J/ApJS/232/8 16yrs of AGNs X-ray spectral analyses from 7Ms CDF-S (Liu+, 2017)

X-ray spectral analyses of AGNs from the 7Ms Chandra Deep Field-South survey:
the distribution, variability, and evolutions of AGN obscuration.
Liu T., Tozzi P., Wang J.-X., Brandt W.N., Vignali C., Xue Y.,
Schneider D.P., Comastri A., Yang G., Bauer F.E., Paolillo M., Luo B.,
Gilli R., Wang Q.D., Giavalisco M., Ji Z., Alexander D.M., Mainieri V.,
Shemmer O., Koekemoer A., Risaliti G.
<Astrophys. J. Suppl. Ser., 232, 8-8 (2017)>
=2017ApJS..232....8L (SIMBAD/NED BibCode)

ADC_Keywords: Active gal. nuclei ; X-ray sources ; Redshifts

Keywords: catalogs; galaxies: active; galaxies: evolution; surveys;
X-rays: galaxies

Abstract:
We present a detailed spectral analysis of the brightest active galactic nuclei (AGNs) identified in the 7Ms Chandra Deep Field-South (CDF-S) survey over a time span of 16 years. Using a model of an intrinsically absorbed power-law plus reflection, with possible soft excess and narrow Fe Kα line, we perform a systematic X-ray spectral analysis, both on the total 7Ms exposure and in four different periods with lengths of 2-21 months. With this approach, we not only present the power-law slopes, column densities N_H, observed fluxes, and absorption-corrected 2-10keV luminosities L_X for our sample of AGNs, but also identify significant spectral variabilities among them on timescales of years. We find that the N_H variabilities can be ascribed to two different types of mechanisms, either flux-driven or flux-independent. We also find that the correlation between the narrow Fe line EW and N_H can be well explained by the continuum suppression with increasing N_H. Accounting for the sample incompleteness and bias, we measure the intrinsic distribution of N_H for the CDF-S AGN population and present reselected subsamples that are complete with respect to N_H. The N_H-complete subsamples enable us to decouple the dependences of N_H on L_X and on redshift. Combining our data with those from C-COSMOS, we confirm the anticorrelation between the average N_H and L_X of AGN, and find a significant increase of the AGN-obscured fraction with redshift at any luminosity. The obscured fraction can be described as $f_{obscured} \sim 0.42(1+z)^{0.60}$.

Description:
The 7Ms CDF-S survey is comprised of observations performed between 1999 October 14, and 2016 March 24, (UTC). Excluding one observation compromised by telemetry saturation and other issues (ObsID 581), there are 102 observations (observation IDs listed in Table 1) in the data set. The exposures collected across 16 years can be grouped into four distinct periods, each spanning 2-21 months.

Table 1:

Period	Observation Date	Time Span	Exposure Time
I	1999.10-2000.12	14 months	1Ms
11 ObsIDs:	1431-0 1431-1 441 582 2406 2405 2312 1672 2409 2313 2239		
II	2007.09-2007.11	2 months	1Ms
12 ObsIDs:	8591 9593 9718 8593 8597 8595 8592 8596 9575 9578 8594 9596		
III	2010.03-2010.07	4 months	2Ms
31 ObsIDs:	12043 12123 12044 12128 12045 12129 12135 12046 12047 12137 12138 12055 12213 12048 12049 12050 12222 12219 12051 12218 12223 12052 12220 12053 12054 12230 12231 12227 12233 12232 12234		
IV	2014.06-2016.03	21 months	3Ms
48 ObsIDs:	16183 16180 16456 16641 16457 16644 16463 17417 17416 16454 16176 16175 16178 16177 16620 16462 17535 17542 16184 16182 16181 17546 16186 16187 16188 16450 16190 16189 17556 16179 17573 17633 17634 16453 16451 16461 16191 16460 16459 17552 16455 16458 17677 18709 18719 16452 18730 16185		

File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
table2.dat	70	1100	Counts and fluxes of each source in each observation period
table3.dat	114	315	Spectral properties
table4.dat	49	50	Narrow Fe Kα lines
table5.dat	49	5	Broad Fe Kα lines

See also:
J/ApJS/121/473 : A diagnostic diagram for Seyfert 2 Galaxies (Bassani+, 1999)
J/ApJS/139/369 : Chandra Deep Field South. 1 Ms catalog (Giacconi+, 2002)

