OUTFLOWS FROM HIGH ACCRETION RATE AGN

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ABSTRACT

X-ray spectral analysis for three high accretion rate AGN, observed by *XMM-Newton*, has been carried out to determine whether they contain evidence for highly-ionised, high-velocity outflows, like that of PDS 456. The results from this analysis is that there are no such outflows present in the three objects. However, there is evidence of absorption from a warm absorber along the line of sight, in one of the objects, with the others being modelled well with a standard power law and blackbody emission to describe the soft excess found.

Key words: AGN; outflows, high-accretion rate.

1. INTRODUCTION

The discovery of high-mass, high-velocity outflows from active galactic nuclei (AGN) in recent years has been a source of great dicussion. The well known target PDS 456 (Reeves et al. 2003) is the best known candidate to exhibit such an outflow. It shows clear evidence for out flowing material in both x-rays and the ultraviolet. Along with PDS 456 there are a small number of other targets that also appear to manifest this type of outflow. Some examples are: PG 1211+143 (Pounds et al. 2003a), APM 08279+5255 (Chartes et al. 2002), PG 0844+349 (Pounds et al. 2003b), PG 1115+080 (Chartes et al. 2003), IRAS 13197-1627 (Dadina & Cappi 2004) and RXJ0136.9-3510 (Ghosh et al. 2004); all appear to be high accretion rate objects.

The signatures of these outflows within the x-ray spectrum of the object, are in the form of absorption due to ionised atoms, H- and He-like in some cases, that have been blue shifted relative to the rest frame of the object. The main absorption features are in the Fe K band, with other prominent absorption features being produced by ionised Mg, O, C, Ne and S. However, the mechanisms behind this phenomenon are unclear.

In an attempt to better constrain the characteristics of the outflow phenomena, and with the assumption that they are found in high accretion rate AGN, a sample of three high accretion rate (super-Eddington) objects were observed with *XMM-Newton*. The three targets are MS 2254.9-3712, PG 1351+640 and QSO 0204+292. All are local ($z < 0.11$), radio quiet AGN. The three targets were taken from a paper by Wang (2003), in which author derives a limit realtionship between the black hole mass and the Hβ line width that is being emitted from the broad-line region. It is concluded that the three targets are all supper-Eddington accretors.

2. SPECTRAL ANALYSIS

Spectral analysis was performed using XSPEC version 11.3. An inital absorbed powerlaw was simultaneously fitted to the hard band, 2.0-10.0 keV, of the spectra from the EPIC cameras, then extended across the whole bandpass, 0.3-10.0 keV. The ratio of the EPIC pn and MOS data sets to the model fit are shown in Fig.'s 1 to 3, for MS 2254.9-3712, PG 1351+640 and QSO 0204+292 respectively.

In the case of MS 2254.9-3712, the intial absorbed powerlaw fit (Fig. 1) shows a clear soft excess below 2 keV and excess around 6.2 keV (observed) but no obvious absorption lines or edges due to the Fe K band. Further modelling resulted in a best fit model of two black body components with temperatures of ~ 0.04 keV and ~ 0.14 keV to descibe the soft excess, a gaussian emission line at ~ 6.40 keV (rest-frame) from neutral iron, and an underlying power-law with $\Gamma \sim 2.00$.

For PG 1351+640, as with MS 2254.9-3712, soft excess can seen from the inital absorbed powerlaw fit (Fig. 2) and there are no obvious absorption or emission features in the hard band. The best model fit comprised of a black body component with a temperature of ~ 0.14 keV, a powerlaw with $\Gamma \sim 1.83$ and an aborption edge at ~ 0.71 keV with an optical depth, $\tau \sim 0.63$.

