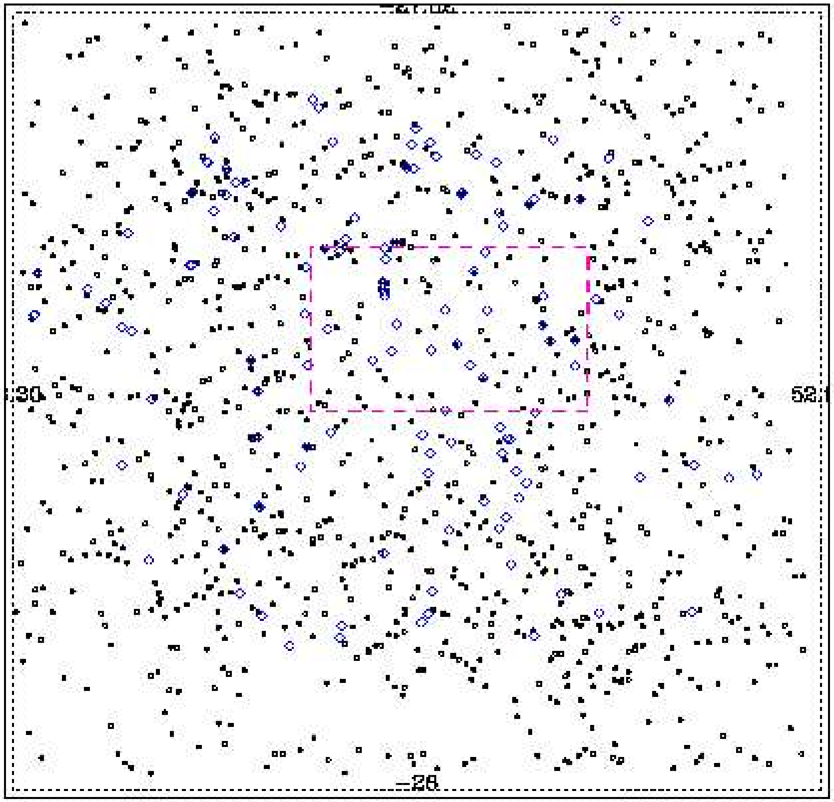
DEPTH DISTRIBUTION IN CDFS: Optical & X-ray sources

See also paper by Adami et al which studies more in detail the composition of single structures

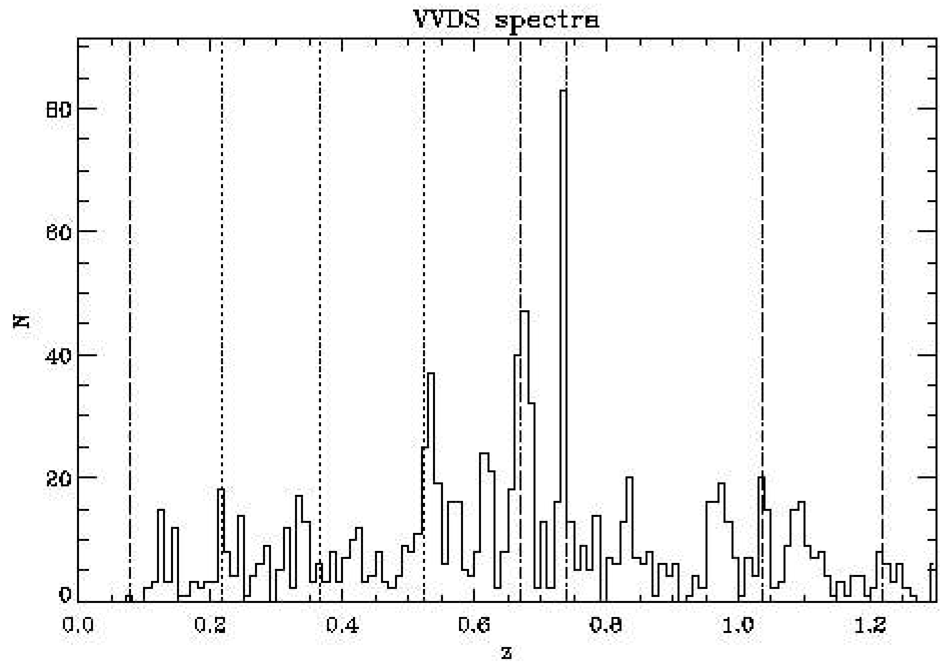
- Gilli et al (2003) suggested a correspondence between peaks found in redshift in the K20 sample and those found for X-ray sources (with z) in the CDFS; this would imply a large transverse coherence (K20 area is a fraction of CDFS) and that X-ray sources trace same structures
- By looking at the VVDS data (only) one can test this z-peaks correspondence and if there is any difference between optical galaxies and X-ray sources in the spatial distribution on large large scales



