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Mid-UV Spectral Diagnostics

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Abstract. The mid-ultraviolet is an important diagnostic region due to its sensitivity to the hottest stars of a stellar population. Sources of mid-UV flux include main sequence turn-off stars, the basic clocks of stellar evolution, and also blue horizontal branch stars and blue stragglers. We describe some observed trends in mid-UV colors and spectral indices.

Keywords. ultraviolet, spectra, stellar populations, stellar ages, stellar metallicities

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With the possible exception of blue horizontal branch stars and blue stragglers, stars near the main sequence turn-off (MSTO) are the hottest stars in a stellar population. The mid-UV spectrum of a single stellar population (SSP) older than a Gyr or so looks like that of a single F-type star, because F-type MSTO stars are the dominant contributors to the flux in the mid-ultraviolet. The isolation of MSTO stars in the mid-UV simplifies analyses of SSP's because main-sequence, F-type stars are well understood.

The problem is that the ultraviolet spectra of F-type stars cannot be modeled satisfactorily, so observed spectra are needed to build up the UV spectrum of a stellar population. UV spectra from the IUE observatory have been used to good effect (Fanelli *et al.* 1990, Pickles 1998, Maraston *et al.* 2009). More recently, high-quality UV spectra have become available from Hubble's Next Generation Spectral Library (NGSL) (http://archive.stsci.edu/prepds/stisngsl/). The NGSL consists of high-S/N, $R \sim 1000$ spectra of 374 stars with good coverage of the HR diagram at different metallicities. All the spectra have an absolute flux calibration, so that wide-band spectrophotometry (e.g. colors, spectral breaks) is also possible. The spectral coverage of NGSL spectra is broad (2000-10000 Å), so the optical spectrum can be used to derive the basic stellar parameters ($T_{\rm eff}$, $\log g$, and [Fe/H]), and these parameters can then be used to calibrate the mid-ultraviolet spectrum. Thus, trends in spectral indices with atmospheric paramenters are easily assessed.

Figure 1 shows a montage of the mid-UV–blue spectra of stars near the MSTO having a super-solar metallicity ordered by decreasing effective temperature. In the temperature sequence shown here (5500-7500 K), the Mg I λ2852 line weakens with increasing temperature and disappears by temperatures above 7500 K, while the Mg II λ2800 doublet weakens only slightly. The strength of the Mg I line relative to the Mg II line is a good indicator of temperature, and the mid-UV color is a good indicator of metallicity. We have found that a combination of the ratio of Mg II/Mg I line strengths and the mid-UV color is a promising indicator of age and metallicity of a stellar population.

References

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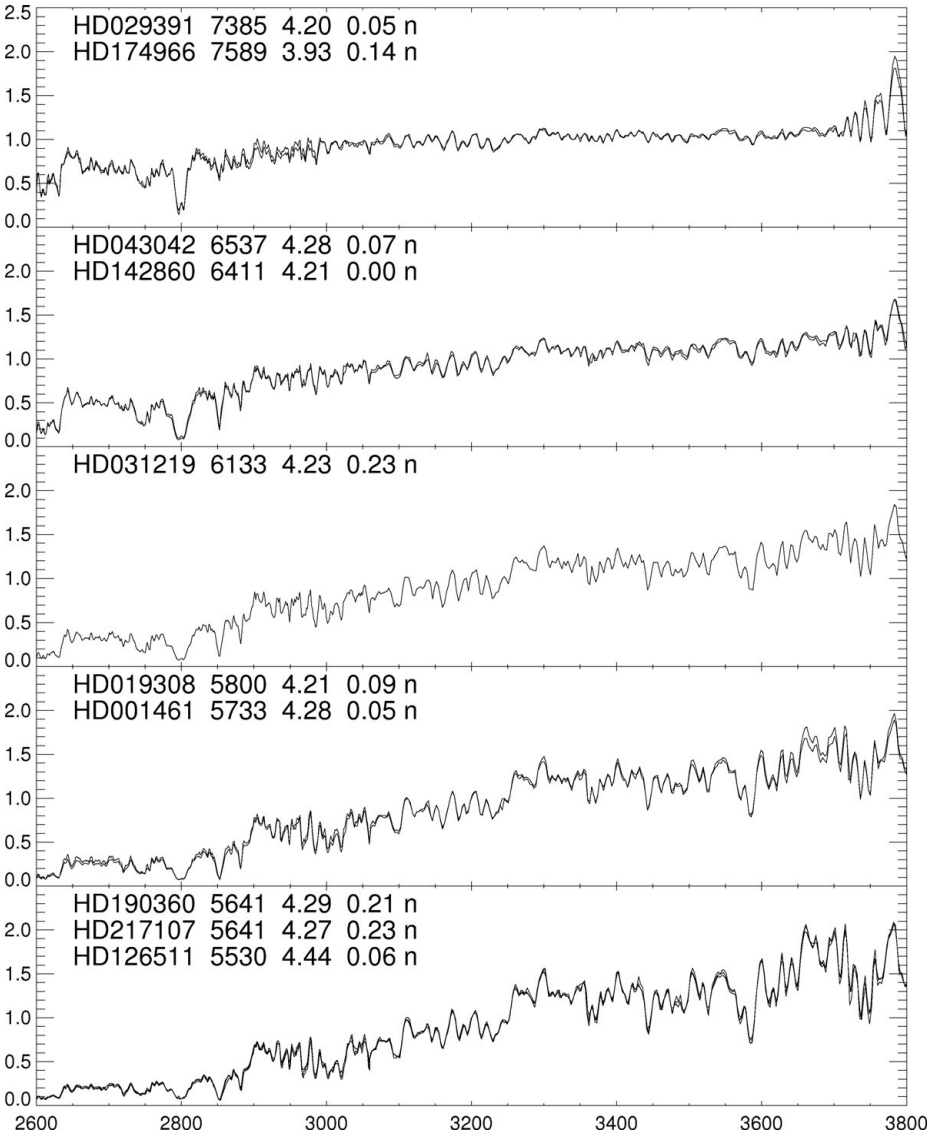

Figure 1. NGSL spectra in the mid-to-near UV normalized to 1 at 3000-3500 Å. The stars and their preliminary parameters ($T_{\rm eff}$, $\log g$, [Fe/H], and [α/Fe]) indicator) derived from MARCS models are listed in each panel. The close similarity of multiple spectra of similar stars shown in a given panel attests to the high quality of the spectra.

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