o AND : A MULTISITE MULTITECHNIQUES INTERNATIONAL CAMPAIGN
FIRST REPORT

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1) A short summary of what is known on this star:

Omicron Andromedae is a multiple system of at least four stars (figure 1). According to several papers (see bibliography:(1) to (5)), the system characteristics are as follows (see Table 1):
- The distance between A and the B1-B2 system has decreased from 0.39" (1975) to 0.25" (1987). A suggested period could be around 30 years.
- The few previous speckle measurements of component "a" led to the possibility of a 3.7 years orbit around A, according to the 1975 to 1984 observations.
The calculations with a 3.7 years orbit led to the prediction of a maximum distance of 0.077" at 1992.738 (i.e. at the end of septembre 1992), with a North - South orientation.
But a strong contradiction appears: given the spectrophotometric distance (188 parsecs), this calculated orbit would give a mass of 180 $M_\odot$ to the A-a system ! (or if we consider the 188 pc distance to be exact, then a deduced 14 years orbital period for A-a does not fit the speckle positions !

From a photometric point of view, the B ⇄ Be (with eventual shell phase) ⇄ B switching in o And can be drawn schematically (figure 2).

When the star is at its light minimum (Be phase), it displays a double wave light curve of 1.6 day period, with a ≃ 0.1 magnitude amplitude in the visible.

It has been shown recently through precise photometric observations (5) that the 1.6 day period with double wave light curve still exists when the star is in its "normal" B phase, but with a ≃ 10 millimagnitude amplitude that makes it very difficult to detect with such a "long period".

2) Purpose and means of the campaign:

We decided of a campaign on this star with several techniques, in order to solve the contradictions mentionned above, and also to get a better description of this rather complex system, i.e.:
- Investigating the relation between photometry (activity + rotation / or pulsations ?) and spectroscopy (photospheric line profiles, activity in the hydrogen Balmer lines series).
- Trying to find if any coincidence (coupling) exists between the Be-Be shell phase of star (A) and the eventual proximity of "a" (which also means getting a better orbit for "a").

- If possible (with luck !): finding the characteristic time constant of the B ⇄ Be switching (we know it is under 40 days... but it could be hours as well, or even less !).

a) On the one hand, the multitechniques aspect of the campaign is necessary as no single technique can give an unbiased description of the whole star (for example, line profile variations in Be stars very often display an apparent period half the photometric (rotation?) one).

b) On the other hand simultaneity between multitechniques observations is necessary as soon as we want to identify short time scale phenomena like activity variations, and eventually separate activity from regular phenomena in the different "parts" of the star: its "surface" (phase of photospheric activity), its "atmosphere" (enveloppe status), the surrounding circumstellar medium and the eventual influence of binarity when the star is multiple (Table 2 is non exhaustive).

c) The rather long period (i.e. long compared to a night of observation from a single site) meant that we had to organize as far as possible a longitude coordinated campaign, in cooperation with colleagues from other continents. In Europe, there is only a very small number of available photometric telescopes: in 1992, the only existing dedicated photometric telescopes were located at Calar Alto -Spain-, Jungfraujoch -Switzerland- and Merate -Italy-, although we hoped photometry could also be made from the Canary islands - Spain - and from Locarno - Switzerland). So some well equiped european amateurs were invited and joined the photometric part of the campaign (among them GEOS members).

3) The observation campaign. First results.

Table 3 shows the observing data of the campaign itself. A few comments should be made:
The weather in september-october 1992 has been exceptionally bad in Europe, ...and very good in Baja California ! So no photometric or interferometric data has been collected in Europe, and only a few spectroscopic data (3 nights), while in Mexico all available time has been used with a high efficiency.
Interferometric observations carried out at the CERGA observatory -France- during the summer of 1991 will be reduced and probably will bring some complementary -although "out of phase"- information on o And.

The data are to be reduced in an homogeneous way (this will last several months), each technique being under the responsibility of a "principal investigator", and the corresponding results written and signed by the participants. Discussions and meetings should give later a synthesis of this campaign.

