SPECTROSCOPIC OBSERVATIONS OF THE FAR ULTRAVIOLET BACKGROUND

Christopher Martin
Columbia Astrophysics Laboratory
New York, NY USA

Mark Hurwitz and Stuart Bowyer
University of California
Berkeley, CA USA

ABSTRACT. We report on results from the Berkeley Ultraviolet Experiment (UVX), which performed 15 ± 2 Å resolution spectroscopy of the diffuse far ultraviolet background in eight directions. We have used the spectrum obtained in the direction of low H I column density to derive constraints on any extragalactic background. We find evidence that a hitherto unidentified dust component is present that accounts for most of the background in directions of low neutral hydrogen column density.

The spectrum from the direction with the lowest $N_{\rm H\,I}$ (1×10^{20} cm^{-2}; Stark et al. 1989) (hereafter observation 1) is illustrated in Figure 1*a*. The signal-to-noise ratio obtained in this spectrum is 10:1 in 15 Å bins, which represents a substantial increase in quality over the very limited number of previously published spectra. Because the dust scattering level in this direction should be lowest of our directions sampled, we consider this observation the strongest constraint on any extragalactic component. The spectrum shows prominent emission from C IV 1550 Å and O III] (Martin and Bowyer 1990). No other significant deviations from a slowly varying continuum shape are apparent.

We explore the hypothesis in the following analysis that the continuum of this spectrum consists of two components: dust-scattered galactic starlight and an unknown galactic or extragalactic offset that produces significant flux at low H I column densities. To deconvolve these components and to investigate further the nature of the residual continuum, we have compared this spectrum with the spectrum from a relatively nearby direction (l = 132, b = 40; hereafter observation 2) which has a higher $N_{\rm H\,I}$ (4×10^{20} cm^{-2}, Stark et al. 1989) this spectrum

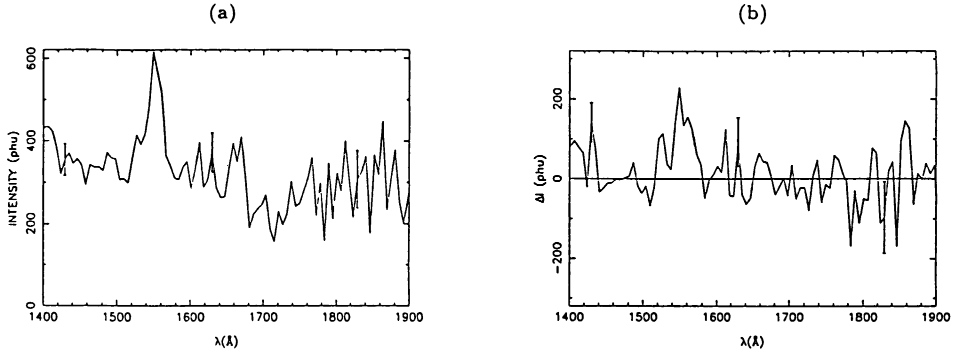

Figure 1. (*a*) Background-corrected but unsmoothed spectrum of observation 1. (*b*) Difference spectrum of $\Delta I = I_1 - 0.65 I_2$.

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includes fluorescence H_2 emission, Martin, Hurwitz, and Bowyer 1989. When the H_2 fluorescence is subtracted from observation 2, the residual spectrum is remarkably similar to that of observation 1. This is emphasized in Figure 1*b*, which illustrates the difference spectrum $\Delta I = I_1 - 0.65 I_2$ (H_2 corrected). No systematic differences are present at >50 ph cm^{-2} s^{-1} sr^{-1} Å^{-1}, aside from the C IV 1550 Å line.

If a significant extragalactic component exists, then its spectrum must be very similar to that of dust-scattered starlight, in order to achieve this excellent cancellation. Since we know observation 2 is dominated by dust-scattered starlight, we are lead to the conclusion that the same can be said for observation 1, barring a fortuitous coincidence in the spectrum of a hypothetical extragalactic component. An additional dust component corresponding to an equivalent $N_{\mathrm{H\,I}} = 1.5 \times 10^{20}$ cm^{-2} must be present in the direction of observation 1 to produce the observed flux ratio, I_1/I_2.

Using these spectra, we can also rule out significant contributions to the background offset from airglow, zodiacal light, H_2 fluorescence, normal galaxies, and decaying massive neutrinos. The relative smoothness of the spectrum rules out a large contribution of redshifted line radiation formed in matter with large-scale structure. We summarize these conclusions in Table 1.

TABLE 1. The UV Background Offset: Limits on Possible Contributors

Component	I_λ(phu)	Reference
Observed Intensity	280 ± 50	1, 6, 4
Airglow	<10	1
Zodiacal Light	<10	1, 2
H_2 Fluorescence	<12	5
H II 2-photon	55	1
Dust	80–200	5, 1
C IV gas	10–15	4
Galaxies	50	3
QSO/AGN	<10	3
Redshifted Line	<50	5
Unexplained	0–110	5

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