POSTER PAPERS - SESSIONS 3 and 4.

Chairman : J. GRAHAM.

Graham:

The two papers on (1) the new results for Eta Carina by Viotti et al. and (2) that by Wolf et al. on Be stars in the MC's both pointed out that one is not always dealing with perfect symmetry in these objects. It bothered me this morning that we seemed to be concentrating on the simplest geometrical case of spherical symmetry in the stellar winds. Is this an observational fact or a necessary thing to adopt in order to make any progress?

Lamers:

For the star P Cyg we have no evidence that the wind is not spherically symmetric. For Be stars there is strong evidence that their mass loss is not spherically symmetric. For instance the mass loss rates derived from UV observations for pole on stars is about 100 times smaller than from the IR observations where we are able to see emission from the disk.

Stalio:

A general comment on the stars we discussed this morning. The structure that has been presented today involves a star, a wind and a cool static shell around the wind - a kind of PN structure except in that case the wind is hot and of high velocity. Now what happens to this static shell when the wind hits it, particularly at a phase where the mass loss rate has increased by say a factor of 100. Is it destroyed or does it act like a barrier around the star? Secondly the kind of structure envisaged is quite contrary to what is observed for a WR star where we have a hot wind with very high velocity. If these stars come from P Cyg stars what happens to the shell?

Graham:

I wanted to highlight the poster paper by Azzopardi and Meyssonier which gives new results on a survey for H-alpha emission line stars in the LMC based on a 4 hour exposure Schmidt plate, which is pretty hard to get. I hope the paper will give details of the plate epoch since it is very important to know when a star starts becoming an emission line object and when it stops being so.

C. W. H. De Loore et al. (eds.), Luminous Stars and Associations in Galaxies, 277–283.

Kontizas M.:

What evidence have you that the H-alpha emission stars are Be stars and how many Be stars have been found compared to the total number of B stars?

Azzopardi:

This survey is at an early stage. At present we have identified all kinds of H emission-line objects which are mainly Be stars, PN, and unresolved HII regions. Nevertheless, if we consider the H emission line objects showing up a continuum we can say that about 80% of discovered field objects are Be stars.

Kontizas E.

Are the H emission objects cluster or field stars and for the cluster NGC 330 do the H emission objects you find coincide with the Be stars found years ago by Feast?

Azzopardi:

It is not known if they are cluster stars, and the objects we are finding are not the same as those found by Feast.

Graham:

I want to turn now to some posters dealing with individual objects. The question I have for Wolf and Stahl concerning MWC300 is : to what extent is the distance above the plane sensitive to the interstellar extinction used; could it be closer and therefore possibly not a runaway star?

Wolf:

We are fairly sure of its distance if the identification with a hypergiant is correct and there are strong indications that it is a hypergiant in that its observed absorption spectrum is almost identical to usual hypergiant spectra.

de Jager:

The results from the paper dealing with V444 Cyg are cearly very important. Do all WR stars have this high temperature?

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Conti:

I would not be surprised if we had some WN5 stars at one temperature and others at another - it would be scary but it would not surprise me. There are not very many WR eclipsing binary systems suitable for this kind of analysis. We really need to apply better models for these stars to get a handle on meaningful temperatures.

Lamers:

Is it true that one really has to go well above 50000 K for WR temperature to get mass loss rates from radiation pressure to those observed?

Conti:

If you want WR mass loss to be radiatively driven you need these high temperatures. Also if they are He burning then the He burning Main Sequence is generally at these hot values.

Stickland:

I'd throw in the comment that in our recent study of CQ Cep, where we used the binary characteristics and the distance, if we took a temperature of 30000K we got serious over-contact. This could only be relieved by raising the temperature above about 55000K even though it is a WN7 star.

Kudritzki:

A comment concerning the WR stars. The big problem in the past for models of WR atmospheres was that no matter what one did you could never produce an extended atmosphere. Now when you take these high temperatures you come close to the Eddington limit, and you can easily get an extended photosphere with supersonic velocities.

Nugis:

How can you reconcile the adopted high effective temperature with the presence of strong HeI lines in the spectrum of V444 Cyg?

Kudritzki:

Up to now we did not concentrate on line formation calculations. However, assuming grey radiative equilibrium in the wind, the

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temperature quickly drops to 30000K at r = 3r* from 90000K at r (Tau Ross = 1). In consequence there is a change to explain the HeI lines. However, I agree that it will be crucial for future work to check the temperature structure of the wind against the line spectrum information.

Vanbeveren:

How does the luminosity you obtain and the binary mass of V444 Cyg correspond with the theoretical M-L relations for He burning stars?

