

Astron. Astrophys. Suppl. Ser. 73, 217-224 (1988)

Study of AG Carinae. I. The 1977 spectrum of the star (*)

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Summary. — Spectroscopic observations of the variable P Cygni-like star AG Car have been obtained in February 1977. At this epoch, the star was in a relative minimum phase ($V = 7.6$) observed during a long and comparatively quiet period of intermediate brightness. The spectrum, which displays prominent P Cygni lines of HeI, SiIII, NII and FeIII, is very similar to that of P Cygni. The corresponding equivalent spectral type is B2-3 Ib. Weak CII and OII lines are also present, confirming the suggested carbon-oxygen underabundance. The CaII K line shows two absorption components at -20 and -70 km/s, which are partly due to the interstellar medium. The radial velocity analysis confirms the presence of an outward accelerated envelope, where collisions and turbulence may play an important role. Five different absorption components found in the Balmer lines reveal the multiple shell structure of the envelope. As in P Cygni, they are probably due to a recurrent ejection mechanism. We also discuss the possible correlation with the small luminosity variations seen nearly every year. The observation of broad [FeII] emission lines, in contrast with the absence of permitted ones, implies the presence of a low density shell expanding at about 200 km/s.

Key words : stars : variable — stars : emission-line — stars : winds — spectroscopy — AG Carinae.

1. Introduction.

AG Car (HD 94910) is a P Cygni-like star surrounded by a small ring nebula (Thackeray, 1977) and well known for its large photometric and spectroscopic variability on time scales of months to years.

The visual spectrum and its changes during the period 1949-1959 have been studied by Caputo and Viotti (1970) who reported variations of the equivalent spectral type from AII to BOI. They also pointed out the absence of carbon and oxygen lines in their spectra. On the basis of both its photometric and spectroscopic behaviours, AG Car presents many similarities with S Dor variables (Wolf and Stahl, 1982 ; Viotti *et al.*, 1984).

AG Car seems to suffer an intense and variable stellar wind, as suggested by a strong IR excess (Bensammar *et al.*, 1981) and in agreement with the high mass-loss rate derived from the H β profile (Wolf and Stahl, 1982). Large variations in the infrared flux, accompanied by important spectral changes have been observed between 1980 and 1982 by Whitelock *et al.* (1983) and interpreted

as due to a small shell ejection which occurred in 1980/81. Observation of double, blueshifted and variable FeII absorption lines, which dominate the UV spectrum of AG Car (Johnson, 1982), also supports the idea that this star is losing mass at a variable rate.

The planetary-like ring surrounding AG Car was listed as 289-0° 1 in the catalogue of Perek and Kohoutek (1967) and is known for its very low excitation (Thackeray, 1950).

Spectroscopic data have been obtained for both AG Car and its ring nebula during two observing runs carried out at La Silla in February 1977 and January 1983. In this first paper dealing with the star we report observations of previously undetected stellar features and we analyse the complex radial velocity structure seen in some line profiles. A second paper will be devoted to the analysis of the spectrum of the nebula and its classification.

2. Observations.

The set of spectrograms concerning the star (1977) has been obtained with the coude spectrograph of the European Southern Observatory (ESO) 1.52 m telescope at La Silla, on baked Kodak IIaO emulsion. These cover the useful spectral range $\lambda\lambda 3400-5100$ Å. The widened, short exposure plates of AG Car are suited for the study

(*) Based on observations collected at the European Southern Observatory at La Silla (Chile).

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of the central star. Two standard stars, κ Vel and η Hya, were also observed. All plates were calibrated photometrically by means of the ETA calibration spectrograph. The characteristics of these spectrograms are summarized in table I.

TABLE I. — *List of coude spectrograms.*

Object	Plate No	Date	Exposure (s)	Dispersion (Å/mm)	Widening (μ)
AG Car	F5018	22 Feb 1977	720	20	350
η Hya	F5016	"	60	20	350
AG Car	G8167	23 Feb 1977	2100	12	470
κ Vel	G8166	"	75	12	780
η Hya	F5028	"	45	20	410

The plates G 8167 and F 5018 have been scanned with the GRANT measuring machine at ESO (Garching) and reduced with the IHAP complex of programs. Equivalent widths have been measured whenever possible and no significant difference was observed between the values from these two plates. Therefore, only a mean value is reported in table II separately for the absorption (W_{abs}) and emission (W_{em}) components of the profiles. These measurements are accurate to within 10 % (somewhat larger for the faintest lines). No intensity reduction was possible for the plates of the standard stars, because their spectra are overexposed.

For the lines observed in both spectrograms (G 8167 and F 5018), heliocentric radial velocities have been determined. The spectra of the standard stars were reduced similarly and the derived mean radial velocity of κ Vel and η Hya were compared with those given in the catalogue of Wilson (1953). A correction of + 6 km/s has been applied to our radial velocities (mainly from κ Vel the catalogued radial velocity of which is more accurate). No significant velocity difference between the two spectra of AG Car has been detected and a mean value is also reported in table II for both the absorption (V_{abs}) and the emission (V_{em}) components of the observed lines ; a typical accuracy of 10 km s⁻¹ was found for a single line (2 km s⁻¹ for the brightest lines).

