NEWSLETTER OF CHEMICALLY PECULIAR RED GIANT STARS

Bulletin sur les Etoiles Tardive a Spectre Particulier

NUMBER 17 DECEMBER 1994

Edited by
Sandra B. Yorka
Denison University

I. MESSAGE FROM THE WORKING GROUP CHAIRMAN

A. Progress Report on IAU Symposium 177

We are happy to report that our proposal to hold an IAU Symposium on the topic "The Carbon Star Phenomenon" was accepted by the IAU Executive Committee at its 66th meeting, which was held in The Hague at the conclusion of the recent General Assembly. It will be Symposium No. 177, and it will be held in or near Antalya, Turkey, in late May of 1996, as we proposed.

The EC has appointed the following to the Scientific Organizing Committee for Symposium 177: Zeki Aslan (Turkey), Hollis Johnson (USA), Uffe Jorgensen (Denmark), Tom Lloyd Evans (South Africa), Mario Magalhaes (Brazil), Janet Mattei (USA), Monique Querci (France), Verne Smith (USA), Takashi Tsuji (Japan), and Robert Wing (USA, Chair). This is the committee that we proposed, with no changes or additions; most of its members have been active in the affairs of our Working Group. In addition, Zeki Aslan of Antalya has been appointed Chair of the Local Organizing Committee.

IAU Commission 45 is serving as the Sponsoring Commission for the Symposium. In addition, the Symposium has been endorsed by Commissions 27, 29, and 36, and I thank the former Presidents of those Commissions for writing letters in support of our proposal.

The precise meeting site for Symposium 177 is still uncertain. In August I spent several days in Antalya with LOC Chair Zeki Aslan, and we visited about a dozen large hotels in Antalya and the nearby town of Kemer. All were interested in hosting the Symposium, and several gave us quotations for the costs involved. One hotel, at a particularly beautiful and convenient location, seemed ideal except for its somewhat inferior conference room; and when they showed us drawings for a new conference center that they were planning to build on an adjacent promontory overlooking the Mediterranean -- and assured us that it would be ready before the end of 1995 -- we thought we had found the perfect site. Unfortunately, the hotel informed us in December that the construction of their conference center has been delayed indefinitely. Consequently our two LOC members in Antalya have been revisiting the other hotels and collecting bids. Fortunately several hotels are still interested. We hope to make a final decision on the meeting site within a few weeks.

Until the site is pinned down, we cannot be absolutely certain about the dates. We are, however, aiming for the last week of May, 1996. That is the date that will be announced in the next issue of the IAU Information Bulletin, and we will not change it unless absolutely necessary.

The previous issue of this Newsletter (June 1994) included a preliminary draft of the scientific program for Symposim 177; we expect to be able to present a more definitive program in the next issue (June 1995).

B. Working Group Sponsorship by Commission 27 on Variable Stars

In the course of the IAU General Assembly in The Hague last August, John Percy, the out-going President of Commission 27 on Variable Stars, informed me that his Commission was interested in being considered a sponsor of the Working Group on Peculiar Red Giants. At John's suggestion, I attended a business meeting of Commission 27 and spoke briefly about the purposes of the WG, our Newsletter, and our symposium proposal. A motion was made, and enthusiastically passed, expressing the desire of Commission 27 to become a sponsor of the WG.

As you know, our WG has had two sponsors -- Commission 29 on Stellar Spectra and Commission 45 on Stellar Classification -- since it was established as an IAU Working Group at the 1985 GA in New Delhi. Our officers, mailing lists, and meeting programs consequently have always had a spectroscopic slant. However, it seems to me that our WG could pay more attention to the well-known fact that most red giants are variable both in brightness and in spectrum, and I expect that variability studies will play a significant role at Symposium 177. I therefore feel it is very appropriate to include Commission 27 among our sponsors. You may have noticed that the cover of this paper edition of the Newsletter has been modified to include Commission 27.

At a time when the IAU is considering a drastic streamlining of its structure and a major reduction in the number of Working Groups, the survival of existing Working Groups may depend on the interest shown in them. This evidence of interest in our WG by Commission 27 could not have come at a better time.

