XMM-Newton View of Pairs of Active Galaxies: Activation of Quiescent AGN?

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Abstract: We report XMM-Newton observations of three nearby galaxy pairs, **AM0707-273**, **AM1211-465** and **AM2040-674**. All members were previously classified as HII galaxies. All the galaxies were detected with XMM-Newton and each member was isolated and analyzed independently. The X-ray spectra reveal **strong evidence of AGN activity in AM1211-465NE**. We have measured a luminosity of $1.9\pm0.2\times10^{42}$ erg/s in the 2-10 keV band and the presence of a neutral Fe-Kα line with a significance level of 98%. The high n_H value measured, $2.16\pm0.15\times10^{22}$ cm^{-2}, would explain the misclassification of the source. **Marginal evidence of AGN** nature was found in the X-ray spectra of **AM1211-465SW** and **AM0707-273E**. The X-ray emission of the remaining galaxies can be explained with starburst activity. Our results agree with the **scenario for quasar activation** (Mortlock et al. 1999, MNRAS, 309), in which the gas accretion triggered by encounters of galaxies could refuel a quiescent nuclear black hole, powering the AGN.

1. Introduction

Recent X-ray studies show that many interacting galaxies classified as non-AGN are in fact active showing that optical spectroscopy is sometimes inefficient in revealing the presence of AGN (Komossa et al. 2003, ApJ, 582; Ballo et al. 2004, ApJ, 600; Guainazzi et al. 2005, A&A, 429).

Exhaustive studies show that galactic interactions are thought to be effective in driving the gas from the circumnuclear region into the inner nuclear regions. An empirical model (Mortlock et al. 1999) suggests that when the galaxies reach a certain distance, tidal interactions cause gas flowing into the cores of galaxies *switching on* the BH. Mortlock et al. estimated this *activation distance* to be in the range of 50-100 kpc.

On the basis of the *activation distance model*, we have studied with XMM-Newton three nearby galaxy pairs: AM0707-273, AM1211-465 and AM2040-674. Interestingly, all the 6 galaxies in the sample are classified as HII galaxies based on optical and IR data (Sekiguchi & Wolstencroft 1992, MNRAS, 255).

2. XMM-Newton Data Analysis

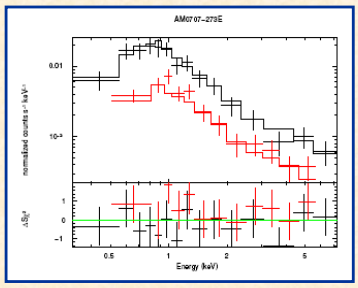


Figure 1b. Observed spectrum (pn in black and MOS12 in red), best fit model and residuals of AM0707-273E. The best fit model consists of a power law (Γ=1.4±0.3) and an absorbed (N_H=8±0.3×10^{21} cm -2) thermal (kT=0.18±0.12 keV) emission. The resulted luminosities are $L_{0.5\text{-}2\ keV}$ = 1.82±0.11×10^{41} and $L_{2\text{-}10\ keV}$=1.53±0.05×10^{40} erg/s.

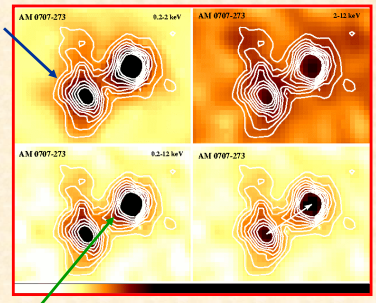


Figure 1a Smooth pn images of AM0707-273 in the 0.2-12 keV, 0.2-2 kev, 2-12 keV bands and the 0.2-12 keV image with the surface brightness contours superimpose. AM0707-273E shows a more extended profile than its companion. Both galaxies present intense nuclear emission in the hard band.

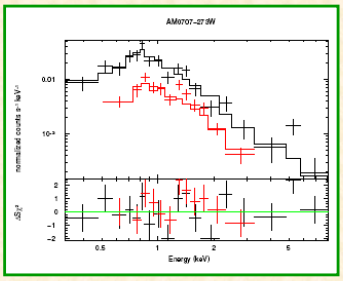


Figure 1c Same as Fig1b for AM0707-273W. The best fit model consists of an absorbed (N_H=1.7±1.3×10^{21} cm^{-2}) power law (Γ=2.2±0.6) and an absorbed (N_H=4±3×10^{21} cm^{-2}) thermal (kT=0.4±0.2 keV) emission. The resulted luminosities are $L_{0.5\text{-}2\ keV}$ = 2.08±0.15×10^{40} and $L_{2\text{-}10\ keV}$=8.4±0.2×10^{39} erg/s.

