IUE OBSERVATIONS OF QUASARS

M. Schmidt, R. F. Green, J. R. Pier
Hale Observatories
California Institute of Technology
Carnegie Institution of Washington
and
F. B. Estabrook, A. L. Lane, H. D. Wahlquist
Jet Propulsion Laboratory

Spectra of six quasars have been obtained with the International Ultraviolet Explorer Satellite. Five of the six show no evidence for strong Lyα absorption between the redshifted and rest wavelengths, for $.23 \leq z_{em} \leq 1.72$. In addition, the quasar PG 1115+080 at z=1.72 shows no evidence for strong He I absorption from the resonance transition at λ584 Å. These results confirm that the intergalactic medium must be both tenuous and hot enough to produce an optical depth <0.1 in neutral hydrogen and helium. In no case was the Lyman edge detected in absorption near z_{em}. Four of the objects produce an average Lyα/Hβ intensity ratio of 6.3, in disagreement with the theoretical prediction for Case B optically thick recombination of 30. Also, two of the objects show Lyγ in emission, a result unexpected from Case B line transfer assumptions. The Lyα emission line in 3C 351 shows the identical sharp core plus 20,000 km s^{-1} broad wings observed in Hβ and Mg II, implying a common origin in the same dynamical ensemble of emitting regions. These quasars show systematically steeper spectral indices when the energy distributions are fit from the ultraviolet through the visible than those derived from the visible spectra alone. PG 1115+080 shows a featureless continuum down to an observed λ1173 Å. The ionizing spectrum, with $f_\nu \alpha \nu^{-2.0}$, therefore persists beyond 2 Rydbergs. The spectrum of PG 1247+268, with z=2.038, contains a strong absorption line at observed λ2697 Å, with no net flux detected from λ2000 Å down to the observed limit at λ1150 Å. This result is interpreted as absorption in Lyα and the Ly edge at z=1.218. Low dispersion optical spectra show no evidence for Mg II or C IV absorption in the same system; the signal to noise ratio is too low in the IUE spectrum to confirm Lyβ. We conclude that the line of sight intersects a metal-poor cloud with $\tau \leq 1$ in the Ly continuum, at $(1+z_{em})/(1 + z_{abs}) = 1.37$.

G.O. Abell and P. J. E. Peebles (eds.), Objects of High Redshift, 125–126.

DISCUSSION

Aller: These observations of such faint objects are truly quite remarkable. I presume that you selected quasars that had small interstellar extinction (which can put such a severe restraint on measurements of many galactic objects).

Green: It is true that these quasars are generally at high galactic latitude. The worst case is 3C 351, at b = 36°. I examined the effects of interstellar reddening on this object by assuming an average cosecant reddening law, in the form proposed by Sandage, and by applying the Code et al. extinction curve. There was no effect on the fitted spectral index, and the Lyman to Balmer line ratios were increased by 20%. Since the qualitative consequences are not changed and this is the extreme case, the data as shown were not corrected for interstellar reddening.

Longair: In the case of 3C 390.3, the line profiles can be decomposed into broad-line and narrow-line components, the narrow lines having the standard recombination ratio of Lyα to Hα while the broad lines have the anomalous ratio. Have you been able to perform this decomposition for your quasars and what are the answers?

Green: The only quasar of the four with observed Lyman and Balmer emission lines for which a decomposition seems possible is 3C 351, but it has not yet been done. The total Lyα:Hβ ratio is around 3, but the sharp-line component contributes only ~ 10% to the total Hβ flux according to Grandi and Phillips. It is therefore possible that 3C 351 resembles 3C 390.3 in line component ratios, and that will be investigated. In the case of PKS 1302-102, Lyγ is seen in emission, so the standard model cannot be strictly applicable.