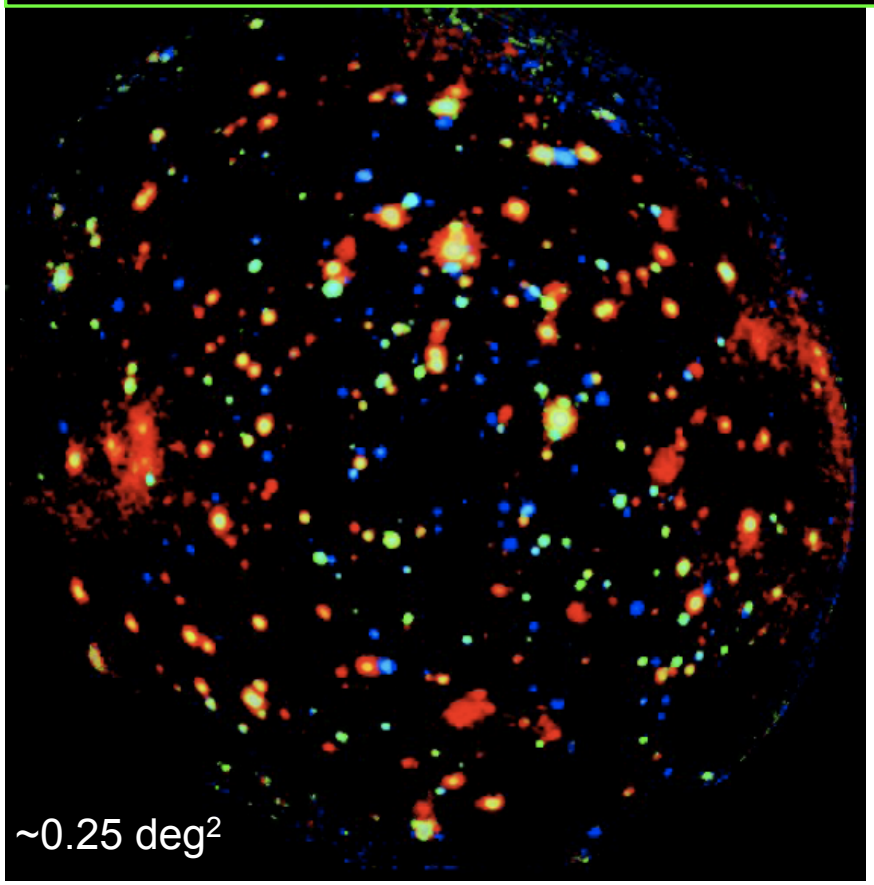
X-ray spectral fitting in X-ray survey fields: CDF-S and COSMOS