C. Business Meeting of August 20, 1994

The Working Group on Peculiar Red Giants held a Business Meeting in The Hague on Saturday morning, August 20, in conjunction with the 22nd General Assembly of the IAU. It was attended by 25-30 people, including 5 members of its Organizing Committee.

I began the meeting by describing our symposium proposal. I had understood that the Executive Committee would act on the proposal on August 14, but on that day the EC decided to consider only the proposals for meetings in 1995, leaving the fate of 1996 meetings to be decided by the incoming EC two weeks later. At our Business Meeting, therefore, we could speak only of the "proposal", and all of us left The Hague before learning its outcome. [In fact I did not learn the EC's decision until late September]. I did, however, show a number of freshly-developed slides of Antalya and its hotels, and I slipped in a few slides of Ulugh Beg's ancient observatory in Samarkand and the modern Assy Observatory in Kazakhstan, which I had visited in July.

Other business concerned the future of the WG, its officers, and its Newsletter. Since the EC had been considering restructuring proposals that would consolidate commissions and eliminate many of the WGs, there was some doubt, when we arrived in The Hague, whether our WG and its sponsoring commissions would continue to exist beyond the General Assembly. However, by the time of our Business Meeting the EC had informed us that they would be taking no drastic action at that time, and that the current body of commissions and working groups would be retained for another triennium while the restructuring proposals were discussed further. Thus we were able to make plans for the next three years.

A WG needs a Chair, and a Newsletter needs an Editor. I received no nominations for either position in response to the appeal in the last issue of the Newsletter, and no nominations were made at the Business Meeting either, even though self-nominations were encouraged. Hollis Johnson moved that I should continue as Chair, and this motion was seconded and passed without audible dissent. I was also asked to ask Sandra Yorka to continue as Editor, and I am very pleased that she has agreed to do so.

D. Changes in the Working Group's Organizing Committee

With regard to other members of the WG's Organizing Committee, there is only one change to report. Because of the small attendance at our Business Meeting, I did not consider it a good time to try to elect a completely new slate of OC members, as we had done in 1991. We simply collected ideas concerning possible future OC members, in case vacancies should arise.

During the Autumn I contacted all current members of the OC and asked if they would like to serve for another triennium. All but one responded affirmatively; the exception was Hollis Johnson, who had already served three terms, including one as Chair. I am pleased to report that John Lattanzio, of Monash University in Clayton, Australia, has agreed to take Hollis's place on the OC. John is a theoretician who specializes in stellar interiors and evolution, and he brings to the OC a dimension that we did not have previously.

This change takes effect, I presume, with the distribution of this Newsletter. A revised list of OC members and their addresses is given at the end of this issue.

E. Thanks to Hollis

With Hollis Johnson's departure from the Organizing Committee, I would like to thank him for his tremendous efforts on behalf of the Working Group on Peculiar Red Giants and the whole field of research that our WG represents. Hollis has served on the Organizing Committee since its beginning in Strasbourg in 1984, and he chaired it from 1988 to 1991. He also organized the very successful IAU Colloquium 106, which was held at Indiana University in 1988. Although he has recently retired from teaching, he remains active in research and is presently turning out model atmospheres at the Niels Bohr Institute in Copenhagen (although he still answers e-mail sent to Indiana). Hollis will continue as a member of the SOC for Symposium 177 and, I trust, as a frequent contributor to this Newsletter!

--- Robert F. Wing
Chair, WG on Peculiar Red Giants

II. SPECIAL REPORT

A COMPARISON OF s- AND r-PROCESS NUCLEOSYNTHESIS IN THE GLOBULAR CLUSTER OMEGA CENTAURI

Verne V. Smith
Department of Astronomy, University of Texas, Austin TX 78712
verne@astro.as.utexas.edu

The globular cluster Omega Cen is the most massive of known Galactic globular clusters and is unique in displaying large star-to-star variations in the abundances of all elements analyzed up to now. Although it is well established that there exist star-to-star abundance variations in all other globular clusters studied, these variations are restricted to carbon and nitrogen, and in many cases oxygen, and in some clusters sodium and aluminum. Excellent and comprehensive reviews of these latter abundance variations can be found in Smith (1987, PASP 99,67), Suntzeff