Finally, the initial fit to QSO 0204+292 (Fig. 3) revealed that there is absorption of the powerlaw that the Galactic absorption cannot account for between 0.6 and 1.4 keV, suggesting the presence of absorbing material intrinsic to

the object. This absorption is modelled well using the ABSORI model. The final model has an absorbing material with a column denisty of $N_H = 2.96$ x 10^{21} cm^{-2} and ionisation parameter, $\xi \sim 0.36$, an aborption edge at ~ 0.75 keV with $\tau \sim 0.77$, an undying powerlaw of $\Gamma \sim 1.62$ and guassian emission at ~ 6.36 (rest-frame) from a Fe Kα transition. The inclusion of an aborption edge is needed to model further absorption believed to be associated with the unresolved transmition array (UTA) of ionised iron.

3. DISCUSSION

The best fit models for the three data sets do not show evidence for high-mass, high velocity outflows, e.g. Fe K-band absorption. MS 2254.9-3712 and PG 1351+640 show emmision common to type 1 AGN. Whereas the third target QSO 0204+292 exhibits the presence of a warm absorbing material along the line of sight. The lack of any outflow poses some questions. Are the three targets really accreting above the Eddington limit?; Could the outflow have become completely ionised, such that we can no longer see the absorbing column?; Is having a high accretion rate the only pre-requisit?

4. CONCLUSIONS

The analysis of the x-ray spectra from three suspected high accretion objects was carried out to determine the presence of (or lack of), a high-mass, high-velocity outlow. No clear evidence for such outflows were found using EPIC data.

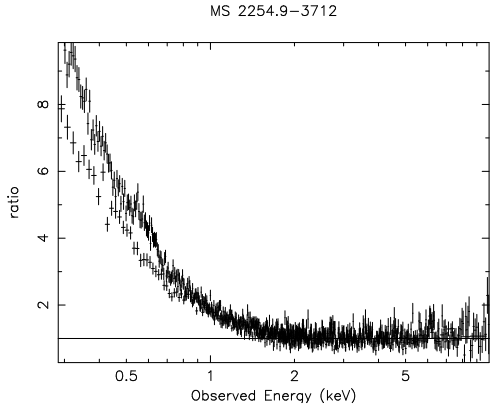

Figure 1. Ratio plot of EPIC spectral data for MS 2254.9-3712 to a simple power-law fit between 2-10keV, extended down to 0.3keV. It clearly shows strong soft excess below 2 keV.

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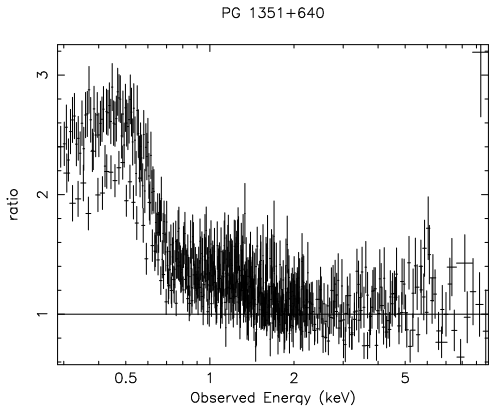

Figure 2. Ratio plot of EPIC spectral data for PG 1351+640 to a simple power-law fit between 2-10keV, extended down to 0.3keV. It clearly shows strong soft excess below 2 keV.

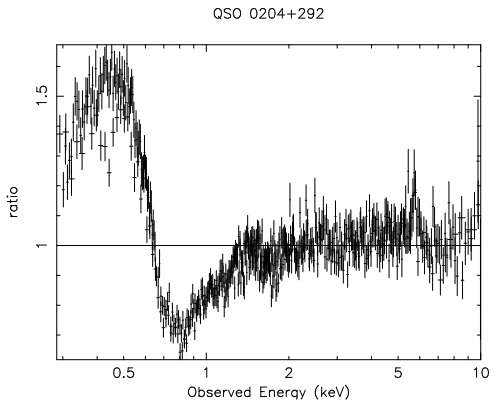

Figure 3. Ratio plot of EPIC spectral data for QSO 0204+292 to a simple power-law fit between 2-10keV, extended down to 0.3keV. It reveals absorption between 0.6 and 1.4 keV.

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