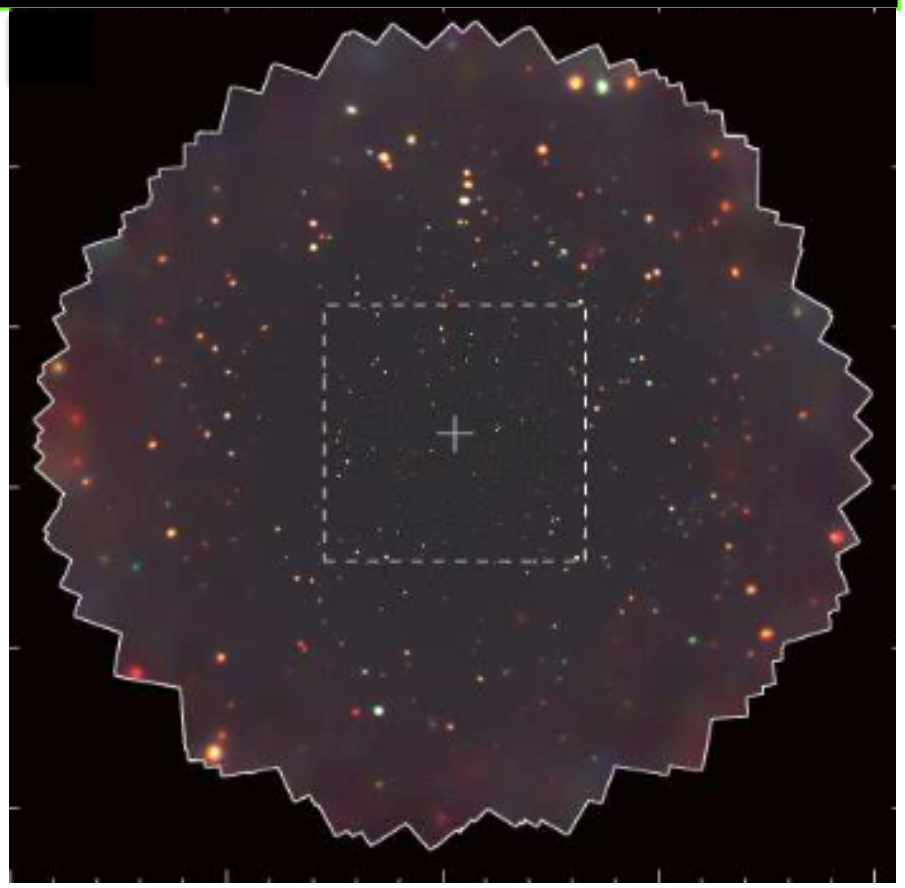
***Chandra* Deep Field-South (CDF-S)**	**COSMOS**
≈7Ms *Chandra* exposure (last obs. at March 2016)	≈1.8Ms *Chandra* exposure (+2.8Ms extending area and depth)
≈3Ms XMM-*Newton* exposure	≈1.55Ms XMM-*Newton* exposure
Deep multi-wavelength coverage	Deep multi-wavelength coverage
One of the legacy fields (no deeper field for the next 20 yrs)	Shallower than the CDF-S but on a larger patch of the sky

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)

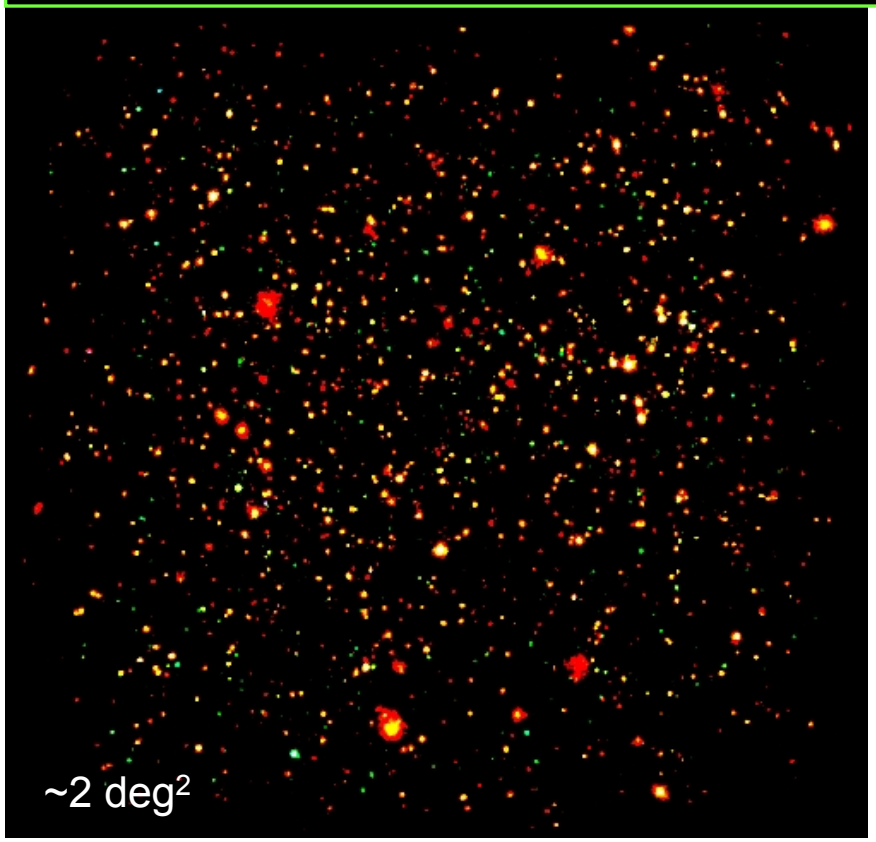
Chandra-CDFS 7 Ms survey
(PI: R. Giacconi, W.N Brandt; Xue+11, Luo+17)