(1993, in "The Globular Cluster-Galaxy Connection", ASP Conf. Ser., Vol. 48, p. 167), or Kraft (1994, PASP 106, 553). A common theme quite probably uniting the C, N, O, Na, and Al variations is that this quintet of elements can have their abundances altered by various aspects of H-burning in low- to intermediate-mass stars (Langer, Hoffman, and Sneden 1993, PASP 105, 301; see also Denisenkov and Denisenkova 1990, Soviet Astron. Lett. 16, 275 in reference to more massive stars). The heavier nuclei, such as Ca or Fe and the neutron-rich elements past the Fe-peak, require more advanced nuclear burning stages, or later stages of stellar evolution, in order for their abundances to be changed measurably.

In contrast to all the globular clusters which display abundance variations in the limited suite of elements whose abundances are altered by H-burning, it was recognized almost thirty years ago that Omega Cen is different and must have star-to-star variations in the abundances of Fe-peak elements. This recognition came about through the observation of the large width in color of the giant branch of Omega Cen, signifyng a range in the abundance of iron, or at least a variation in some combination of the electron donors in the stellar envelope such as Ca, Mg, or Si (Woolley et al. 1966, Roy. Obs. Ann. No. 2; Cannon and Stobie 1973, MNRAS 162, 207). High-resolution spectroscopic analyses of stars in Omega Cen by Cohen (1981, ApJ 247, 869), Mallia and Pagel (1981, MNRAS 194, 421), and Gratton (1982, A&A 115, 336) indeed found variations of nearly 1.0 dex in all elements studied, including Fe, Ca, Mg, Si, and Ti, as well as the heavier elements such as Sr, Zr, and Ba. It thus appears that Omega Cen underwent a period of sustained star formation (perhaps lasting 10**9 years) during its early history, with chemical self-enrichment and evolution occurring within this stellar system, independent of any galactic chemical evolution processes.

It is also known from spectroscopic observations that Omega Cen contains numerous heavy-element-rich stars that are classified as CH, barium, or S stars (Dickens and Bell 1976, ApJ 207, 506; Lloyd Evans 1983, MNRAS 204, 975). These heavy-element stars contain overabundances of carbon-12, along with the heavy elements produced by the slow capture of neutrons onto Fe-peak seed nuclei: the so-called s-process. Stars overabundant in 12C and the s-process elements are usually associated with stellar evolution through He-burning thermal pulses along the asymptotic giant branch (AGB) and the subsequent "third dredge-up". Among the field stars, most S stars are AGB stars undergoing thermal pulses and the third dredge-up, while the lower-luminosity barium and CH stars are binary systems with a white dwarf star that, when it was a thermally-pulsing AGB star, transferred s-process and 12C-rich material to its companion, which is now viewed as a CH or barium star (McClure 1984, PASP 96, 117). The heavy-element-rich stars in Omega Cen are not of high enough luminosity to be thermally-pulsing AGB stars, and a simple assumption would be to associate these peculiar stars with the field stars sharing similar overabundances: the binary barium and CH stars. Lloyd Evans (1983) suggested, however, that the peculiar stars in Omega Cen may not be the result of binary evolution, but rather the result of primordial abundance peculiarities in the gas from which the stars formed. Such a picture would suggest that the internal chemical enrichment in Omega Cen must have contained large contributions from thermally-pulsing AGB stars. Support for Lloyd Evans' hypothesis was provided by abundance analyses of s-process elements as a function of [Fe/H] in the stars of Omega Cen by Francois, Spite, and Spite (1988, A&A 191, 267), Paltoglou and Norris (1989, ApJ 336, 185), and Vanture, Wallerstein, and Brown (1994, PASP 106, 835): these authors found that the s-process to Fe abundance ratio [s/Fe] increases as the overall Fe abundance [Fe/H] increases in the cluster. If Omega Cen has undergone internal chemical enrichment, then the most metal-rich stars must be among the last to form, and it is these stars that are the heavy-element-rich members classified as CH, barium, or S stars. If these peculiar stars were the result of binary mass transfer, it is not clear why the most metal-rich stars should be strongly favored for being in binary systems. The Lloyd Evans hypothesis of primordial enrichment of the gas in Omega Cen through stellar and chemical evolution appears to be the simplest one, although it implies that the gas in Omega Cen was contaminated heavily with the products of s-process nucleosynthesis.

