PERIOD REVISIONS FOR AX ANDROMEDAE AND WX CANIS MINORIS

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Abstract

The AAVSO light curves of WX Canis Minoris and AX Andromedae showed apparent periods which were twice as long as the published periods. The analysis of available data indicate that the periods should be revised upward, for WX CMi, from 209.75 to 420.1 days, and for AX And, from 189 to 380 days.

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1. WX CMi: Background and Data

When WX Canis Minoris was first noticed by O. Morgenroth in 1934, it was announced as a suspected nova. Subsequent findings by Kukarkin (1934) and Deleporte (1934) led Morgenroth to revise his original hypothesis and the star was designated a Mira Ceti type variable, with a period of 419 days (Morgenroth 1935).

Morgenroth's period was used in catalogues until the 1958 General Catalogue of Variable Stars was published. Here the period was changed to one half the original- 209.5 days. The only reference given was to the previous edition (1948), but in that edition the 419 day period was listed, with the Morgenroth article as a reference.

The discrepancy in the period of WX CMi was mentioned in an article by Dr. William E. Bidelman. He notes, "It seems possible the original period is more nearly correct." (Bidelman 1965).

The period was revised again in the 1968 GCVS, this time to 209.75 days. The references were the 1958 GCVS, and Tsesevich's and Kazanasmas' Atlas of Finding Charts for Variable Stars. There is a finding chart for WX CMi, but the star is incorrectly identified. The correct position, as plotted on recent AAVSO finding charts, has been verified by AAVSO observations and by both the Patrol Plates at Harvard College Observatory (RH-RB series) and the Palomar Sky Survey.

The star indicated by Tsesevich as WX CMi was found easily on the RH-RB plates and was not seen to vary at all. Its constant magnitude is approximately 11.2. It appears equally bright on the red and blue Palomar photos (long period variables are generally redder). On the other hand, the star indicated by AAVSO finding charts (see Figure 1) is sometimes seen at magnitudes as bright as 11.3, but at other times cannot be seen at all, even on plates which reach 14.7 magnitudes. In addition, this star is very much brighter on the Palomar red photograph.

The data available for analysis are from various sources, beginning with Morgenroth's photographic data (February 1929-October 1934; Morgenroth 1935). These overlapped the data from my own study of the HCO Patrol plates (RH-RB series: October 1930-January 1952; Damon B series: February 1968-July 1980). Last and most thorough are the AAVSO observations (January 1975-May 1980; prior to 1975, WX CMi was misidentified on AAVSO finding charts).

2. WX CMi: Methods

To investigate the period, I used several computer programs. The

first was a period-search program (Morbey 1973). For each assumed period, this program sorts the observed magnitudes into ten phase bins and then computes the difference between the maximum and minimum magnitudes in each bin. The largest difference is discarded and the remaining nine values are summed. This sum is normalized by dividing it by seven times the standard deviation of the magnitudes. The resulting "figure of merit" (FOM) is evaluated for a range of periods, and the smallest FOM indicates the most likely period. See also Morbey (1978) for a slightly modified version.

In addition to the Morbey period-search program, a second program was run for verification. This period-search program is based on a "phase dispersion minimization" technique (Stellingwerf 1978). The results of both programs were significant.

The most conclusive program, FAZE, accepts a period and an epoch, and then calculates and plots magnitude vs. phase. Concerning the results (see Figure 2), each graph employed exactly the same data and epoch.

The programs discussed above were kindly made available to the AAVSO by Drs. William Liller and Emilia Belserene.

3. WX CMi: Conclusions

The data indicate that any period in the area of the original (419 days) is twice as likely as any period in the range of the published period. In fact, in a range which includes both periods, the present 209-day period does not even fall in the 24 most likely candidates.

To find the best period fit, I slowly narrowed the field of search and decreased the phase step; eventually all most likely periods were rounding to 420.1. The second period search program confirmed this value. The phase diagrams from FAZE (Figure 2) offer convincing visual evidence for the 420.1 days period. On the basis of these analyses, I believe the period of WX Canis Minoris to be 420.1 days.

4. AX And: Background and Data

AX Andromedae is a Mira-type variable star, with a magnitude range of about 10.5 to 14.8. It was first noticed in 1939 by S. Faddeeva on the plates of the Moscow Observatory; a finding chart in the announcement article agrees with the AAVSO finding chart (see Figure 3). A period of 189 days was suggested (Meshkova 1940).

This period was first questioned by J. A. Mattei, Director of the AAVSO, when several years of AAVSO data were studied for annual predictions of maxima and minima dates. Observations from 1970 through 1980 show a well-defined light curve for AX And, with a period of 380 days, just twice the Meshkova period.

To obtain more data, I examined the RH-BM series of Patrol plates at Harvard College Observatory. I found useful plates dating from December 1930 through October 1948; these dates happened to overlap the dates of the plates studied by Faddeeva and his colleagues.

5. AX And: Conclusions

By plotting the photographic data from HCO on the same graph with the AAVSO data, I was able to verify the 380 day period. I was also able to confirm the identification of AX Andromedae by comparing the light variations on two sequences of plates taken at HCO and the Moscow Observatory.

I have included a light curve which depicts data from AAVSO observers, data from HCO plates, and data from the Meshkova article (see Figure 4). Based on the data from these sources, I believe the period of AX Andromedae to be 380 days, not 189 days as originally published.

