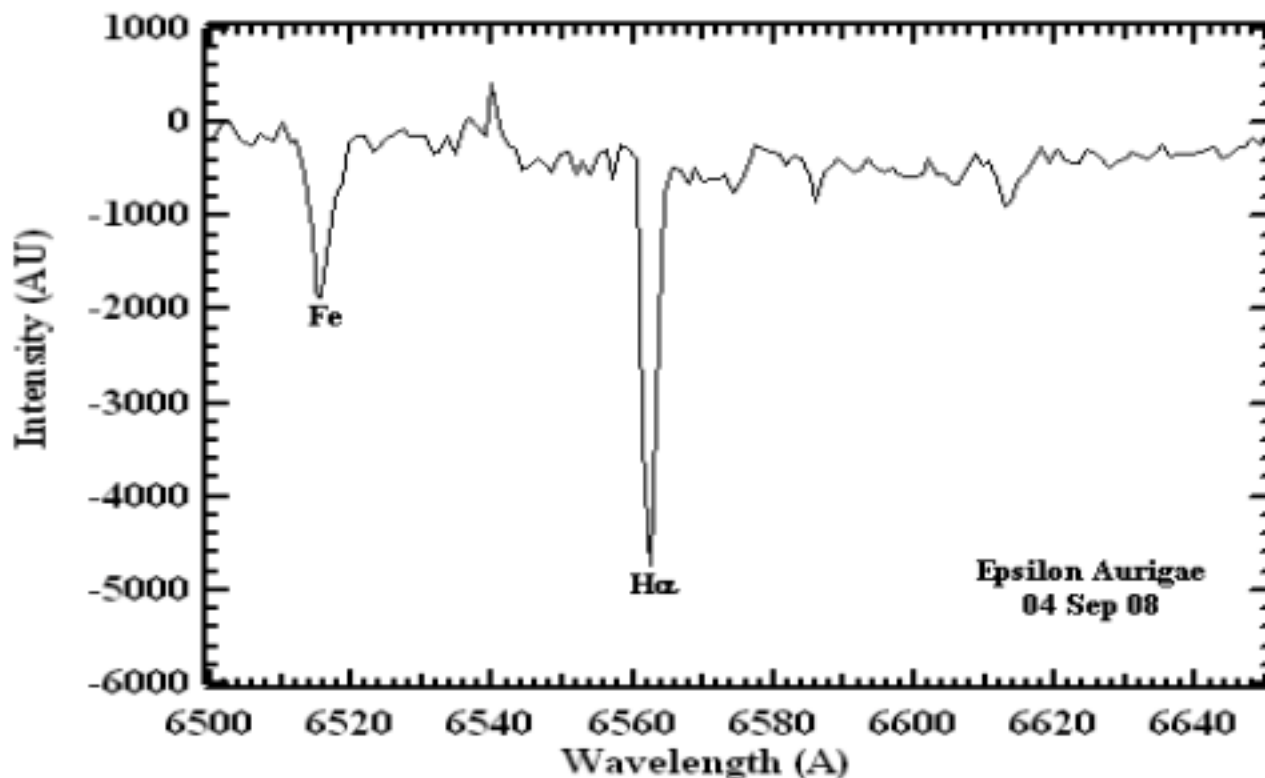
University of Delaware

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bem@udel.edu



On 18 Sep 2008

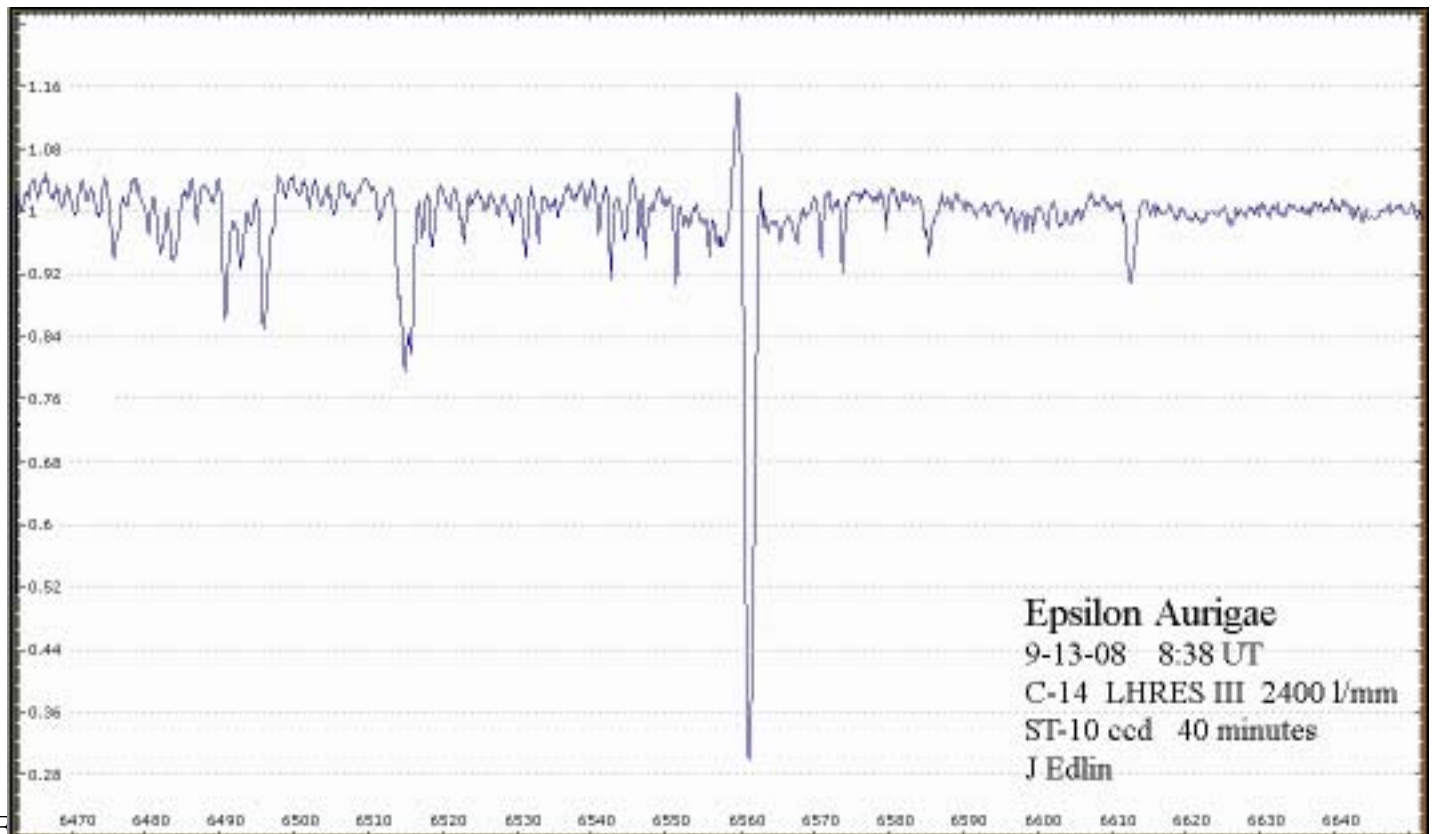
Jim Edlin wrote:

On the subject of Epsilon Aurigae, I made this observation of it on 9-13-08 with the LHRES III at 2400 l/mm centered on Ha line. It is calibrated and instrument response corrected and normalized to 1.

If we are to follow it, how often should we observe it??? Is there need to cover the whole spectrum or just concentrate on Ha???

Jim

"James Edlin" <jedlin@cableone.net>



E

Spectral Archives

Dr. Lothar Shane has kindly agreed to help with the archiving of the epsilon Aurigae spectra.

Dr. Otmar Stahl of Heidelberg Observatory has offered to archive epsilon Aurigae spectra in a database on his server.

See <http://stahl.homelinux.org:8000/otmar/specdb/>
and <http://www.lsw.uni-heidelberg.de/?lang=en>
and the page of Otmar Stahl
<http://www.lsw.uni-heidelberg.de/users/ostahl/>.