These observations were carried out when AG Car is in a relative minimum phase : $V = 7.6$ (see Fig. 7 and Sect. 4).

3. Description of the spectrum.

The dominant features of our spectra of AG Car are strong Balmer and HeI lines with P Cygni profiles indicating that AG Car is surrounded by an expanding envelope. All the lines reported by Caputo and Viotti (1970) are observed except those of SiII, FeII and SiIV, which are absent. Additional lines mainly due to HeI and NII are identified in our spectra. The P Cygni-type profiles, characterizing the majority of the stellar fea-

tures, display an emission/absorption intensity ratio highly variable from line to line. The spectrum of AG Car is illustrated in figure 1. For line identifications, the reader is referred to table II, where V_{abs} and V_{em} are the heliocentric radial velocities (km/s) of the absorption and emission components respectively, and W_{abs} , W_{em} are the corresponding equivalent widths (Å).

TABLE II. — *The identified features in the spectrum of AG Car.*

ION	LAB.WAL (Å)	V ABS (KM/S)	V EM (KM/S)	W ABS (Å)	W EM (Å)	REMARKS
HE I	3498.64	(-132)	(48)			
HE I	3512.51	(-83)				
HE I	3530.49	-125	(36)			
HE I	3554.46	(-167)	(20)			
HE I	3587.16	-182	35			BL FE III ?
SI III	3590.46		-14			
FE III	3600.93	(-139)	16			
FE III	3603.88	(-107)	-5			
HE I	3613.64	-149	13			
HE I	3634.24	-114	27			
H 23	3673.76	(-140)				
H 22	3676.37	(-97)				
H 21	3679.36	-122	(24)			
H 20	3682.81	-132				
H 19	3686.83	-139	(17)			
H 18	3691.56	-125	11			
H 17	3697.15	-142	14			
H 16	3703.86					BL HE I
H 15	3711.97	-125	24			
H 14	3721.94	-131	20			
H 13	3734.37	-172	12			
H 12	3750.15	-142	25			
H 11	3770.63	-172	39			
SI III	3791.41		(-17)			
H 10	3797.90	-154	33			
SI III	3806.56	(-168)	-16			
HE I	3819.60	-132	32			
H 9	3835.39	-169	29			
N II	3856.07					BL N II
HE I	3867.48	-123	(34)			
HE I	3871.82	-111	5			
H 8	3889.05					BL HE I
HE I	3926.53	-104	(33)	0.27		
CA II	3933.66	-70		0.18		B
CA II	3933.66	-20	59	0.45		B
N II	3955.85	(-80)	(-1)			
HE I	3964.73	-154	4	0.62		
H EPS	3970.07	-162	26	1.04		
N II	3995.00	-98	18	0.29		
FE III	4005.64	-145	-13	0.08		
HE I	4009.27	-106	(31)	0.42		
FE III	4022.36		-5			
HE I	4026.19	-146	19	0.73		
H DEL	4101.74	-171	30	1.00		
HE I	4120.84	-122	14	0.28	0.67	
HE I	4143.76	-117	16	0.63	0.41	
FE III	4164.85		(-9)			
N II	4241.79	(-162)	14			
FE II F	4244.40					BL N II
O II	4253.74	-79	19	(0.05)	0.13	
C II	4267.15		(9)		0.10	
FE II F	4276.83		(10)		0.50	
FE II F	4287.40		9		1.15	DOUBLE LINE
FE II F	4319.62	-4			0.58	DOUBLE LINE
H GAM	4340.47	-178	27			A
FE II F	4358.37					BL FE II F
FE III	4371.10		(17)		0.22	
N II	4375.00		25			
FE III	4382.31	(-142)	7		0.22	
HE I	4387.93	-133	22	0.74	0.83	
FE III	4395.78	-142	-5	0.22	0.21	
FE II F	4413.78					BL FE III
FE III	4419.59	-140	-6	0.22	0.47	
FE III	4430.95	-134		0.22	0.38	BL N II
HE I	4437.55	-117	11	0.14	0.15	
N II	4447.03	-2			0.20	
HE I	4471.48	-153	20	0.81	4.16	
MG II	4481.33	-151	(-30)		(0.17)	
SI III	4552.65	-92	35	0.39	0.19	
SI III	4567.87	-87	(15)	0.35	0.13	
SI III	4574.77	-80	(25)	0.18		
N II	4601.48	-109	13	0.24	0.40	
N II	4607.15	-109	23	0.25	0.23	
N II	4613.87	-97	5	0.11	0.25	
N II	4621.39	-101	3	0.14	0.29	

TABLE II (continued).