CDFS:

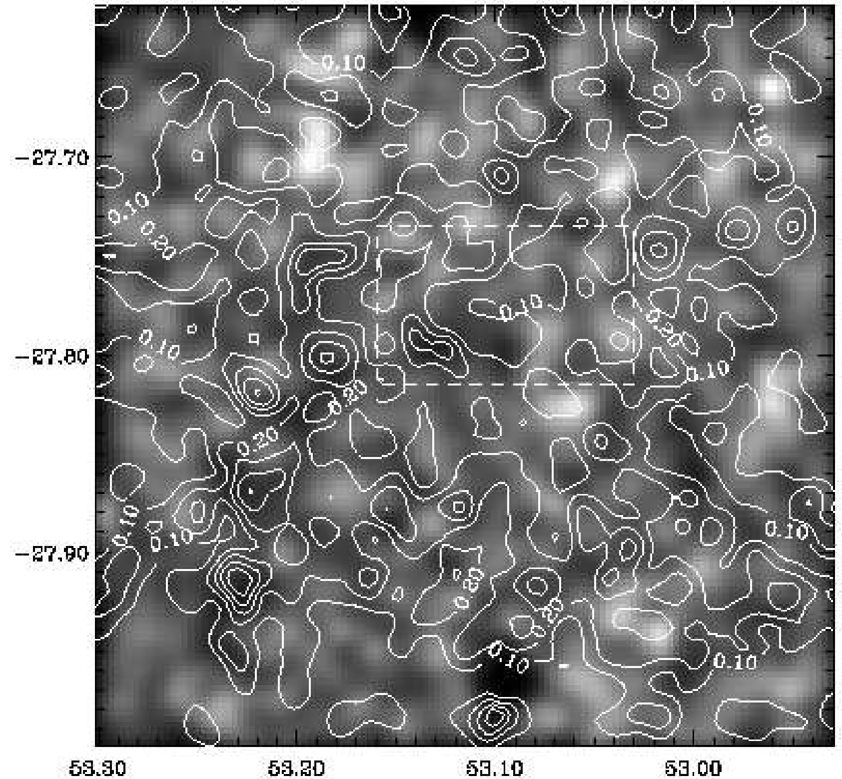
K20 area (dashed rectangle)
X-ray sources (blue diamonds)
VVDS galaxies (black dots)

Limit the present analysis to 1-D and to z<1.3;
VVDS galaxies with flag >1



The simplest thing: a constant bin histogram.