The supplied calibrated 1D-spectra must be in fits the below format. Before incorporation in the data base the spectra needs to be transformed into a common format. This work Lothar has agreed to do, because it is too much work for Dr. Otmar Stahl.

The following data should exist in the header of the supplied spectra. Most important parameters in bold:

```
BITPIX = -32 / number of bits per data pixel
NAXIS = 1 / number of data axes
NAXIS1 = 1536 / length of data axis 1
COMMENT Generated by Visual Spec 3.5.1
CRVAL1 = 6457.78307468635 /wavelength of first pixel in Angstr°m
CDEL1 = .11482037281 / step width each pixel (dispersion) in Angstr°m
OBJNAME = ' eps Aur' / Current name of the object
DATE-OBS= '2007-12-20T20:50:00 ' / Date of observation start (in UT !!!)
EXPTIME = 1200 / [s] Total time of exposure
BSS_INST= 'C14 LHIREs R:2400 Sigma KF1603 '/instrument
BSS_SITE= 'Voelklingen(D) '/observation site
OBSERVER= 'Lothar Schanne '
CUNIT1 = 'Angstrom' / Wavelength unit
CTYPE1 = 'Wavelength'
CRPIX1 = 1. / Reference pixel
BSS_VHEL= 0. / [km/s] Heliocentric speed
BSS_COSM= ' '
BSS_TELL= 'no correction '
BSS_NORM= ' '
JD = 2454455.368056
DATE = '2007-12-20' / in UT !!!!
TIME = 20:50:0 / in UT !!!!
END
```