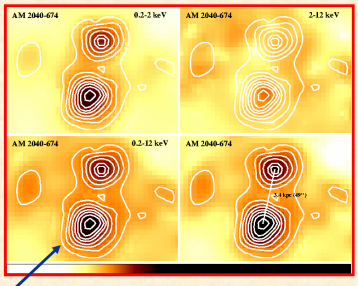


Figure 2a Same as in Fig.1a for AM2040-674. The north component is not visible in the hard band.

Figure 2b. Same as Fig1b for AM2040-674S. The best fit model consists of a power law (Γ=1.7±0.3) and a thermal (kT=0.34±0.09 keV) emission. The resulted luminosities are $L_{0.5\text{-}2\ keV}$ = 5.3±0.06×10^{40} and $L_{2\text{-}10\ keV}$=5.6±1.0×10^{40} erg/s.

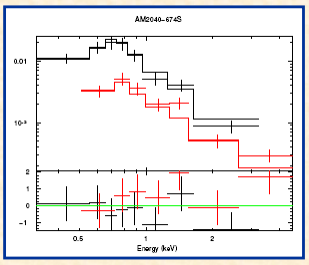
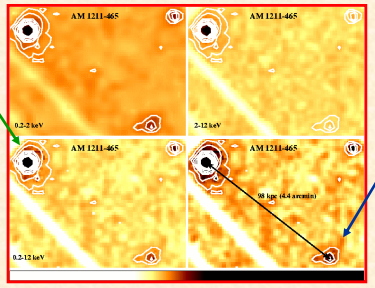


Figure 3a Same as in Fig. 1a for AM1211-465. Both members show extended emission. The hard band image shows very intense emission in AM1211-465NE.



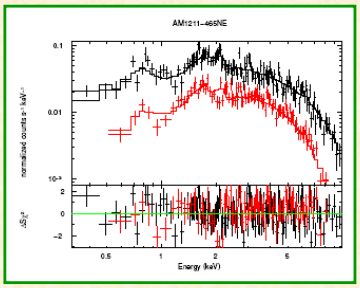


Figure 3c Same as Fig1b for AM1211-465NE. The best fit model consists of an absorbed (N_H = 2.16±0.15×10^{22} cm^{-2}) power law (Γ=1.66±0.14) and an absorbed (N_H=5±3×10^{21} cm^{-2}) thermal (kT=0.21±0.15 keV) emission. The resulted luminosities are $L_{0.5\text{-}2\ keV}$ = 1.3±0.2×10^{42} and $L_{2\text{-}10\ keV}$=1.9±0.2×10^{42} erg/s. A neutral FeKα line is also marginally (98% according to the F-test) detected.

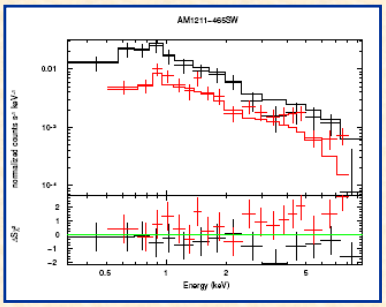


Figure 3b. Same as Fig1b for AM1211-465SW. The best fit model consists of a power law (Γ=1.0±0.2) and an absorbed (N_H=8.3±0.9×10^{21} cm^{-2}) thermal (kT=0.11±0.06 keV) emission. The resulted luminosities are $L_{0.5\text{-}2\ keV}$ = 3.49±0.09×10^{42} and $L_{2\text{-}10\ keV}$=1.5±0.3×10^{41} erg/s.

3. Conclusions

The main conclusions of the XMM-Newton data analysis of three close pairs of similar size galaxies, **AM0707-273**, **AM1211-465**, and **AM2040-674** are:

- The six galaxies were detected and each pair member isolated. Five allowed spectral fitting (hard power law plus soft thermal component). The luminosities in the 0.3-10 keV band are in the range of (0.3-90)10^{41} erg/s.
- An **AGN was unambiguously unveiled in AM1211-465NE** and potentially in its companion. If this is the case, **AM1211-465 would be** the forth example of **a binary AGN**. AM0707-273E could also hosts a low luminosity AGN. AM0707-273W and both members of AM2040-674 are HII galaxies.
- Our results **agree with the theory of the activation of quiescent black holes through the gas accretion triggered by encounters of galaxies**. This type of analysis probed the importance of X-ray studies of galaxy pairs to accurately determine the nature of their nuclei, in particular in those suffering high absorption.