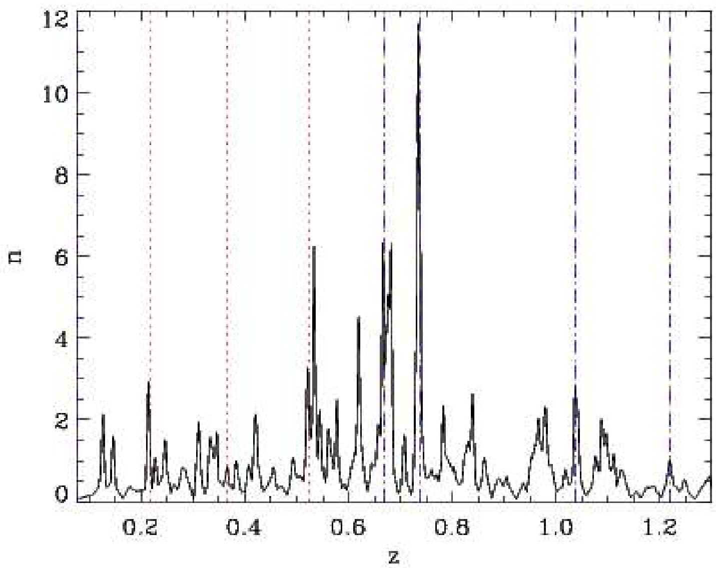
There is good correspondence for the three highest peaks and for some other minor ones (K20 peaks are dotted lines, X-ray sources dashed lines); others however do not correspond

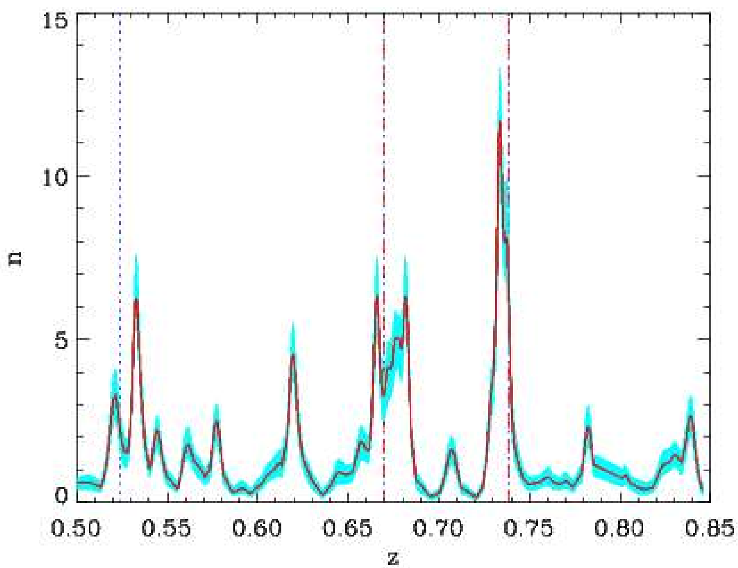


In 1D By compressing along orthogonal directions we do not have to worry about small scale sampling biases: the contours are relative to the sampled fraction and are slightly anticorrelated with the surface sample because of the ~constant VIMOS sampling; the variations are however on much smaller angular scales than the entire field.
The white areas have high surface density, while the contours denote the z sampling fraction, larger in the low density regions.

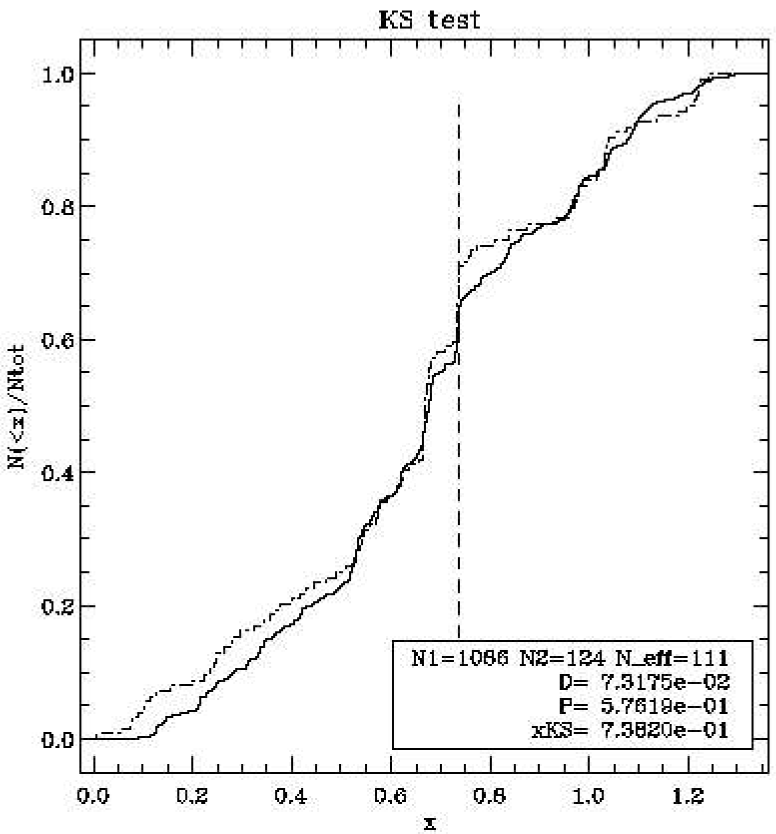
A better comparison: use an **adaptive** smoothing:

