ON THE BRIGHTNESS AND PULSATIONAL PROPERTIES
OF YELLOW SUPERGIANTS

A. Arellano Ferro
Department of Astronomy, University of Toronto, and
Instituto de Astronomía, Universidad Nacional Autónoma de
México.

ABSTRACT. Most of the existing data in the literature is
used to search for the periodicity of five yellow super-
giant variables. The pulsational mode and Q-values are dis-
cussed, being the luminosity the key parameter for their ac-
curate determination. An attempt to find the spherical har-
monic ℓ from the light and colour variation phase shift is
carried out.

PERIODICITY

The periodicity in these stars is not strict. The character-
istic time of variation has been found for the five yellow supergiants
in Table 1, using virtually all existing observations in the literature.
Photometry and radial velocities have been studied when available. In
the case of the eclipsing binary ε Aur, data out of the eclipse have
been preferred to avoid contamination by the companion. Period changes
were detected (ε Aur). A new period switch was found for HD161796, from
43 days in 1981 to 62 days in 1982 (details will be published in a
forthcoming paper).

Table 1. Pulsational properties of five yellow supergiants.

Star	P (days)	Epoch	M_v	$M/M_\odot$	Q	ℓ
HD161796	62,43	1979–82	−8 — −9	14–24	0.047–0.071	0
89 Her	63.5	1977–78 1980–81	−6.7 — −9	13–24	0.056–0.190	?
ε Aur	123, 160	1927–30 1931–61	−8.7	16	0.160	$\sim$2 or odd
V509Cas	385	1978–81	−9.5 — −9.1	26–30	0.066–0.087	≧ 4
ρ Cas	483	1964–68 1979–81	−9.5	29	0.180	$\sim$2 or odd

PULSATION CONSTANT Q

Theoretical calculations show that Q-values for luminous stars with convective envelopes range between 0.04 and 0.06 for radial fundamental mode pulsations (Takeuti 1979). Larger Q-values are normally interpreted as non-radial oscillations (Maeder 1980). Empirical Q-values were obtained using equation (2) in Maeder (1980), where Q is a function of P, M, M_v and T_e. T_e was estimated from the spectral type; M from theoretical models with mass loss (Maeder 1980). M_v is then the key parameter for the determination of Q. For ε Aur, V509 Cas and ρ Cas, M_v is known from their membership in OB associations (Stothers 1971; Humphreys 1978). They are non-radial pulsators. For HD161796 and 89 Her M_v is uncertain. However, arguments such as period ratios (HD161796) and capricious phasing changing from season to season between V, B-V and radial velocities (89 Her), seem to indicate that HD161796 is a radial pulsator (Fernie 1983) and 89 Her is a non-pure radial pulsator.

SPHERICAL HARMONIC ORDER ℓ

The spherical harmonic order ℓ (ℓ = 0 for radial modes) can be estimated from the phase shift between V and B-V variations (Balona & Stobie 1979;1980). For the long period yellow supergiants, the main difficulty is that simultaneous observations seldom exist and cycles are ill-defined. Simultaneous observations by the author (to be published) and some from the literature permit the estimations of ℓ in Table 1. This method leaves much room open for improvement when more appropriate data become available.

REFERENCES

Balona, L.A. & Stobie, R.S. (1979). Mon. Not. R. astr. Soc., **189**, 649.

Balona, L.A. & Stobie, R.S. (1980). Mon. Not. R. astr. Soc., **190**, 931.

Fernie, J.D. (1983). Astrophys. J., **265**, 999.

Humphreys, R.M. (1978). Astrophys. J. Suppl., **38**, 309.

Maeder, A. (1980). Astr. Astrophys., **90**, 311.

Stothers, R. (1971). Nature, **229**, 180.

Takeuti, M. (1979). Science Reports, Tohoku University, **62**, 7.