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THE WARM ABSORBER OF THE QUASAR MR2251-178

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MR 2251-178 was the first quasar initially discovered in X-rays, and the first one found to host a warm absorber. The quasar has a high ratio of X-ray to optical luminosity, is surrounded by a giant HII gas envelope, and is located in the outskirts of a cluster of galaxies. Here, we present results from an analysis of the X-ray spectral and variability properties of this source based on deep ROSAT observations. In particular, the warm absorber is modeled in detail.

KEY WORDS Active galaxies: MR2251-178, warm absorbers, photoionization modeling

1 INTRODUCTION

Warm absorbers are an important diagnostic of the physical conditions within the central regions of active galaxies. They have been observed in ~50% of the well-studied Seyfert galaxies (see Komossa, 1999 for a review). Their presence was recently confirmed with Chandra observations of NGC 5548 which revealed a rich absorption line spectrum (Kaastra et al., 2000). The study of the ionized material provides a wealth of information about the nature of the warm absorber itself, its relation to other components of the active nucleus, and the intrinsic AGN X-ray spectral shape. Modeling of the few quasars that show warm absorbers, like MR2251-178, is also important for investigating the relation between warm absorbers in Seyferts and quasars and the cause of their different abundances.

MR2251-178, at z = 0.064, was detected as a bright X-ray source in the course of the Ariel V all-sky survey (Cooke et al., 1978) and identified with the quasar by Ricker et al. (1978) from observations with the SAS-3 X-ray Observatory. It was the first quasar initially identified from X-ray observations. Halpern (1984) suggested the presence of a warm absorber in MR2251-178, based on Einstein observations.
2 RESULTS OF THE X-RAY ANALYSIS

Based on an analysis of a deep ROSAT PSPC X-ray observation of MR2251-178, we obtained the following results:

The mean source count rate was 3.1 cts s\(^{-1}\), a factor of 3 higher than during the ROSAT all-sky survey observation performed 3 yrs earlier. Short-timescale variability of order 20% on the timescale of 1000 sec is present.

A single power-law spectral fit to the data gives \( \Gamma_x = -2.3 \) and \( \chi^2_{\text{red}} = 5.4 \), completely unacceptable. The column density of cold absorbing material was fixed to the Galactic value towards MR2251-178, \( N_{H,Gal} = 2.77 \times 10^{20} \text{ cm}^{-2} \). If \( N_H \) is treated as free parameter, it does not exceed the Galactic value. Among various non-power-law spectral models compared to the data (like a power-law plus soft excess, or Raymond–Smith emission), we failed to obtain any acceptable fits.

The presence of a warm absorber markedly improves the fit. Performing a two-edges fit with edge energies fixed at the theoretical values of OVII and OVIII we obtain \( \tau_{\text{OVII}} = 0.26 \pm 0.12 \), \( \tau_{\text{OVIII}} = 0.20 \pm 0.12 \), and \( \Gamma_x = -2.20 \pm 0.02 \). Next, a warm absorber model based on photoionization calculations (see Komossa and Fink, 1997 for details) with the code Cloudy (Ferland, 1993) was applied. We find an ionization parameter \( \log U = 0.5^{+0.3}_{-0.2} \) and a column density of the warm absorber \( \log N_w = 22.6^{+0.2}_{-0.1} \). We then split the total data set into three subsets according to the flux-state of the source, and fit these data separately. The best-fit parameters remain the same within the error bars; no changes in the warm absorber are detected. We have checked that none of the observed optical-UV emission lines of MR2251-178 are over-predicted by our best-fit warm absorber model. For instance, we derive a warm-absorber intrinsic intensity ratio in the emission lines [FeXIV]\( \lambda5303/\text{H}\beta \) of 0.02.

Finally, we have searched for excess cold absorption in the X-ray spectrum of MR2251-178 which is expected to be present if the giant HII emission line nebula that surrounds the quasar possesses an HI extension (e.g., Bergeron et al., 1983; Shopbell et al., 1999). However, interestingly, there is no evidence for cold absorbing material along the line of sight in excess of the Galactic value. This finding constrains models for the origin of the giant emission-line envelope.

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References