The Evolving XUV Absorber in NGC3516

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Abstract. For NGC3516 we find that the X-ray warm absorption and the broad UV associated absorption features can be produced by the same absorbing material. We argue that the evolution of the XUV absorber from pre-1992 to 1995 is consistent with expectation for an expanding, outflowing material.

1. NGC3516: X-ray and UV Observations

NGC3516 contains the strongest UV absorption system known in a Seyfert 1 galaxy. This system contains at least two distinct components: a broad (FWHM$\sim$2000 km/s) variable component and a narrow ($\sim$500 km/s) non-variable component. Both the broad and the narrow systems contain high as well as low ionization absorption lines. Recent observations have shown that the broad high ionization absorption lines have *disappeared* since $\sim$1992 (Koratkar et al. 1996 and references therein, Kriss et al. 1996)

We analyze a high signal-to-noise (S/N) ROSAT PSPC archival spectrum of NGC3516 obtained in 1992. The high S/N allows the strong detection of both OVII and OVIII edges independently, in spite of the limited spectral resolution of the PSPC. A warm absorber fit to the data shows that the absorber is highly ionized (U= $10^{+2.6}_{-2.1}$), and has a large column density $N_H \sim 10^{22}$ cm^{-2}.

2. The XUV Absorber

In several AGN, the X-ray and the UV absorbers were found to be one and the same (the 'XUV' absorbers, Mathur et al. 1994, 1995). Is it also true for NGC3516? The absorption systems in NGC3516 are clearly complex with multiple components (Kriss et al. 1996). It is the *high ionization, broad* absorption system that is most likely to be associated with the X-ray warm absorber. Investigation of this question is tricky, however, because the broad absorption lines have disappeared. Here we argue that the XUV absorption picture is *consistent* with the presence of a highly ionized X-ray absorber and the current non-detection of CIV and NV broad absorption lines (see Fig. 1). The X-ray absorber *MUST* have a UV signature showing OVI absorption lines (Fig. 1). Since there were no simultaneous ROSAT & far-UV observations in 1992, this cannot be directly determined. However, we note that in the 1995 HUT observations, OVI doublets are unresolved, but consistent with being broad (FWHM=1076$\pm$146 km/s).

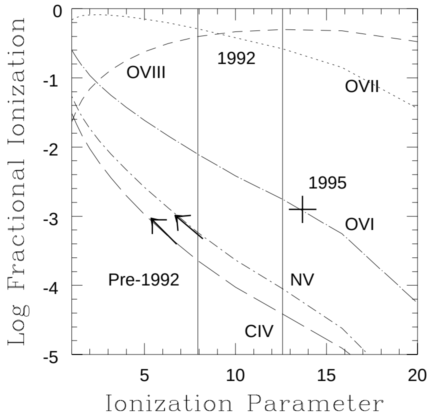

Figure 1. Ionization fractions f of OVI, OVII, OVIII, CIV and NV as a function of ionization parameter, U (with CLOUDY, Ferland 1991). The vertical lines define the range of U for which the ratio f_{OVII}/f_{OVIII} lies within the observed ROSAT range. The arrows on the CIV and NV curves indicate the lower limits of $f_{CIV} \gtrsim 3 \times 10^{-4}$ and $f_{NV} \gtrsim 3.1 \times 10^{-4}$ based on the published IUE data. The + mark corresponds to the HUT data in Kriss et al. 1996.

We argue that the XUV absorber in NGC3516 has evolved with time (Fig. 1). **Pre-1992:** It showed broad, high ionization CIV and NV absorption lines and an X-ray ionized absorber ($U \lesssim 7$). As it evolves, outflowing and expanding, the density falls and the ionization parameter increases. **1992:** CIV and NV absorption lines disappeared; X-ray absorber is still present with OVI lines in the UV ($U \sim 10$) (No UV data available to verify). **1995:** CIV and NV absorption line remain absent; X-ray absorber is present. OVI lines are present, and detected with HUT ($U \sim 13.5$). **Post-1996:** We predict that the OVI absorption lines will disappear as the ionization parameter increases further ($U \gtrsim 20$). The OVIII edge will continue to strengthen relative to the OVII edge. Eventually, even the X-ray absorber will also disappear.

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References

Ferland, G. F. 1991 "HAZY", OSU Astronomy Department Internal Report

Kriss, G. et al. 1996, ApJL, in press

Koratkar, A. et al. 1996, ApJ, in press

Mathur, S., Wilkes, B., Elvis, M. & Fiore, F. 1994, ApJ, 434, 493

Mathur, S., Elvis, M. & Wilkes, B. 1995, ApJ, 452, 230