In our current study of Omega Cen members (Smith, Cunha, and Lambert 1995, in preparation), we have obtained the first abundance determinations of an r-process element to compare to the s-process species; the r-process of rapid neutron capture is usually associated with Type II supernovae, which, of course, are massive stars. Our analysis is based upon spectra obtained at Cerro Tololo Inter-American Observatory with the 4-m telescope and cassegrain cross-dispersed echelle spectrometer (plus CCD detector) operated at a spectral resolution of R = 18,000. We have analyzed a sample of warm giants with Teff = 4100-4600 K, spanning a range in metallicity [Fe/H] from -1.0 to -2.1, and for which we have excellent high-S/N spectra (S/N ~ 100-200). Included in the abundance analysis are the primarily s-process elements Y, Ba, and La, along with the r-process element Eu. We find the same results for the s-process species as in the previously-mentioned studies, namely, a large increase in [s/Fe] with increasing [Fe/H]. On the other hand we find a remarkable deficiency in [Eu/Fe] in the Omega Cen stars, with perhaps a slight trend of increasing [Eu/Fe] with increasing [Fe/H]. The values found here for [Eu/Fe], from -0.8 to -0.2 over the range from -2.0 to -1.0 in [Fe/H], are lower than any obtained in previously studied field halo stars at these metallicities. In fact, a comparison of Eu to the s-process elements in Omega Cen indicates that the Eu abundances can be explained completely, or almost completely, as s-process in origin. This result stengthens the conclusion that the chemical enrichment history of Omega Cen was dominated largely by contributions from s-process nucleosynthesis for the heavy elements and appears to be distinct from that of the vast majority of field halo stars studied to date. This makes Omega Cen an attractive laboratory for probing AGB heavy-element synthesis and, up to now, a unique system displaying chemical evolution of a somewhat different sort.

III. RESEARCH NEWS

T. Soyano and H. Maehara (Okayama Astrophys. Obs.) have been making a deep Schmidt survey of cool carbon stars along the galactic plane (1987-1993). They have issued the following six lists with finding charts:

Vol.	Region	Longitude	Area	No. of Stars
1.	Cassiopeia	120	180	210
2.	Anticenter	180	200	125
3.	Cygnus	90	240	128
4.	Serpens-Aquila-Scutum	30	240	60
5.	Perseus-Camelopardaris	150	235	226
6.	Monoceros	210	235	135

These lists were published in the Annals of the Tokyo Astronomical Observatory (Vols. 1-3) and the Publiations of the National Astronomical Observatory (Vols. 4-6). In total, 884 carbon stars were detected in 1330 square degrees along the northern plane. Many new carbon stars were discovered in the earlier lists, and the first and second lists were merged in the General Catalogue of Cool Carbon Stars (Stephenson 1989). But the majority of the stars in the later lists are identified with stars in Stephenson's Catalogue, IRAS sources, and recent deep surveys. The survey will be finished soon, perhaps after one more list. Soyano and Maehara are making follow-up observations of these carbon stars with the Kiso and Okayama telescopes.

The source OH 231.8+4.2 consists of a Mira variable star embedded in a highly collimated bipolar nebula and thus appears to be representative of a transitional stage between a red giant and a planetary nebula. J. Kastner (MIT) and D. Weintraub (Vanderbilt U.) have obtained polarimetric near-infrared images of this source to ascertain its density structure (AJ, in press, March 1995). The patterns of polarization revealed in J and K images are characteristic of scattering of light from the central star by dust distributed in bipolar lobes. The signature of a dense circumstellar disk, previously hypothesized to explain the obscuration of the central star at optical and near-infrared wavelengths, is evident in the polarization maps and in a map of J-K color. Combined with the polarization information, the measured color gradients across the bipolar lobes suggest that the lobes are evacuated bubbles. Various lines of evidence suggest that only a small fraction of the total nebular mass resides in the circmstellar disk. This finding would appear to set OH 231.8+4.2 apart from other "classical" evolved bipolar nebulae, in which disks may dominate the circumstellar masses. Kastner and Weintraub suggest that the OH 231.8+4.2 nebula may be the endpoint of stellar evolution for an early A star that was surrounded throughout its main-sequence lifetime by a particulate disk. Such a disk might have resembled the dusty disk around Beta Pictoris and, like that structure, would have had to be continually replenished in order to survive until the central star's ascent of the red giant branch. This model naturally explains the confinement of bipolar planetary nebulae to low galactic latitudes.