J/AJ/126/539 : The Chandra Deep Fields North and South (Alexander+, 2003)
J/ApJS/161/21 : Extended Chandra Deep Field-South survey (Lehmer+, 2005)
J/A+A/451/457 : X-ray properties of AGN in CDFS (Tozzi+, 2006)
J/AJ/131/2373 : Extended Chandra Deep Field-South survey (Virani+, 2006)
J/ApJ/681/1163 : Late-type galaxies in Chandra deep fields (Lehmer+, 2008)
J/ApJS/179/19 : CDFS survey: 2 Ms source catalogs (Luo+, 2008)
J/AJ/135/1505 : CDFs AGNs X-ray power-law photon index (Saez+, 2008)
J/ApJS/184/158 : Chandra COSMOS survey I. (Elvis+, 2009)
J/ApJS/180/102 : AEGIS-X: Chandra deep survey (Laird+, 2009)
J/ApJ/728/58 : Swift-BAT survey of AGNs (Burlon+, 2011)
J/A+A/533/A119 : GOODS-Herschel North and South catalogs (Elbaz+, 2011)
J/ApJ/740/37 : Obscured AGN at z~0.5-1 in the CDFS (Luo+, 2011)
J/ApJ/742/3 : Photometric catalogs for ECDF-S and CDF-N (Rafferty+, 2011)
J/ApJS/195/10 : The CDF-S survey: 4Ms source catalogs (Xue+, 2011)
J/ApJ/754/45 : IR properties of Swift/BAT X-ray AGNs (Ichikawa+, 2012)
J/MNRAS/420/2190 : ECDFS sources with radio counterparts (Vattakunnel+, 2012)
J/ApJ/748/124 : AGN X-ray variability in the 4Ms catalog (Young+, 2012)
J/MNRAS/436/3759 : ECDFS sources optical/IR counterparts (Bonzini+, 2013)
J/A+A/556/A114 : Obscured AGNs in CDF-S (Castello-Mor+, 2013)
J/A+A/555/A42 : The XMM-CDFS catalogues (Ranalli+, 2013)
J/MNRAS/443/1999 : X-ray spectral analysis of AGNs (Brightman+, 2014)
J/A+A/564/A125 : AGN Torus model comparison of AGN in the CDFS (Buchner+, 2014)
J/ApJ/802/89 : Luminosity function of X-ray-selected AGNs (Buchner+, 2015)
J/A+A/576/A130 : Ultra-deep cat. of X-ray groups in ECDF-S (Finoguenov+, 2015)
J/ApJ/807/129 : X-ray to MIR luminosities relation of AGNs (Stern, 2015)
J/ApJ/819/62 : The COSMOS-Legacy Survey (CLS) catalog (Civano+, 2016)
J/ApJ/825/7 : Evolution of ~6Ms CDF-S galaxies (Lehmer+, 2016)
J/A+A/593/A55 : MEXSAS catalogue (Vagnetti+, 2016)
J/ApJS/224/15 : Improved 2Ms and 250ks Chandra catalogs (Xue+, 2016)
J/ApJ/831/145 : 6Ms Chandra long-term analyses of AGNs (Yang+, 2016)
J/ApJ/835/74 : IR photom. of AGNs in Swift/BAT 70month cat. (Ichikawa+, 2017)
J/ApJS/228/2 : Chandra Deep Field-South survey: 7Ms sources (Luo+, 2017)

Byte-by-byte Description of file: table2.dat

Bytes	Format	Units	Label	Explanations
1- 4	I4	---	ID	[20/988] Identifier from Luo+ 2017, J/ApJS/228/2
6- 8	A3	---	Per	Observation period (see the "Description" section above)
10- 14	I5	ct	Scts	[0/13061] Soft band (0.5-2keV) counts
16- 18	I3	ct	e_Scts	[1/115] Uncertainty in Scts
20- 23	I4	ct	Hcts	[0/7706] Hard band (2-7keV) counts
25- 26	I2	ct	e_Hcts	[4/90] Uncertainty in Hcts
28- 34	F7.3	10-16mW/m2	FS	[0/680] Soft band (0.5-2keV) flux
36- 41	F6.3	10-16mW/m2	e_FS	[0/64] Lower uncertainty in FS
43- 48	F6.3	10-16mW/m2	E_FS	[0.02/39] Upper uncertainty in FS
50- 56	F7.3	10-16mW/m2	FH	[0/816] Hard band (2-7keV) flux
58- 63	F6.3	10-16mW/m2	e_FH	[0/28] Lower uncertainty in FH
65- 70	F6.3	10-16mW/m2	E_FH	[0.2/37] Upper uncertainty in FH