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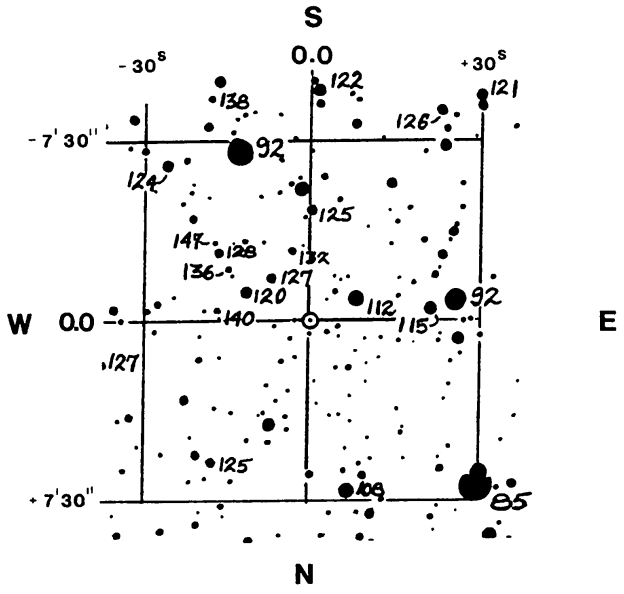

Figure 1. Finding chart for WX Canis Minoris, $\alpha = 07^h06^m52^s$, $\delta = +07°40'1$ (1900), taken from "e" scale (10"/mm) AAVSO preliminary chart for WX CMi, 070607.

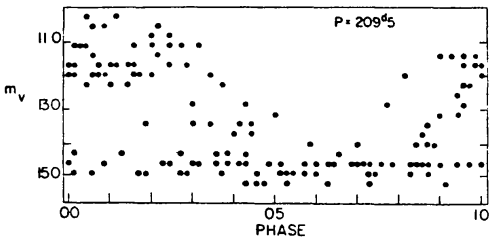

Figure 2a. Light curve of WX CMi, utilizing AAVSO visual data. The period is 209.5 days, the given value.

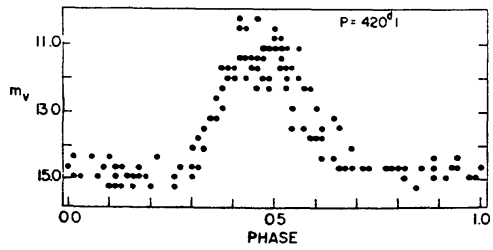

Figure 2b. Light curve of WX CMi, utilizing AAVSO visual data. The period is 420.1 days, the value which best fits the data. This value is the suggested true period.

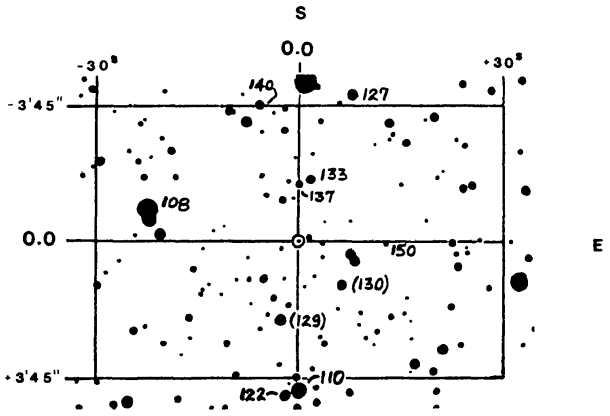

Figure 3. Finder chart for AX Andromedae, $\alpha = 02^{h}26^{m}16^{s}$, $\delta = +46°03'.0$ (1900), taken from "f" scale (5"/mm) AAVSO preliminary chart for AX And, 022646.

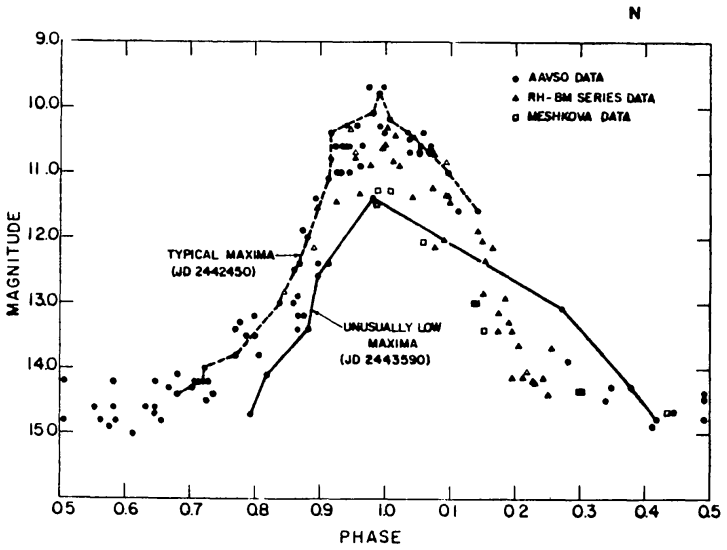

Figure 4. Light curve of AX Andromedae, utilizing visual data from AAVSO and photographic data from HCO plates and Meshkova (1940). The period is 380 days.