A few preliminary results can be pointed out:

- During the campaign, the star was in its "regular B" phase (fig.3 shows an example of the Hα line during the campaign): so the photometric variations, if any, will probably be of very small amplitude.
- Strong variations occur from night to night in the HeI 4471 and in the MgII 4481 A lines (Fig.4), probably not entirely due to the B1-B2 binarity. Of course all these preliminary results need confirmation.
- Speckle interferometry carried out in Russia with the 6 m telescope (August 8-10th) shows that the B1B2 distance to component A has decreased to 0.183 ± 0.002" in 1992, while component "a" -provided its detection is confirmed- is now at 0.036", and at ≃ 90° from its predicted position !
So we already know that the 3.7 years period is very probably wrong, as both the distance and angle of "a" are opposite to the previsions.

4) Provisional conclusions

Due to the large amount of photometric data collected, we will probably be able to derive our own ephemeris, on which the photospheric lines behavior can be "phased", i.e. giving a strong constraint on any future explanation and model.

The speckle observations show that the whole system as a multiple star has now to be totally reconsidered (masses and orbital periods).

As the campaign did not coincide with a -still unpredictable- B to Be transition phase ("an observed star never performs"!), we still have no idea about the time constants involved in such process and, in this star, we have no measurement of the phase lag between the beginning of the larger photometric variations and the beginning of the Be phase (when emission appears).

This field of investigation is wide open to the amateurs: They could carry a survey of o And as well as of a few Be stars that show such behavior:

a) Regular and precise observations would allow to measure at last the time constants in the hot stars activity (entrance in emission or shell phase, as well as disparition of these phenomena).

b) Very simple means could be used to monitor the "flares" in the lines of the Balmer series (see (6)), i.e. getting a direct statistical and perhaps quantitative measurement of the activity, in relation with the more or less "punctual" mass flow going out of the star.

Bibliography:

1 - Hill et al. (1988) PASP 100, 283
2 - Hill et al. (1989) PASP 101, 258
3 - Mac Alister and Hartkopf (1988) 2nd Catalogue of interferometric measurements of binary stars (Georgia State Univ. Atlanta, 30303 USA)
4 - Morand and Sareyan (1992) GEOS N.C.683
5 - Sareyan et al. (1992) Astron. Astrophys. 257, 567
6 - Ghosh et al. (1986) IBVS n°2897

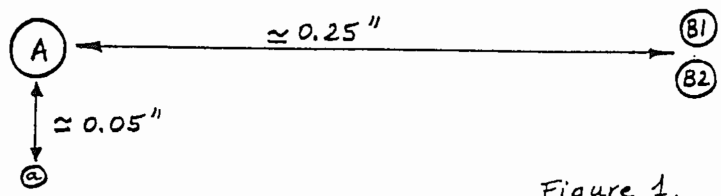

Figure 1.

Table 1

STAR	TYPE	COMMENTS	Δm - MAGNITUDE DIFFERENCE WITH A
A	B5II-IIIe	v sini ≃ 240km/s	magnitude of A - 3.8
B1 B2	B7V? B8V?	a spectroscopic binary (33 days period): B8IV-V	Δm - 0.5 to 1 (speckle) or Δm ≃ 2 (spectroscopy)
a	?	speckle detection	Δm - 1 to 2

