AG Pegasi: THE EPISODE OF MINIMUM 1985

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ABSTRACT. The profiles of the emission lines of H_α, HeI 5876 and HeII 5411 in the spectrum of AG Peg obtained in the minimum of 1985 are described. The light curves in UBVRI system are presented. No indication for the presence of a magnetic field exceeding the error of observations (200 gauss) has been found.

AG Peg is one of the brightest symbiotic stars. Its binarity has been reliably detected by spectral (Merrill, 1959; Boyarchuk, 1967) and photometrical (Belyakina, 1968) observations. A detailed study of emission line intensities and their displacements allowed Hutchings, Cowley and Redman (1975) to conclude that in AG Peg there is a stream of matter flowing from the hot dwarf component toward the cool giant. But according to a generally accepted hypothesis an accretion disc is being formed round the hot component as a result of gas outflow from the cool giant toward the hot star.

Thus, models of two kind of symbiotic stars are proposed, being probably contradictory in explaining the phenomenon of symbiotic stars. The best approach to this abscure problem in our opinion is a specially developed observational program which was initiated in the middle of 1985. The star AG Peg is being observed at the Crimean Astrophysical Observatory with the 2.6-m telescope with a CCD array, a 1.25-m telescope and a 0.64-m telescope. The chief line profiles studied with the 2.6-m telescope are those of H_α, HeII 5411 Å and HeI 5875 Å with spectral resolution $\Delta\lambda$ = 0.05 Å. The 1.25-m and 0.64-m telescopes are used for the UBVRI and UBV photometry of AG Peg respectively. With the 6-m telescope of the Special

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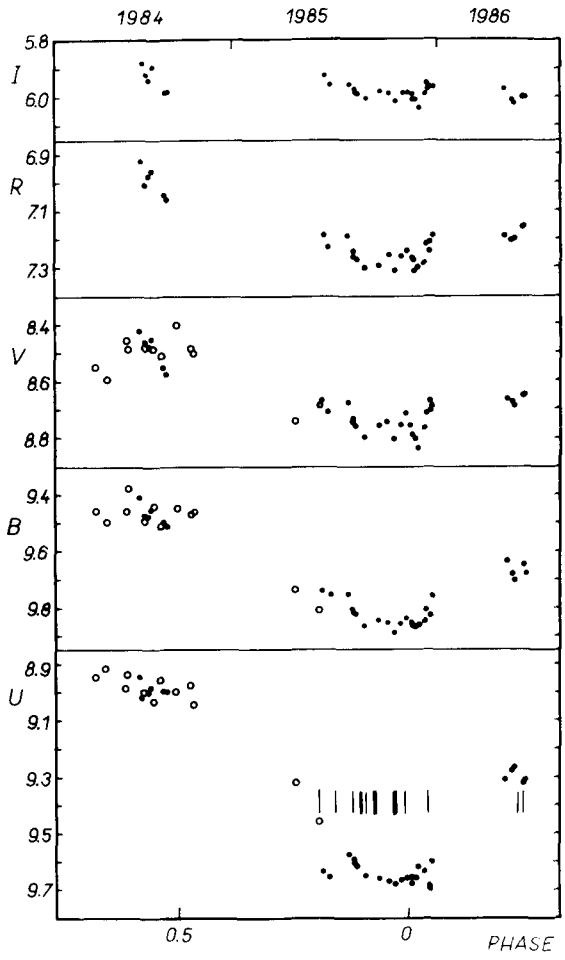

Fig. 1. The brightness variations of AG Peg. o - 0.64-m telescope observations, ● - 1.25-m telescope observations. The vertical lines indicate the epodis pf spectral observations.

Astrophysical Observatory the magnetic fields are being measured and spectrograms with a dispersion of 9 Å/mm in the region 5000 - 3800 ÅÅ are obtained.

A goal of our communication is to present the first results of the observations and to draw attention to that exciting problem.

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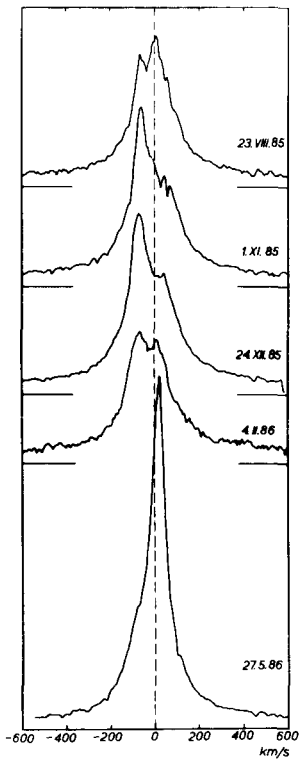

Fig. 2. H_α line profiles.

1. THE OBSERVATIONS OF BRIGHTNESS VARIATIONS

Figure 1 shows the brightness variations in the UBVRI system obtained from December 1984 till June 1986. The strongest variations are observed in the U-filter. The amplitude of the variations decreases with the wavelength and in the I-filter they almost vanish. According to radial velocity curves (Hutchings, Cowley, Redman, 1975) at minimum brightness the cool component takes the front position. (We think that minimum brightness, i.e. Φ = 0.0 occurred on November 10, 1985). The width and shape of minimum refute a possibility of an eclipse of the hot component. For instance, in case of CI Cyg the minimum is sharp and corresponds to 0.1 of the period. Therefore we suspect that the minimum may possible have some connection with the eclipse of an extended source of high temperature radiation and rotation of a cool

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component with inhomogeneous surface brightness, so that the side facing the hot component is 'heated' by a by a very hot star.

2. SPECTROSCOPIC OBSERVATIONS

In Figure 1 spectroscopic observations are indicated by vertical lines.