Kastner and Weintraub also conducted a similar polarimetric near-IR imaging investigation of IRC+10216 (1994 ApJ 439, 719). These images demonstrate convincingly that the dust envelope of this prototypical mass-losing carbon star is not spherically symmetric, and they support a model in which the envelope of IRC+10216 is weakly bipolar and viewed at an intermediate inclination angle such that we have a direct line of sight to the central star. The axisymmetric near-infrared intensity and polarization morphologies are best understood in terms of enhanced mass loss in the equatorial plane. These observations make clear that axi-symmetric structure can be well established before an intermediate-mass star leaves the asymptotic giant branch. It is possible that the dust envelope of IRC+10216 presents an early manifestation of the more pro-found bipolar structure that characterizes highly evolved carbon-rich pre-planetary nebulae such as AFGL 2688.

L. Zacs (Riga), with V.G. Klochkova and V.E. Panchuk (Nizhny Arkhyz), has carried out observations of the proto-planetary nebula candidate IRAS 22272+5435. A high-resolution, high signal-to-noise spectrum was obtained with the 6-m telescope. The spectroscopic indicators provide the atmospheric parameters Teff = 5600 K and log g = 0.5 (cgs), approxi-mately equal to those for G2 supergiants. The authors find that IRAS 22272+5435 is iron poor: [Fe/H]= -0.49 dex; however, other iron-peak elements are overabundant. A standard LTE analysis with model atmospheres shows that Li is overabundant in IRAS 22272+5435. The carbon abundance based on three CI lines and the oxygen abundance computed from the for-bidden line at 6300.32 A gives C/O ~ 12. The elements of the alpha-process are found to be overabundant relative to the Sun, except for Ca, which has a normal abundance. Heavy neutron-capture elements are over-abundant, by +2.0 dex on the average. The radial velocity derived from roughly 40 absorption lines is found to be -39.7 km/sec, suggesting that IRAS 22272+5435 probably does not belong to the halo. The observed asym-metry of strong absorption lines may be the result of velocity gradients, probably mass outflow, in the atmosphere of this object. The radial velo-city, low iron abundance, overabundance of carbon and s-process elements, and the detached circumstellar shell suggest that IRAS 22272+5435 is an evolved low-mass star of the old (thick) disk population.

B. Hrivnak (Valparaiso Univ.), in a paper soon to be published (ApJ, Jan. 1995), presents a spectroscopic study of 6 post-AGB proto-planetary nebulae (PPN), which all display the spectra of G-type supergiants. They each are found to show absorption features of molecular carbon (C2, and in most cases C3) and strong absorption lines due to s-process elements in their visible spectra. Other evidences of a carbon-rich nature are found in published molecular line millimeter emissions (CO and HCN) and 3.3-micron features attributed to PAHs. These properties are in accord with what one would expect in a post-AGB star in which carbon-rich material formed in thermal pulses is dredged up to the surface of a mass-losing object. A correlation is found between the presence of molecular C2 absorption and the presence of the recently discovered (Kwok et al. 1989, ApJ 360, L23) but unidentified 21-micron emission feature. This strengthens the suggestion that carbon is a major component of the mole-cule producing this feature. Four additional PPN which share some of these properties are also discussed.

Kwok (U. Calgary) and Hrivnak have continued their observational study of PPN, gathering photometric and spectroscopic data on a number of newly-identified PPN candidates selected from cool IRAS sources. Hrivnak and collaborators have been monitoring a number of these and have found them to display radial-velocity and photometric variability.