F(2-10keV)≈6.6×10^{-16} erg/cm^2/s

F(0.5-2keV)≈6.4^{-18} erg/cm^2/s

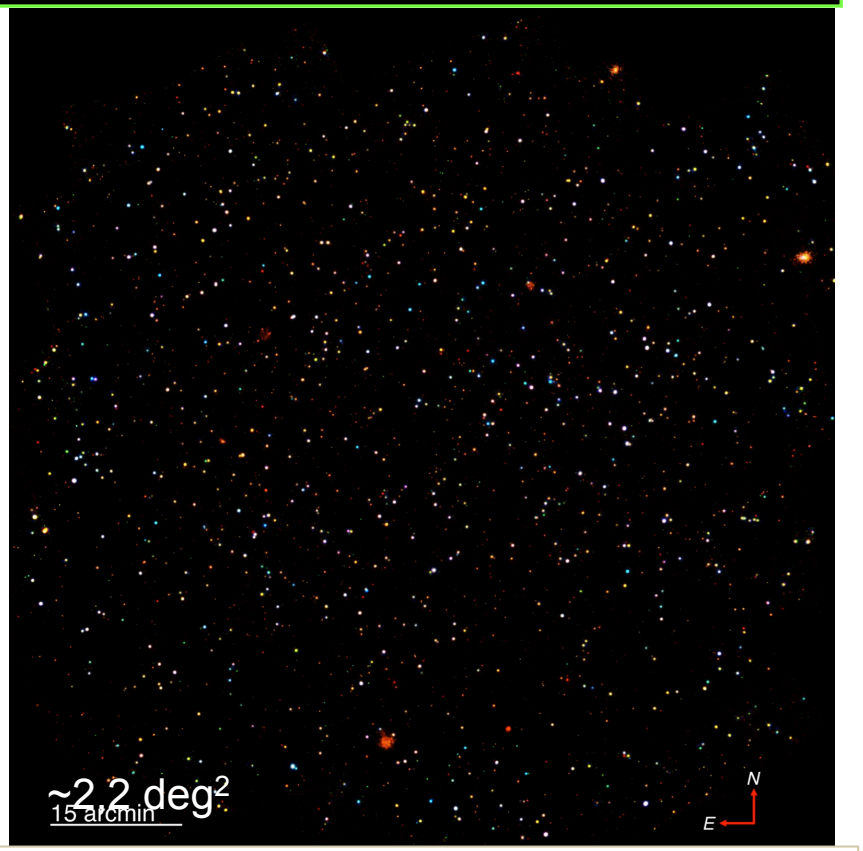
Capable of probing the high-z Universe with some photon statistics

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} erg/cm^2/s



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

F(0.5-2keV)≈1.9×10^{-16} erg/cm^2/s

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

PLAN (I)

MAIN

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

XID_Luo17 (7Ms)

	XID_Xue11	XID_XMM	Source coordinates	z	Opt. Class + Info
551	412	144	03:32:29.86 -27:51:06.1	3.700	NL (Comastri+11)
746	546	180	03:32:39.68 -27:48:51.1	3.064	NL (Vito+13)
730	533	48	03:32:38.93 -27:57:00.9	0.298	NL
242	193	289	03:32:13.25 -27:42:41.3	0.605	NL
249	198	–	03:32:13.86 -27:42:49.3	0.735	NL (close to Xue=193)

1 CDF-S

2 COSMOS

Chandra-ID	XMM-ID	Source coordinates	z	Opt. Class
358	1	150.10517 +1.98123	0.372	BL
482	2608	150.42484 +2.066277	0.125	NL

All spectra and response matrices are provided

PLAN (II)

