COMBINED LOW RESOLUTION IUE SPECTRA AND OPTICAL SPECTROPHOTOMETRY

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1.0 INTRODUCTION

Low resolution IUE SWP and LWR spectra have been combined with the extensive optical spectrophotometry recently published by Gunn and Stryker (1983) to provide absolute flux distributions from 1100 A to 10680 A for various stellar objects.

The IUE ultraviolet spectral atlas (Wu et al. 1981) presented low resolution SWP and LWR spectra for fifty stars, covering a large range in spectral types and luminosity classes. Recently, an optical stellar spectrophotometric atlas was published (Gunn and Stryker 1983) containing observations for 175 stars, spanning the wavelength range from 3130 A to 10680 A. The latter atlas is available from the National Space Science Data Center (NSSDC) in a compact machine-readable version (Warren 1983) and thus presents the opportunity to compare and combine both ultraviolet data from the IUE data archives and comparable optical observations for various stars in common. The merged data set provides both a useful extension of the IUE spectral atlas into the optical and a valuable resource for research programs requiring a large wavelength baseline, such as stellar reddening studies and continuum synthesis.

2.0 THE GUNN-STRYKER SPECTROPHOTOMETRIC ATLAS

The optical spectrophotometry is described in detail by Gunn and Stryker (1983). Briefly, the atlas contains observations for 175 relatively bright stars, obtained with Oke's (1969) multichannel spectrophotometer on the 5 m Hale telescope. In the "blue" region (3130 A - 5740 A), the data have a resolution of 20 A; in the "red" region (5760 A - 10680 A), the resolution is 40 A. Thus, there is an overlap of 70 A between the IUE LWR data, which extends to 3200 A, and the "blue" optical spectrophotometry.

The machine-readable version of the optical atlas (Warren 1983) provides normalized dereddened fluxes [f(5500 A) = 1.00] in frequency units, in addition to calculated broad-band colors and the visual absorption. In order to most easily combine the ultraviolet and optical data, the optical spectrophotometry is converted to absolute fluxes in wavelength units using the corrected V magnitude published with the atlas, viz.

$$f_0(\lambda) = [3.67 \text{ X } 10^{-(20 + 0.4V_0)} c/\lambda^2] f(\nu)$$

where c is the speed of light and f_ν are the normalized flux values. The fluxes are then reddened, using the numerical approximation to the Whitford (1958) extinction relation as given in Gunn and Stryker (1983),

$$f(\lambda) = 10^{-(0.4 \cdot A_V \cdot A_\lambda)} f_0(\lambda)$$

where A_V is the visual absorption and A_λ is the calculated absorption at the desired wavelength. It is important to note that the IUE and optical observations are not contemporaneous; real differences between the different wavelength regimes may thus exist, especially for variable stars.

3.0 MERGED ULTRAVIOLET AND OPTICAL OBSERVATIONS

As an example of combined IUE and optical data, we show the results for the bright (V = 5.97) O5 star, 9 Sgr = HD 164794 in figures 1 and 2. In figure 1, the fluxes are displayed on a logarithmic scale versus wavelength in angstroms. The IUE SWP and LWR spectra have been linearly interpolated and resampled at a uniform spacing of 1 A. The 2200 A feature is prominent and the P Cygni nature of the NV and CIV lines can also be seen below 3200 A. Various of the optical Balmer lines are evident in the optical spectrophotometry; the change in resolution between the "blue" and "red" regions can also be discerned.

An enlarged section of figure 1 is seen in figure 2, showing the overlap region between the IUE and optical data near 3200 A. The increased scatter in the IUE fluxes redward of 3080 A is due to the rapidly changing character of the inverse sensitivity function in this region. Nonetheless, the independent calibrations appear to join the IUE and optical fluxes satisfactorily to within 10 - 12%, consistent with the published uncertainties. A reasonable agreement was anticipated as 9 Sgr is not known to show light variations, although it does have a variable radial velocity with an amplitude of about 4 km/sec (Abt and Biggs 1972).

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FIGURE CAPTIONS

Figure 1. The IUE SWP and LWR spectra for 9 Sgr = HD164794 are shown combined with the Gunn-Stryker optical spectrophotometry. The flux scale is logarithmic with units of ergs/cm+2 s A and observed fluxes are plotted. Note the strong 2200 A feature in the ultraviolet. The apparent smoothness of the optical data is due to the coarser resolution.

