THE Mg II FEATURES NEAR 2800Å AND SPECTRAL CLASSIFICATION

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The Mg II resonance lines at 2795.523 and 2802.698Å and their respective subordinate lines at 2797.989 and 2790.768Å are probably among the most prominent and interesting spectral features in the ultraviolet; they are perhaps the most significant in the mid-ultraviolet. They are also observable in one form or the other in stars of practically all spectral types. We shall discuss relatively high (about 0.4Å) resolution observations of these features.

I. GENERAL BEHAVIOR OF THE Mg II FEATURES

a. Main-sequence Stars

In the early spectral types both the resonance and subordinate lines are seen primarily as absorption lines. An interstellar absorption of varying strengths is superimposed on the photospheric absorption of the resonance lines. The strengths of the photospheric resonance and subordinate lines increase from O to B, e.g., Lamers et al. (1973) and Kondo et al. (1975). The subordinate lines begin to merge with the resonance lines in late-B stars. In mid-A type stars, the resonance and subordinate absorption strengths become maximum. In F-type stars, the photospheric absorption strenghts continue to decrease. Chromospheric emissions become definitely detectable in F-type stars (Kondo et al. 1972). In a G2 V star, the sun, the chromospheric emission is fairly prominent at the core of relatively weak photospheric absorption. In K and M-type stars, this region is presumably dominated by the chromospheric emissions of Mg II resonance lines with the photospheric absorption becoming negligible in late-K stars; the only extant observation in this region is that of ε Eri (K2 V) (McClintock et al. 1975).

b. Giants

The general behavior of the Mg II lines in giants is fairly analogous to that for main-sequence stars. The emission features in G and K giants often show asymmetry (Kondo et al. 1976a) as a result of the chromospheric turbulence or the mass flow.

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c. Supergiants

The Mg II features in supergiants differ significantly from those in the main-sequence stars as follows. In stars of mid-B to mid-A the resonance lines are affected by shortward shifted additional absorption arising in the outward moving shell, e.g., Kondo et al. (1976b). In K and M spectral types, in which the Mg II features are effectively entirely in resonance emissions, the 2795Å component is markedly asymmetric due to the selective absorption near 2795Å by neutral metals in the circumstellar shell whereas the 2802Å component is symmetric (Kondo et al. 1972, 1976b; Bernat and Lambert 1976).

II. ABSOLUTE MAGNITUDES VERSUS Mg II EMISSION WIDTHS

The relationship between the absolute magnitudes of stars and the Ca II K line emission widths, W (expressed in terms of the Doppler velocity km sec^{-1}), was first discovered by Wilson and Bappu (1957). There are several reasons why one might expect the Mg II emissions to be more prominent and easier to detect than Ca II K emission as discussed by Kondo et al. (1972); the possible existence of a relationship similar to the one found by Wilson and Bappu was first suggested in that paper. This relationship was subsequently explored by several workers. According to the latest study by Kondo et al. (1976b), the relationship may be expressed as

$$M_V = -12.45 (\log W) + 28.78.$$

III. ABSORPTION WIDTHS AND SPECTRAL TYPES

The absorption widths increase from O to late-B; in late-B stars, the widths of the subordinate lines increase from luminosity class V stars to luminosity class I stars. In the main-sequence and giant stars, the absorption widths continue to increase to late-A, where maximum values are attained; the widths then decrease into F and G types. In mid-B to mid-A type supergiants, the widths are also increased by the excess absorption taking place in the outward moving shell.

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