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NOTE ON THE PERIOD OF OO AQUILAE

OO Aquilae is a W UMa system with unusual deep eclipses; it has been recommended for observations in a supplement to Dr.Plavec's wellknown list ("Sudden period changes?"). To-day, the variable is far from being a neglected object, since observers of the Nürnberg-Izmir group obtained a valuable set of photoelectric minima and a short discussion of some recent observations in IBVS No. 391 already led to the conclusion of a "rapidly shortening" period (Pohl). Comparing recent elements with earlier ones is, however, a method usually much less suited for a detailed study of period changes than a discussion of the O - C curve. This we attempt here, based on the entire available material.

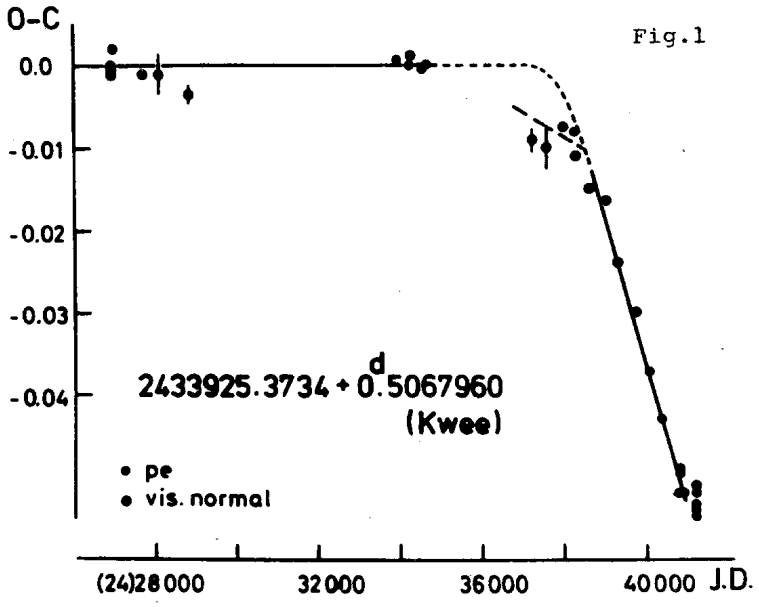

Fig.1

New elements in IBVS No. 391, especially Pohl (IV), seem to represent recent minima up to 1970 very well. Yet a comparison weth Kwee's early photoelectric observations (1951-53) in-

dicates, by very high residuals amounting to nearly P/2,a confusion of primary and secondary minimum. (A quick estimate shows that the observed shortening of the period cannot be responsible for a phase-shift of about 0.4.) Therefore, in all cases of OO Aquilae minima mentioned in IBVS Nos. 391, 456, 530 and 687, it should be read primary minimum instead of secondary minimum and vice versa. The zero-epoch JD 2439300.682 itself, used in formula (IV), belongs to a secondary minimum as indicated in IBVS No. 154 by E=10012.5. A corresponding change in the ephemeris formula gives then

Min. I = JD 2440858.291 + $0^d.5067868$. E Pohl (IV^X)

In Fig. 1 we present the complete O-C diagram, based on Kwee's elements, representing all available minima since the discovery of the variability. Visual observations are always combined to normal minima. No distinction between primary and secondary minimum has been made. There was, obviously, a substantial decrease of the period some time after Kwee's observations; it took place between two longer sections of apparently constant eclipsing period. These values of P, before and after the decrease, are well established by Kwee and by Pohl,respectively,

In order to obtain a closer insight into this shortening of the period we modified somewhat the first visual normal point mentioned by Pohl and supplied five additional visual normals:

JD 2437200.534 ± 0.0016 (sec.),Ashbrook (n=13)
37533.751 ± 0.0024 (pr.) Ashbrook, ST,BAV (n=9)
37946.2854± 0.0008 (pr.) BAV (n=11)
38238.450 ± 0.0017 (sec.) ST, PK (n=6)
38611.4476± 0.0008 (sec.) ST (n=9)
JD 2438972.7916± 0.0009 (sec.) IBVS Nos.111,114,119 (n=25)

(Here ST stands for "Sky and Telescope", PK for Pohl and Kizilirmak and BAV for the Berlin observers.)

