The AGN activity in a sample of IR Luminous Major Mergers

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Are AGN triggered as a consequence of a merging process? or by secular evolution? Studying “win” (similar size and mass) galaxies interacting with each other can provide useful insights.

- GW by SMBH-SMBH coalescence - e.g., M. Montanari + 89.
- ULIRGs are mergers - known since the IRAS Catalogue of BG in 1985.
- Most low-z Radio Galaxies are mergers - Heckman 86, Collina & de Juan 95, Ramos Ameida +12, Tadhunter +16.
- Fraction of AGNs in mergers increases with smaller separations - Silverman +11, Satyapal +14, Ellison +15.
- Radio-loud AGN are mergers - Chiaberge +16.
- AGNs are 5 times more likely to be obscured if hosted by mergers WISE IR colours - Weston +16.
- Obscuring material covers ~95% of the X-ray sources in later merger stages - Ricci +17.

Pairs of galaxies with two AGNs have mainly been discovered serendipitously in X-rays (Komossa +03, Bailon +04, Guainazzi +05, etc.), in radio (Green+10) or, fewer of them, in large X-ray samples (Teng+12, Conforti+15) and in other wavelengths (i.e., Mueller-Sánchez+15).

X-rays are probably the best tool to detect hidden AGN (i.e., Koss +12).

We are studying a sample of 70 nearby (z<0.05) IR bright Arp-Madore major mergers (Cat+2), for which multi-wavelength images are available.

From these we have previously observed 3 pairs with projected separations 10<r<100 kpc with XMM-Newton (Jiménez-Bailón+07), and 8 pairs with r<10 kpc with Chandra (in prep.). Archival search for XMM-Newton and Chandra observations provided data of other 14 galaxies of the sample (see table below).

We present here new XMM-Newton observations of 4 more pairs of this sample, which have been selected using their WISE IR colours as a diagnostic tool. We compare the results for these 8 galaxies with the data of the 36 merging galaxies of this sample previously detected with XMM-Newton and/or Chandra.

Images of the new 4 pairs of galaxies observed with XMM-Newton: left X-ray emission in the 0.3 – 8.0 keV band, overlaid on DSS colour images, centre: X-ray emission in the 0.3 – 1.2 keV band overlaid on optical DSS contours, right: X-ray emission in the 1.2 – 6.0 keV band overlaid on optical DSS contours.

Left: WISE color-color plot for the galaxies of the SMV sample, classified by the activity type, and for the known pairs of AGNs detected in X-rays (blue triangles). Bottom: WISE color-color plot for a sample of interacting and merging galaxies with the AGN region (a) and extended AGN region (b) indicated (Weston+17).

Profile of some of the H brightest pairs, from the HI Parkes All Sky Survey (HPASS). We are analysing possible correlations of the gas peculiar velocity fields of these interacting galaxies in relation to their SF or AGN activities (see e.g. Genzel +15).

The X-ray spectra of some of the galaxies of this sample show strong evidences of AGN activity, like the pair AM 1211-465 NE/SW. This is the less perturbed and one of the most separated pairs of our sample, confirming the results by Ellison +11 that pairs of AGNs can be found at large separations even if they are more frequent at shorter separations.

Individual AGN found: AM 0127-524 S, AM 0545-493 S and AM 0905-274 W.

For AM 1217-354 SW, AM 2055-521 SW and AM 2319-425 NE their X-ray nuclear emission is compatible with their previous classification as Sy2. The nuclear emission in AM 2318-425, instead, was not detected.

The spectra and luminosity of pairs like AM 0707-273 E/W or AM 0316-573 E/W, would be compatible with a very heavy absorption as observed in other binary AGNs previously detected in X-rays (Risaliti+06, Bailón+07), and extended AGN region (b) indicated (Weston+17).

The X-ray luminosity of the nuclei of these galaxies is in most cases lower than the one expected if their WISE 12 μm luminosity was coming from a nuclear AGN (as happens for very bright AGN). Note that most luminous SMV at z>2 reside in highly obscured environments, most of them undetected in X-rays at <100 kpc (Mateos +17).

Besides the nuclear emission some of these pairs show some bright extranuclear sources, like AM 2319-425, and some extended emission is probably also enhanced by the interactions.

The on-going analysis of the X-ray emission combined with data in other wavelengths is also being analysed in the context of interactions simulations (see Mihos +06, Lotz +18).