J/ApJ/825/7 Evolution of ~6Ms CDF-S galaxies (Lehmer+, 2016)

The evolution of normal galaxy X-ray emission through cosmic history:
constraints from the 6Ms Chandra Deep Field-South.
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Fragos T., Hornschemeier A.E., Luo B., Xue Y.Q., Bauer F.E., Gilfanov M.,
Ranalli P., Schneider D.P., Shemmer O., Tozzi P., Trump J.R., Vignali C.,
Wang J.-X., Yukita M., Zezas A.
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=2016ApJ...825....7L (SIMBAD/NED BibCode)

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

Keywords: galaxies: evolution; surveys; X-rays: binaries; X-rays: galaxies;
X-rays: general

Abstract:
We present measurements of the evolution of normal-galaxy X-ray emission from z~0-7 using local galaxies and galaxy samples in the ~6Ms Chandra Deep Field-South (CDF-S) survey. The majority of the CDF-S galaxies are observed at rest-frame energies above 2keV, where the emission is expected to be dominated by X-ray binary (XRB) populations; however, hot gas is expected to provide small contributions to the observed-frame $\lesssim$1keV emission at z$\lesssim$1. We show that a single scaling relation between X-ray luminosity (L_X) and star-formation rate (SFR) literature, is insufficient for characterizing the average X-ray emission at all redshifts. We establish that scaling relations involving not only SFR, but also stellar mass (M_*) and redshift, provide significantly improved characterizations of the average X-ray emission from normal galaxy populations at z~0-7. We further provide the first empirical constraints on the redshift evolution of X-ray emission from both low-mass XRB (LMXB) and high-mass XRB (HMXB) populations and their scalings with M_* and SFR, respectively.

Description:
We began with an initial sample of 32508 galaxies in the Great Observatories Origins Deep Survey South (GOODS-S) footprint as presented in Section 2 of Xue et al. (2012, J/ApJ/758/129). We cut our initial sample to the 24941 objects that were within 7' of the mean ~6Ms CDF-S aimpoint, a region where the Chandra point-spread function (PSF) is sharpest and the corresponding X-ray sensitivity is highest. See text for further explanations.

File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
table1.dat	75	63	Stacked subsample properties
table2.dat	124	63	Galaxy stacking results

See also:
J/ApJ/813/82 : z<0.06 broad-line AGN emission-line measures (Reines+, 2015)
J/ApJ/801/97 : GOODS-S+UDS stellar masses from CANDELS (Santini+, 2015)
J/MNRAS/446/470 : ULX candidates in luminous IR galaxies (Luangtip+, 2015)
J/ApJ/777/18 : Stellar mass functions of galaxies to z=4 (Muzzin+, 2013)
J/ApJ/776/L31 : Energy feedback from XRB from z=0 to z=19.92 (Fragos+, 2013)
J/ApJ/774/136 : Xray obs. of SINGS gal. compared to models (Tzanavaris+, 2013)
J/ApJ/766/19 : XRB population synthesis models in 0<z<20 gal (Tremmel+, 2013)
J/ApJ/764/41 : X-ray binary evolution across cosmic time (Fragos+, 2013)
J/ApJ/758/129 : 4Ms Chandra Deep Field South 6-8keV galaxies (Xue+, 2012)
J/A+A/542/A16 : X-ray detection of radio-selected SF galaxies (Ranalli+, 2012)
J/MNRAS/420/2190 : ECDFS sources with radio counterparts (Vattakunnel+, 2012)
J/MNRAS/419/2095 : HMXBs in nearby galaxies (Mineo+, 2012)
J/ApJ/742/3 : Photometric catalogs for ECDF-S and CDF-N (Rafferty+, 2011)
J/ApJ/740/37 : Obscured AGN at z~0.5-1 in the CDFS (Luo+, 2011)
J/A+A/533/A119 : GOODS-Herschel North and South catalogs (Elbaz+, 2011)
J/ApJS/195/10 : The CDF-S survey: 4Ms source catalogs (Xue+, 2011)
J/ApJS/191/124 : Optical spectrosc. of ECDF-S X-ray sources (Silverman+, 2010)
J/ApJ/681/1163 : Late-type galaxies in Chandra deep fields (Lehmer+, 2008)
J/A+A/437/883 : K20 survey: spectroscopic catalogue (Mignoli+, 2005)
J/ApJS/155/271 : CDF-South: Optical spectroscopy (Szokoly+, 2004)
J/ApJ/602/231 : Chandra X-ray point sources in nearby gal. (Colbert+, 2004)
http://hedam.lam.fr/GOODS-Herschel/ : GOODS-Herschel survey home page

Byte-by-byte Description of file: table1.dat

Bytes	Format	Units	Label	Explanations
1- 3	I3	---	Seq	Unique stacked subsample identifier (1)