A close-up of the star's recent behaviour is given in Fig.2. The essential constancy of the period between 1965 and 1970 is clearly demonstrated. Minima observed in 1971 yield

systematically positive O-C values again. On the other hand, the regrettable gap of almost 15 years between the earliest timings of minima (by Florja, Martynov, Soloviev, Lause, Bodokia) and the observations at Leiden prevents us from getting a definite picture of the period changes. The longest series of observations is due to Martinov (1932-37). Forming two "last normals" from his times of minima we obtain the residuals: O-C= $=-0^d.001$ resp. $-0^d.003(5)$, according to Kwee's formula (see Fig.1) This may perhaps indicate the possibility of smaller oscillations but does not suggest major changes in the period. It is worth noting that Martinov's discussion results in a period almost identical to the value given much later by Kwee (P_M- $-P_K$=-0.09 sec.) Since its discovery the period decreased by

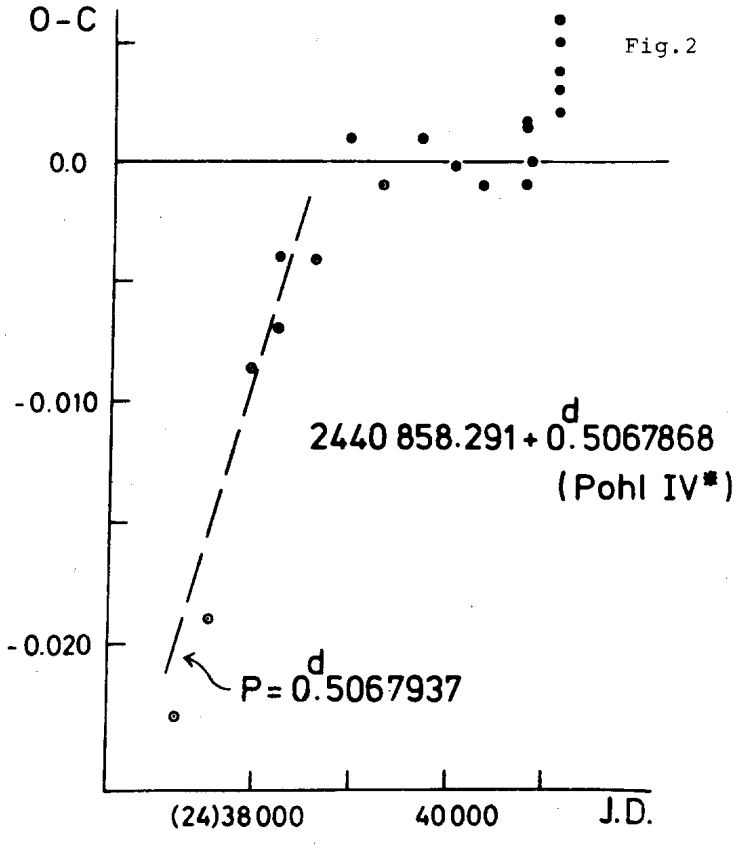

Fig.2

about 0.8 sec, all the change having taken place between 1953 and 1965. A steady, linear decerase of the period over this entire time interval would lead to more than twice as high O-C values as observed. A span of only 1600 days could suffice for this transition to the later period, as tentatively indicated in Fig.1 around JD 2438000. This possibility is certainly supported by Pohl's first photoelectric epoch of minimum and it can be reconciled with many visual timings, too. It is, however, flatly contradicting to the first two of the visual minima listed above, in particular to Ashbrook's series of observations from 1960.

The reliability of these epochs of minimum (2437200 and 2437533) is an intriguing question. The second, not very accurate, normal combines the timings of several observers, with O-C values ranging from $+0^d.001$ to $-0^d.024$. Among those, the 3 minima by Ashbrook represent systematically the smaller (more negative) values, their mean differing from the mean of the other 6 determinations by $-0^d.011$. This is, however, hardly a significant statistics; moreover 1952 observations by Ashbrook are in almost perfect agreement with photoelectrically derived epochs of minimum by Kwee and Fitch. It would be difficult to motivate the rejection of these two normals while accepting them as they are renders the "continuous transition" of Fig.1 untenable. In this case a sudden decrease of the period becomes a serious possibility as shown in both figures by the straight line corresponding to $P = 0^d.5067937$.

Still rather fragmentary, the following picture of the period changes of OO Aquilae emerges:

The period was constant or nearly constant between 1932 and 1953 with possible small fluctuations of probably less than 0.1 sec. Between 1953 and 1965 the period shortened considerably. It is not possible to reconstruct the exact circumstances of this decrease any more: it may have occurred continuously as well as in a succession of abrupt changes.

After 1965 the period remained virtually constant again, till quite recently a sudden increase by nearly 0,4 sec seems to be indicated. Further photoelectric observations are urgently requested.

References

For a list of individual studies or series of observations see: Finding List for Observers of Eclipsing Variables, Harvard Annals Vol 111, more recently issues of the IBVS and some of the Reports of Commission 42 of the IAU (esp.in IAU Transactions XIII A).

The period has been discussed by

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