S. V. Vorontsov and V. N. Zharkov. *The theoretical spectrum of the sun's oscillations*. A large volume of new experimental data has now been accumulated to support the authenticity of the observed 160-minute solar oscillation.[1] Identification of this period with the theoretical oscillation spectrum of the contemporary sun model has come up against major difficulties.[2,3] Thus, the periods of the radial oscillations are shorter than an hour. Dipolar oscillations could not be recorded in Crimean Astrophysical Observatory experiments. In the quadrupole oscillation spectrum, the 160-minute period falls in the range of periods of high g-modes. Then, in order to explain the 160-minute period in terms of one of the higher gravitational modes (g_{10} or g_{11}), it is necessary to explain a mechanism that would result in excitation of only one of a whole series of oscillations of similar structure and periods. A more natural possibility for identification of the 160-minute period can be proposed, but it requires modification of the contemporary model. This possibility was long overlooked because of certain shortcomings of the generally accepted scheme of classification of theoretical-spectrum oscillations into p, f, and g modes.[4] This classification applies well to polytropic models, for which, indeed, it was proposed by Cowling.[5] In the contemporary detailed model of the sun[6,7], the polytropic exponent changes stepwise from about 3.4 in the interior radiation region to 1.5 in an extended external convection zone. For this model, an oscillation that differs sharply from other g-modes with similar periods appears in the spectrum of higher g-modes with numbers $n > 4$. In this oscillation, the maximum amplitudes are concentrated in the external regions of the sun, and the amplitudes in the internal regions are very low. The existence of this preferred mode among the g-modes with similar periods means that even with equal energies, this mode will produce incomparably greater amplitudes at the surface than other g-modes. The possibility that such a preferred mode may exist in the theoretical spectrum is easily understood if the classification problem is regarded from the standpoint taken in the theory of the Earth's natural oscillations. For a model with a discontinuity in the radial distribution of material parameters, there are two types of oscillations; oscillations of the outer regions and core oscillations. The high period of the fundamental frequency of the outer-region oscillations then lies among the core-oscillation periods. On continuous smoothing of the discontinuity, the core oscillations become gravitational g-modes. Thus, the spectrum of the outer-region oscillation periods overlaps the period spectrum of the internal gravitational oscillations. In the range of periods where this overlap occurs, the oscillations will be of mixed nature. The mixing decreases with increasing number n of the oscillation, since the outer-region oscillations are strongly displaced toward the surface. For the contemporary sun model, the outer-region fundamental is clearly distinguished in the spectrum of g-mode periods beginning with $n=6$. For the quadrupole oscillations ($n=2$), however, there is less mixing, and this gives a whole set of similarly structured g-modes with comparatively high amplitudes at the surface. Thus, explaining the 160-minute period as the fundamental quadrupole period of the outer regions eliminates the need to find a resonant-excitation mechanism; however, this explanation requires modification of the present model.

Because of Coriolis forces, the spatial pattern of the oscillations should precess slowly in longitude and latitude in the direction opposite to the sun's rotation. The precession angular velocity is determined by the eigenfunctions of the oscillation. Calculations indicate that because of this effect, the shift-pattern rotation of the outer-region quadrupole fundamental should lag the rotation of the oscillating sphere by twice as great an amount for an observer in an inertial coordinate frame. Then interpretation of the 160-minute period as the outer-region quadrupole fundamental could provide a natural explanation for the observed 27-day cycle in the amplitude of the 160-minute oscillation.

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