

COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 2387

Konkoly Observatory
Budapest
18 August 1983
HU ISSN 0374-0676

ON SOME REMARKABLE PULSATION PROPERTIES OF THE HIGH-LATITUDE F-TYPE
SUPERGIANTS

In his recent paper Fernie (1983) states that HD 161796 is unique among known Cepheid-like variables in switching pulsational modes. However, we would like to show in this note that the pulsation properties of HD 161796 are shared by a group of stars which are similar to each other also in many other aspects. This group of variable F-type supergiants far above the galactic plane was proposed in our recent note (Sasselov, 1983) and HD 161796 belongs to it. To avoid clumsiness thereafter, let us name these luminous massive stars of normal Population I composition "UU Her- type" stars (after the member with best studied photometric behaviour).

All "UU Her- type" stars relatively well studied photometrically, possess at least two distinct alternating pulsational modes, switching from one to the other. This phenomenon has been observed in UU Her by Beyer (1948) - periods of 71 and 90 days; and in HD 161796 - by Fernie (1983) - periods of 43 and 62 days. For 89 Her, the observations in 1980 of Percy and Welch (1981) combined with those of Arellano Ferro (1983) show a clearly developed sine variation with a period of 61 days, as opposed to the one of 68 days in 1977/78. Similarly, for BL Tel(F), the value in the V pass band in 1977/78 is likely ~ 73 days, quite different from the previous distinct periodicity of 65.1 days (van Genderen, 1983). The extensive observations of UU Her show that the actual switching from one pulsational mode to the other occurs after an interval of irregular variability. From the observations of Fernie (1981) one can see that exactly the same happened to 89 Her in 1979 when switching from the 68^d to the 61^d mode; and to BL Tel(F) in 1976 (van Genderen, 1983).

Observations of UU Her in 1978/79 (Sasselov, Perem.Zv., in press) point to a distinct pulsation period of 80 days, i.e. a third one, different from the other two periods. Thus, for longer intervals of time pulsational mode switching in these stars may not be confined to two modes only. Hence, we get various ratios.

A curious phenomenon that has impressed most of the observers mentioned above seems to be common for all "UU Her- type" stars, too: not often, pulsation at full amplitude may cease abruptly - the star remaining constant for a couple of months - and then breaking into oscillations abruptly again. Observed in UU Her in 1935 (for 62 days); in HD 161796 in 1981 (for 64 days); perhaps, in BL Tel(F) in 1969; and, may be, in the end of 1978 in 89 Her.

A unique feature revealed so far only in UU Her is the frequency modulation of its pulsations, unaffected by the mode switching, and probably - not a light-time effect (Sasselov, 1981).

The observations of another "UU Her- type" star - HD 112374 are insufficient to discuss its variability in details. We suggest that it should be observed further from the southern hemisphere. More observations of BL Tel are necessary now, as well.

Discussing the pulsation properties of the "UU Her - type" stars, we have to mention in brief the problems about the interpretation of their light variability. For HD 161796 in particular, Fernie (1983) attributes it to radial pulsations. However, apart from posing much theoretical difficulties, radial pulsations appear to be inconsistent with the behaviour of the other "UU Her- type" stars, as well. The explanation by means of nonradial pulsations seems least contradicting, moreover that the theoretical study by Shibahashi and Osaki (1981) shows that low harmonic f-modes can readily be excited in supergiants on the left-hand side of the Cepheid instability strip - just where the "UU Her- type" stars are located. The harmonic index increases rapidly towards higher temperatures ($\ell \approx 100$ at $T_{\text{eff}} = 10000\text{K}$) and this may explain the confinement of specific variability to F-type supergiants only. Also mode coupling among radial and nonradial modes perhaps should not be completely ruled out in the close vicinities of the instability strip. However, as a whole, this interpretation also remains conjectural. The recent detection of a probable massive dark companion to 89 Her (Arellano Ferro, 1983), similar to the one in BL Tel, along with the appreciably complex variability of the "UU Her- type" stars, indicates at least that the exact solution may be rather complicated.

The author is much indebted to N.S. Nikolov and G.R. Ivanov for their continuous interest and support.

DIMITAR D. SASSELOV

Dept. of Astronomy, University of Sofia, Bulgaria

References:

- Arellano Ferro, A. 1983, Ph.D.Thesis, University of Toronto
Beyer, M. 1948, Astron.Abh., Erg.-Heft zu den Astron..Nachr., 11, Nr. 4, D63
Ferne, J.D. 1981, Astrophys.J., 243, 576
Ferne, J.D. 1983, Astrophys.J., 265, 999
Percy, J.R., and Welch, D. 1981, Publ.A.S.P., 93, 367
Sasselov, D.D. 1981, Astron.Circ., No. 1167, 6
Sasselov, D.D. I.B.V.S. No. 2314
Shibahashi, H., and Osaki, Y. 1981, Publ.A.S.Japan, 33, 427
van Genderen, A. 1983, Astron.Astrophys., 119, 265