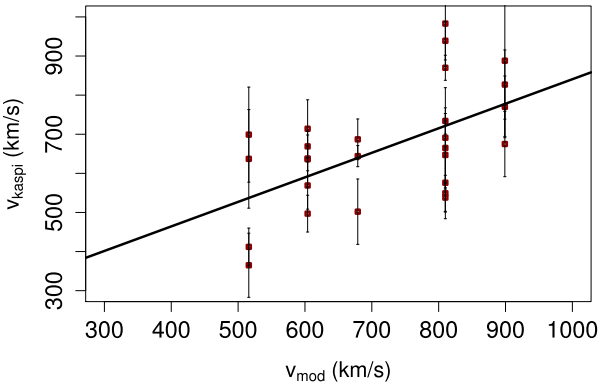

Fig. 13. Measured vs model-predicted velocities for the group of unblended lines given in Table 2 of Ramírez et al. (2005). The measurements are taken from Kaspi et al. (2002). The solid line is the best line after a linear regression for model C.

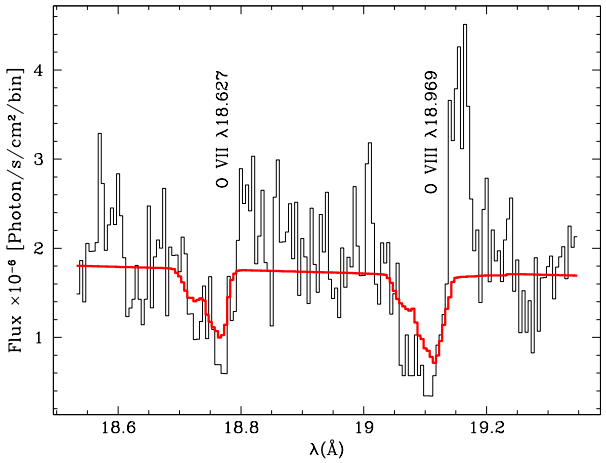

Fig. 14. A graphical representation of the flows HIF and LIF with the line profiles seen in NGC 3783 (histogram). Solid line is the composite model (model C) with two flows. It can be seen that it was necessary to include the second low-ionization flow in order to reproduce the asymmetry of these lines. Otherwise the high-ionization flow would form a more extended red wing.

index of $\Gamma = 1.77$, suitable for this AGN, and have set an extra absorber `the wabs`[3] model in XSPEC, and the composite fluxes generated by the HIF and the LIF components. To compose the O VIII λ18.969 line profile we have summed the fluxes from both flows using equation (12) (where $m = 22$). With this approximation the profile predicted by the two-outflow model is in excellent agreement with observations (Ramírez et al. 2005). The red wing of the troughs in the range 0–1000 km s^{-1} is formed by the HIF, while the blue wing in the range ∼1000–2500 km s^{-1} is formed by the LIF. These values are in agreement with the values measured for this lines in the observed spectrum.

This is the first time that such theoretical work has been carried out to explain the asymmetry seen in absorption in the X-ray spectrum of AGNs. Other work has been able to explain the blue wings of UV lines, like the well-studied C IV λ 1549, for example from radiation-driven disk-wind models (Proga 2003). So we cannot conclude that the model presented here is unique for the description of the asymmetry seen in X-ray lines of AGNs, until detailed comparisons are made with such models, including the X-ray line profile produced by a wind from a Keplerian accretion disk (Knigge, Woods, & Drew 1995; Shlosman, Vitello, & Mauche 1996; Proga et al. 2000; Drew & Proga 2000). Further work is necessary for such a comparison, and we plan to do that in a near future.

7. SUMMARY

We have computed photoionized wind-flow models for the X-ray spectrum of NGC 3783. We studied single continously absorbing models, as well as multiple optically thin components linked through an analytic wind velocity law. We found that the single continuously absorbing model yields gas column densities and optical depths that are too large, unless one adopts very low ($\sim 10^{3-4}$ cm^{-3}) densities and metal abundances (∼0.01 solar). On the other hand, the multicomponent model is able to reproduce observations very well. For this model we compute ionization properties of the material using a velocity law compatible with a radiative wind. Our model is consistent with $\log n_0 \sim 11.35$ [cm^{-3}], a launching radii of $\log r_0 \sim 15$ [cm], and a terminal velocities of $v_\infty \sim 1500$ km s^{-1}, which yield a mass loss rate of the order of $\dot{M}_{\rm out} \sim 1\ M_\odot$/yr (assuming a volumetric factor $f_{\rm vol} = 0.1$). If we assume an ionizing luminosity $L \sim 2 \times 10^{44}$ erg s^{-1} (Peterson et al. 2004), and an accretion efficiency of $\eta = 0.1$, the Eddington mass accretion rate is $\dot{M}_{\rm edd} \sim 0.01\ M_\odot$/yr. This is consistent with the result of Crenshaw & Kraemer (2007) for NGC 4151, and Ramírez (2008) for APM 08279+5255, of $\dot{M}_{\rm out}/\dot{M}_{\rm edd} > 10$. However, it is different from the supposition made by Gonçalves et al. (2006), of $\dot{M}_{\rm out}/\dot{M}_{\rm edd} \leq 1$, using their photoionization code TITAN, for computing the single medium in pressure equilibrium.

Finally, the asymmetry seen in the lines of the X-ray spectrum of NGC 3783 required a model with two outflows. One flow, with a launching ionization parameter of $\log \xi_0 \sim 3$ and a column density of

[3] $N_{\rm wabs} = 0.1 \times 10^{22}$ cm^{-2}.