GEOS
EB 22

GEOS CIRCULAR ON ECLIPSING BINARIES
December 1993

GEOS
3, promenade Vénézia
F 78000 VERSAILLES

AP AND : RESULTS OF THE FIRST PHOTOELECTRIC MEASUREMENTS AND REVISION OF THE ELEMENTS

SUMMARY

Photoelectric measurements of AP And permitted to remove the doubt on its period. New instants of minima, added to those formerly published, gave a more precise ephemeris :

JD hel (min) 25863.8838 + 1.58729068 d x E (4)

RESUME

Des mesures photoélectriques de AP And ont permis de lever l'incertitude quant à sa période. De nouveaux instants de minima ajoutés à ceux anciennement publiés ont donné une éphéméride plus précise :

JJ hél (min) 25863.8838 + 1.58729068 j x E (4)

RIASSUNTO

Misure fotoelecttriche di AP And hanno permesso di togliere l'incertezza quanto al suo periodo. Nuovi istanti di minimo aggiunti a quelli un tempo pubblicati hanno dato un' effemeride puì precisa :

JJ hel (min) 25863.8838 + 1.58729068 j x E (4)

RESUMEN

Medidas fotoeléctricas de AP And han permitido resolver la incertidumbre referida a su período. Los nuevos instantes de mínimos añadidos a los antiguamente publicados han permitido obtener efemérides más precisas : JD hel (min) 25863.8838 + 1.58729068 d x E (4)

1. INTRODUCTION

AP And (23h 49min 30s + 45° 47.4') (2000) is listed in the General Catalogue of Variable Stars (Kholopov et al, 1985) with the following elements and information :

JD hel (min) 26565.460 + 1.5872920 d x E (1)

EA/DM (both components are main sequence stars and do not fill their inner Roche lobes) ; mag 11.3 to 11.9 (p) ; sp F5 ; the period may be two times shorter.

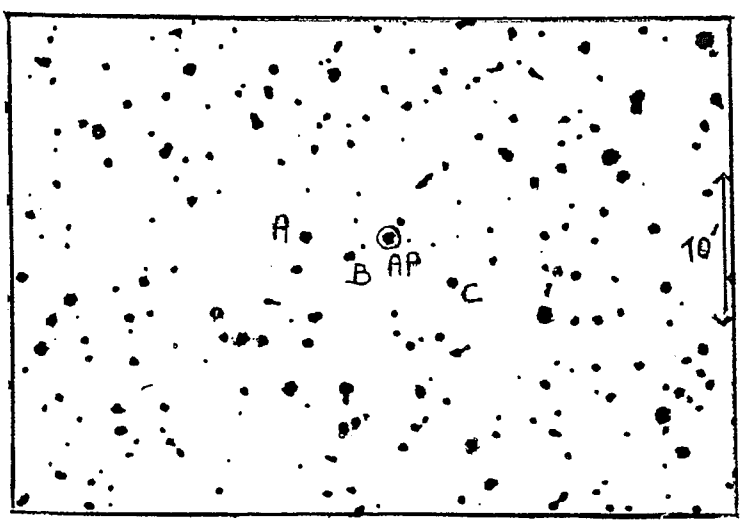

fig 1 : chart of AP And with its comparison stars

Historically, this star was first announced as an eclipsing star of short period by K. Lassovszky (1931). In 1932, he published a light curve very much like that of an EA star without a secondary minimum using the following elements :

JD hel (min) 26565.460 + 0.79365 d x E (2)

Afterwards, B. Whitney (1957) measured AP And on his own photographic plates. He gave 15 instants of minima, each of these determined from a number of field plates varying from 1 to 25. He deduced the eclipses duration to be 0.12 period long with primary and secondary minima, and the period nearly twice that of K. Lassovszky : 1.5872920 day. These elements were published in the GCVS 85 with a note concerning the doubt on the period.

A new study of AP And was published in 1960 : K. Löchel measured the star on 180 photographic plates taken at Sonneberg between 1950 and 1960. He determined 12 minima to which he could add 4 additional minima obtained by H.Huth on his own plates taken between 1929 and 1936. The period found with these minima was slighty shorter than the one from Lassovszky. From the composited light curve of the 180 photographic measurements. K. Löchel thought, as B. Whitney, that the real period was double. He proposed (in addition to shifting the origin epoch of a half period) the following ephemeris :

JD hel (min) 25864.684 + 1.587288 d x E (3)

2. VISUAL OBSERVATIONS

The first visual minimum I could came across was published in the BBSAG Bulletin n° 25 (1976) : it is the result of the estimates of Roger Diethelm.

At GEOS, I mentionned the doubt concerning the period of AP And and the lack of a regular survey of this star : FT 39 (March 1990) and NC 647 (April 1991). Roland Boninsegna obtained one minimum and the author, ten more.

These visual observations showed that the GCVS 85 ephemeris was still more or less valid, although the O−C were slightly negative.

