The XMM ultra-deep Survey in the CDFS

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SUMMARY

The ultradeep (about 3 Ms) XMM exposure in the Chandra Deep Field South (CDFS) will provide the most sensitive view of the hard (> 5 keV) X-ray sky.The XMM high-energy throughput will return high-quality X-ray spectra for a large sample of heavily obscured ($N_H > 10^{23}$ cm^{-2}) AGN. We will study with an unprecedented photon statistic obscured and Compton-Thick AGN at the redshift peak of their activity (z ~ 1-2), characterize the average profile and intensity of the iron line and, thanks to the excellent multiwavelength coverage, assess the role of accreting SMBHs in the context of galaxy evolution. This project will create an XMM legacy and a pathfinder for future X-ray missions.

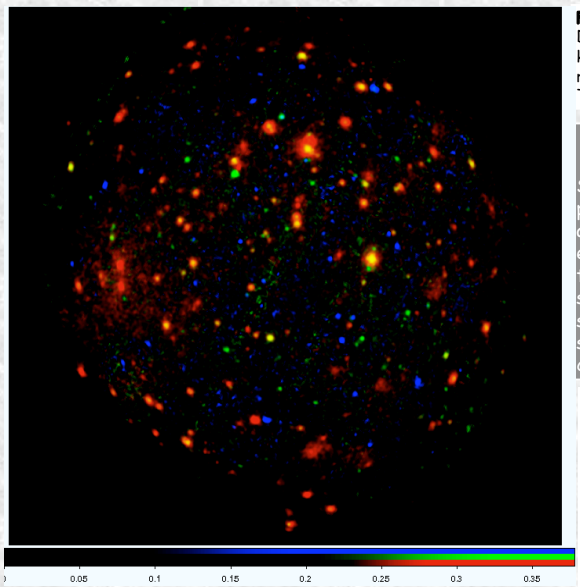


FIG. 1. The XMM-Newton ultra-deep pointing (exposure time of about 1.5 Msec) in the Chandra Deep Field South (CDF-S). The image was obtained by combining three energy bands:soft (0.4-1 keV), medium (1-2 keV), and hard (2-8 keV), coded with different colours (red, green, and blue, respectively).
The image spans about 30 arcmin on a side, and has been adaptively smoothed.

XMM Data Analysis

Standard cleaning criteria were applied to the original event files to remove flares and periods of high background. The individual pointings were corrected for astrometry and the pn and mos images added together. The summed image (Fig. 1) is for a total exposure of about 1.5 Ms (pn) and 1.9 Ms (mos). Additional exposures, performed over the last few months, are being processed. In the hard band (2-8 keV) about 150 sources are detected with more than 500 counts. Good quality (> 1000 counts) X-ray spectra are obtained for about 50 objects. Once the survey will be completed, the statistic above will be almost doubled. A systematic analysis of the X-ray spectra is currently ongoing. Selected results are presented below.

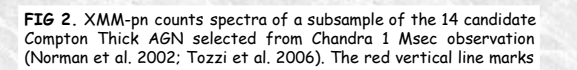


FIG 2. XMM-pn counts spectra of a subsample of the 14 candidate Compton Thick AGN selected from Chandra 1 Msec observation (Norman et al. 2002; Tozzi et al. 2006). The red vertical line marks the expected position of the iron 6.4 keV Kα line at the source redshift (as labeled).