Byte-by-byte Description of file: table3.dat

Bytes	Format	Units	Label	Explanations
1- 5	A5	---	Cpt	Compton ("thick": 22 occurrences or "thin")
7- 10	I4	---	ID	[20/988] Identifier in the 7Ms CDF-S catalog (Luo+ 2017, J/ApJS/228/2)
12- 17	F6.4	---	z	[0.1/5.3] Redshift from Luo+, 2017, J/ApJS/228/2
18	A1	---	f_z	Flag on z (s=secure spectroscopic) (1)
20- 28	A9	---	Per	Observation period (see the "Description" section above) (2)
30	A1	---	l_NH	Limit flag on NH
31- 37	F7.3	10+22/cm2	NH	[0.005/600] Hydrogen column density (3)
39- 45	F7.3	10+22/cm2	e_NH	[0.005/514]? Lower 90% uncertainty in NH
47- 53	F7.3	10+22/cm2	E_NH	[0/554]? Upper 90% uncertainty in NH
55- 58	F4.2	---	Gamma	[1.4/2.4]? Power-law slope
59	A1	---	f_Gamma	[f] f=fixed
61- 64	F4.2	---	e_Gamma	[0.02/0.4]? Lower 90% uncertainty in Gamma
66- 69	F4.2	---	E_Gamma	[0.02/0.4]? Upper 90% uncertainty in Gamma
71- 77	E7.1	ph/cm2/s	SRate	? Soft band (0.5-2keV) net count rate; in photon/cm^2/s units (4)
79- 85	E7.1	ph/cm2/s	HRate	? Hard band (2-7keV) net count rate in photon/cm^2/s units (4)
87- 91	F5.2	[10-7W]	logL	[39.5/48]? log 2-10keV unabsorbed luminosity; in erg/s (5)
93- 96	F4.2	[10-7W]	e_logL	[0/3]? Lower 90% uncertainty in logL
98-101	F4.2	[10-7W]	E_logL	[0/5]? Upper 90% uncertainty in logL
103-106	F4.1	---	C-NH	[-1/24] Completeness flag (6)
108-114	A7	---	Model	Period number in which soft excess component added (see the "Description" section above) (7)

Note (1): Flag on redshift as follows:
s = secure spectroscopic (148 occurrences);
i = insecure spectroscopic (26 occurrences);
p = photometry (97 occurrences)
x = X-ray spectroscopic-z (5 occurrences).

Note (2): If NH is found variable. This field is empty if NH is not variable.
If more than one period is given in one line, their NH are set as the same. If one period of a source whose NH is variable is not given in the table, its NH is set as the average of the NH of the other periods.
Note (3): Note the NH for Compton-thick sources are considered unreliable and not used in this work.
Note (4): Averaged among the four periods, weighted by the exposure time.

Note (5): This value is highly uncertain in the cases of extreme Compton-thick absorption, where the transmitted power-law becomes too weak.
Note (6): Use the filter C-NH≥NH to select a subsample which is complete with respect to NH at logNH<NH, where NH can be 23, 23.5, or 24. -1 means Compton-thick.
Note (7): 0 means soft excess is found in the 7Ms stacked spectrum. Empty means no soft excess is found.

Byte-by-byte Description of file: table[45].dat

Bytes	Format	Units	Label	Explanations
1- 4	I4	---	ID	[26/988] Identifier
6- 9	F4.2	keV	Energy	[6/6.7] Rest-frame central energy
11- 14	F4.2	keV	e_Energy	Negative 1σ error on Energy
16- 19	F4.2	keV	E_Energy	Positive 1σ error on Energy
21- 24	I4	eV	EW	[66/2569] Rest-frame equivalent-width
26- 29	I4	eV	e_EW	Negative 1σ error on EW
31- 34	I4	eV	E_EW	Positive 1σ error on EW
36- 39	F4.2	keV	sigma	[0.2/3]? Rest-frame width (only for table 5)
41- 44	F4.2	keV	e_sigma	? Negative 1σ error on sigma
46- 49	F4.2	keV	E_sigma	? Positive 1σ error on sigma

History:
From electronic version of the journal

Acknowledgements:
Teng Liu [lewtonstein {at} gmail . com]

(End) Prepared by [AAS], Emmanuelle Perret [CDS] 29-Sep-2017