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THE WARM ABSORBER OF THE SEYFERT GALAXY NGC 5548

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We present a spectral analysis of the X-ray *Chandra* data of the Seyfert 1 Galaxy NGC 5548. The warm absorber present in this object was modeled with the code PHASE. We detected two different outflow velocity systems in this source. One of the absorbing systems has outflow velocity of -1091 ± 63 km s^{-1} and the other of -568 ± 49 km s^{-1}. Each system required two absorption components with different ionization level to fit the observed features. Each velocity system may consist of a multi-phase medium.

NGC 5548 (catalogued as Seyfert 1) is at a redshift of $z = 0.017175 \pm 0.000023$, with a luminosity $L_{2-6\mathrm{KeV}} = 2.016 \times 10^{43}$ erg s^{-1}. Its spectrum presents intrinsic absorption lines in the UV (with outflow velocity of $-1041, -667, -530, -336$ and -166 km s^{-1}; Crenshaw et al. 2003) and X-ray bands (Steenbrugge et al. 2005).

We have analysed the *Chandra* HETG and LETG data of NGC 5548 (total exposure time of 800 ks). The intrinsic continuum is well reproduced by a powerlaw with Γ=1.59–1.77, and a blackbody component (kT = 0.1 keV). In our models, this continuum is attenuated by Galactic absorption ($N_H = 1.65 \times 10^{20}\mathrm{cm}^{-2}$).

The warm absorber of NGC 5548 was modeled with the code PHASE (Krongold et al. 2003). This code has 3 free parameters per absorbing component, namely (1) the ionization parameter at the illuminated face of the absorber $U = Q(H)/4\pi r^2 n_H c$, where $Q(H)$ is the rate of H ionizing photons, r is the distance to the source, n_H is the hydrogen number density and c is the speed of light; (2) the equivalent hydrogen column density N_H, and (3) the outflow velocity of the absorbing material.

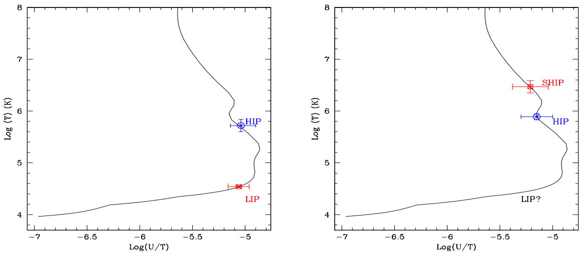

Fig. 1. Curve of thermal stability. Both plots show the two-phase absorber in pressure equilibrium. The absorbing components have very different temperatures but lie close to each other in the U/T axis ($\propto P^{-1}$ the gas pressure).

We find that the warm absorber in NGC 5548 requires two outflow velocity systems (V_{Outf}=-568 ± 49 km s^{-1} and V_{Out}=-1091 km s^{-1}), and that each velocity system consists of two absorbing components. For the first system, one absorbing component (with log U = −0.51) contributes to the absorption with OVII-VI and the so-called Fe M-shell UTA, while the other (with log U = 0.67) contributes with SiXI-XIV, MgXI, and FeVII-XI. For the second system, one absorbing phase (with log U = 0.67), produces absorption by SiXI-XIV, MgXI, FeVII-XI, and the other (with log U = 1.23), produces absorption by OVIII, NeX, MgXII, SiXIV-XVI. We find that the two absorbing components that form each velocity system are in pressure equilibrium with each other (Figure 1). This suggests that each velocity system consists of a multi-phase medium (as found in other ionized outflows, e.g. Krongold et al. 2005; Krongold et al. 2007). The kinematic components found on the X-rays are in agreement with the kinematic components forming the UV absorber. This supports the idea that the UV and X-ray absorption are part of the same phenomenon. The data do not necessarily require a continuous radial range of ionization structures, as suggested before (Steenbrugge et al. 2005).

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