ION	LAB. WAL (Å)	V ABS (KM/S)	V EM (KM/S)	W ABS (Å)	W EM (Å)	REMARKS
N II	4630.54	-114	18	0.40	0.50	
N II	4643.09	-116	28	0.31	0.32	
O II	4649.14	(-76)		0.17		
HE I	4713.15	-154	4	0.28	1.92	
N II	4788.13		3		0.14	
N II	4803.27		3		0.22	
SI III	4813.29		(-6)			
SI III	4828.92		(10)			
H BETA	4861.33	-192	24			A
N II	4895.20	(-133)	-10	0.14	0.25	
HE I	4921.93	-140	15	0.93	1.54	
N II	4994.36	(-87)	-3		0.28	
N II	5001.30	-116	8		0.24	
N II	5005.14	-114	23		0.36	
N II	5010.62	(-75)	27	0.28		BL HE I ?
HE I	5015.68	-168	15	1.03	3.61	
N II	5040.76		(6)			
HE I	5047.74		(14)		1.12	BL N II
FE III	5073.78	(-98)	(15)	0.28	0.33	
FE III	5086.69	(-75)	(17)	(0.15)	0.37	

ADDITIONAL REMARKS

- W ABS IS MEASURABLE FROM 3900 Å ; W EM FROM 4100 Å FOR FAINT LINES AND FROM 4300 Å FOR ALL LINES
- VALUES IN BRACKETS MORE UNCERTAIN
- A: H GAM AND H BETA ARE NOT COVERED BY THE CALIBRATION CURVE
- B: EQUIVALENT WIDTHS ARE OBTAINED FROM GAUSSIAN FITTING

MgII $\lambda 4481$ is observed with a weak P Cygni-type profile. SiII $\lambda \lambda 4128-4131$ is doubtfully present on plate G 8167. Forbidden [FeII] lines have been detected in both spectrograms as broad emission features. Two of them seem to have a double structure. Some of the most interesting lines are those belonging to CII at $\lambda 4267$ and to OII at $\lambda \lambda 4254, 4650$, which have never been reported before in the spectrum of AG Car. These lines are faint but definitely present because they appear on both spectrograms. CII $\lambda 4267$ only shows an emission component while OII $\lambda 4254$ displays a well defined P Cygni profile. OII $\lambda 4650$, perhaps more doubtful, is observed in absorption.

In order to determine the equivalent spectral type of AG Car at this epoch, we have compared our spectra with those given in the Atlas of Representative Stellar Spectra of Yamashita *et al.* (1977). A B 2-3 equivalent spectral type seems to match the main characteristics of this star. For such a spectral type, OII is represented by the two lines at 4254 and 4650 Å, and by two additional lines at 4415 and 4349 Å. But the first one, if present, is blended with [FeII] and/or FeIII lines while the second one is also not intense in the spectrum of P Cygni itself (de Groot, 1969). The five intensity ratios of NII, HeI and SiIII absorption lines proposed by Yamashita *et al.* (1977) as luminosity criteria, have been estimated in the case of AG Car and are quite similar to those characterizing Ib supergiants. Therefore, a B 2-3 Ib equivalent spectral type seems reasonable for AG Car at this epoch of observation.

Table III gives the mean radial velocity of each ion. This table shows that there are significant velocity differences among different ions. The velocities of the absorption components have been plotted in figure 3 against the total excitation (ionization + mean excitation potential of the lower level of the line transition). Since the lines of higher excitation should be formed deeper in

TABLE III. — Mean radial velocities.

Ion	V _{abs} (km/s)	σ (km/s)	n	V _{em} (km/s)	σ (km/s)	n
H	-152	22	16	+24	8	13
He I	-134	22	19	+17	9	15
N II	-108	8	9	+12	12	17
O II	-79		1	+19		1
Mg II	-151		1			
Si III	-86	6	3	+2	30	3
Fe III	-140	5	4	-2	10	7

the envelope, this behaviour suggests that the wind is accelerated outwards.

3.1 THE BALMER LINES. — The Balmer lines are observed up to H 23. The latest members of the series are only seen in absorption, the emission part of the lines forming the continuum. The profiles of the earliest members are dominated by emission which is especially large and intense for H β and H γ . In addition, these lines display very extended emission wings (FWZI \sim 2000 km/s) which can be explained in terms of electron scattering (Bernat and Lambert, 1978 ; Bensammar *et al.*, 1981 ; Wolf and Stahl, 1982).

The Balmer progression, illustrated in figure 4, is indicative of a slightly accelerated wind. Similar Balmer progressions were found at different epochs by Caputo and Viotti (1970) and Wolf and Stahl (1982), suggesting that the accelerated nature of the wind is a typical feature of AG Car.

The Balmer lines exhibit a complex absorption/emission structure illustrated in figure 2. Multiple components are observed in the absorption lines. Their radial velocities have been measured and plotted against the quantum number n (Fig. 5). Only the plate G 8167 was used because of its better spectral resolution. In this figure, five different Balmer progressions are apparent, quite parallel to each other, suggesting that they are related to different physical regions of the envelope. The separation of about 40 km/s found between these curves is perhaps indicative of a regular shell ejection mechanisms. All these absorption components are of comparable strength for the latest members of the series. On the contrary, for the earliest members, they blend progressively and the component at about -170 km/s dominates.

