BOOK REVIEW

MULTIPLE PERIODIC VARIABLE STARS

Walter S. Fitch (ed.), D. Reidel Publishing Company, Dordrecht, Holland/Boston, U.S.A., 1976. 348 pp., $35.00.

Nature has a sense of humor. Otherwise why did she have Nova Cygni 1975, the nova of the decade, erupt with 100 variable star astronomers from 25 different countries out of action, able to make only naked eye estimates from downtown Budapest.

This book, volume 60 of Astrophysics and Space Science Library, contains the 15 invited review papers presented at I.A.U. Colloquium No. 29, which was the sixth in the series of Bamberg-Budapest Variable Star Colloquia. Most of the familiar variable star types are treated, usually with separate reviews on the observational and theoretical aspects, which I find helpful. The colloquium theme itself, multiple periodicities, is a clever way to emphasize how much we are learning about variable stars; a decade ago many of these phenomena were described as anomalous, irregular, or random.

I am always amused to see that certain variable stars continue to stump the theoreticians; even their most obvious observational features are not understood even approximately. J.R. Lesh, M.L. Aizenman and S. Kato show that the β CMa (= β Cep) variability, presumably some sort of pulsation, is still largely a puzzle. And I am amazed to hear B. Szeidl describe the many interlocking periodicities found by observers in the RR Lyr variables and then to hear R.F. Stellingwerf admit that the theoreticians are having so much trouble understanding even the well-known Blazhko effect and the period changes in the RR Lyr variables.

At the other extreme are the Cepheids. R.S. Stobie, A.N. Cox, and J.P. Cox show how sophisticated computer programs can reproduce the instability strip, the period-luminosity relation, the detailed shape of the light curves (including bumps), etc. They can even tell us where the Cepheids are in their life cycle. In my opinion they are now just tightening up the last few screws.

Between these two extremes are the other variables. Here the battles are in full swing and ground is being gained year by year.

Ten years ago the peculiar A (Ap) stars presented a bewildering array of seemingly unrelated phenomena. Now S.C. Wolff shows us the picture is taking shape, in the form of the oblique rotator model. Certain chemical elements concentrate near the two magnetic poles, which are inclined with respect to the rotational axis. The variable light, the variable spectrum, and the variable magnetic field are all explained as a simple consequence of the star's rotation. A. Baglin emphasizes, however, that we are far from understanding <u>why</u> certain elements (like Si, Cr, Eu, and Sr) became concentrated at the magnetic poles.

A. Baglin offers a satisfying explanation for why the metallic line (Am) stars do <u>not</u> vary even though they mingle with the Ap stars in the H-R diagram. Rather recently we have learned that Am stars <u>are</u> Am stars because they occur in close binary systems, where they are forced to rotate synchronously. This rapid synchronous rotation produces a mixing which removes helium from the outer envelope and, since helium in the envelope is the sine qua non for variability in the instability strip, thereby prevents pulsation.

AAVSO'ers who look at red variables would enjoy reading

P.R. Wood's review. Those red variables with large amplitudes (Miras) are pulsating in their first overtone mode. Those with smaller amplitudes and more irregularities (the semi-regulars) are pulsating in their second overtone mode. Pulsation in the fundamental mode is unstable and never seen; P.R. Wood thinks it is related to the formation of a planetary nebula. Other periodicities are seen also, co-existing with the basic pulsation, but most of these are not yet explained.

W.S. Fitch and J.O. Petersen explain in expert detail the manifold periodicities seen in the RRs (= AI Vel = dwarf Cepheid) variables and in the δ Sct variables. Several long-standing questions are answered at last. W.S. Fitch demonstrates that the δ Sct variables _are_ really periodic, in the sense that there is one basic pulsational frequency; but in the many cases where they are members of a binary system different parts of the star pulsate with different phases and amplitudes. He further argues that there is no basic difference (in mass, evolutionary status, etc.) between the RRs variables and the δ Sct variables. Both are at the lower end of the instability strip but the δ Sct variables have smaller amplitudes due to damping of their radial oscillations by the influence of their close companions.

AAVSO'ers who look at dwarf novae would be fascinated by B. Warner's paper. In the last ten years we have made great strides in understanding variables like U Gem and SS Cyg, but B. Warner shows us there is much more to be learned. He finds that cataclysmic variables with short (≤30 days) recurrence periods almost all belong to two subgroups. One is the already known Z Cam subgroup. The second is the new subgroup he finds characterized by super-maxima, i.e., maxima lasting 10-20 days rather than only a few days. He dubs these the SU UMa variables. Theoreticians have this hot potato in their hands now.

Forgive me if I find the last paper, my own, the most interesting. Here I describe the many variabilities and multiple periodicities seen in the RS CVn binaries and in related binaries such as the flare star binaries like BY Dra, the W UMa binaries, and the unique white dwarf binary V471 Tau. The correct explanation seems to be large regions of spot activity darkening preferentially one hemisphere of one component. Theoreticians, who have yet to understand fully spot activity on our sun, are understandably reluctant to tackle the RS CVn binaries. But stars with large spotted regions can no longer be ignored, especially now that speckle interferometry has let us actually "see" large dark regions on certain stars like the red giant Betelgeuse.

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