Features now appear better and some (e.g. Z=0.67) no longer appear as a single peak (cf Adami et al)



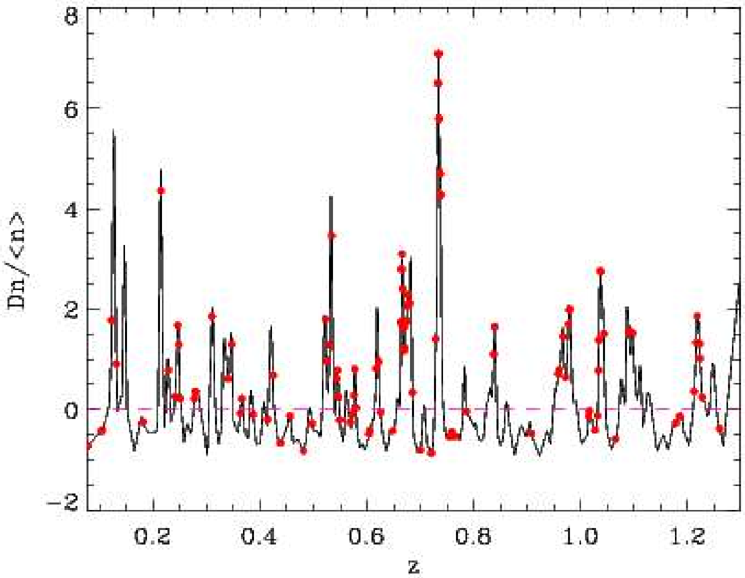


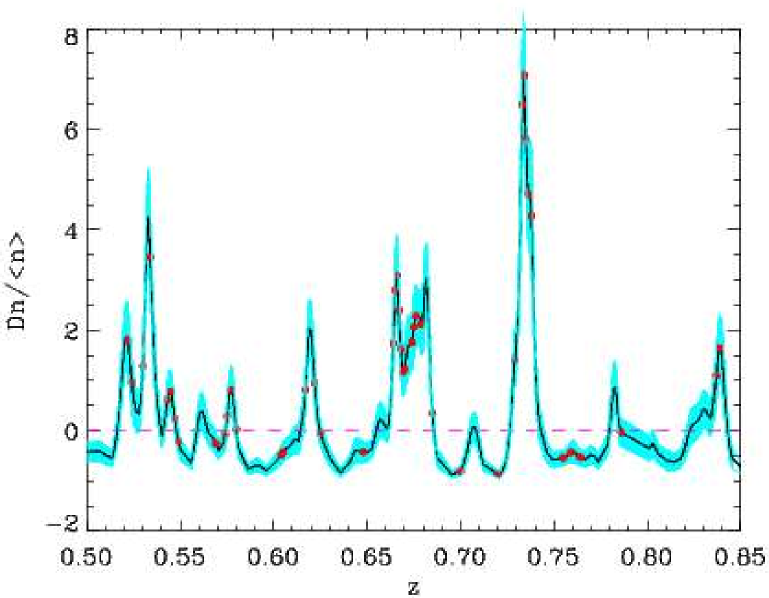
In this way we obtain an estimate of the continuous optical field n(z). We also have an estimate of the uncertainty through bootstrap resamplings (the shaded cyan region)