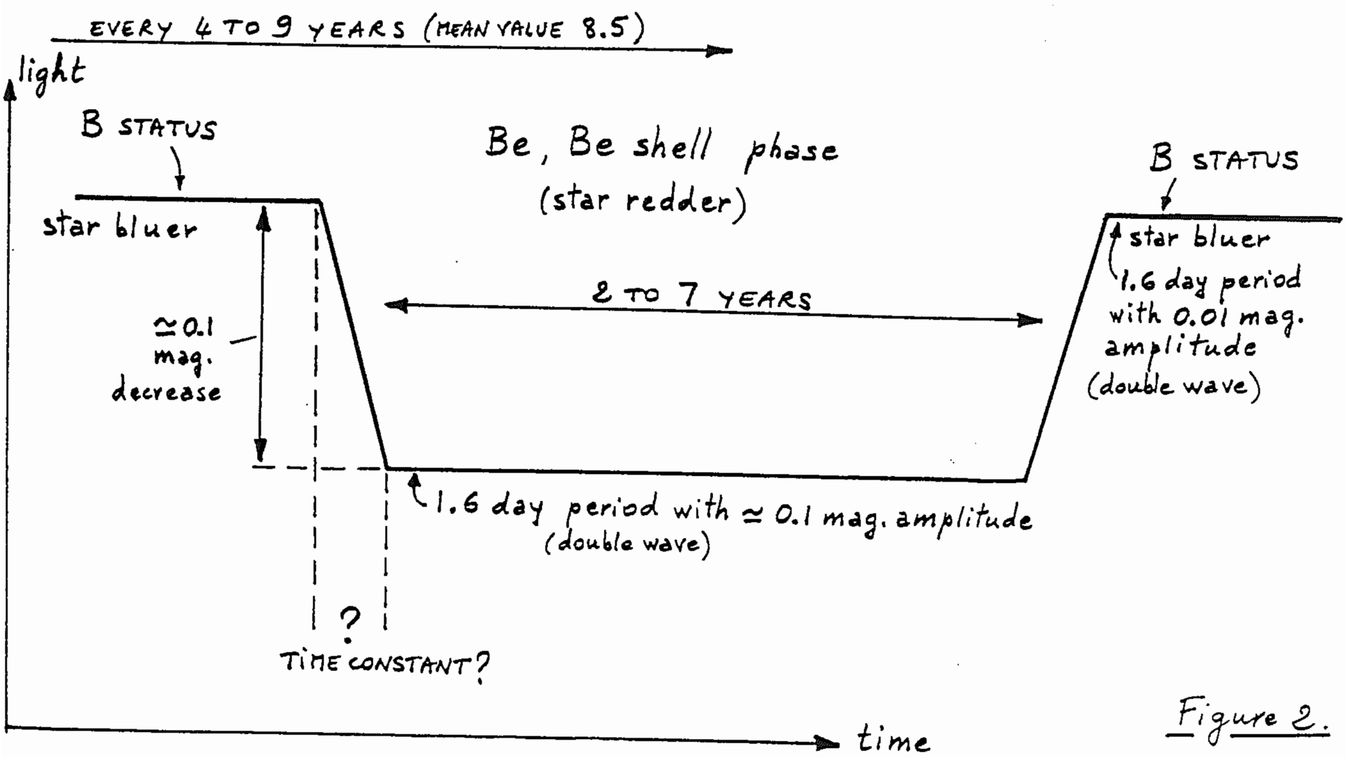

Figure 2.

Table 2:

TECHNIQUE	PHENOMENON	...FROM	EXPECTED RESULT
PHOTOMETRY	activity + rotation or (/and?) pulsation	photospheric continuum	ephemeris, phasing of the observations
	H line bursts	stellar atmosphere	activity (6)
SPECTROSCOPY	emission, shell	high stellar atmosphere (H lines)	emission detection, eventual periodicities (hours to years...)
	redistribution of visible flux	circumstellar (CS) medium	IR and/or UV excess
	binarity	photospheric lines	detection and measurement of binarity
POLARIMETRY	enveloppe activity, "dust" of CS region, asphericity	atmosphere, CS region	detection, measurement of anisotropies
	lines profiles	emission lines compared to the continuum	modeling
	binarity		eventual detection, or polarimetric binarity correction
INTERFEROMETRY	extension of the CS region	nearby CS medium	detection and importance of CS enveloppe (e.g. Hα)
	binarity	very close companions	detection
SPECKLE	binarity	nearby companions	detection, "position", luminosity

Table 3. The campaign:

TECHNIQUE	ANTICIPATED	ACHIEVED	COMMENTS
PHOTOMETRY	Mexico (SPM) Italy (GEOS) Italy (Merate) France (Nice) Switzerland (Locarno) China (Beijing)	yes no no no no yes USA	27 nights weather weather weather instrumental problems 5 nights 5 + 4 nights
SPECTROSCOPY (Hα + HeI 6678 HeI 4471 + MgII 4481)	Mexico (SPM) France (OHP) China (Beijing) China (Yunnan) Italy (Merate)	yes yes yes yes no	≃ 200 spectra 48 spectra 6 nights 2 nights weather
POLARIMETRY	Poland, USA	?	
INTERFEROMETRY	France (CERGA)	no	weather
SPECKLE	Russia (Zelenchuk)	yes	