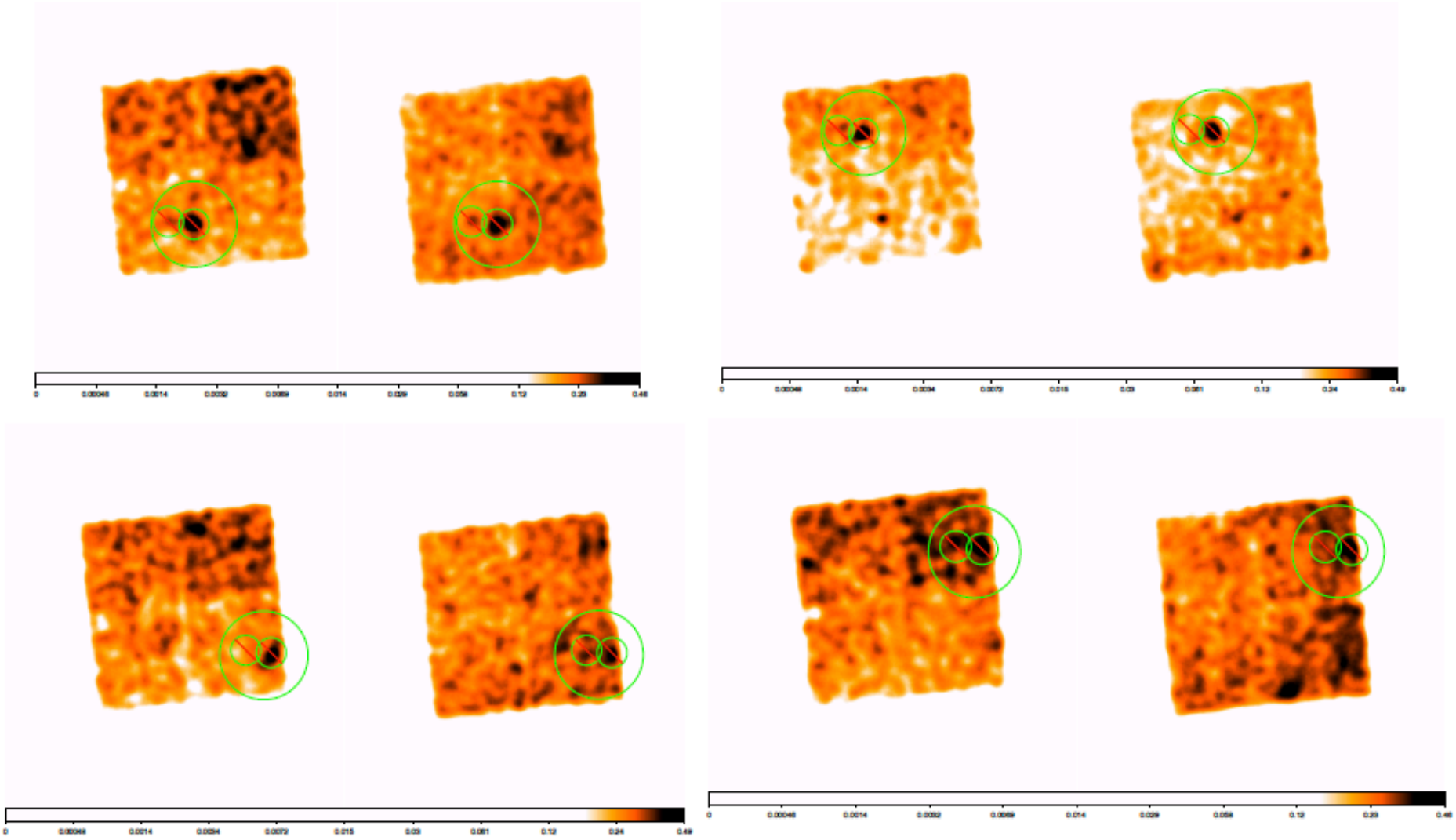
MAIN – CDFS

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

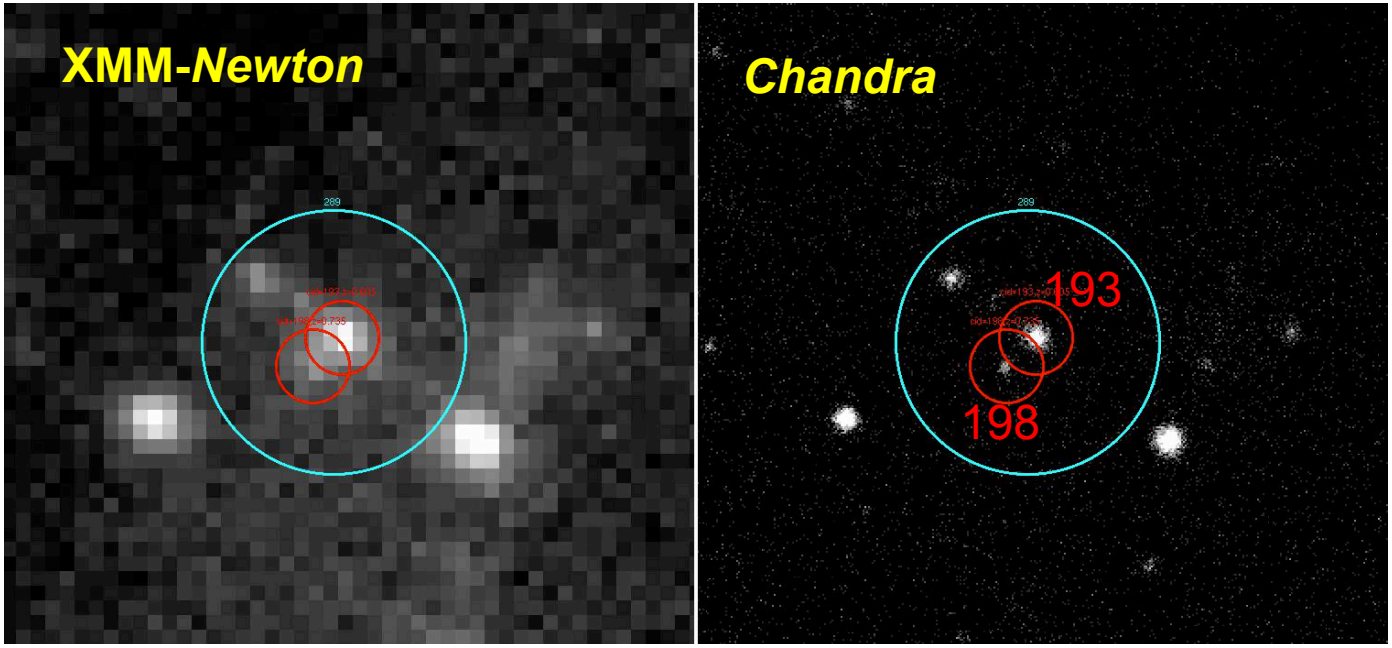


PLAN (III)

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



b.

All spectra and response matrices are provided

Main publications

CDF-S

- Comastri A. et al. 2011, A&A, 526, L9

Introduction to heavily obscured AGN in XMM-CDFS and focus on the AGN at z=3.700.

- Xue Y.Q. et al. 2011, ApJS, 195, 10

4Ms Chandra source catalog.

Xue+11: 4Ms Chandra source catalog

- Vito F. et al. 2013, MNRAS, 428, 354

High-redshift AGN population in the CDF-S: X-ray spectra and LogN-LogS.

- Ranalli P. et al. 2013, A&A, 555, A42

The XMM deep survey in the CDF-S III. Point source catalogue and number counts in the hard X-rays.

Ranalli+13: 3Ms XMM source catalog

- Luo B. et al. 2016, ApJ Suppl., 228, 2

The Chandra Deep Field-South Survey: 7 Ms Source Catalogs.

Luo+17: 7Ms Chandra source catalog

XMM/C-COSMOS

- Brusa M. et al. 2010, ApJ, 716, 348

The XMM-Newton wide-field survey in the COSMOS field (XMM-COSMOS).

- Civano F. et al. 2012, ApJ Suppl., 201, 30

The Chandra COSMOS Survey. III. Optical and infrared identification of X-ray point sources.

COSMOS-Legacy

- Civano F. et al. 2016, ApJ, 819, 62

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

NuSTAR Extragalactic Surveys

- Zappacosta L. et al. 2018, ApJ, 854, 33

The NuSTAR Extragalactic Surveys: X-Ray Spectroscopic Analysis of the Bright Hard-band Selected Sample.