THE EMPIRICAL PERIOD-RADIUS RELATION FOR PULSATING STARS : A SYNTHESIS BASED ON PHOTOMETRIC AND RADIAL VELOCITY MEASUREMENTS

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The relation existing between the radius and the period for the pulsating stars of a given class constitutes a powerful test for the theory of stellar evolution and for the identification of the pulsation modes. In recent years, several authors have determined the mean radius of a lot of pulsating stars of various classes by applying the Baade-Wesselink method. Fig. 1 presents the resulting general logP - logR diagram grouping these determinations. The sources for the radii are given by Burki and Meylan (1986). The variable stars in known binaries have been excluded since the presence of a companion biases the radius calculation (Burki, 1984). The determinations marked by arrows are based on the radial velocities by CORAVEL (1m telescope at the Haute-Provence Observatory, France) or/and on the photometry in the Geneva system (40cm and 70cm telescopes at La Silla Observatory, Chile).

For the classical cepheids, two linear regressions have been calculated:

$$\log R = 1.16 + 0.72 \log P \qquad P<10d \qquad (1)$$
$$\log R = 1.03 + 0.77 \log P \qquad P>10d \qquad (2)$$

The difference between these two relations, if really significant, could be due to the mass loss process affecting the evolution of massive stars (Burki, 1985). For the cepheids with P<10d, the various theoretical models yield a mean relation $\log R = 1.18 + 0.69 \log P$ (Fernie,1984), which is quasi-identical with (1). This allows one to derive, from the definition $Q = P(\overline{\rho}/\overline{\rho}_{\odot})^{1/2}$, an equation relating Q, R and M (mass) :

$$Q = 0.0238\ M^{0.5}\ R^{-0.1} \qquad P<10d \qquad (3)$$

For the population II cepheids (BL Herculis and W Virginis stars), the relation is:

$$\log R = 0.87 + 0.54 \log P \qquad (4)$$

and it is remarkable to see that this relation satisfies globally well the RR Lyrae, δ Scuti and SX Phoenicis stars. By adopting 0.6 $M_{\odot}$ for the typical mass of the population II cepheids and RR Lyrae stars (Harris, 1985), the following relation can be deduced :

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$$\log Q = -1.4 + 0.2 \log P \qquad (5)$$

In Fig. 1 is also shown the location of FG Sge, the nucleus of a planetary nebula for which Mayor and Acker (1980) derived a value of the mean radius for the years 1978-1979.

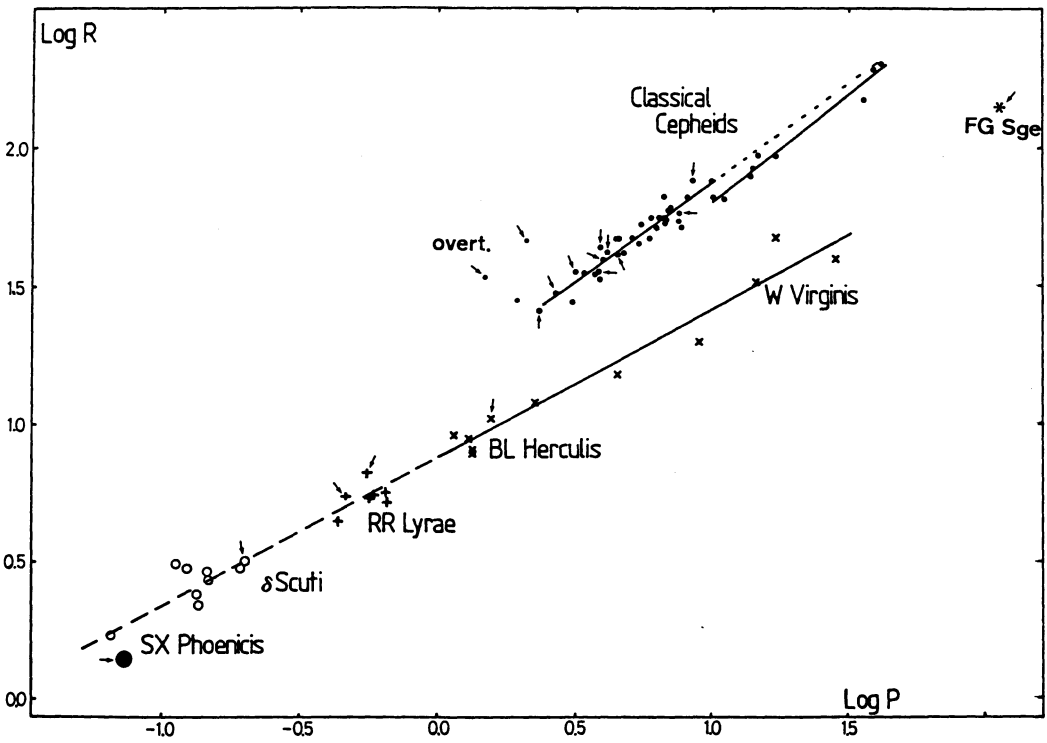

Figure 1. The logR - logP relations for pulsating stars.

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