THE VARIABLE HI ABSORPTION (z=0.524) IN THE SPECTRUM OF AO 0235+164+

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The spectrum of AO 0235+164 (z>0.85) reveals the presence of absorbing gas (z=0.524) which has been studied extensively at radio and optical wavelengths (See Wolfe, Davis and Briggs, 1982 for bibliography). A program by Wolfe et al. to monitor the radio absorption line at 932 MHz showed that the profile had changed during a 5 year period. The observation led to a tightly constrained model in which variations in the source continuum were capable of driving the HI hyperfine level populations (and hence the optical depths of the features in the absorption line) by virtue of the hypothesized close proximity of the source to the clouds. A continued monitoring program has not shown the predicted correspondence between the continuum variation and the behavior of the individual features, and this model has therefore been ruled out.

The violent variability of 0235+164 naturally leads to models where the radio source structure changes behind a non-uniform absorbing medium whose properties are time-invariant. Furthermore, while the individual features vary, the general character of the profile remains unchanged--as would be expected for a situation where radiating blobs die out in time, allowing the radio centroid to shift back toward the compact component. In this scheme, it is expected that certain patterns in the relative behavior of the fine depths will repeat, depending on the position of the source centroid. In fact a covariance analysis of the variations in the 4 principal features can be related to a model where a point source moves behind clouds with gradients in their properties (Briggs, 1983). The outcome of this model, which reproduces the observed behavior, are "pseudo-gradients" and "pseudo-motions" describing the clouds and the source motion overtime. The relation of these quantities to true motions and cloud structure requires high spatial resolution information obtainable only from VLBI. Knowledge of the milli-arc-second source structure or precise astrometric position of the centroid at the absorption frequency or VLBI spectra observations as a function of time for comparison with the single dish profile will help to define the free parameters of the model (angular size and orientation).

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VLBI observations in the absorption line have been performed at a few epochs (Wolfe et al., 1978; Johnston et al. 1979; Briggs, Broderich, Condon, Davis, Johnston, Romney, Wolfe, in preparation) and a systematic VLBI monitoring program has been initiated by Baath, Benson, Briggs, Davis, Johnston, Jones, Ronnang, and Wolfe. One result is that a comparison of spectral visibilities taken on a Bonn-Arecibo baseline in 1977 and 1981 shows an apparent change in interferometer phase. Although the phase shift observed in feature B corresponds to an angular displacement of only $\sim$0.1 mas, its presence implies that the source structure must extend at least $\sim$2 mas and that the cloud must vary in opacity over this extent ($\sim$20pc).

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