The emission profile also shows some substructures. In the most intense (but not too wide) emission lines, mainly those of H and HeI, we can observe a faint red satellite emission. Looking at figure 1, this feature is well seen in the HeI lines at $\lambda \lambda 4713, 4921$ and 5015 Å. It is found to be displaced by about +200 km/s. In addition, the emission profile is splitted into 2 or 3 different components of similar intensity (see Fig. 2). Such a profile is compatible with the multiple shell structure of the wind suggested before. Whenever measurable, the radial velocities of these components have been reported

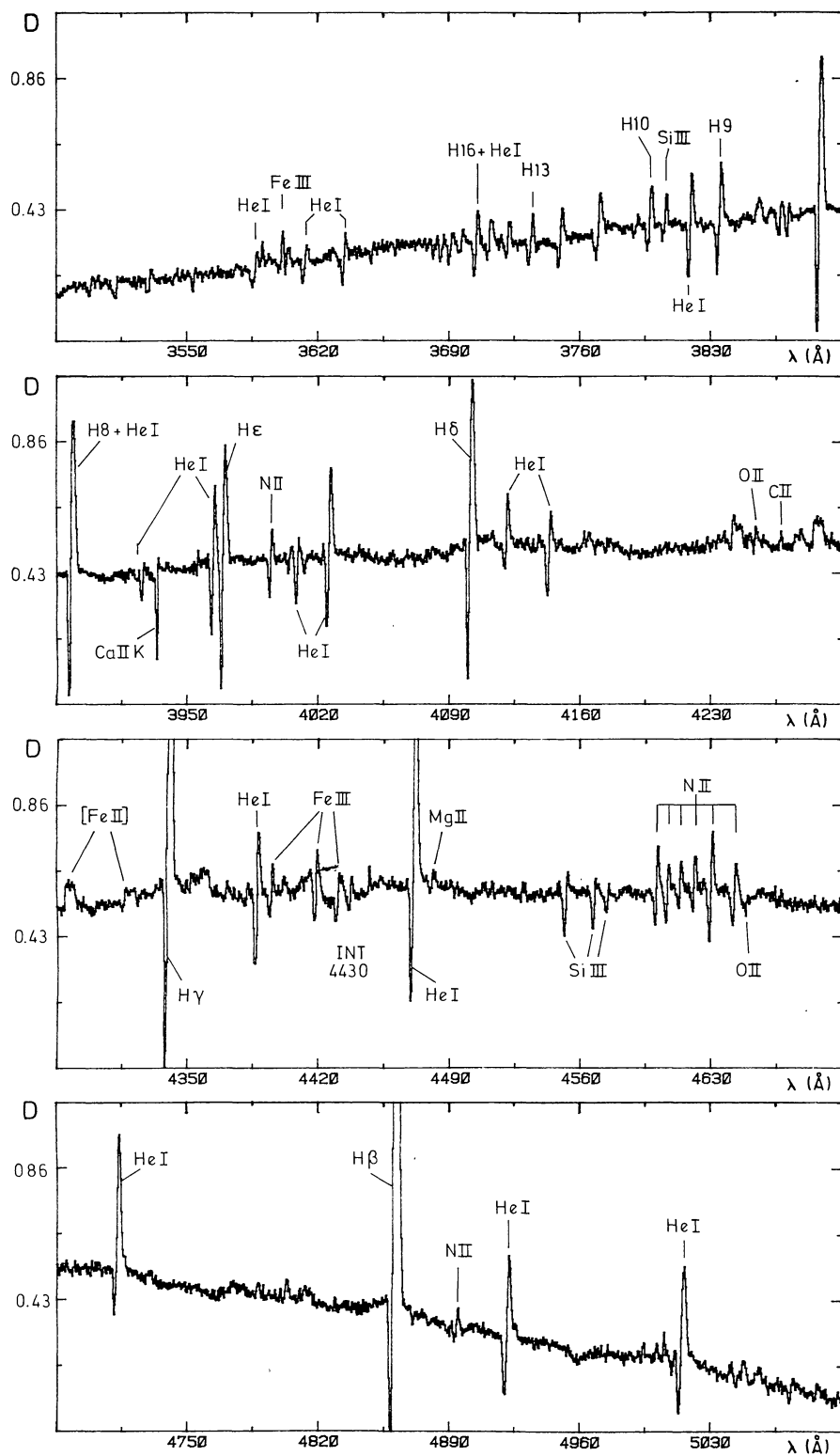


FIGURE 1. — The spectrum of AG Car (sum of plates G8167 and F5018) recorded in February 1977. Ordinates represent plate densities. Some lines are indicated but a complete list of the identified features is given in table II.