3. PHOTOELECTRIC MEASUREMENTS

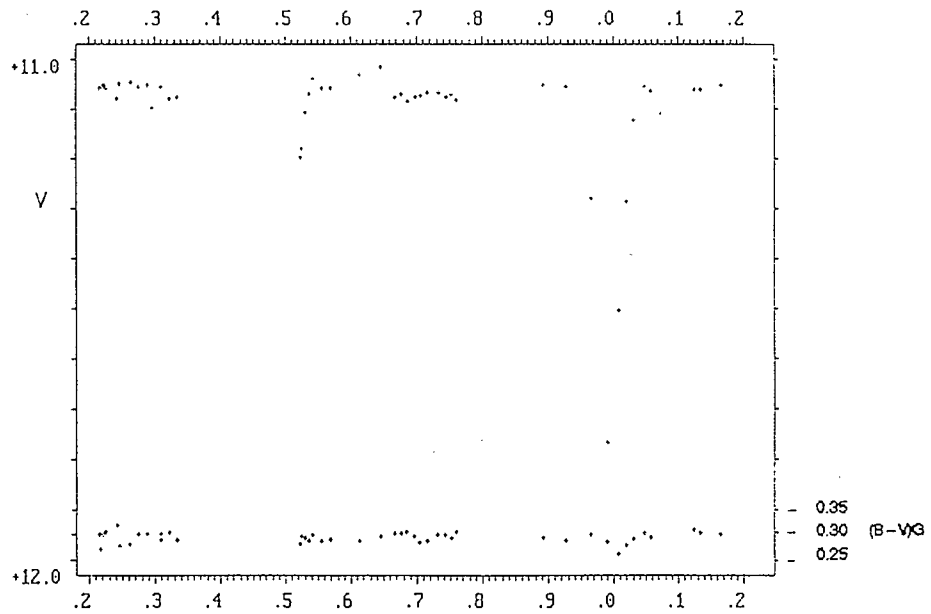

fig 2 : composited light curve of AP And using 45 photoelectric measurements in V and 45 color indices (B−V)G with the elements of ephemeris (1)

In order to remove the doubt about its period, AP And was measured during two GEOS missions at the Jungfraujoch observatory with the photometer attached on the 76-cm telescope. This photometer is equipped with filters of the Geneva photometric system. 24 measurements in B and in V were obtained at the end of 1991 – beginning of 1992 and 21 others in December 1992.

The mean magnitude of AP And at maximum is 11.06 in V (± 0.03) and the faintest is 11.77 in V. It is possible that the minimum obtained was from a secondary (K. Löchel, 1960).

The colour indices of AP And do not vary or vary very slightly : from – 0.259 to – 0.321 in the Geneva system ; from 0.57 to 0.52 in the Johnson and Morgan system after transformation with the formulae of Meylan and Hauck(1981). The system consists of two stars of nearly equal colors and masses. In that case, the primary and secondary minima are of about the same amplitude and we can be sure that the period of AP And is 1.59 day and not twice shorter since in spite of the lack of measurements between phases 0.34 and 0.52, no light variation appears at phases 0.25 and 0.75 for which we have a lot of measurements.

4. PERIOD IMPROVEMENT

Table 1 contains 15 minima determined by B. Whitney (1957) and 14 by H. Huth and K. Löchel (1960). In K. Löchel's paper, two minima were listed twice with very little difference in the instants. In the two cases, I calculated the mean moment. To these earlier photographic timings, I could add 12 visual minima and a photoelectric one.

Two of K. Löchel's minima are outside the 3 sigma limit of the series. They have been omitted in the final linear regression. It is impossible to know if they were calculated from one or more photographic plates.

Table 1 : minima of AP And used to determinate with more accuracy its period elements (ephemeris 4).

OBSERVERS	METHODS	JD HEL (2400000 +)	E	O–C (4)
HUTH	p	25865.488	1	+ 0.0169
HUTH	p	25981.350	74	+ 0.0066
HUTH	p	26273.400	248	– 0.0048
HUTH	p	28407.516	1602.5	– 0.0012
WHITHNEY	p	30675.751	3031.5	– 0.0046
WHITHNEY	p	30695.589	3044	– 0.0077
WHITHNEY	p	31402.735	3489.5	+ 0.0003
WHITHNEY	p	31468.605	3531	– 0.0022
WHITHNEY	p	31702.730	3678.5	– 0.0026
WHITHNEY	p	32063.840	3906	– 0.0012
WHITHNEY	p	32067.809	3908.5	– 0.0005
WHITHNEY	p	32445.583	4146.5	– 0.0017
WHITHNEY	p	32552.724	4214	– 0.0028
WHITHNEY	p	33187.642	4614	– 0.0011
WHITHNEY	p	33672.569	4919.5	+ 0.0086
LOCHEL *	p	34284.516	5305	+ 0.0551
WHITHNEY	p	34387.634	5370	– 0.0008
WHITHNEY	p	34683.674	5556.5	+ 0.0095
WHITHNEY	p	35391.595	6002.5	– 0.0012
LOCHEL *	p	35718.513	6208.5	– 0.0650
WHITHNEY	p	35810.643	6266.5	+ 0.0021
LOCHEL	p	36053.496	6419.5	– 0.0004
HUTH–LOCHEL	p	36399.533	6637.5	+ 0.0073

