Dissecting Photometric Redshifts for AGN using XMM- and Chandra- COSMOS

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RATIONALE: Nowadays, we can estimate the photometric redshifts of normal galaxies with a 2% accuracy and almost no outliers. However, determining accurate and reliable photometric redshifts for sources dominated by an active galactic nucleus (AGN) remain challenging for a number of reasons. First of all, powerful AGNs are dominated by a power-law SED, whose shape produces a color-redshift degeneracy that only a complete and deep multi-wavelength coverage can break. Secondly, the galaxies that host an AGN contribute in most cases to the global SED of the source. The number of possible different types of galaxies and relative host/AGN contributions (as a function of wavelength) is so large that degeneracies between templates and redshifts are unavoidable. Finally, flux variability is an intrinsic property of AGN that many multi-wavelength surveys do not take into account when planning their observations, leading to problems in achieving a robust SED fit.

APPROACH:

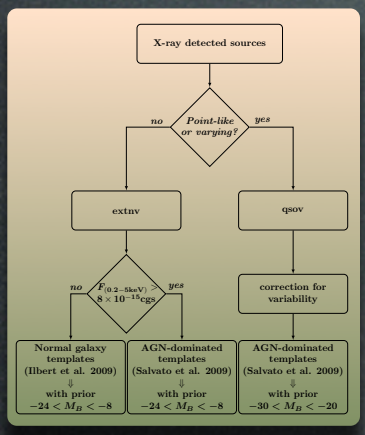
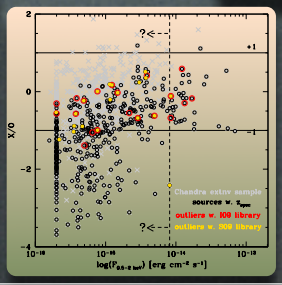


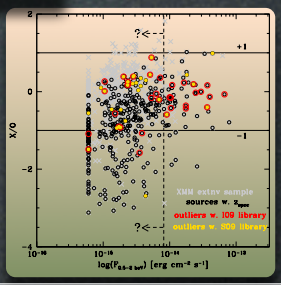
Fig.1: Layout of the procedure that has been defined in Salvato et al 2011, in order to obtain accurate phtometric redshifts for X-ray sources, independently on the galaxy/AGN relative contribution.

Only by taking into account simultaneously the physical properties of the sources, such as their morphology, variability, and X-ray flux, the photometric redshifts for AGN and QSO can reach the accuracy typically achieved for non active galaxies.
By combining XMM-COSMOS (e.g.Brusa et al 2010) and Chandra-COSMOS (e.g. Elvis et al 2009, Civano et al 2011), we could construct a spectroscopic sample of 1200 sources with i_{AB}<25.5mag (average i_{AB}=22.5) and with $F_{(0.2\text{-}5keV)}$>2x10^{-16} erg/cm^2/s. For these sources, also HST/ACS images (Scoville et al. 2007) and multi-band, multi-epoch photometry is available (Capak et al 2007). **With this sample we were able to single out and solve the major problems affecting photometric redshifts for AGN/QSO (Salvato et al. 2009, Salvato et al. 2011).**

JUSTIFICATION FOR THE APPROCH:

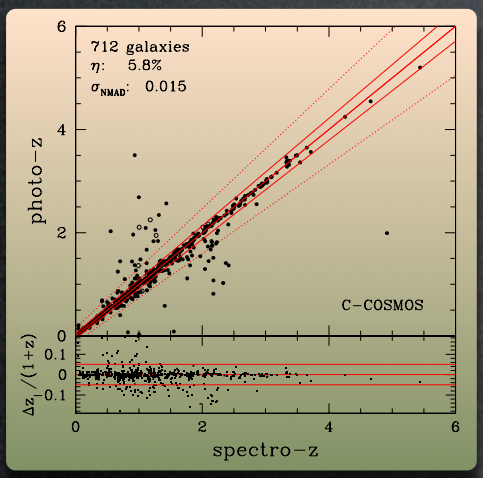
Library	C-COSMOS extnv i<22.5		C-COSMOS extnv i<22.5		C-COSMOS extnv all		XMM-COSMOS extnv i<22.5	
	η (%)	σ	η (%)	σ	η (%)	σ	η (%)	σ
Normal galaxy templates I09	4.2	0.015	9.0	0.041	5.7	0.017	7.7	0.017
AGN-dominated templates (S09)	2.7	0.020	18.4	0.093	6.0	0.028	4.4	0.022
using I09 or S09 library, depending on the X-ray flux of the source	2.4	0.014	10.3	0.041	4.1	0.017	4.7	0.016

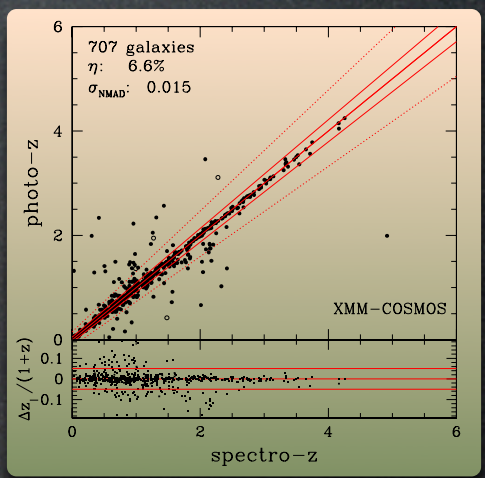




While using only templates of normal galaxies (I09), high accuracy (indicated with σ in the table) can be obtained for all the sources in the "extnv" sample in Chandra (Left) and XMM (Right). However, the number of outliers (η in the table) is halved for X-ray bright sources (F_X>8e-15 erg/cm^2/s), by using AGN-dominated templates (S09). For this reason we adopted a "combined" approach, choosing the templates on the base of the X-ray flux. Note that 91% of the sources best fit by a normal galaxy template have a luminosity typical of AGN-dominated sources.

PHOTO-Z ACCURACY:





Results: Adopting the procedure described in the flow-chart, we obtained an accuracy of σ=0.015 with a handful of outliers. 2/3 of the outliers are faint optical sources (i_{AB}>23 mag), for which the large photometric uncertainties increase the color-redshift degeneracies when fitting the SED. The same procedure was recently applied to the couterparts of XMM detected sources in the Lockman Hole, providing an accuracy of σ=0.08 and a fraction of outliers η=12% (Fotopoulou et al. 2011). The accuracy is comparable to the results in COSMOS, if the same photometric bands and depths as used for the Lockman Hole are used and no variability correction is applied. New photo-z for X-AEGIS amd CDFS will be available soon.

References: Brusa et al. 2010, ApJ, 716, 348; Capak et al 2007, ApJS, 172, 99; Civano et al. 2011, in preparation; Elvis et al. 2009, ApJS, 184, 158; Fotopoulou et al 2011, ApJ, Submitted; Ilbert et al. 2009, ApJ, 690, 1236; Scoville et al. 2007, ApJS, 172, 38; Salvato et al., 2009 ApJ, 690, 1250 ; Salvato et al. 2011, ApJ, Submitted.