T. Lloyd Evans (SAAO) reports that V Hya continues its currently spectacular career, with intense resonance emission lines and bands in March and May 1994, weaker in July but with signs of fresh mass ejection. R Lep still had emission of NaD, KI and RbI in July and subsequent visual observations showed that it was experiencing a faint minimum following a faint maximum in May. The accretion disk in the V Hya system was in a high state in May, the first seen for some time - a good opportunity to study it while the carbon star is faint, but of course it hides the blue-violet spectrum in the latter so one cannot see possible C3 or CN emission which may well arise from resonance emission. Further observations are planned.

R.E. Stencel (Univ. Denver) and collaborators report on their site survey for the Womble Observatory on Mt. Evans, Colorado (elev. 4303 m). A sky-brightness model based on the methods of Garstang predicts a Mt. Evans zenith sky brightness of 21.65 mag per square arcsec in V. V-band CCD observations of the photometrically-calibrated cluster NGC 7790, obtained in Aug./Sept. 1994 during a period marked by forest fires in the Western U.S., indicate an observed near-zenith sky brightness no brighter than 19.5 mag per square arcsec. Additional observations are planned to determine whether seasonal differences occur. Acoustic sounding observations of the airflow over the observatory indicate an atmospheric correlation length of a few meters and a long-exposure seeing disk of less than 1 arcsec. Concurrent in-dome seeing tests with an antique on-site 0.6-m telescope indicate times of sub-arcsecond seeing; further statistics are being developed. Negotiations with the U.S. Forest Service for permission to build a 4-meter-class optical-IR telescope are proceeding well, and the authors would like to contact additional potential collaborators for this project.

M. Jalakas and R.E. Stencel (Univ. Denver), with K.G. Carpenter (NASA/Goddard) and R.D. Robinson (Computer Sciences Corp.), have used HST and IUE observations to study of symbiotic binary CI Cygni, which consists of a hot star orbiting a red giant. Matter from the larger star is being transferred to the smaller one. Both IUE and, more recently, the Goddard High Resolution Spectrograph on HST have detected variable ultraviolet emission lines produced by this transfer. By observing phase-dependent changes in the Doppler velocity of the matter, it is possible to map the direction of the flow. The authors have re-examined two different types of lines -- resonance and inter-combination -- which had been reported to show velocity differences. With these data they find the relative locations of high- and low-density features in the matter transfer.

W.H. Bauer, T.G. Grenfell, and D.M. Taylor (Wellesley College), in collaboration with R.E. Stencel (Univ. Denver), have observed short-time-scale variations in IUE spectra of the long-period interacting binary VV Cephei. Significant changes in the ultraviolet line profiles have been seen on time scales as short as two weeks in this 20-year eclipsing system. In addition, ultraviolet fluxes obtained by integrating the IUE spectra have shown variations of nearly a factor of two over two-week intervals.

A consortium of 16 astronomers led by H.R. Johnson (Indiana Univ.) and including 3 other members of our WG's Organizing Committee (U.G. Jorgensen, M. Querci, and R.F. Wing) has completed its examination of the ultraviolet spectrum of the first carbon star to be observed with HST, UU Aurigae. The data consist of a low-resolution FOS spectrum covering the interval from 2222 to 3275 A and a high-resolution GHRS spectrum in the more restricted (2787-2833 A) region of the Mg II h and k lines. Emission lines from C II, Mg I, Mg II, Al II, Si II, Fe I, and Fe II are identified in the FOS spectrum. One of the Fe I lines, a narrow feature at 2807 A not previously reported but also seen in the high-resolution spectrum, is identified with a line of Fe I multiplet UV45 and attributed to fluorescence, caused by the wavelength coincidence between the strong C II line at 2325 A and a predicted line of Fe I (UV13), which has the same upper state as the 2807 A line. The complex Mg II profiles show evidence of outflow velocities of 40-60 km/sec in the chromosphere, although the outflow at the top of the chromosphere, where the Mg II self-absorption arises, is reduced to about 10 km/sec. Careful empirical NLTE modeling of the chromospheric temperature and velocity structure is being undertaken in an attempt to shed light on the relationship between stellar chromospheres and the phenomenon of mass loss.