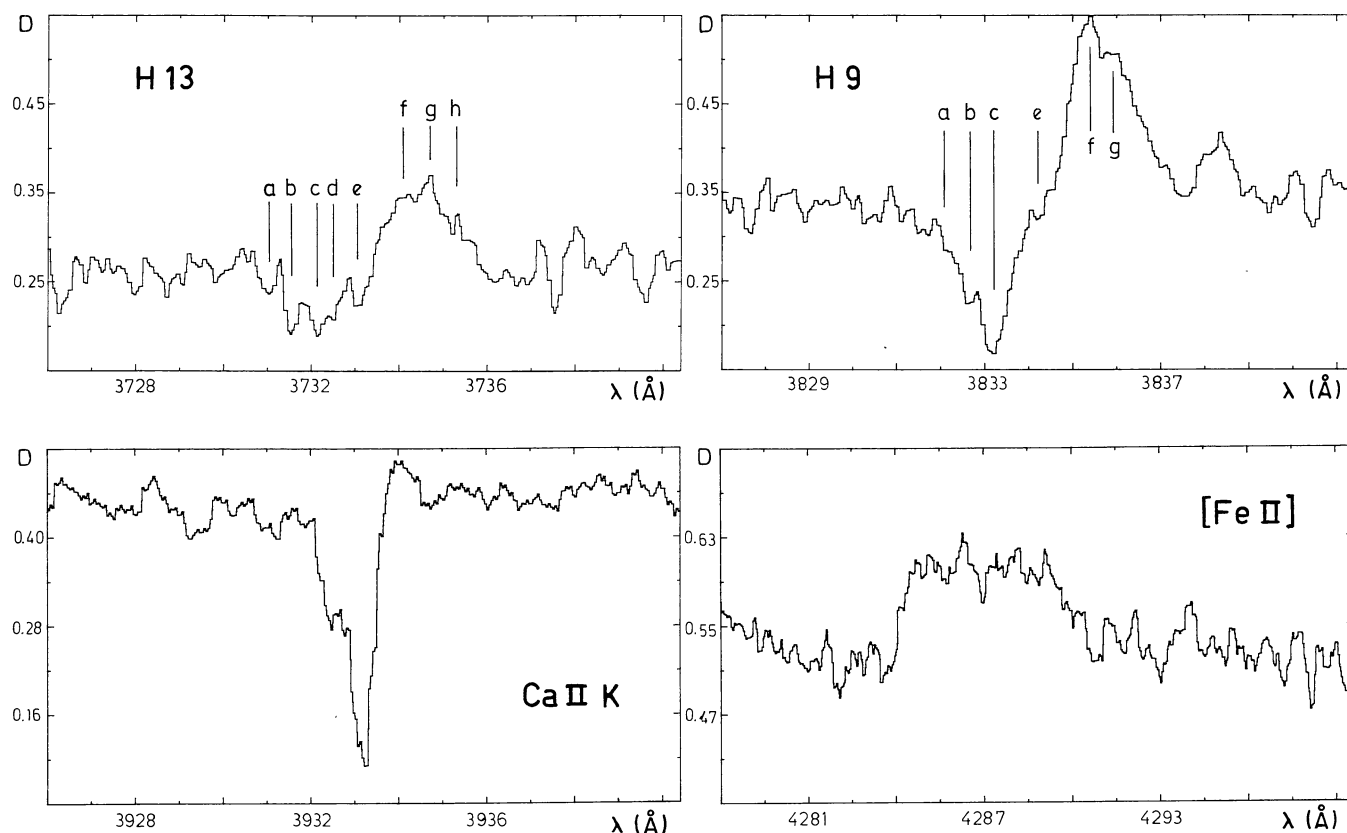


FIGURE 2. — The complex structure of some lines observed in the spectrum of AG Car. Ordinates represent plate densities. The illustrated Balmer line profiles are taken from plate G8167 where the spectral resolution is better. The addition of the spectral features observed in both spectrograms has been made for the other lines.

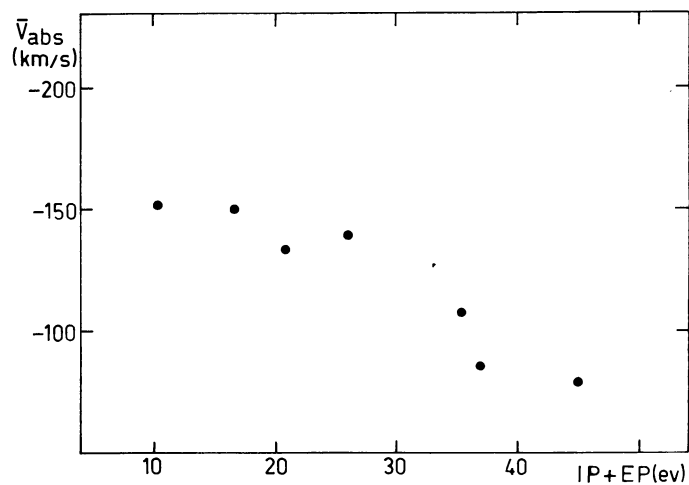


FIGURE 3. — The mean heliocentric radial velocity of the absorption lines representative of each ion is reported here against the total excitation (mean excitation potential of the lower levels of the observed transitions + ionization potential).

