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Spectroscopy of Seyferts in the Far-UV

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Abstract. We present our preliminary far-ultraviolet spectra of the Seyfert Mrk 533 obtained with *FUSE.* These are among the first FUV spectra of a purportedly edge-on Seyfert, and show narrow OVI emission as well as some evidence for intrinsic absorption.

Keywords : Seyfert galaxies – emission lines – absorption – UV spectroscopy

1. The Background and the Observations

Active galaxies have extremely luminous nuclei whose light far outshines their stellar light. These nuclei are powered by accretion onto supermassive blackholes. Seyfert galaxies are a low-luminosity subclass of active galaxies. The signatures of such activity in the case of the Seyfert (Sy) subclass are strong emission lines with implied Doppler broadening $\gtrsim 300$ km s^{-1} and a wide range of ionization, and also strong X-ray emission. Seyferts have traditionally been broadly classified into types 1 and 2, distinguished primarily by the clear presence or absence of the broad permitted emission lines (FWHM >1000 km s^{-1}). The Unified Scheme (*e.g.*, Antonucci, 1993) attempts to unify the two Seyfert types by hypothesizing a ubiquitous obscuring torus around their nuclei; the central emission (including the distinctive very broad line emission) is obscured when the Sy is oriented with its torus edge-on, and it then appears to us as a Sy 2. This idea has received strong support from the discovery of broad lines in the spectra of the polarized emission of a number of Sy 2s.

Our aim in the study presented here was to compare the hot gaseous outflows in Seyferts of the purportedly pole-on and edge-on kinds, as manifested in the OVI emission line and associated absorption which occur in the Far Ultraviolet. This is possible using *FUSE* (the Far-Ultraviolet Spectroscopic Explorer: Sahnow *et al.* 2000) that can probe such outflows with unprecedented

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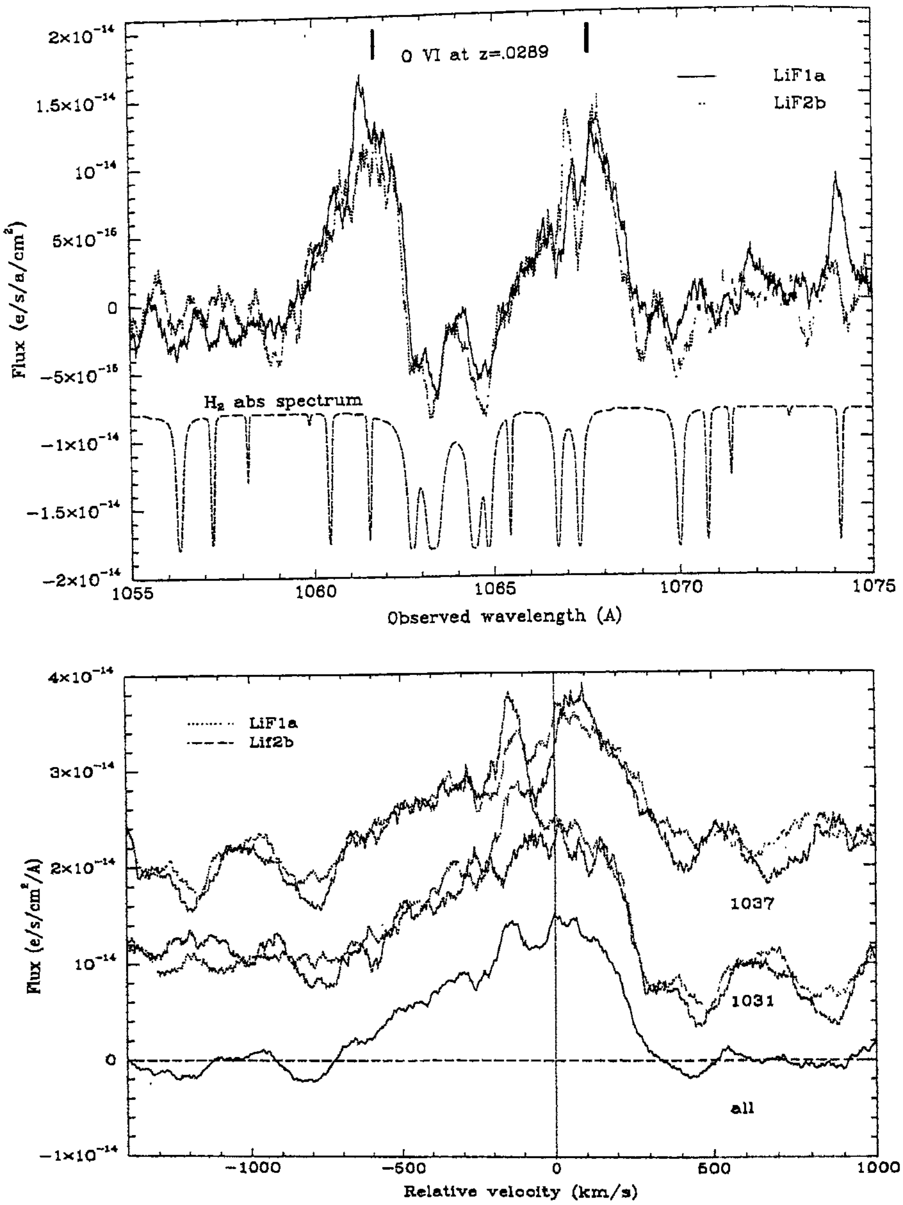

Figure 1. The spectrum in the top panel shows the redshifted OVI doublet region of Mrk 533. Data are from the detectors LiF1a & LiF2b which give redundant coverage of this region. Below in this panel is the absorption spectrum of Galactic H_2, illustrating that several of the dips in the Mrk 533 spectra are contamination from absorption in our Galaxy. In the lower panel, the same Mrk 533 spectra are plotted in velocity space. At the bottom is the combination of all the four spectra illustrating both the Galactic contamination and the intrinsic dips (see text).

spectral resolution. We present our preliminary results for Mrk 533, which is a Seyfert that is believed to have a central "hidden" Broad Emission Line Region detected periscopically via spectropolarimetry.

Using FUSE, we observed Mrk 533 through a 30″ × 30″ aperture with a spectral resolution of 20000 in the 900-1200Å range with an effective area near the OVI lines of 26 sq cm.

2. The Spectra and our Results

- We detect the OVI $\lambda\lambda$ 1031,1037 doublet (a permitted line) in emission (Fig. 1) at the expected cosmologically redshifted position ($z = 0.0289$).
- The OVI emission line is relatively narrow, *i.e.*, the implied FWHM is $<$ 1000 km s^{-1}. This is in predicted contrast to the OVI line seen in purportedly pole-on Seyferts (type 1s) which show a broad component sometimes accompanied by a narrower (Narrow Line Region) component (*e.g.*, Kriss *et al.* (2002)).
- The weaker red wing of the OVI line may result from partial obscuration of emission from outflowing gas on the far side of the nucleus, although some of the weakening is due to absorption by Galactic H_2.
- Our preliminary analysis taking into account features produced by Galactic H_2 absorption suggests that at least two of the troughs seen in the OVI line are absorption features intrinsic to Mrk 533 (at –200 km s^{-1} and –800 km s^{-1} relative to systemic). The data also show weak CIII λ977 emission (not shown here), which again suggests intrinisic absorption at –200 km s^{-1} relative to systemic. The observation of intrinsic absorption troughs would be consistent with an accelerated wind from the central source, with the the blue-shifted absorption being from a cloud in the outer region of the conical outflow (*e.g.*, Hutchings *et al.* 2001; de Kool 1997).

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