N. Mauron (Montpellier) and Ch. Guilain (Toulouse) have detected Na I and K I emission around Beta Peg (M2.5 II), Rho Per (M4 IIIa), and CE Tau (M2 Iab), thus expanding on previous detections to very low mass loss rates. Supplementary data for Alpha Ori and Mu Cep, and upper limits for TX Psc, Y CVn, Rho Cas and BU Gem, were also obtained. The line ratio NaI(5896)/KI(7699) was found to be about 3, within a factor of 2, for the envelopes of Mu Cep, Alpha Her, and Omicron Cet. It is considerably different for Alpha Ori, in the sense that Na I is about 80 times too faint. CE Tau seems to display a similar effect. Their analysis suggests that Na I interstellar absorption in the line of sight to Betelgeuse is the simplest explanation, although not completely convincing. Despite its location in the galactic plane, the shell around Mu Cep would not be so strongly affected by interstellar Na I owing to a favorable Doppler shift. If the faintness of Na I emission in Betelgeuse is due to such interstellar mutilation (and possibly also to envelope inhomogeneities and measurement errors), these observations strengthen the evidence for a low condensation of K and Na in oxygen-rich envelopes with moderate mass-loss rates.

C.J. Skinner (Lawrence Livermore Nat. Lab.) has observed the 8-13 micron spectrum of the unusual dusty early-R star HD 100764 and confirms its large IR excess. Contrary to earlier speculation this star does not have silicate dust around it and is probably not directly linked evolutionarily to the controversial carbon stars with silicate dust features. To explain the IR brightness with a reasonable total mass in the dust shell, it is proposed that HD 100764 has a dusty disk comprised principally of amorphous carbon, with a grain size distribution fairly similar to those seen in Vega-excess stars. It seems most likely that the star acquired its dusty disk from a companion which has already evolved through the AGB and PN phases.

IV. SPECIAL TOPICS

MULTIFREQUENCY OBSERVATIONS OF THE SYMBIOTIC STAR AG DRACONIS DURING ITS 1994 OUTBURST

Roberto Viotti
Istituto di Astrofisica Spaziale, CNR, Via Fermi 21,
00044 Frascati, Italy
uvspace@v8550.ias.fra.cnr.it
or viotti@astrom.rm.astro.it
FAX: 39-6-9416847

AG Dra is a symbiotic binary with a K3 III type primary and a hot subdwarf secondary. The star is one of the most interesting symbiotic stars for many reasons. It is a high-velocity, high-galactic-latitude star (i.e. a Halo object). The light curve is very irregular, with many light maxima with amplitudes of 1-2 mag and long-lasting phases of minimum (around V = 10). The quasi-periodic (about 554 d) variation in the U band is probably associated with the orbital motion of the system. According to Huang et al. (1994 A&AS, 106, 413), the cool component of AG Dra may be a supergiant, and this fact might help to overcome theoretical difficulties in explaining its outbursts. AG Dra is also the most intense X-ray source among symbiotic stars.

The historical light curve of AG Dra is characterized by numerous light maxima between 1890 to 1966. After 1966 the star remained at minimum (about V = 10) until November 1980, when it brightened to V = 8.3. After a phase of gradual fading, there was a new maximum of V = 8.5 in December 1981. This active phase in the early 1980s was well studied in the optical and UV, and it was one of the most spectacular events followed with IUE (but unfortunately not with an X-ray satellite). By mid-1983 AG Dra was again at minimum.

Subsequently, two minor episodes occurred in February-March 1985 (when it reached V = 9.3) and in January-February 1986 (Vmax = 9). These episodes were followed with both the IUE and EXOSAT satellites. It was found that, while the UV emission-line and continuum intensity followed the visual light curve, the X-ray flux faded considerably during both maxima. This behavior might be due to a temperature drop of a non-black-body hot component, or to the continuous absorption of the X-rays shortward of the N IV ionization limit. Since the summer of 1990, AG Dra has been observed with the ROSAT PSPC on several occasions, unveiling a supersoft X-ray emission suggesting steady hydrogen burning during its previous low state (K.F. Biekert, J.C. Greiner, et al., in prep.).

