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Distribution of polarization and intensity of radiation across the stellar disk and numberical values of atmospheric characteristics governing this distribution

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Abstract

Computations of polarization and intensity of radiation from a unit stellar surface area are presented, as well as a study of the numerical characteristics of atmospheres - single-scattering albedo Ωλ and the initial source functionλ(δλ), which define the polarization behaviour of atmospheres. The radiatively stable models of stellar atmospheres presented by Kurucz et al. (1974) and Kurucz (1979) have been used for calculations. Since the Ωλ versus optical depth τλ dependence is rather weak, it has been assumed that Ωλ(τλ=cost. With a fixed effective temperature Teff maximum values of Ω are characteristic of stars featuring the lowest surface gravity acceleration g. Among stars with radiatively stable atmospheres, maximum values of Ω (λ=5000 Å) ≈ 0.4-0.6 are exhibited by supergiants with Teff=8000-20 000 K. The plot of Ω(λ) is characterized by discontinuities at the boundaries of spectral series for hydrogen and, sometimes, for helium. Maximum Ωλ are attained in the Lyman region of λ=912-1200 Å, where Ωλ can reach the value 0.7-0.9 for supergiants, this value being ≳ 0.3 for Main-Sequence stars. For stars with Teff ≳ 35 000 K, high values of Ωλ also are attained for λ<912 Å. Within the infrared region, Ωλ is always small because of bremsstrahlung absorption. A rapid growth of the source function Bλ with <λ typical for ultraviolet range (within the Wien part of spectrum), together with high values of Ωλ results in the strong polarization of emission from a unit stellar surface element, sometimes exceeding the values for the case of a pure electron scattering. For longer wavelengths, where the limb-darkening coefficient is smaller, the plane of polarization abruptly turns 90° in the central parts of the visible stellar disk. © 1985 D. Reidel Publishing Company.

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