Kudritzki:

If we assume 90000K for T(eff) at r = 2.9R(sun) then we are above the Zero Age Helium MS by a factor of two in L. This is not too worrying since we expect the observational He MS to have a certain bandwidth. In addition even if we go to the lower limit of 70000 K given by Cherepaschuk et al. we get a reasonable value of L though the extension of the photosphere is somewhat reduced. However, several quantitative improvements in the calculation of the line force will have to be made before we can become really ambitious and compare the results with evolutionary calculations in detail. Another question is whether the WR stars could be He shell burning?

Chiosi:

The lifetime in He shell burning is extremely short.

Lamers:

I would like to ask a question on the paper by John Hillier. In your thesis you showed that the velocity law in the WR star HD 50896 goes in two steps: first an acceleration to 1800 km/s and then, much further out, a second acceleration region up to 2700 km/s. Do you still require this two-step acceleration in your new models?

Hillier:

The model still requires the wind to reach its terminal velocity at large radii. Constraints on the velocity law come from the optical line profiles of HeII and HeI. For example, the HeII (n - 4) transitions show no evidence for emission at veloxities > 1800 km/s, whereas the terminal velocity derived from the UV lines is about 2700 km/s. From the illustration I have given of the region where the HeII lines are formed it follows that the wind velocity must be lower than 1800 km/s at r < 20r(core). The HeI profiles push the limit to even larger radii in the wind.

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Graham:

I want to turn now to the papers dealing with searches for WR stars in galaxies. It seems to me that the interpretation of such searches can be very sensitive both to bias and also to completeness, and that we need to put on a quantitative basis estimates of completness.

Moffat:

Surveys of WR stars in galaxies can give meaningful results if treated differentially (e.g. comparing the numbers of stars of a given type down to a limit in absolute magnitude and line strength in one galaxy an another) as opposed to absolute comparisons.

Graham:

The paper by McGregor, Hyland and Hillier on southern P-Cygni stars shows tht we are dealing with a complex situation. Not only do they show FeII and MgII in the environment but strong evidence for molecular CO emission, which of course just to exist has to come from a pretty low temperature regime of a few thousand degrees or so. Again this shows that we are not dealing with a simple situation with these stars.

Lamers:

Where do they think these CO lines are formed? In the star P-Cygni which is not in their sample, we found some evidence for cool dust at a temperature of about 600 K.

Viotti:

I think one important result, derived with two different methods by the Heidelberg and France-Italy groups, is in the evidence for asymmetry in the expanding envelopes of these very luminous line stars in the MC's. This would be an important step to explain some peculiarities such as the presence of circumstellar dust referred to by Lamers. In your list you include some objects which are not proper P Cygni stars, such as the binary GG Car and the symbiotic star BY Car. Actually in the latter star you can find some easier explanation for the CO emission.

Graham:

I would like to ask how the results on emission line stars

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compare between the studies by Bohannan and that by Stahl et al. ?

Bohannan:

I compared my spectroscopic description of emission-line stars that were in common with the work of Stahl et al. on bright emission-line stars in the LMC. I found that those stars which I found different from the earliest descriptions by Feast, Thackeray and Wesselink, showed variations in the short time interval between my spectra and those of Stahl. Those that showed no variations on the long timescale appeared similar also on the short timescale. If these are to be identified with Hubble-Sandage variables, or whatever we call luminous blue variables with emission lines, it should be noted that some of them have an almost constant spectroscopic appearance over the past 25 years and show none of the obvious photometric or spectroscopic variability of the real H-S variables in M33.

Graham:

Walborn certainly convinced me that it looks like the idea of a supermassive, > 1000 M_o object in the centre of R136 is not on. I would like to ask Appenzeller and de Jager whether they are happy to consider stars of say 200 M_o.

Appenzeller:

I do not see any insurmountable difficulties for such objects.

de Jager:

I agree with Appenzeller that 200 M_o stars will be stable, showing only (weak) vibration, but their atmospheres may be near-unstable, with the Eddington-gamma close to unity, so that small disturbances, like the vibrations mentioned, will be sufficient to cause strong (episodal) ejection of mass, in extreme cases even comparable to the Eta Carina events. Actually Eta Car may be such a case.

Feast:

I would like to ask Nolan Walborn if the derived stellar content of 30 Doradus, with its large WR population but lack of HS variables rules out the hypothesis that the latter evolved into the former as we have heard discussed several times at this meeting.

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Walborn:

It is likely that the most luminous, narrow-lined, WN objects found in 30 Doradus and the Carina nebular can be produced from very massive stars without a H-S phase. Eta Carina may be considered an extreme H-S variable; it may represent a short-lived post-WN, pre-supernova stage of a very massive star.

Zinnecker:

What is the age of 30 Doradus?

Walborn:

2-3 million years on the basis of the predicted Main Sequence lifetimes of the most massive stars, which are evolved.