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AGN Luminosity Function: ultra hard X-ray sources

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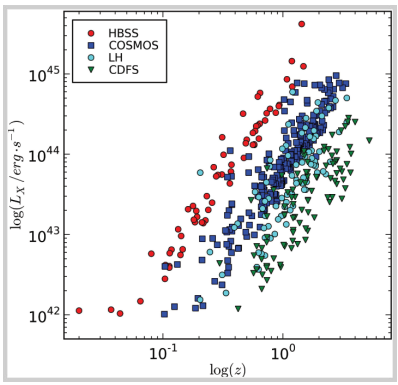
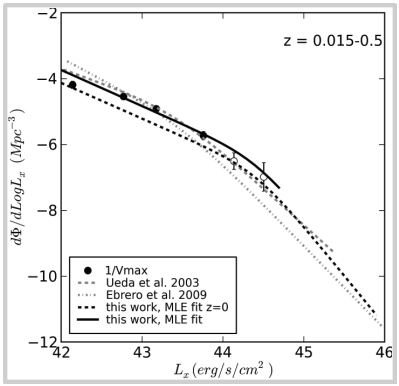
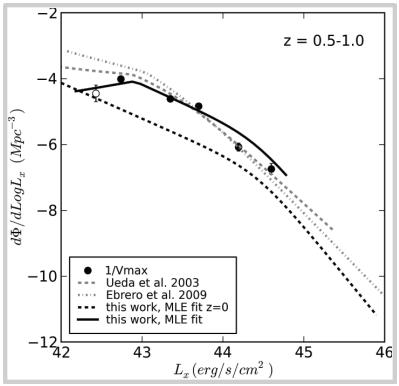
The active galactic nuclei (AGN) luminosity function describes the number of AGN per unit co-moving volume per unit luminosity and is of paramount importance unveiling the accretion history of the Universe.

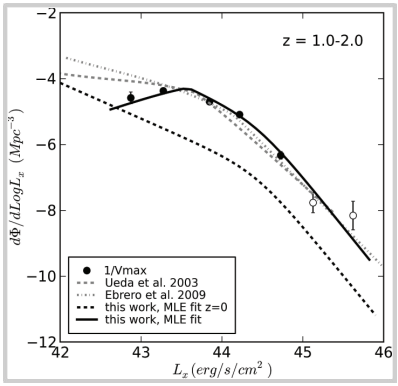


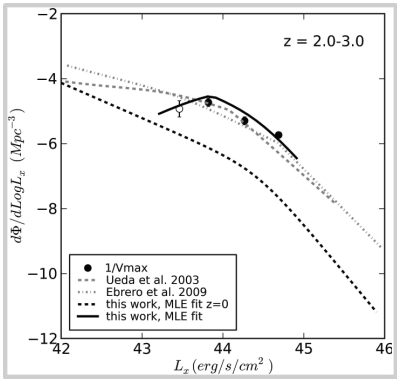
Studies of the the luminosity function in the Soft X-ray band (0.5-2.0 keV)[1,2] and Hard X-ray band (2.0-10.0 keV)[3,4] showed that the AGN evolution is described best as Luminosity Dependent Density Evolution (LDDE). Recent studies, suggest a decoupled evolution of the luminosity from the redshift (ILDE[5], LADE[6]).

Here, we present the **Ultra Hard X-ray luminosity function** utilizing for the first time a very extensive sample (~500 sources) in the 5.0-10.0 keV band. The sample contains sources from the *HBSS*[7], *XMM-COSMOS*[8], *Lockman Hole*[9], *CDFS*[10]. Combining large and deep surveys, we achieve a good coverage of the luminosity-redshift plane, with a redshift range 0.02<z<4 and luminosities 42<logL_x<46, with 98% completeness in redshift. The 5-10 keV band is sensitive also to absorbed sources, as the flux lost due to photoelectric absorption is small even for hydrogen column densities a few times 10^{23}cm^{-2}.



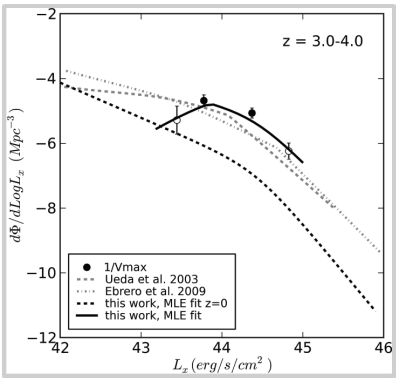


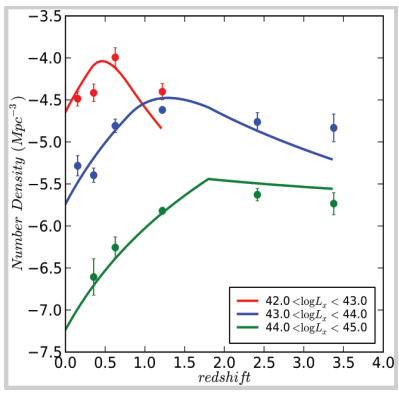




Using Maximum Likelihood Estimation to fit all the formalizations of the luminosity function used in the literature to our dataset and applying the Akaike Information Criterion (AIC)[11] we favor the **LDDE[2] model**.

At low redshifts our result is in agreement with luminosity functions estimated in the 2-10keV . At higher redshifts, our MLE fit suggests *stronger evolution* of the luminosity function in the bright end, while the faint end at high redshift still remains loosely constrained.





The agreement of our result, and the previous studies in the 2-10 keV band demonstrates that, indeed the 5-10 keV is not affected by the photo-electric absorption. Excluding an extra modeling step, we reduce the assumptions and possible uncertainties propagating in our result. Furthermore, the agreement of the result, suggests that the 5-10 keV band does not survey a different AGN population.

Finally, the number density of AGN as a function of redshift for different luminosity bins, demonstrates that the more luminous AGNs were formed before the less luminous ones. This supports the anti-hierarchical scenario of black hole formation, also found in other studies.

1. Miyaji et al., 2000
2. Hasinger et al., 2005
3. Ueda et al., 2003
4. Ebrero et al., 2009
5. Yencho et al., 2009
6. Aird et al., 2010
7. Della Ceca et al., 2004
8. Cappelluti et al., 2009
9. Brunner et al., 2008
10. Xue et al., 2011
11. Akaike, 1974