Figure 2. The transition region between the IUE and optical data in Fig. 1 is displayed on an enlarged scale. The overlap between the two data sets is 70 A and the agreement of the independent flux calibrations is 10 - 12%. The observations are not contemporaneous.

Figure 1

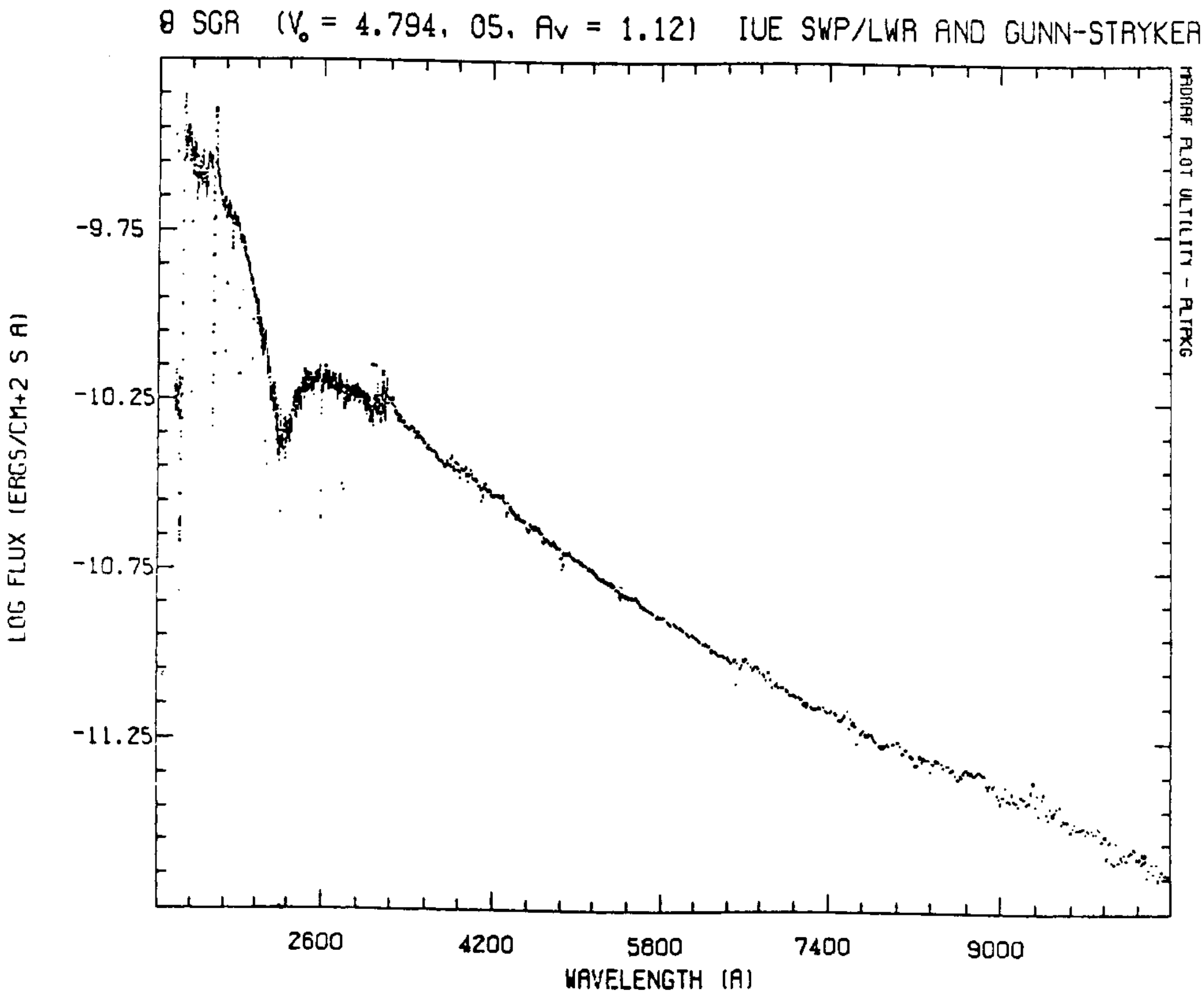
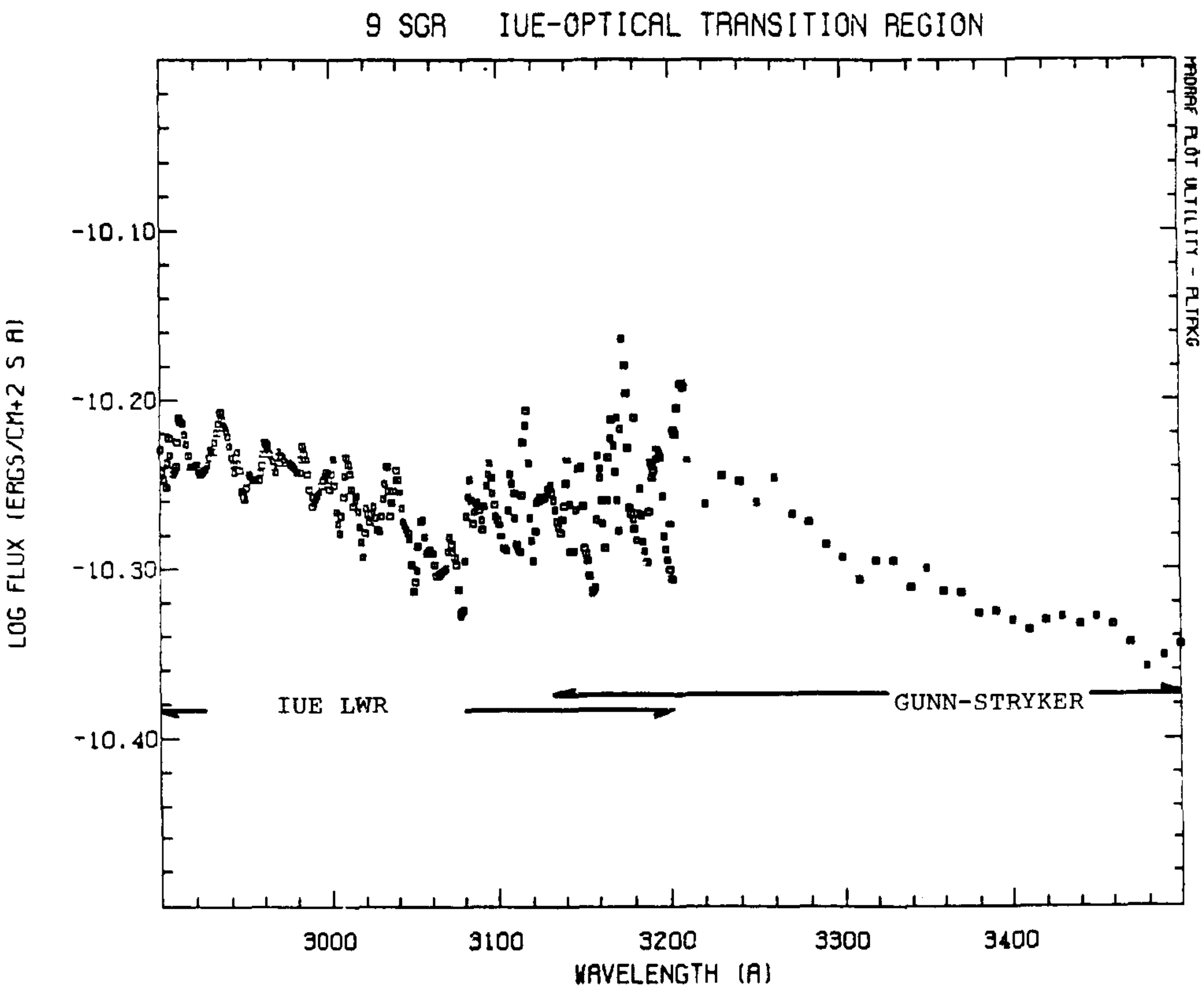

θ SGR (V₀ = 4.794, 05, Av = 1.12) IUE SWP/LWR AND GUNN-STRYKER
LOG FLUX (ERGS/CM+2 S A)
-9.75
-10.25
-10.75
-11.25
2600
4200
5800
7400
9000
WAVELENGTH (A)
MADRAF PLOT UTILITY - PLTPKG

Figure 2


9 SGR IUE-OPTICAL TRANSITION REGION
LOG FLUX (ERGS/CM+2 S A)
-10.10
-10.20
-10.30
-10.40
3000
3100
3200
3300
3400
WAVELENGTH (A)
IUE LWR
GUNN-STRYKER
MADRAF PLOT ULTILITY - PLTPKG