You can display and edit the header of your spectra with the Fits File Editor:
<<http://heasarc.gsfc.nasa.gov/ftools/fv/>><http://heasarc.gsfc.nasa.gov/ftools/fv/>

The spectra should be supplied to Lothar at l.schanne@arcor.de

The spectra in the database are available to all. Use the database query:
<<http://stahl.homelinux.org:8000/otmar/specdb/>><http://stahl.homelinux.org:8000/otmar/specdb/>

For question please contact Lothar Schanne at l.schanne@arcor.de

<http://spektroskopie.fg-vds.de/forum/viewforum.php?f=17>

Polarimetry

No data or correspondence.

Interferometry

No data or correspondence.

From Dr. Bob

Now that epsilon Aurigae is rising before midnight, the final pre-eclipse observing season is upon us. Your photometry and spectroscopy will help provide context for the coming eclipse, so please keep up the good effort and report your results here.

Elizabeth Griffith of Dominion Astrophysical Observatory reported to us on high dispersion spectra obtained November 2007 and compared with March 2002, there appear to be weak but extra absorptions present in the latest one at 40 to 50 km/sec redshifts, suggesting the outermost layers of the disk are already coming into view in front of the F star primary. For those with spectroscopic capability, you should watch the H-alpha region, sodium D (5900A) and blue regions (4300-4600A) for changes. One of the best recent discussions of the changes in the optical spectrum due to eclipse was published by Steno Ferluga, 1991 online at:

<http://adsabs.harvard.edu/abs/1991A%26A...243..230F>

For those few who can reach the far red spectroscopically, Lambert and Sawyer saw big, persistent changes to the neutral potassium lines (7664 & 7699 A) after mid-eclipse see: **<http://adsabs.harvard.edu/abs/1986PASP...98..389L>**

We've been fortunate to have obtained some telescope time this season as follows: Nov-Dec 2008, final K band interferometry studies with the Palomar Testbed Interferometer (PTI). In a paper submitted to Astrophysical Journal, we reported on the archival PTI data and found no strong evidence for changing F star diameter between 1997 and 2007, despite suggestions that the epsilon Aurigae primary is shrinking. Sadly, PTI is facing decommissioning in 2009.

In December 2008, we have as first run on the CHARA array atop Mt. Wilson to begin imaging interferometry in order to calibrate an attempt to measure the effect of the eclipsing body next year autumn.

January 2009 brings our first scheduled use of the "SpeX" near infrared spectrograph on the NASA Infrared Telescope Facility (IRTF) at Mauna Kea, in an effort to verify the increase in the strength of CO features during eclipse and associated with the companion in epsilon Aur. Mike Sitko at U of Cincinnati reports having obtained "BASS" and "MIRSI" near-mid IR spectrophotometry of eps Aur at IRTF last season, and plans to continue same.

Reminder: Original paper copies of the 1985 eps Aur Workshop Proceedings are available on request, free, if interested parties will provide me with a snail mail address. A collector's item! Whiles supplies last.

Dr. Robert Stencel
University of Denver Astronomy Program
<rstencel@du.edu>

Interesting Paper

Spectroscopy of Massive Stars

by
Yael Naze

Bulletin de la Societe Royale des Sciences de Liege - Vol. 75, 2006, pp. 20-61

Abstract

Although rare, massive stars, being the main sources of ionizing radiation, chemical enrichment and mechanical energy in the Galaxy, are the most important objects of the stellar population. This review presents the many different aspects of the main tool used to study these stars, i.e. spectroscopy. The first part consists in an introduction on these objects and their physical properties (mass, wind, evolution, relation with their environment). Next, the spectral behaviour of single massive stars is investigated, in the visible as well as in the X-ray domain. Finally, the last part of this paper deals with massive binaries, especially those exhibiting a colliding wind phenomenon.

http://www.chimiefs.ulg.ac.be/SRSL/newSRSL/modules/FCKeditor/upload/File/75_2006/Naze-V75-2006-p20-61.pdf

NEW BOOK (Now Available)

Epsilon Aurigae A Mysterious Star System
by
Hopkins and Stencel

This is a 287 page soft cover book covering the history of epsilon Aurigae and the observations both in and out of eclipse as well as the different techniques used.

For more information
<http://www.hposoft.com/EAur09/Book.html>

Anyone wishing to contribute to the Newsletter, is most welcome. Please send contributions to me at phxjeff@hposoft.com.

Anyone desiring not to receive the Newsletter announcements, please e-mail me and I will remove your name from the mailing list.

Clear Skies!
Jeff

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