The Intrinsic UV/Soft X-Ray Spectrum Of Quasars

Francesco Haardt

*Department of Astronomy & Astrophysics, Institute of Theoretical
Physics, Göteborg University & Chalmers University of Technology, 412
96 Göteborg, Sweden*

Piero Madau

*Space Telescope Science Institute, 3700 San Martin Drive, Baltimore
MD 21218, USA*

Abstract.
    The detection of a HeII absorption trough in the spectra of three
high-redshift quasars provides new constraints on the spectral shape of
the UV extragalactic background. The relative strengths of the observed
flux decrements at the rest-frame wavelengths of 1216 and 304 Å require
a relatively soft radiation field at 4 ryd compared to 1 ryd. If the ionizing
metagalactic flux is dominated by the integrated light from QSOs, and the
HeII reionization of the universe was completed well before $z \sim 3$, then
the UV/soft X-ray spectrum of individual quasars at these epochs must,
once the cosmological "filtering" through material along the line of sight is
taken into account, satisfy similar constraints on the average. We model
the propagation of AGN-like ionizing radiation through the intergalactic
medium using CUBA, a numerical code developed in our prior work. We
show that, in order to explain the reported HeII absorption, any thermal
component responsible for the "soft X-ray excess" observed in the spectra
of AGNs at $z \lesssim 0.3$ must, at $z \sim 3$, have a typical temperature $\gtrsim 80$ eV,
and a luminosity not exceeding $\approx 20\%$ of that of the "UV bump".

1. Results

By means of the code named CUBA (described in HMI), we have calculated the
ratio $\eta \equiv N_{\rm HeII}/N_{\rm HI}$ for a set of QSO spectral models as discussed in HMII.
    The HI and HeII opacities computed with various QSO background models
have been then tested against the observed values. Together with the already
mentioned HeII data, we have taken a collection of HI data. The calculated
redshift dependent HeII D_A (the fractional flux decrement shortward of Lyα)
is shown in Figure for different input QSO spectral models, together with the
available data points. In the left upper panel we plotted also HI D_A against the
data.
    From the Figure it is evident that:
    • The spectral slope below ~ 1000Å of integrated QSO spectrum must be
comprised between 1.5 and 2.

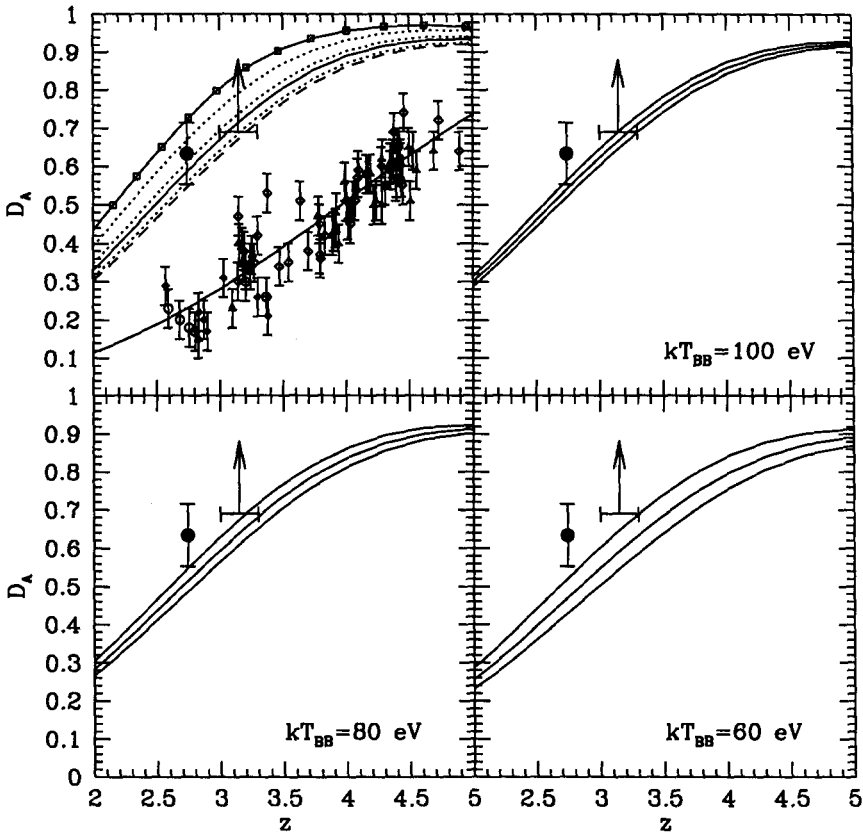File: ion_ex_0_6.d_ X: . Y: . : Sep 3 11:11 1996

Figure 1. The quantity D_A for HI and HeII computed for various QSO spectral models is tested against existing data.

• The soft excess observed in QSO spectra at $z \lesssim 0.3$ must have at $z \sim 3$ a temperature $\gtrsim 80$ eV, and a luminosity not exceeding $\approx 20\%$ of that of the UV bump.

A detailed analysis and discussion, with all the relevant references, will appear in HMII.

References

Haardt F., Madau P., 1996, ApJ, 461, 20 (HMI)

Haardt F., Madau P., 1996, in prep. (HMII)