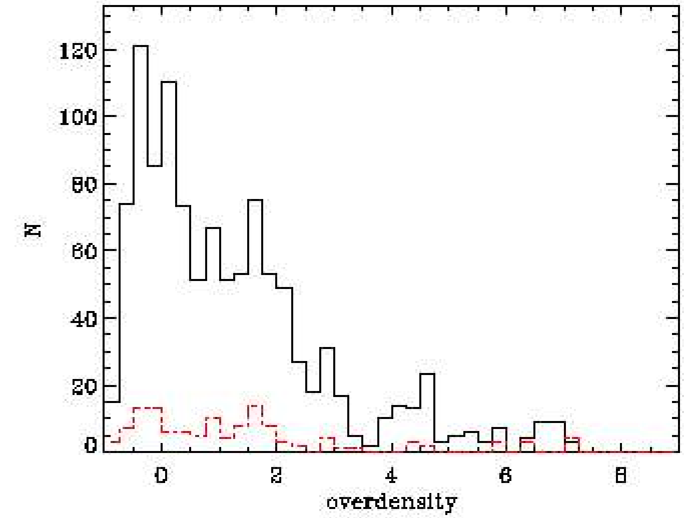
Not a significant difference in KS test: the distribution in z of X-ray sources is compatible with that of optical galaxies (just a few are in common so can consider as independent). Same as in CDFN (Cowie et al.)

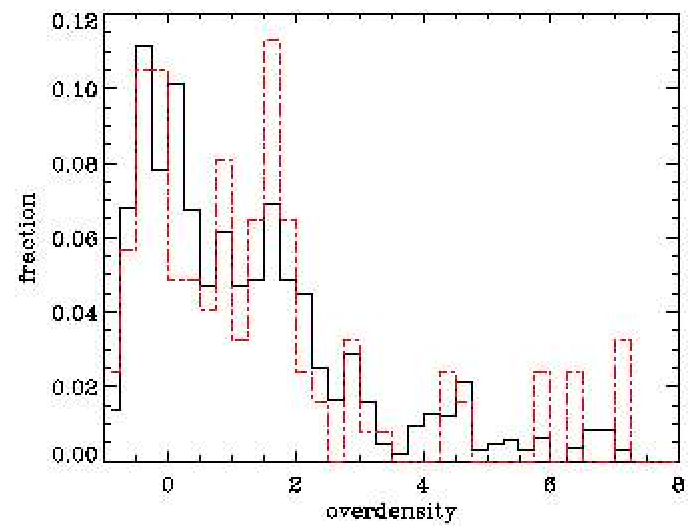
Look at overdensities: consider dn(z)/<n(z)> and check if X-ray sources (red points) lie preferentially in high (or low) density regions





