Stacking analysis of Deep X-ray Surveys

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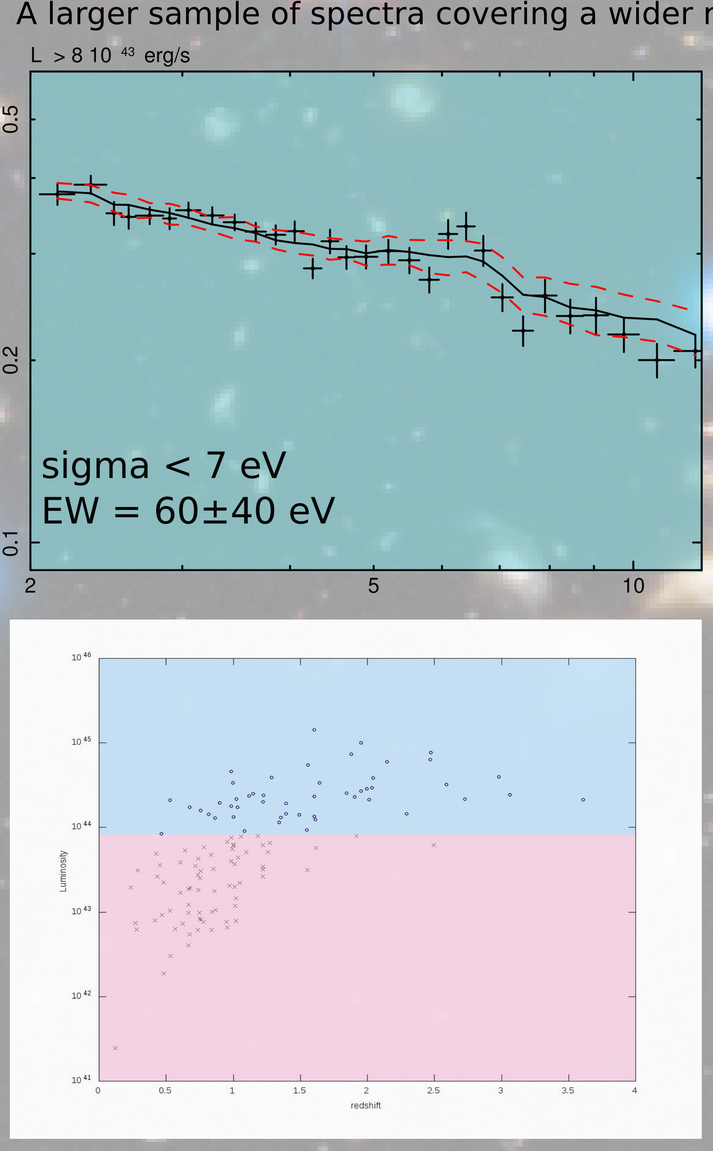
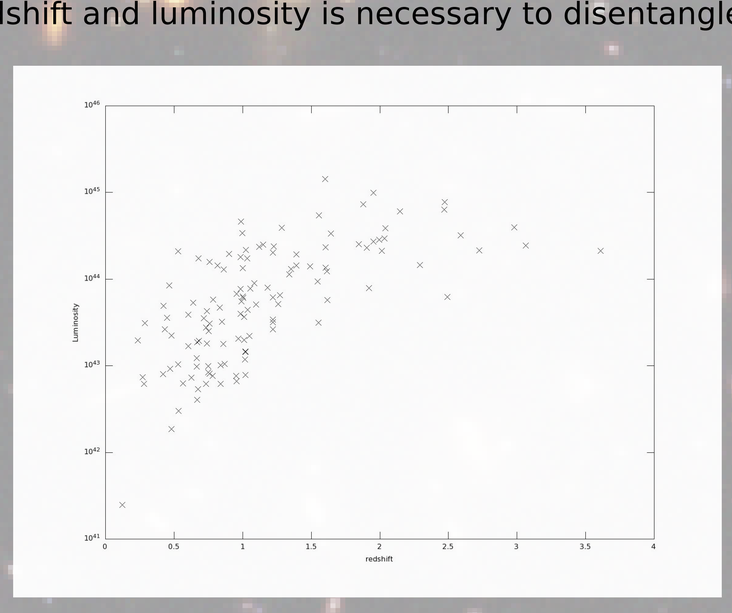
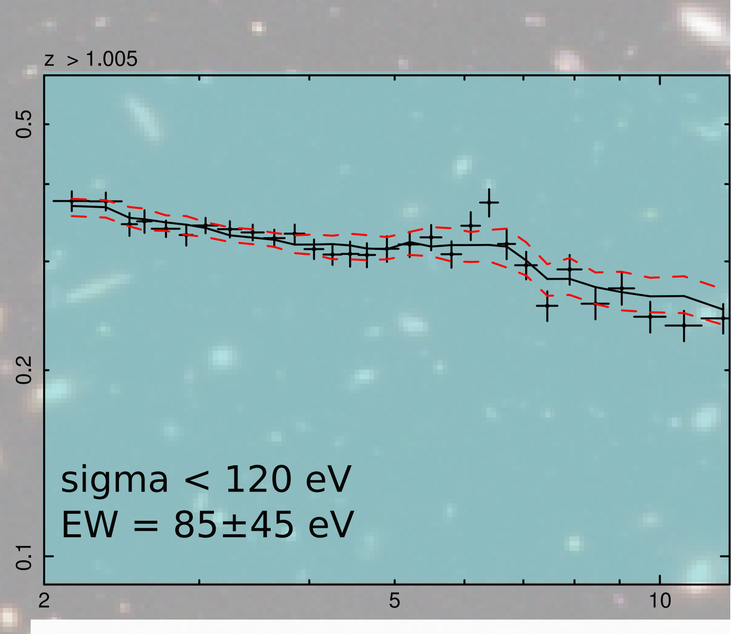
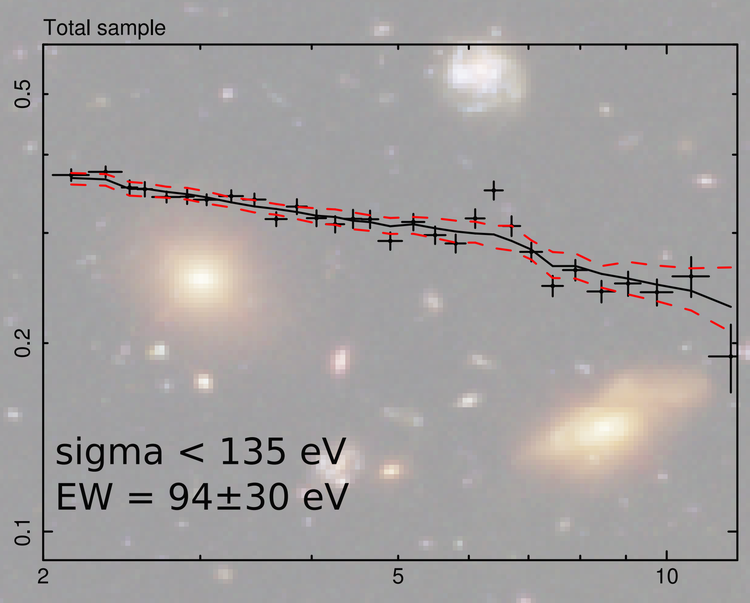
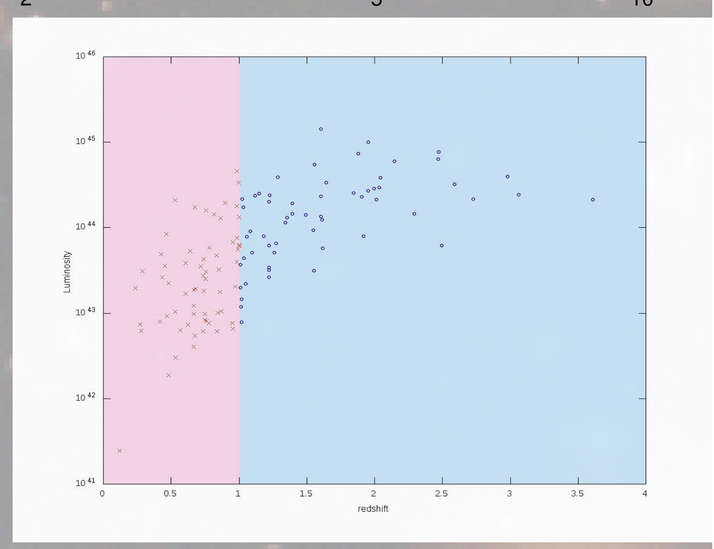
The Iron lines in the X-ray spectra of Active Galactic Nuclei provide us with valuable information about the emitting processes in the central engine.
We analyzed the good quality (>200 net counts) Chandra X-ray spectra of Chandra Deep Field North (2 Ms), Chandra Deep Field South (2 Ms), and AEGIS (3.4 Ms) sources (Luo+08,Laird+09). The samples span a broad range of redshift up to z = 3.5 and they explore lower X-ray luminosities than the other samples previously studied with stacking methods (e.g. Corral+08, Streblyanska+05). We constructed sub samples in redshift and luminosity bins, in order to check if the Iron line properties vary with those parameters.
We fitted each spectrum continuum with an absorbed powerlaw, and we used the best fit parameters to make the correction for the detector response matrices. Following the method of Corral+08, we corrected each spectrum for galactic absorption, shifted it to rest frame, we normalized it using the integrated continuum between 2 and 5 keV, and we finally computed the average spectum. In order to represent the continuum with a good statistic, we ran 100 simulations of our sample using the best fit continuum parameters.
We detected a significant narrow Iron line in all the samples. We did not detect significant broad Iron line components, with the exception of the low luminosity low redshift sample.
The most intense Iron lines are detected at low redshift and low Luminosity, and the line significance decreases with growing brightness and redshift. Because of the distribution of our samples with luminosity and redshift, we cannot separate the effects of those parameters on the detection of the line.
A larger sample of spectra covering a wider range in redshift and luminosity is necessary to disentangle both effects.