OBSERVERS	METHODS	JD HEL (2400000 +)	E	O−C (4)
LOCHEL	p	36426.524	6654.5	+ 0.0143
HUTH−LOCHEL	p	36484.452	6691	+ 0.0062
LOCHEL	p	36526.483	6717.5	− 0.0260
LOCHEL	p	36807.431	6894.5	− 0.0284
LOCHEL	p	36818.555	6901.5	− 0.0155
LOCHEL	p	36819.385	6902	+ 0.0209
RD	v	42777.261	10655.5	+ 0.0013
VBR	v	48087.540	14001	− 0.0007
VBR	v	48176.409	14057	− 0.0199
VBR	v	48495.481	14258	+ 0.0066
BNN	v	48499.432	14260.5	− 0.0106
VBR	v	48499.457	14260.5	+ 0.0144
VBR	v	48538.342	14285	+ 0.0108
VBR	v	48588.328	14316.5	− 0.0029
VBR	v	48596.264	14321.5	− 0.0033
VBR	v	48603.415	14326	+ 0.0049
PHO	p.e.	48619.284	14336	+ 0.0010
VBR	v	48915.331	14522.5	+ 0.0182
VBR	v	49210.537	14708.5	− 0.0118

p = photographic; v = visual; p.e. = photoelectric
RD = Roger Diethelm (BBSAG) ; BNN = Roland Boninsegna (GEOS) ; VBR = Jacqueline Vandenbroere (GEOS).
* = minima not used in the final calculations

JD hel (min) 25863.8838 + 1.58729068 d x E (4)
± 0.0033 ± 0.00000067 (confidence 95%)

This ephemeris was calculated with the 40 minima listed above. Note that the period has not varied much since 1929.

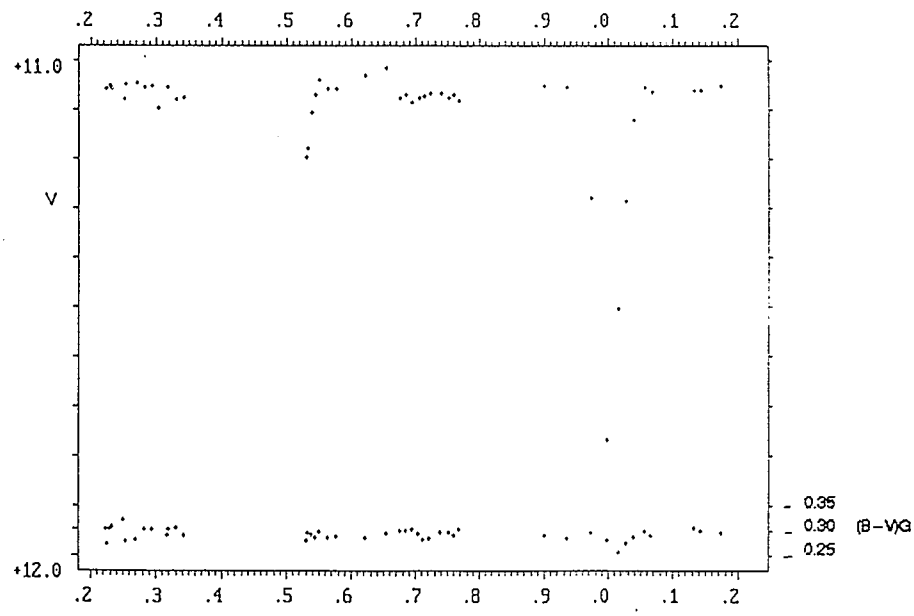

fig 3 : composited light curve of the photoelectric measurements with the elements of ephemeris 4.

5. CONCLUSION

AP And is an eclipsing star whose primary and secondary minima cannot be discriminated. Its magnitude ranges from 11.06 (V) to > 11.77 (V). Its mean colour index (B−V) is about 0.55 and is constant or slightly variable.

6. BIBLIOGRAPHY

- Roger Diethelm, 1976, BBSAG Bulletin n° 25.
- K. Lassovszky, 1931, Astronomische Nachrichten, 243, 400.
- K. Lassovszky, 1932, Astronomische Nachrichten, 245, 349.
- K. Löchel, 1960, Mitteilungen über veränderliche Sterne, Berlin – Babelsberg und Sonneberg, 455.
- G. Meylan and B. Hauck, 1981, Astronomy and Astrophysics Supplement Series, 46, 281.
- B.S. Whitney, 1957, The Astronomical Journal, 371, 62.
- P.N. Kholopov et al, 1985, General Catalogue of Variable Stars, fourth edition.

Jacqueline Vandenbroere