In June 1994 AG Dra started a new major phase of activity (IAU Circular 6009), marked by a rapid brightening from V = 9.9 to V = 8.4 on June 14, followed by a slower increase to 8.1 on July 6-10. This rise was accompanied by a considerable brightening of the IUE continuum and the optical and UV emission-line fluxes, which in the beginning of July appeared stronger than during the 1981 outburst (IAUC 6039, 6044). The He II 164 nm line is very strong. ROSAT HRI observations were also made, and the data analysis is in progress at MPE.

The behavior of AG Dra in the coming months cannot be predicted, but the intensity of the 1994 outburst is strongly suggestive of an episode of very long duration (many months to 1-2 years). We therefore urge observers to continue monitoring this object throughout 1995 with any facility, including ground and space spectroscopy, polarimetry, and narrow-band imagery.

For further information, contact R. Viotti by mail, email, or FAX as given above.

V. MEETINGS

February 6-10, 1995
Astrophysical Applications of Stellar Pulsation
Cape Town, South Africa
Contact: R. S. Stobie
pulsation@saao.ac.za

March 27-30, 1995
Astrophysics in the EUV
IAU Coll. 152
Berkeley, California, USA.
Contact: S. Lilly
iau152@cea.berkeley.edu

June 18-23, 1995
The Origins, Evolution, and Destinies of Binaries in Clusters
Calgary, Alberta, Canada
Contact: E. F. Milone
milone@acs.ucalgary.ca

June 25-30, 1995
Cataclysmic Variables and Related Objects
Keele, Staffordshire, England
Contact: F. A. Ringwald
far@astro.keele.ac.uk

July 3-7, 1995
Radio Emission from the Stars and the Sun
Barcelona, Spain
Contact: J. M. Paredes
radio@mizar.am.ub.es

July 10-21, 1995
Evolutionary Processes in Binary Stars
Cambridge, England
bin95@mail.ast.cam.ac.uk

October 3-6, 1995
Cool Stars, Stellar Systems and the Sun
9th Cambridge Workshop
Florence, Italy
Contact: R. Pallavicini
pallavic@arcetri.astro.it

October 9-11, 1995
Formation of the Galactic Halo: Inside and Out
- honoring the 65th birthday of George Preston
Tucson, Arizona, USA
Contact: R. Zinn
zinn@astro.yale.edu

October 9-13, 1995
Stellar Surface Structure
Vienna, Austria
Contact: K. G. Strassmeier or J. Linsky
iau@astro.ast.univie.ac.at
jlinsky@jila.colorado.edu

VI. THE WG ORGANIZING COMMITTEE

Uffe Grae Jorgensen
Niels Bohr Institute
Blegdamsvej 17
DK-2100 Copenhagen
Denmark
uffegj@nbivax.nbi.dk

John Lattanzio
Dept. of Mathematics
Monash University
Clayton, Victoria 3168
Australia
johnl@flash.maths.monash.edu.au

A. Mario Magalhaes
Instituto Astronomico e Geofisico
Universidade de Sao Paulo
Caixa Postal 9638
Sao Paulo,SP 01065-970
Brazil
magalhaes%iagusp.decnet@fapg.fapesp.br

Monique Querci
Obs. Midi-Pyrenees
14 Avenue Edouard Belin
F-31400 Toulouse
France
querci@obs-mip.fr

Verne V. Smith
Dept. of Astronomy
University of Texas
Austin, TX 78712
USA
verne@astro.as.utexas.edu

Robert E. Stencel
Dept. of Physics & Astronomy
Univ. of Denver
Denver, CO 80208
USA
rstencel@diana.du.edu

Takashi Tsuji
Tokyo Astronomical Observatory
Mitaka
Tokyo 181
Japan
ttsuji@c1.mtk.nao.ac.jp

Robert F. Wing
(WG Chair)
Dept. of Astronomy
Ohio State Univ.
174 W. 18th Ave.
Columbus, OH 43210
USA
wing.1@osu.edu

Sandra B. Yorka
(Editor)
Dept. of Physics & Astronomy
Denison University
Granville, OH 43023
USA
yorka@cc.denison.edu