## X-ray spectral fitting in X-ray survey fields: CDF-S and COSMOS

<table>
<thead>
<tr>
<th>Chandra Deep Field-South (CDF-S)</th>
<th>COSMOS</th>
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<tbody>
<tr>
<td>≈7Ms <em>Chandra</em> exposure (last obs. at March 2016)</td>
<td>≈1.8Ms <em>Chandra</em> exposure (+2.8Ms extending area and depth)</td>
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<tr>
<td>≈3Ms <em>XMM-Newton</em> exposure</td>
<td>≈1.55Ms <em>XMM-Newton</em> exposure</td>
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<td>Deep multi-wavelength coverage</td>
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<td>One of the legacy fields (no deeper field for the next 20 yrs)</td>
<td>Shallower than the CDF-S but on a larger patch of the sky</td>
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*Chandra*: good on-axis PSF (i.e., excellent angular resolution) and low background
- Sensitive to faint and distant AGN

*XMM-Newton*: larger effective area (hence photon statistics), but much worse angular resolution and higher background
- Better for X-ray spectroscopy of relatively bright AGN
The deepest X-ray field: CDF-S

XMM-CDFS 3 Ms survey
(PI: A. Comastri; Ranalli+13)

$F(2-10\text{keV}) \approx 6.6 \times 10^{-16} \text{erg/cm}^2/\text{s}$

Chandra-CDFS 7 Ms survey
(PI: R. Giacconi, W.N Brandt; Xue+11, Luo+16)

$F(0.5-2\text{keV}) \approx 6.4 \times 10^{-18} \text{erg/cm}^2/\text{s}$

Capable of probing the high-z Universe with some photon statistics
Relatively large-area X-ray field: COSMOS

XMM-COSMOS 1.5 Ms survey
(PI: G. Hasinger; Cappelluti+09)

F(2-10keV)≈9.3×10^{-15} \text{erg/cm}^2/\text{s}

Chandra-COSMOS 1.8 Ms survey
(PI: M. Elvis, F. Civano; Elvis+09, Civano+16)

F(0.5-2keV)≈1.9×10^{-16} \text{erg/cm}^2/\text{s}

Capable of probing rare (e.g., luminous) objects
PLAN (I)

1. **CDF-S**: Fit *Chandra* spectra for 2/4 sources (excluding XID_Xue11=198) and the XMM spectra (all EPIC cameras) for these two sources; compare the spectral results.
2. **COSMOS**: Fit simultaneously *Chandra/XMM/NuSTAR* data for 1 out of 2 AGN.

All spectra and response matrices are provided.
PLAN (II)

MAIN – CDFS

1. Group the spectra (grppha) accordingly to the quality of the data
2. Load spectra in XSPEC
3. Define a spectral model and fit it to the data
4. Once a physically justified model is obtained, save the X-ray spectral parameters (including errors) and produce confidence contours
5. Check for further components (to lower the data/model residuals) – Return to point 3
6. For each spectrum, compare *Chandra* and *XMM-Newton* spectral results

MAIN – COSMOS

1. The same as above; here all of the spectra (*Chandra*, *XMM-Newton* and *NuSTAR*) are fitted *simultaneously*. What about relative normalizations?
**NuSTAR**: two detectors, large PSF FWHM, strong gradients in the background (dark regions in the figure below) across the field of view.
PLAN (III)

OPTIONAL (not necessarily in this order)

a. Fit some of the remaining CDF-S Chandra/XMM-Newton spectra
b. Verify the X-ray spectral differences between XMM_ID=289 and the two Chandra sources XID_Xue11=193 and 198
c. Fit the COSMOS spectra of the remaining source

Effects of blending in XMM exposures

All spectra and response matrices are provided
Main publications

CDF-S

  Introduction to heavily obscured AGN in XMM-CDFS and focus on the AGN at z=3.700.
  4Ms Chandra source catalog.
  High-redshift AGN population in the CDF-S: X-ray spectra and LogN-LogS.
  The XMM deep survey in the CDF-S III. Point source catalogue and number counts in the hard X-rays.
  The Chandra Deep Field-South Survey: 7 Ms Source Catalogs.

XMM/C-COSMOS

  The XMM-Newton wide-field survey in the COSMOS field (XMM-COSMOS).
  The Chandra COSMOS Survey. III. Optical and infrared identification of X-ray point sources.

COSMOS-Legacy

  The Chandra-COSMOS Legacy Survey: overview and point-source catalog.