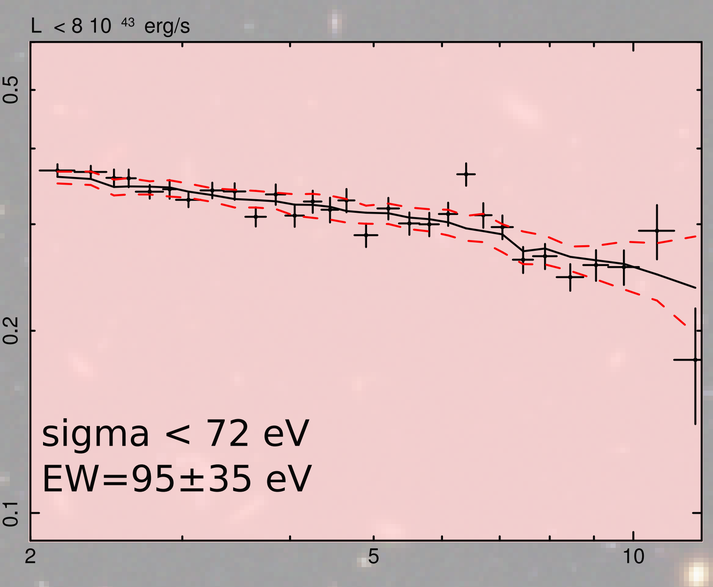


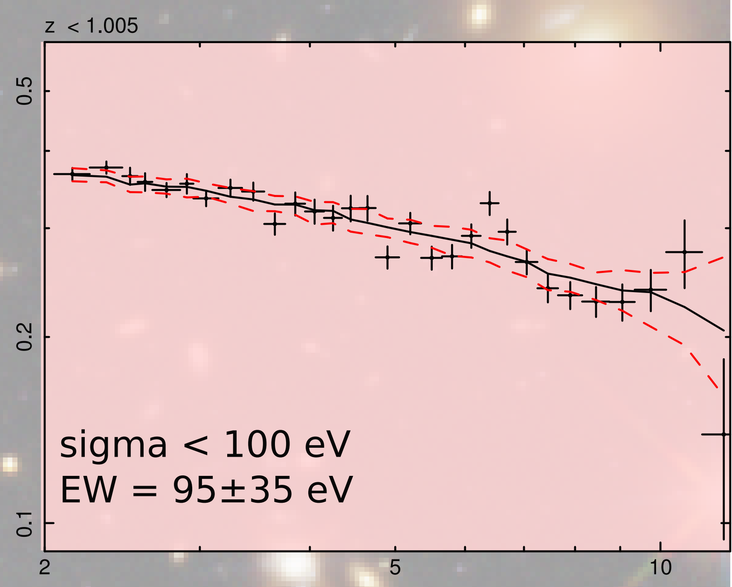




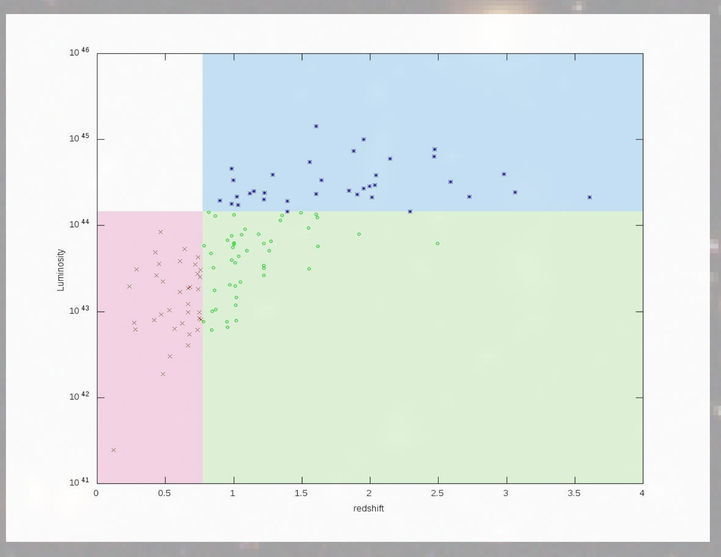


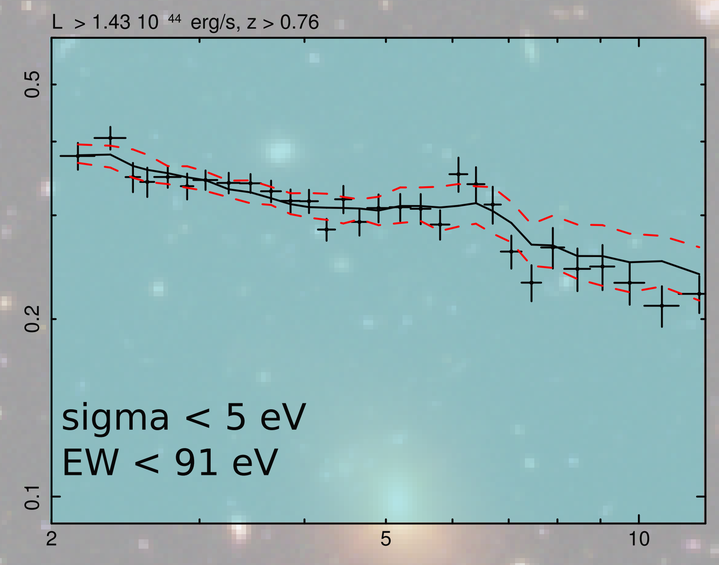




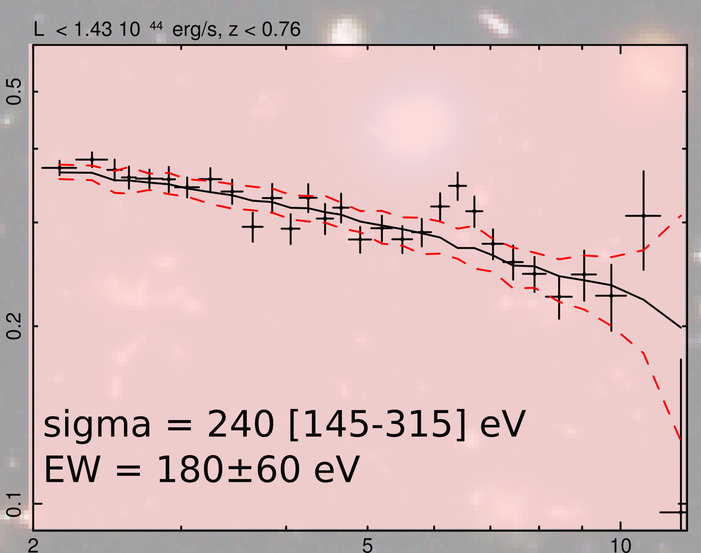


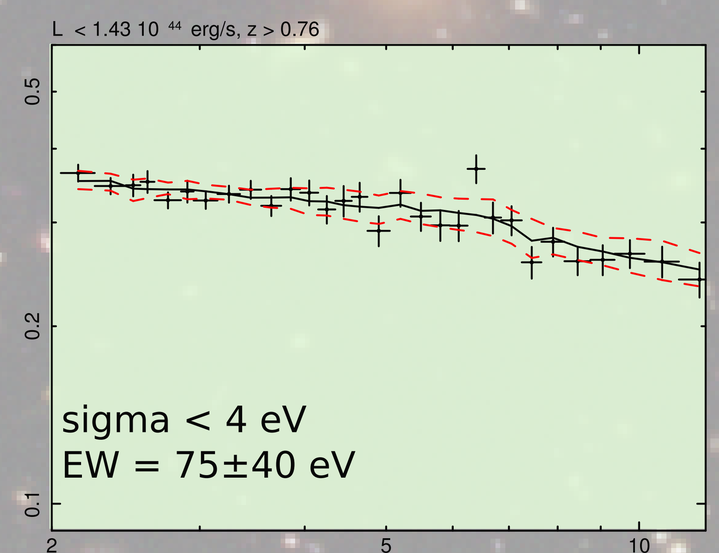
The data points represent the mean observed spectrum.
The continuus line is the median of the 100 mean simulated spectra and it was used as a table model in Xspec for the analysis.
The confidence interval for a given parameter corresponds to 90% probability.
The reported line widths are calculated taking in account the method broadening that is 120 eV (estimated making simulations of an unresolved Iron line).
The dashed lines include 68% of our simulations.





We estimated the significance of the Iron line as the percentage of the mean simulated spectra with a lower flux than the flux in the mean observed spectrum (calculated between 6.2 - 6.6 keV).





Significance of the Iron line and average properties of the samples

	Significance	<z>	$\langle L \rangle_{43}$ (10^{43}erg/s)
Total	1	1.15	13.82
L_{43}<8	1	0.85	2.89
L_{43}>8	0.98	1.6	30.2
Z<1.005	1	0.7	5.43
Z>1.005	0.98	1.62	22.5
L_{43}<14.3, z<0.76	1	0.57	2
L_{43}<14.3, z>0.76	0.98	1.14	5.58
L_{43}>14.3, z>0.76	0.88	1.8	37.05

Bibliography:
Corral et al 2008 A&A V492, 71-80
Streblyanska et al 2005 A&A V432, 395-400
Laird et al 2009 APJS 180
Alexander et al 2003 AJ V125, 383-397
Luo et al 2008 AJSS V179, 19-36

Background picture: http://chandra.harvard.edu