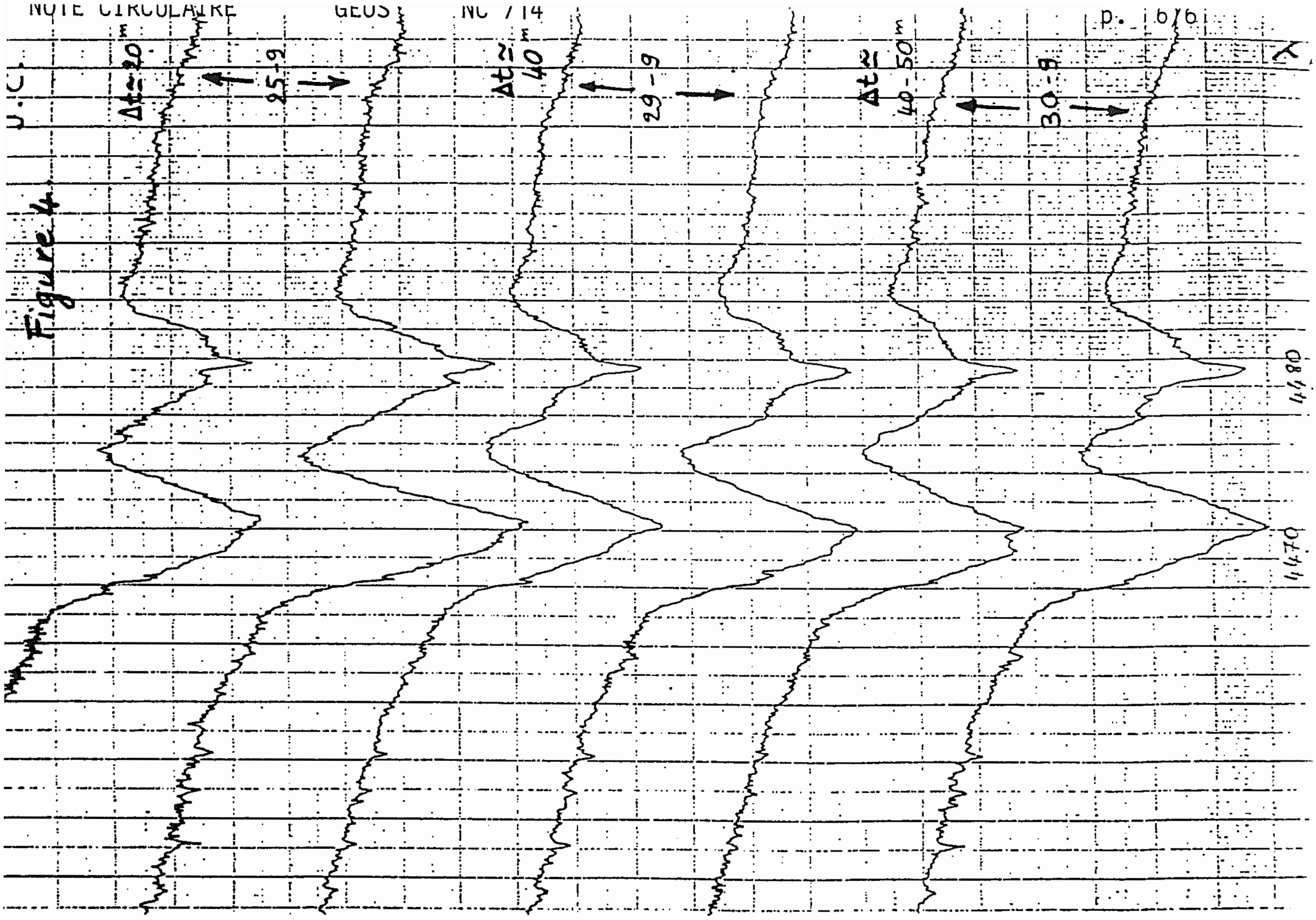
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Figure 4.
Δt≃20m
25-9
Δt≃ 40m
29-9
Δt≃ 40-50m
30-9
λ
4480
4470