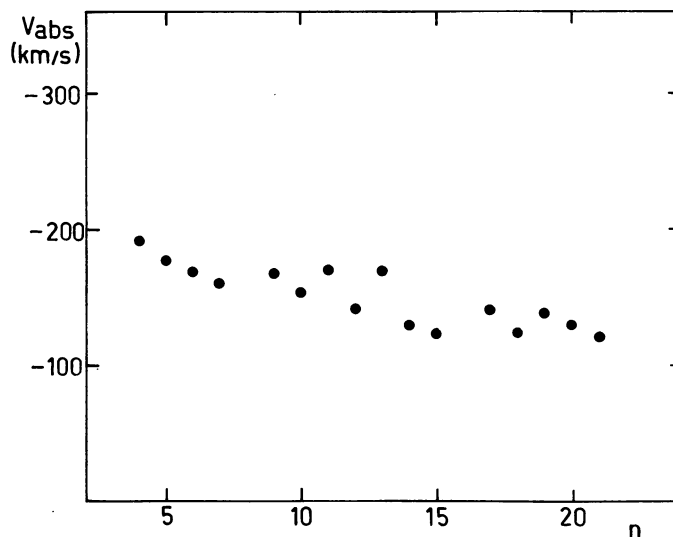


FIGURE 4. — The Balmer progression of the radial velocity measured for the absorption components in AG Car.

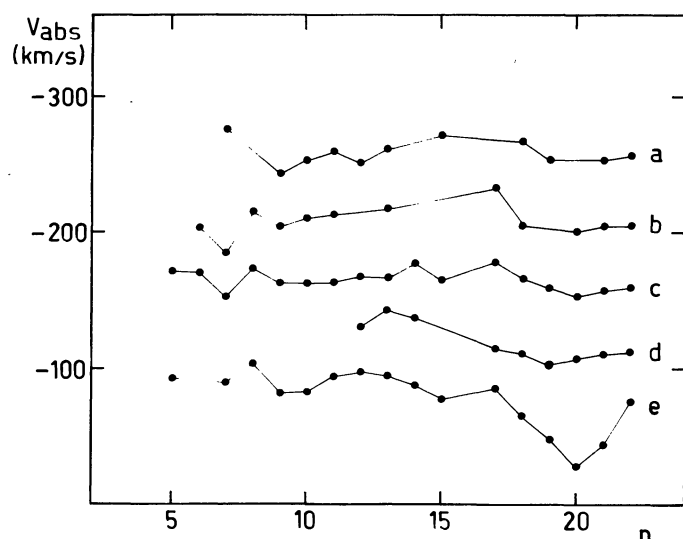


FIGURE 5. — The heliocentric radial velocity measured for each absorption component of the Balmer lines is reported here against the quantum number n . The individual letters refer to the components identified in figure 2. As n decreases, the component c progressively dominates the other ones such that the component d can no longer be detected.

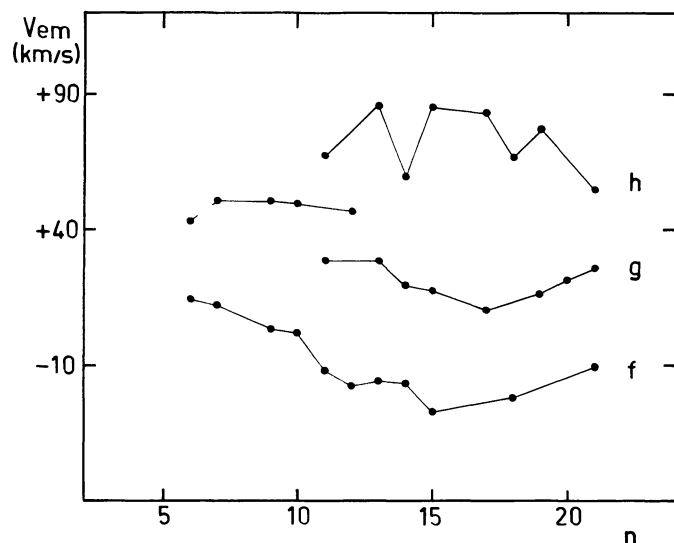


FIGURE 6. — The heliocentric radial velocity measured for each emission component of the Balmer lines is reported here against the quantum number n . The letters refer to the components identified in figure 2. As n decreases, the components g et h get progressively blended.

against n in figure 6. The central one is nearly at a constant velocity and close to the systemic velocity of the star (+18 km/s) proposed by Wolf and Stahl (1982). The velocity separation seems to decrease when the line becomes more intense, probably because of a progressive blend (it can also be a real physical effect, related to the velocity law and/or due to a differential rotation plus expansion).

The greatest velocity of the hydrogen atoms, as measured from the blue edge of the absorption profile of $H\beta$, is $V_{\text{edge}} = -278$ km/s.

3.2 THE HELIUM LINES. — The helium lines show complex profiles with emission/absorption intensity ratios highly variable from line to line. Both absorption and emission lines display components at different velocities, which, as for the Balmer lines, are probably related to the presence of a shell structure in the wind.