5- 7	F3.1	---	zlo	[0/5] Lower redshift boundary of sample
9- 11	F3.1	---	zup	[0.5/7] Upper redshift boundary of sample
13- 16	F4.2	---	<z>	[0.3/6] Mean redshift
18- 19	I2	---	NGal	[12/60] Number of galaxies stacked in bin
21	I1	---	Ndet	[0/7] Number of sources detected individually in bin
23- 26	F4.1	Msun/yr	SFRlo	[0.2/27.3] Lower SFR boundary of sample
28- 32	F5.1	Msun/yr	SFRup	[21.7/707] Upper SFR boundary of sample
34- 38	F5.1	Msun/yr	<SFR>	[0.8/132] Mean Star Formation Rate
40- 43	F4.1	Msun/yr	e_<SFR>	[0.4/52] The 1σ error in <SFR>
45- 48	F4.1	[Msun]	logM*	[9.3/11] Log mean stellar mass (2)
50- 52	F3.1	[Msun]	e_logM*	[0/0.1] The 1σ error in logM*
54- 58	F5.2	Gyr-1	sSFRlo	[0.01/23] Lower sSFR boundary of sample
60- 64	F5.2	Gyr-1	sSFRup	[0.02/40] Upper sSFR boundary of sample
66- 70	F5.2	Gyr-1	<sSFR>	[0.02/28] Mean specific Star Formation Rate
72- 75	F4.2	Gyr-1	e_<sSFR>	[0.01/9] The 1σ error in <sSFR>

Note (1): The subsample ID has been assigned to each subsample and is ordered based on ascending redshift bin, and within each redshift bin, ascending sSFR.
Note (2): The stellar mass is bounded by limits on SFR and sSFR, as well as a hard lower bound of M^{lim}_{*} = 1e9 solMass.

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

Bytes	Format	Units	Label	Explanations
1- 2	I2	---	Seq	Unique stacked subsample identifier
4- 7	F4.1	---	S/N0.5-1	[-0.7/14.1] Signal-to-Noise in 0.5-1keV band
9- 12	F4.1	---	S/N1-2	[-0.1/18] Signal-to-Noise in 1-2keV band
14- 17	F4.1	---	S/N2-4	[-2/9.1] Signal-to-Noise in 2-4keV band
19	A1	---	l_C0.5-1	Limit flag on C0.5-1
20- 24	F5.1	ct	C0.5-1	[21/266] Net 0.5-1 keV counts (3)
26- 30	F5.1	ct	e_C0.5-1	[8/180]? The 1σ error in C0.5-1
32	A1	---	l_C1-2	Limit flag on C1-2
33- 37	F5.1	ct	C1-2	[32/438] Net 1-2 keV counts (3)
39- 43	F5.1	ct	e_C1-2	[8/297]? The 1σ error in C1-2
45	A1	---	l_C2-4	Limit flag on C2-4
46- 50	F5.1	ct	C2-4	[32/200] Net 2-4 keV counts (3)
52- 56	F5.1	ct	e_C2-4	[18/160]? The 1σ error in C2-4
58	A1	---	l_BR1	Limit flag on BR1
59- 62	F4.1	---	BR1	[1/4] The (1-2keV)/(0.5-1keV) band ratio
64- 66	F3.1	---	e_BR1	[1/8]? The 1σ error in BR1
68	A1	---	l_BR2	Limit flag on BR2
69- 72	F4.1	---	BR2	[0.4/2] The (2-4keV)/(1-2keV) band ratio
74- 76	F3.1	---	e_BR2	[0.7/4]? The 1σ error in BR2
78	A1	---	l_logL1	Limit flag on logL1
79- 83	F5.1	[10-7W]	logL1	[39.9/43] Log 0.5-2keV luminosity; erg/s
85- 87	F3.1	[10-7W]	e_logL1	[0.1/0.2]? 1σ error in logL1
89	A1	---	l_logL2	Limit flag on logL2
90- 94	F5.1	[10-7W]	logL2	[39.8/43] Log 2-10keV luminosity; erg/s
96- 98	F3.1	[10-7W]	e_logL2	[0.1/0.3]? 1σ error in logL2
100	A1	---	l_logL/SFR	Limit flag on logL/SFR
101-105	F5.1	[10-7W/Msun.yr]	logL/SFR	[39.4/41] Log 2-10keV luminosity per mean SFR ratio
107-109	F3.1	[10-7W/Msun.yr]	e_logL/SFR	[0.1/0.3]? 1σ error in logL/SFR
111-114	F4.2	%	fAGN	[0/9] Estimated fraction of 2-10keV emission from undetected AGN (4)
116-119	F4.2	%	E_fAGN	[0/7] Upper 1σ error in fAGN
121-124	F4.2	%	e_fAGN	[0/4] Lower 1σ error in fAGN

Note (3): Background-subtracted.

Note (4): These estimates are computed following the methodology outlined in Section 6.1.

History:
From electronic version of the journal

(End) Prepared by [AAS], Emmanuelle Perret [CDS] 19-Aug-2016

*The document above follows the rules of the Standard Description for Astronomical Catalogues; from this documentation it is possible to generate **f77** program to load files into arrays or line by line*