On June 4, September 21 and October 31, 1985, i.e. at phases 0.806, 0.939 and 0.988 respectively, we made an attempt to measure the magnetic fields by using the M-type spectrum. But unfortunately we failed to find a magnetic field higher than the error of measurements (about 200 gauss).

Line profiles obviously show drastic changes. Figure 2 presents H_α line profiles obtained at different dates (in intermediate dates the profiles were almost the same as illustrated). On August 23, 1985 the profile had two components with V/R<1. But in October 1985 the ratio changes as V/R>1 and in May 1986 we observed already a single-component profile, the intensity have considerably increased. The equivalent width of the H_α line in May 1986 (Φ=0.25) was twice as high as during preceding observations. The minimum equivalent width was registered on February 4, 1986. It should be emphasized that the intensity in the line wings remained practically the same. The behavior of intensity in the wings corresponds to radiation damping. This fact is of primary importance. First it means, that in AG Peg no motions of relatively large gaseous streams with velocities exceeding ± 100 km/sec are plausible. Then we are apt to assume, that during our observations we were observing almost the same number of emitting hydrogen atoms and the variations of central intensity was the result of optical depth changes. These changes are probably caused by geometrical effects. Really, if we deal with a gaseous stream then, in a first approximation it can be described in a form a cylinder. Thus the following 'geometry' of our observations may be considered: in August-February the streams were flowing along the line of sight (the absorption being high), in May the streams are perpendicular to the line of sight (the absorption is small). If we assume that the position of central absorption can be adopted as a position of the emission line then we may conclude that in August the gaseous stream as directed from the degenerate dwarf toward the cool giant, the velocity being - 20 km/s. In December it dropped rapidly, to zero. In February the velocity increased up to - 10 km/s. In May no absorption motion was observed in the centre, but the central part of the emission line was displaced by +80 km/s.

A comparative study of H_α, HeI and HeII line profiles also contributes an important information. Figure 3 shows the profiles of these lines (the abscissa is expresses in km/sec) for the end of 1985 and middle of 1986. We see that AG Peg exhibits a very strong stratification of radiation: in the H_α line, maximum intensity corresponds to -70 km/s, in the HeI 5876 line it is +30 km/sec. The

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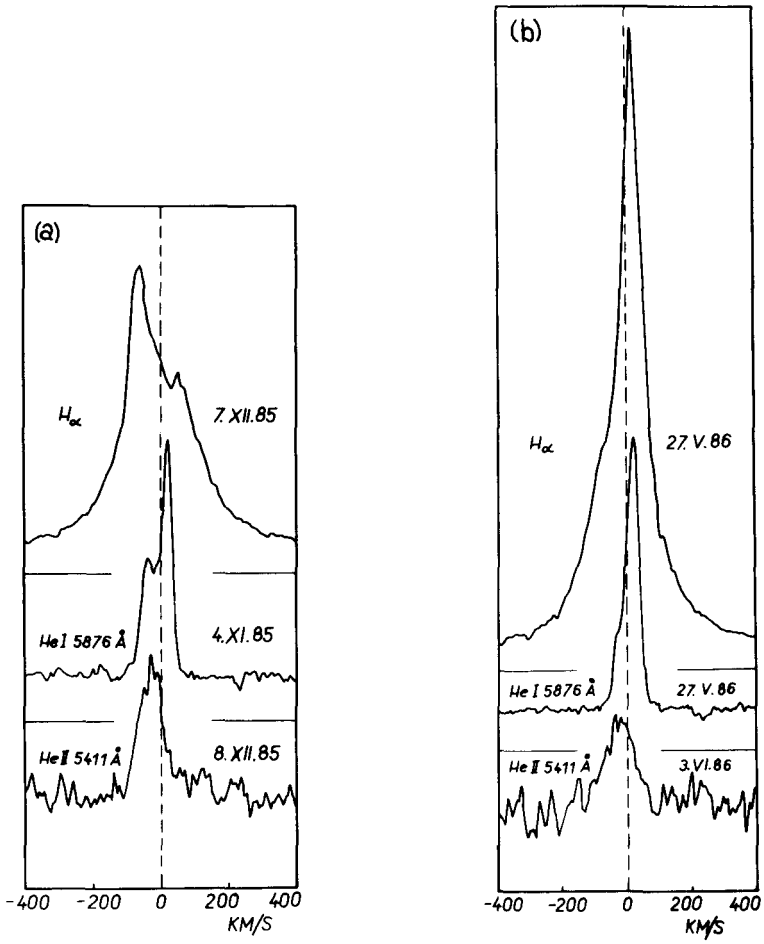

Fig. 3. Profiles of H_α , HeI 5876 and HeII 5411 lines: a) for the end of 1985 and b) for middle of 1986.

HeII line has maximum intensity at zero velocity. The lines have various widths. Large width of H may possibly have some connection with strong absorption in the line, but not with matter motion. HeI line width is about 120 km/s and HeII line - 140 km/sec. This difference is real and can be properly explained in terms of the hypothesis of accretion disc: the HeII line arises in deeper layers of the disk where the rotational velocity is higher than in the surface layers where HeII arises.

The profile of the HeII 5411 line is always observed as single component. It can be explained by the absence of absorption since

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the line arises between two levels of high excitation. On the contrary, HeI 5876 line shows a central depression which indicates the presence of self absorption.

Due to the fact that absorption does exist in these lines one cannot use at least the first members of the Balmer series and HeI triplet for a diagnostic of plasma and matter motion definition.

It seems, however, premature to make any definit conclusion using only these observational data, since they overlap only 1/4 of the period of the star.

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