Because the helium lines are very sensitive to dilution effects, they can provide some information on the physical conditions prevailing in the envelope (see, e.g., Struve and Wurm, 1938; Underhill, 1966; Hutchings, 1968). Caputo and Viotti (1970) have already reported such effects in their observations of AG Car. In our spectra, no systematic difference between the absorption equivalent widths of triplets and singlets can be observed. The ratio $W(4471)/W(4922 + 4387)$ does not show any evidence for dilution effects, despite its sensitivity to the radiation field (Underhill, 1966). On the other hand, we have measured the equivalent width ratio $W_{\text{em}}/W_{\text{abs}}$ for both triplets and singlets lines. This ratio is clearly higher for lines originating from the 2^3P level ($W_{\text{em}}/W_{\text{abs}} = 4.8$) than for those from the 2^1P level ($W_{\text{em}}/W_{\text{abs}} = 1.1$). In addition, the line at $\lambda 5016$ (from the 2^1S level) has a $W_{\text{em}}/W_{\text{abs}}$ ratio of 3.5, also smaller than that obtained for the triplet ones. The predominance of triplet emission lines is typical of envelopes in which radiation is diluted and where collisions are comparable in effect. The presence of turbulence will make the absorption component quite insensitive to the level population and consequently to the dilution effects (Struve and Wurm, 1938).

Radial velocity differences have been investigated for HeI absorption lines originating from different levels. A mean value of -157 km/s is derived for those originating from the 2^1S level, -139 km/s for 2^3P and -129 km/s for 2^1P . These values are compatible with line formation in an accelerated envelope.

3.3 THE CALCIUM LINES. — The K line of singly-ionized calcium shows two absorption components at -20 and -70 km/s with a faint red emission (see Fig. 2). The H line is not detected because it is blended with HeI $\lambda 3965$.

The strongest absorption component has a radial velocity of -20 km/s, quite comparable to the mean value -14 km/s reported by Caputo and Viotti (1970). These authors have found this feature to be mostly of interstellar origin. Their equivalent width is comparable to ours. The second component at -70 km/s could be either interstellar or produced in the wind (forming a P Cygni profile with the emission). A weak -76 km/s absorption is present in the 1983 spectrum of the nebula without component at -20 km/s. We conclude that both components are, at least in part, due to the interstellar medium. Note that high velocity interstellar lines are present in the spectra of many Carina stars (see, e.g., Walborn, 1982).

The most striking characteristic of the CaII K line in AG Car is its variability. Caputo and Viotti (1970) have noticed slight radial velocity variations which follow the stellar variations. Viotti (1971) has proposed that this line may be partially formed in the outermost regions of the atmosphere of the star. Humphreys (1970) has observed CaII K at -76 km/s. Wolf and Stahl (1982) reported four components in the profile at -209 , -151 , -60 and -9 km/s. The two latest probably correspond to our lines but the most intense one is the component at -60 km/s. Whitelock *et al.* (1983) have also reported strong variations in the CaII K profiles between 1980 and 1982. All these observations support the presence of two interstellar lines, always observed near -65 and -15 km/s, which could be differently affected by a variable CaII line formed in the wind.

A similar behavior of the CaII K line is observed in the spectrum of the nearby emission-line star GG Car (see Gosset *et al.*, 1985): a slightly variable absorption is seen at about -20 km/s when a smaller absorption is detected at about -65 km/s. Both are probably affected by emission. Also in HR Car, Viotti (1971) has reported an asymmetry in the CaII K absorption line, probably due to a weaker violet component.

3.4 THE FORBIDDEN IRON LINES. — The strongest lines of [FeII] are present in both our spectrograms of AG Car. These features are generally reported when the star is in a minimum phase (Caputo and Viotti, 1970; Viotti, 1971; Thackeray, 1977; Whitelock *et al.*, 1983). In our spectra, the [FeII] lines show broad and nearly flat-topped (rectangular) emission profiles (FWHM ≈ 410 km/s). The two intense and unblended lines at $\lambda 4287$ and $\lambda 4319$ display a double structure at the highest dispersion (see Fig. 2).

Because flat-topped line profiles are most naturally produced by an optically thin hollow sphere of emitting material (Beals, 1934; Castor, 1970), the observed [FeII] lines probably originates in such a shell. The velocity of this shell (~ 205 km/s) is slightly less than the

terminal velocity of the wind (≥ 278 km/s). If we assume that these lines are formed in the outside part of the wind where conditions of low temperature and density prevail, this shell may be the remnant of matter previously ejected at lower velocities. It is very likely that the weak satellite emission observed at $+200$ km/s in other lines (see Sect. 3.1) is in fact the red part of the line profile formed in this distant region.

The double peaked structure observed for these [FeII] lines may be easily explained by any departure from the spherical geometry which reduces the central intensity of the line.

4. Discussion and conclusions.

The spectrum of AG Car observed in February 1977 is found to be dominated by Balmer, HeI and NII P Cygni line profiles, with an equivalent spectral type B2-3 Ib. No low excitation lines such as SiII and FeII were detected while CII and OII are seen for the first time.

At this epoch, the spectrum of AG Car is very similar to that of P Cyg described, e.g., by de Groot (1969). Nevertheless, numerous lines due to CII, OII, CIII, SIII are currently seen in the spectrum of P Cyg, while they are weak or absent in our spectra of AG Car. This fact was already reported by Caputo and Viotti (1970) and interpreted as due to underabundance of C and O relative to N.