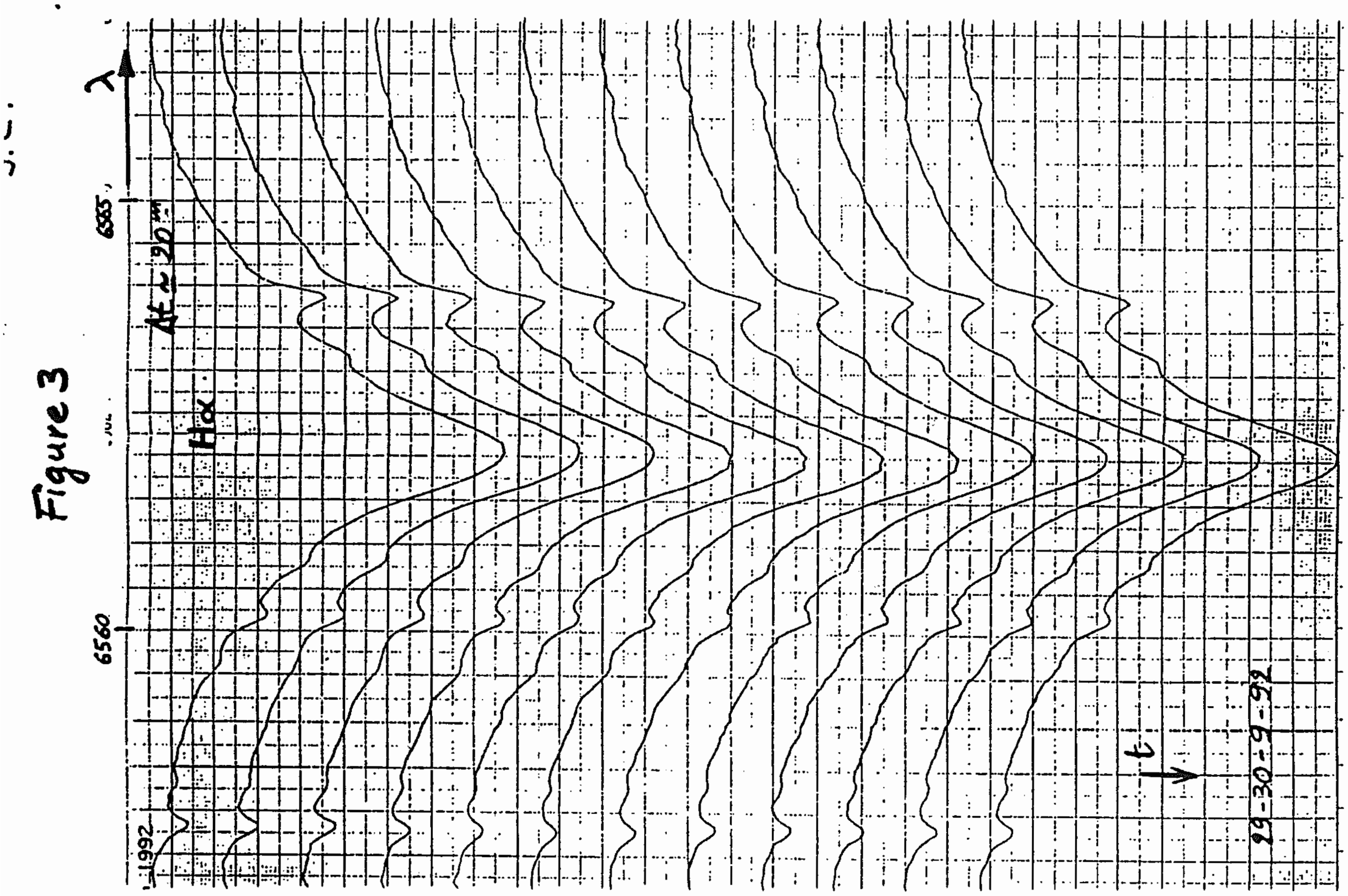
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Figure 3
6565
λ
Δt ≃ 30m
Hα
6560
1992
t
29-30-9-92