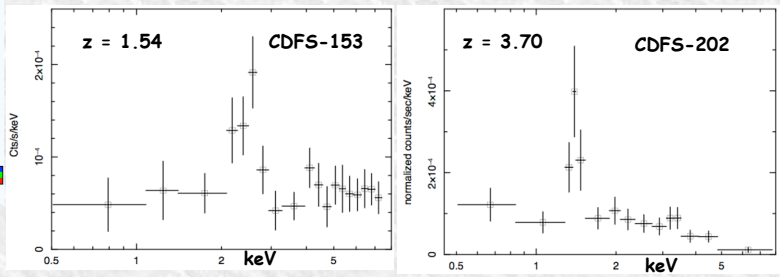
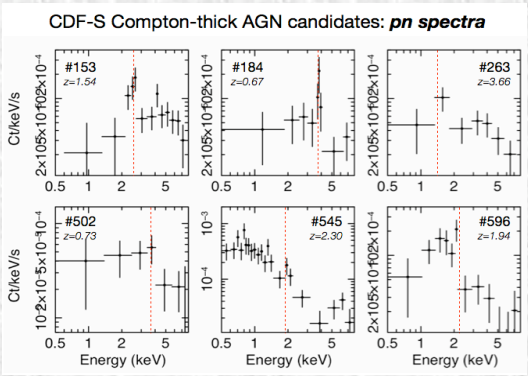


FIG 3. The pn counts spectra of two high-z heavily obscured AGN in the CDFS. The sources belong to the Chandra sample (Fig. 2) and about 1 Ms of XMM-pn observing time is available. A fit with a single power law returns a hard slope in both cases: Γ ~ - 0.3 for CDFS-153 and Γ ~ 0.3 for CDFS-202. Iron Kα line is present in both sources. The line EW strongly depends by the model adopted for the continuum, ranging between 500 eV up to 1.8 keV. A fit with an absorbed power law is preferred for CDFS-202 while the spectrum of CDFS-153 is reflection dominated. In both sources, the obscuring gas column densities are Compton Thick. A full description of the spectral analysis is presented in Comastri et al. 2010 (in preparation).



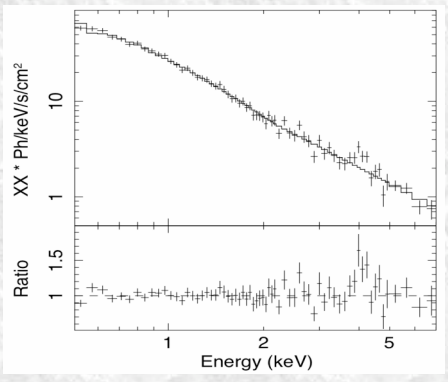


FIG 5. Stacked spectrum of 41 sources in narrow redshift slice centered at z = 0.7, where a highly significant X-ray source overdensity is present (Gilli et al. 2003). All the 41 sources (from the Chandra catalogue of Luo et al. 2008) are stacked together.
The line-like peak around 4 keV is at a slightly higher energy than the rest 6.4 keV line.

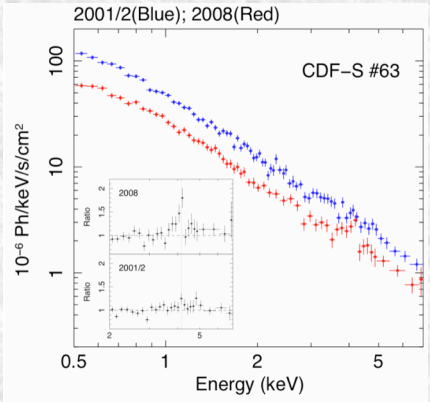


FIG 4. Two-epoch spectrum of a bright Seyfert 1 galaxy at z = 0.56.
Flux variability on a time scale of a few years is clearly present.
The inset shows a zoom on the iron line region. The Fe Kα line strength of CDF-S #63 apparently changed between the archival and the 2008 observations. The line shape in the recent data has a red wing and a narrow core (EW~200 eV). Including the red wing, the total EW is about 270eV (at rest 6.4 keV). The line looks weaker in the archival spectrum (2001/2) with no clear red wing. The EW of the line core is 70 eV. Given the continuum flux change between the two spectra is ~30%, the line flux, besides the EW, has probably increased during the new observations.

REFERENCES

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Tozzi P., et al. 2006 A&A 451, 457

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