The Balmer absorption lines observed in the spectrum of P Cyg are also splitted into 2-3 components which reveal the multiple shell structure of the envelope (see, e.g., de Groot, 1969; Lamers, 1987). One should note that double FeII absorption lines have been detected in the ultraviolet spectrum of both stars (Johnson, 1982; Cassatella *et al.*, 1979). It is therefore very likely that the recurrent shell ejection mechanism proposed for P Cyg (Lamers, 1987 and references therein) also acts in the wind of AG Car.

One of the most interesting problems concerning AG Car and related stars, is the link between luminosity

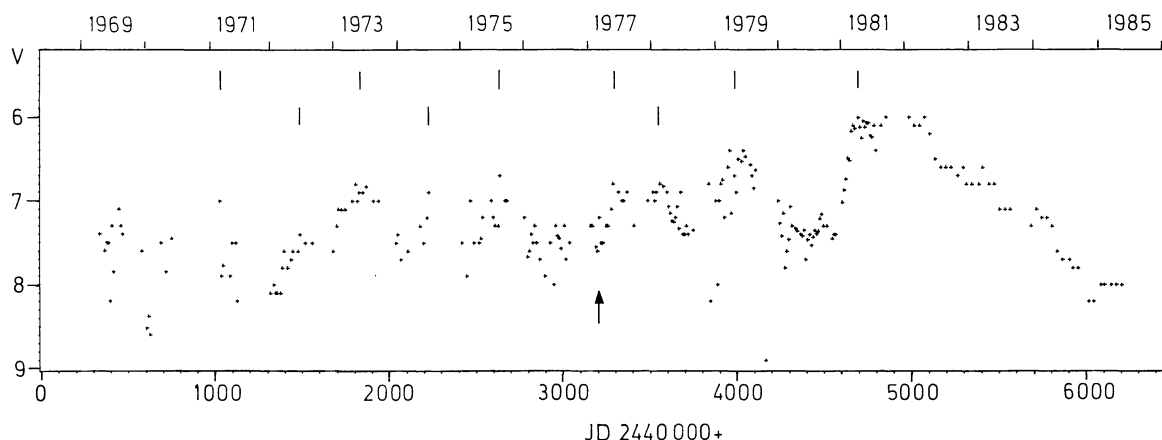


FIGURE 7. — The light curve of AG Car between 1969 and 1985 from visual observations by the Variable Star Section of the Royal Astronomical Society of New Zealand (Bateson, 1987). The values after JD 2444800 are from Stahl (1986). The arrow indicates the epoch of our observations. The positions of the relative luminosity maxima are tentatively marked. Quasi-periodicities around 700 or 350 days may be present.

and spectral variations. Bateson (1987) has made available the visual light curve of AG Car shown in figure 7. During this period, we can distinguish two types of variations on the basis of their amplitudes and timescales.

(1) A very slow (3-5 years) and large (≥ 2 mag) variation occurred in 1980-1985.

(2) Variations of smaller amplitude (0.5-1 mag) clearly seen during the period of intermediate luminosity between JD 2441000 and JD 2444000. As shown in figure 7, these variations may have a quasi-period of about 700 or 350 days.

The spectrum of AG Car discussed in this paper has been obtained when the star was in a phase of relative minimum ($V = 7.6$), during the « quiet » period of intermediate brightness. This spectrum is clearly different from those obtained at the luminosity extrema seen after 1980. Its excitation is intermediate between the early A-type reported at the 1981 maximum ($V \approx 6.1$; Wolf and Stahl, 1982) and the Ofpe/WN9 — type observed at the deep minimum of 1985 ($V \approx 8.1$; Stahl, 1986).

In contrast with the large spectral variations occurring during 1980-1985, the spectra recorded from 1974 to 1978 remain P Cygni-like with little changes (see the spectrograms described by Johnson, 1976; Bensammar *et al.*, 1981; Whitelock *et al.*, 1983). The regularly ejected shells observed at this epoch are probably not massive

enough to produce important spectral and luminosity variations. Nevertheless, we may assume that the ejection of such shells separated by about 40 km/s (see Sect. 3.1), is also at the origin of the small luminosity variations seen nearly every year before February 1977. It is particularly interesting to note that in this view, the shells have an average acceleration of 0.13 cm s^{-2} , a value nearly equal to that reported for P Cyg (Lamers, 1987).

We can therefore conclude that during this rather quiet period of intermediate brightness, the wind characteristics of AG Car are very similar to those of P Cyg, despite some definite differences. It is clear that more photometric and spectroscopic data are needed to know how the small spectral and luminosity changes really correlate.

Acknowledgements.

We wish to thank Dr. F. M. Bateson for providing us valuable photometric data of AG Car and Dr. R. Viotti, the referee of this paper, for helpful comments. It is a pleasure to acknowledge Jean Surdej for fruitful discussions and Mrs Houssonloge for typing the manuscript. Finally, we thank the Centre de Données Stellaires (CDS) at Strasbourg for a complete bibliography on this star.

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