Star formation and host properties of AGN

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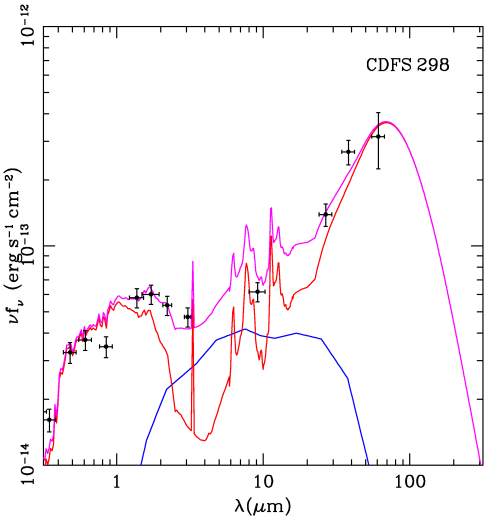
Introduction

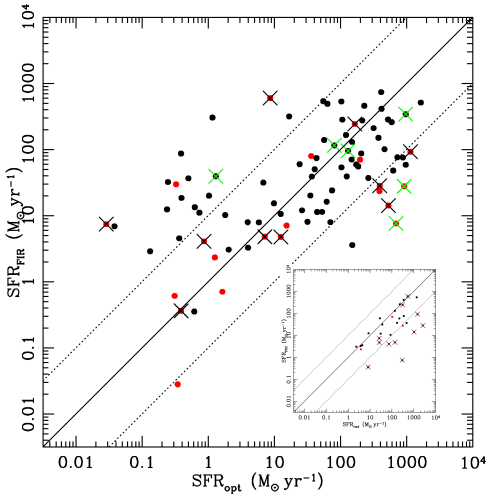
The discovery of an observational link between AGN properties and properties of its host galaxy (the M_{th}-σ relation) has caused an increased interest in their common evolutionary paths. One way to test how the host galaxy affects the evolution of the AGN, or vice-versa, is the study of the relation between the AGN growth and the status of the host galaxy, expressed by its star formation rate. Recent studies of these two quantities give controversial results, e.g. Trichas et al. (2009) and Lutz et al. (2010) find an increase of the 70μm and 870μm luminosity respectively with the X-ray luminosity, while Mullaney et al. (2011) only find an expected redshift dependence of the far-infrared flux with no dependence on the AGN activity. Shao et al. (2010) propose a twofold evolutionary scheme explaining the different behaviors, where secular evolution of the AGN-host system is dominating low AGN luminosity regime (with no AGN – host growth dependency), while merger-driven evolution is important in high AGN luminosities, where it also affects the host galaxy giving rise to the L_{AGN}-L_{host} relation.

Data

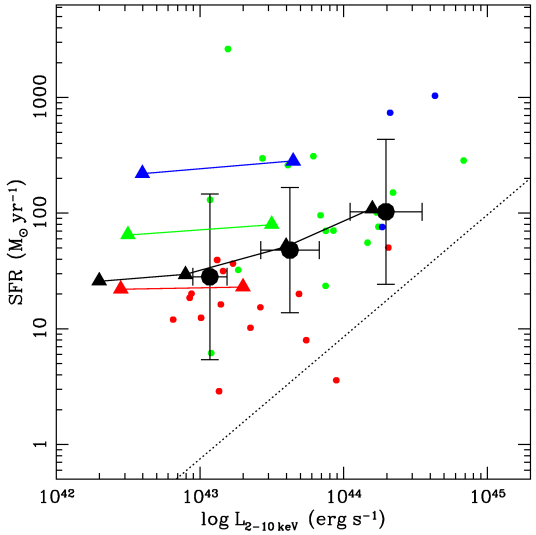
We use the 3Ms XMM survey of the CDFS in order to select the AGN sample for this study. This is the deepest dataset ever observer with XMM and provides a sample of hard-Xray-selected AGN containing over 400 sources. It also has excellent multi-wavelength and spectral coverage, making it ideal for this kind of study.
In order to examine the star formation properties of the hard X-ray AGN, we select those sources which are also observed with a wavelength above 24μm (far-IR or radio). In this spectral regime the effect of the AGN is minimal (except for radio-loud AGN, which are identified and removed from the sample) and it is safe to assume that the flux comes from the host galaxy. We examine this assumption using an SED decomposition technique and isolate any AGN contamination.



Example of the SED fitting technique used to measure the SFR in the optical and far-IR. We use a χ^2 minimization technique to fit a combination of a host-galaxy (red) and an AGN (blue) SED to the broad-band spectrum of the source. The host SED comes form the Chary & Elbaz (2001) library for λ>2μm. At wavelengths below 2μm, we use synthetic stellar templates made with the GALAXEV code (Bruzual & Charlot 2003) and reddened with a Calzetti et al. (2000) law. This way we can measure the star formation rate both from the host far-IR luminosity and from its stellar properties.



Comparison of different methods to measure the star formation rate. In the large image the results obtained form the far-IR luminosity are compared with those from optical-UV SED fitting. Black and yellow crosses refer to objects with no FIR and no optical data respectively. There is a number of sources where the "optical" star formation rate is significantly lower (more than one order of magnitude) than the FIR one, and this prompts us not to use the optical-FIR SED fitting to measure the SFR. The values obtained from radio luminosities in the other hand are consistent with the FIR (see inset image).



We find a weak correlation between the AGN luminosity and the star-formation rate using only the brightest X-ray sources of our sample. With red, green, and blue circles we plot sources in the redshift bins z<1, 1<z<2, and z>2 respectively. The binned datapoints are plotted in larger black dots, with each bin containing 12 sources. Error-bars are at 1σ. With black triangles we plot the points of Lutz et al. (2010), and with colored triangles the stacked data-points of Mullaney et al. (2011) in the same redshift bins. The dotted line is the AGN-only line of Mullaney et al. (2011) indicating the far-IR luminosity of an AGN-only SED.
Our results are in very good agreement with those of Lutz et al. (2010), although we use different techniques, and are markedly different from Mullaney et al. (2011). The SFR-L_x correlation we find could be a redshift effect, as can be seen from the colored points, so we cannot reach a definitive result on its nature. Expanding our dataset to include fainter AGN (work in progress) will help us clarify this issue.

References

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