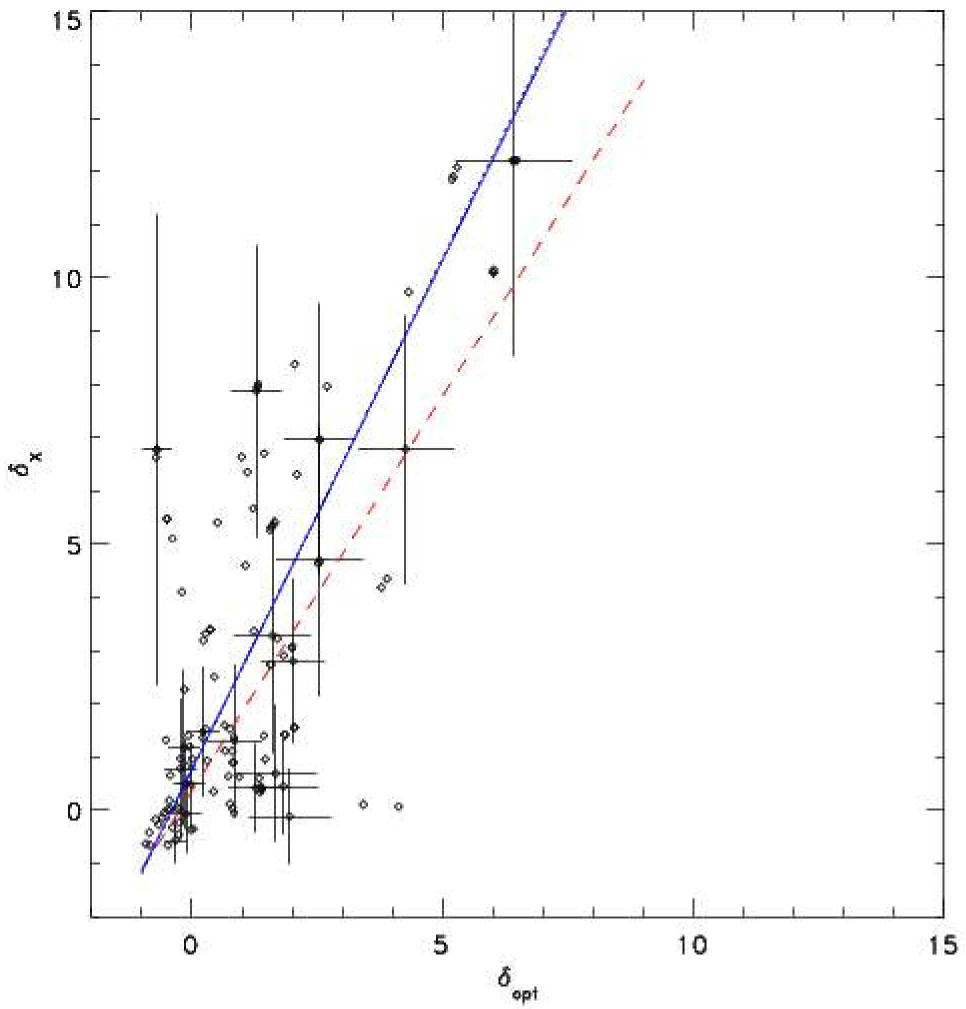
Many red dots are in high density regions but some are in low ones... (e.g. z~0.76)





There is a “hint” that the relative fraction of X-ray sources which are in high density regions is higher (red histogram) but this is not significant according to a KS test (not very powerful...)

Give also a look whether there is a **relative bias** between X-ray sources and optical galaxies (g), i.e. If (dn/n)_x differs from (dn/n)_g.
Obtain (dn/n)_x adaptively and compare the values at the position of X-ray sources, z_xi.



Test the simple linear model: d_x=A+B d_g, where B=b_Xg relative bias of the two populations

Problem: huge and <u>**asymmetric**</u> uncertainties in both quantities. So standard least square fits are not adequate (red line is std OLS; blue is a robust one) and severely underestimate the parameter uncertainty

Do a Montecarlo and robustly fit over 1E6 cases, from 1E3 bootstraps each for galaxy and X-sources density field.

Obtain the joint pdf of A & B and marginalize over B (similar as to integrate out the unknown nuisance parameters which govern the observed density fields)

The result is nominally a high value for B (in blue an approximating Gaussian) with huge uncertainty: B=1.91 +0.90 -0.63 (median and 95% region)

However, this suggests that X-ray sources in the CDFS have a much larger autocorrelation than the optical galaxies in the same volume (which from the table in the VVDS paper have r_0,g ~ 4 Mpc/h, gamma~1.5):

We can ***<u>very roughly</u>*** expect

r_0,x ~ B^(2/gamma) r_0,g ~ 9 Mpc/h

and this is in agreement with what Gilli et al recently found ... (!?!). But beware of cosmic variance and that CDFS is 'peculiar' so not generalize

<u>Problems under the rug</u> (future work?): it would be much better to do a proper 3-D count in cells analysis and to account for evolution etc. but now have only ~120 X-ray sources in a very large volume.... The bias model can also be made more complex but uncertainties already huge with the simplest one....