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The Next Nearest Black Holes: Chandra and HST Observations of X-ray sources in M31

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Abstract. From October 1999 to the present Chandra has taken nearly monthly snap-shot observations of M31. The first 3 years of this dataset in combination with deeper but less frequent XMM observations has allowed the detection of 45 X-ray transients within M31. By analogy to our Galaxy, many of these transients are likely black hole candidates. We have indentified a few optical counterparts of these possible black holes via simultaneous HST imaging. The census allows a study of the endpoints of stellar evolution in our nearest neighbor galaxy. When stacked, the observations also allow a deep study of the M31 X-ray source population, which turns up a few surprises. The supermassive black hole in the center of M31 is the next nearest one after Sgr A*. Chandra and HST observations allow the detection of a weak X-ray source at the position of this SMBH. These observations provide some of the most secure and severe limitations on accretion in SMBH.

Discussion

ERACLEOUS: With repeated observations you should be able to construct the luminosity function every time and study its temporal variations. Have you done that? It would be a very useful piece of information to compare with models.

GARCIA: No, we have not done that. Our sensitivity in each visit is $\sim 10^{36}$ erg/s.

ERACLEOUS: That would still be very useful.

UBERTINI: I am puzzled by the ratio between BHC/NS seen by Chandra. The BEPPOSAX and INTEGRAL data set seems to indicate a lower number of BHC. Can you comment on the possible lower threshold for weak transients observed with your Chandra observation? It is very interesting to understand if there is an intrinsic difference in the BHC/NS ratio within M31 and our Galaxy.

GARCIA: The BEPPOSAX/INTEGRAL transients which are NS may be faint and missed due to our sensitivity limit. These NS transients are also fast – we do have a few, but only a few, transients which are fast, and could be the analogue of the BEPPOSAX NS transients.

MACCARONE: 1. Does the P_{orb}/M_V correlation differ for BHs and NSs?
2. Have you looked for quiescent optical emission from longest orbital period systems?

GARCIA: 1. It probably should, but the present correlation mixes the source categories together. It would be a good idea, now that we know more about which sources are black holes and which are neutron stars, to try to refine that correlation.
2. We have seen emission as they were fading but we haven't yet looked in true quiescence.