Session 4

Source classes that emerge from sampling over galaxies

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Coffee break. Ronan McSwiney, Thierry Courvoisier and Andrey Bykov (left to right) in line for coffee and refills.

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Nuclear sources in galaxies

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Abstract. In the local Universe most massive black holes at the centers of galaxies are not luminous quasars. Is this because (1) they are starved of gas, (2) they accrete without emitting radiation, (3) they refuse to eat, ejecting the incoming material, or (4) they are storing up matter in an accretion disk to feast later?

With Chandra ACIS we have imaged a pilot sample of 6 nearby (D < 30 Mpc) elliptical galaxies chosen to be especially quiescent based on the careful optical spectroscopy of Ho, measured black hole masses (Mbh > 10(7)Msol), and with existing X-ray upper limits (Lx < 10(40)erg/s) implying far sub-Eddington accretion. In these galaxies we can measure, or limit, the diffuse hot interstellar medium, and so constrain the Bondi accretion rate.

Faint X-ray emission is detected at or around the nucleus in each galaxy. The morphology of these weak X-ray sources is complex. The X-ray colors of the sources can be determined, and a moderate quality spectrum for one was obtained. We discuss these results against the possible explanations of black hole quiescence.

On the other hand, a few percent of all galaxies shows evidence for nuclear activity and a brief review of the high energy emission from Active Galactic Nuclei is given.

Discussion

Lipunov: The stationary Bondi solution exist only in Keplerian gravitational potential. Did you include the contribution of the mass of central Globular Cluster? This is important for low massive Super Massive Black Holes (MBH $< 10^6$).

Elvis: We almost resolve the Bondi radius with Chandra and do resolve it with HST so our estimates are quite robust.

Courvoisier: 1. Where do you put the nucleus of our Galaxy in your discussion?
2. Do you consider the X-ray luminosity of the star population that is the source of gas to be accreted?

Elvis: 1. Sgr A* is on our plots and is consistent with ADAF like solutions. I don't know if a comparable stellar mass loss rate has been calculated for the Milky Way but it would be a good thing to attempt.
2. The Stellar population is old and will have a negligible X-ray luminosity.

Chernyakova: Can the model of the accretion with low angular momentum of Beloborodov & Illarionov explain the observed AGN?

Elvis: Low angular momentum accretion can always be invoked to accrete without radiation and should be investigated, however the mass loss from stars will show the angular momentum of the stellar population, so I suspect that this mechanism will not apply to this cold ISM component.

Völk: How would you estimate the possibility of short-term interruptions of accretion (like probably in our own Galactic Center) by SN explosions of the surrounding massive stars? You have not mentioned it in your list.

Elvis: That is certainly possible in principle, but the galaxies we studied have only old stellar populations in their cores and so have no Supernovae; moreover this is unlikely to be the main mechanism keeping SMBH inactive since it would have to be effective 99% of the time.

Maccarone: Have you considered whether the accreted gas in AGN might pile up in a disk and undergo occasional outbursts, instead of being blown out in winds, and are there any AGN with luminosities well in excess of what their gas supplies suggest they should be?

Elvis: I think the bright AGN will make it difficult to measure the gas supply in those systems, so it is difficult to say whether those outbursting systems exist from observations. As for whether it is likely theoretically, I find the idea and the analogy to X-ray binaries intriguing, and have done some work with Aneta Siemiginowska on unstable disks. However, it is probably difficult to get duty cycles so small that 99% of galactic nuclei will be quiescent.

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