**Abstract.** We present results from a coordinated FUSE, HST/STIS and Chandra campaign to study intrinsic UV and X-ray absorption in the outflow of the Seyfert 1 galaxy NGC 7469. Previous non-simultaneous observations of this outflow found two distinct UV absorption components, one of which likely corresponds to the X-ray absorber. The FUSE data reveal that the O VI absorption in this component has strengthened over time, as the continuum flux decreased. We use measured H I, N V, C IV, and O VI column densities to model self-consistently the photoionization state of the absorbers. We confirm the physical picture of the outflow in which the low velocity component is a highly ionized, high density absorber located near the broad emission line region, while the high velocity component is of lower density and resides farther from the central engine.

**1. Introduction**

Absorption edges are visible in the X-ray spectra of about one half of all low redshift AGN (Reynolds 1997; George et al. 1998; Crenshaw, Kraemer & George 2003), virtually all of which also show high-ionization absorption lines in their UV spectra (Crenshaw et al. 1999), suggesting a connection between the two phenomena. The absorption is thought to be intrinsic to the AGN because the complexes are generally blueshifted with respect to the AGNs, and because many absorbers show variability and/or non-unity covering fractions. (See references in Kriss et al. in this proceeding.)

Most high resolution observations of the intrinsic absorption in AGNs, with the exception of recently published observations of Mrk 279 (Scott et al. 2004), have been performed at different times in the UV and X-rays. The high degree of variability in AGN continua complicates self-consistent photoionization modeling from these non-simultaneous data, preventing firm conclusions about the nature of the relationship between UV and X-ray absorbers.

The intrinsic absorption in NGC 7469 has been studied previously using UV and X-ray observations separated by one year (Blustin et al. 2003; Kriss et al. 2003). These authors found two primary UV components, with outflow velocities of -569 and -1898 km s\(^{-1}\), Components 1 and 2, respectively. The Chandra (CXO), FUSE, and HST/STIS campaign presented here is the first set of simultaneous, high-resolution UV and X-ray spectral observations of NGC 7469. Here, we describe the UV and X-ray observations and the properties of the AGN outflow, and we discuss the geometry of the absorption using the results from photoionization models.
Figure 1. Normalized profiles of Lyα and O VI absorption over two epochs of STIS and FUSE observations with Components 1 and 2 marked.

2. Data and Analysis

We obtained a 150 ksec CXO/HETG spectrum of NGC 7469 on 2002 December 12-13, covering 0.5-10 keV. We fit this with an absorbed blackbody + power law continuum, with a photon index of 1.82 and Galactic $N_H = 4.87 \times 10^{20}$ cm$^{-2}$. On 2002 December 13, we observed NGC 7469 with the 30$''$ x 30$''$ low-resolution aperture of FUSE, obtaining a total exposure of 7 ksec. Simultaneously, we obtained 13 ksec of STIS data using the E140M grating and the 0.2$''$ x 0.2$''$ aperture covering 1150-1730 Å. We fit the FUSE and STIS data with a single power law continuum: $F_\lambda = (8.18 \pm 0.06) \times 10^{-14} (\lambda/1000 \ \text{Å})^{-1.082 \pm 0.021}$ ergs s$^{-1}$ cm$^{-2}$ Å$^{-1}$ and with Gaussian emission line profiles from O VI, Ly α, N V, O I + S III, C IV, He II, Si II, and Fe II in the vicinity of the intrinsic absorption lines of interest.

We also observed NGC 7469 with STIS on 2004 June 21-22 for 23 ksec using the same setup described above. For this spectrum, we fit $F_\lambda = (3.25 \pm 0.01) \times 10^{-14} (\lambda/1000 \ \text{Å})^{-1.086 \pm 0.007}$ ergs s$^{-1}$ cm$^{-2}$ Å$^{-1}$.

We measured covering fractions and column densities of the intrinsic absorbers using the IRAF task specfit (Kriss 1994), and we compared photoionization models (Krolik & Kriss 1995, 2001) to the measured H I, N V, C IV, and O VI column densities. We incorporated the observed X-ray and UV slopes and normalizations at the time of the 2002 observations into the input spectral energy distribution for NGC 7469 (Kriss et al. 2000, 2003).

3. Results and Conclusions

We summarize our results as follows:

1. Component 1 shows saturated or nearly saturated O VI absorption. Neutral hydrogen is clearly present, as Lyα is a strong feature, but Lyβ is not detected. The FUSE spectrum near Lyβ is heavily contaminated by
molecular hydrogen absorption. The N V and C IV features associated with this velocity component are weak.

2. Component 2 shows prominent O VI and Lyα absorption. As for Component 1, no Lyβ is found, but the N V and C IV features are stronger than those of Component 1.

3. We do not detect O VII or O VIII absorption in the CXO spectrum, but we do detect O VIII emission and absorption from H-like and He-like Si, Ne, and Mg at velocities consistent with Component 1. Component 2 has no associated X-ray absorber.

4. Consistent with previous results (Kriss et al. 2003), the covering fraction for Component 1 is ~0.5, while that of Component 2 is consistent with one.

5. We see absorption variability in Component 1 over the three observation epochs (Fig. 1): the O VI absorption strengthened between the 1999 FUSE observations (Kriss et al. 2003) and those presented here, as the continuum flux decreased by a factor of ~1.5; and the Lyα absorption increased between 2002 and 2004 as the continuum flux decreased by a factor of ~2.5.

6. The photoionization models combined with the H I, N V, C IV, and O VI column density measurements show that (log(N),U)~(20.0,1.0) for Component 1 and (log N,U)~(18.5,0.08) for Component 2. The C IV and N V column densities are particularly useful for breaking the degeneracy in models based on O VI alone.

Our conclusions are consistent with the previous physical picture of the outflow (Blustin et al. 2003; Kriss et al. 2003). Component 1 is a highly-ionized, high density absorber that is coincident with or interior to the broad emission line region and related to the X-ray absorption and emission component. Compared with Component 1, Component 2 is a lower density and ionization parameter system located at a larger physical distance from the central engine in the absorbing outflow.

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