1986

A Variation on the Baade-Wesselink Technique

Norman R. Simon
University of Nebraska - Lincoln, nsimon@unl.edu

36.08

A Variation on the Baade-Wesselink Technique

N.R. Simon (U. Nebr.-Lincoln)

Consider a radially pulsating star. Expand the radius variation in a Fourier series: $R = R_o + A_i \cos(i\omega t + \phi_i)$ [summation convention]. The velocity is $v = -i\omega A_i \sin(i\omega t + \phi_i)$. The ratio of the radii at two phases of the cycle may be written

$$(R_1/R_2)^2 = (L_1\ T_2^4)/(L_2\ T_1^4) \equiv \alpha. \qquad (1)$$

Setting $R = R_o + \Delta r$ ($\Delta r/R_o << 1$), we obtain $R_o = 2(\alpha\Delta r_2 - \Delta r_1)/(1-\alpha)$. The radial excursion Δr at any phase of the pulsation may be determined from a Fourier fit to the observed velocity curve. Assuming highly accurate velocity data (e.g. CORAVEL data), this can be done very precisely. If we choose phase 2 to be that for which $\Delta r_2 = 0$, we have

$$\alpha = (2/R_o)\Delta r_1 + 1. \qquad (2)$$

Obtaining energy scans at various values of Δr_1, we may use model atmospheres to determine the function $\alpha(\Delta r_1)$ from Eq. (1). Then, the slope yields R_o via Eq. (2). Since the zero point is constrained [$\alpha(0) = 1$], we have a check on our determination of α from the energy scans. Another check comes from choosing Δr_2 in a different way - namely, to correspond to the maximum positive displacement. In that case, α must attain its minimum value at the minimum of Δr_1. We discuss the use of these variations to determine the radius R_o and to test the application of model atmospheres to pulsating stars.