$\mathcal{TGCat}$ Collected Flux Properties File Specification (version 0.1)

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1 Overview

The $\mathcal{TGCat}$[1] Collected Flux Properties ("fprops") files tabulate the flux properties from all the individual spectral extractions (more than 1300 "`summary_fprops.fits`" files) in a few FITS binary tables (one for each instrumental configuration — 5 files in all). Additional information is added to the table uniquely identify a the source and extraction for each measurement. These tables can be used for aggregate analysis on classes of objects, facilitating construction of hardness ratios or line flux indices, for example.

2 Files

Data are split into separate files by grating, instrument, and detector mode.

Filename	Configuration (Grating/Instrument/Mode)	Size [MB]	#Extr	#Src
`tgcat_fprops_hat.fits`	HETG/ACIS/TIMED	6.6	865	280
`tgcat_fprops_hac.fits`	HETG/ACIS/CONTINUOUS	0.7	99	43
`tgcat_fprops_lat.fits`	LETG/ACIS/TIMED	0.9	129	33
`tgcat_fprops_lac.fits`	LETG/ACIS/CONTINUOUS	0.1	10	8
`tgcat_fprops_lh.fits`	LETG/HRC/	1.7	275	101
		10.0	1378	377

[1]The Chandra Grating Spectral Data Catalog and Archive, $<$ `http://tgcat.mit.edu` $>$

3 FITS file structure

The primary extension of the single binary table is called:

```
EXTNAME = 'tgcat_fprops'
```

The configuration is specified by header keywords

```
  INSTRUME   (ACIS or HRC)
  GRATING    (HETG or LETG)
  READMODE   (TIMED, CONTINUOUS, or blank)
```

The table's columns are

#	Name	Type
1	object	String
2	simbad_object	String
3	tgcatid	Int4
4	tgcsrcid	Int4
5	obsid	Int4
6	exposure	Real8
7	simbad_ptype	String
8	simbad_nclass	Int4
9	label	String
10	wmid	Real8
11	wlo	Real8
12	whi	Real8
13	count_rate	Real8
14	err_count_rate	Real8
15	photon_flux	Real8
16	err_photon_flux	Real8
17	energy_flux	Real8
18	err_energy_flux	Real8
19	flag	Int4

4 File content description

object The common object name. This is often—but not necessarily—the name provided by the PI.

simbad_object The primary SIMBAD name

tgcatid The $\mathcal{TGCat}$ extraction ID. Note that there can be multiple extractions for any specific observation identifier (OBSID), e.g. for multiple sources in the field, or extractions with different parameters. (this ID is the unique identifier for the $\mathcal{TGCat}$ database).

tgcsrcid The $\mathcal{TGCat}$ unique source identifier.

obsid The Chandra Observation Identifier (OBSID)

exposure Exposure time, in seconds

simbad_ptype SIMBAD primary object type string (also known as the "Condensed" type). [2]

simbad_nclass The SIMBAD numeric code, expressed as an 8-digit integer. The SIMBAD classes are given and ID of the form nn.nn.nn.nn (with leading zeroes; e.g., 15.01.02.03). In the FITS table, the "." has been omitted to form an integer, which facilitates possible range searches. See the link above for a full list.

label The "label" is a string which defines the band-pass, and is based on strong emission lines in thermal spectra or inter-line continuum (or weak-line) regions. Hence, labels are given the ionic name (e.g. "Fe25", "S15"), or for continuua as a string starting with "c" followed by the central wavelength in mA (e.g., "c13200").

There are currently 45 bands extracted. Hence, there are multiple rows for each extraction with identical source ID values (i.e., all the preceding columns, `object` to `simbad_nclass`).

(See the Appendix for a full listing of the bands.)

wmid Central wavelength of the band; in [Å].

wlo Low wavelength of the band; in [Å].

whi High wavelength of the band; in [Å].

[2] For a full list, follow the "Object Types" link in the "Documentation" column of <http://simbad.harvard.edu/simbad/.

count_rate The count rate integrated over the band defined by wlo, whi; [counts/second], summed over first orders, and if HETG, over gratings HEG and MEG.

err_count_rate The count rate statistical error (Gaussian; sqrt(counts))

photon_flux The integrated flux in the band; in [$\mathrm{photons/cm^2/s}$], obtained from the "unfolded" spectrum. (This is not provided for LETG/HRC observations due to the unresolved overlapping orders). Summed over first orders and if HETG, HEG and MEG.

err_photon_flux The statistical error on the photon flux (scaled from the count rate error). (This is not provided for LETG/HRC observations due to the unresolved overlapping orders).

energy_flux The integrated energy flux in the band; in [$\mathrm{ergs/cm^2/s}$], obtained from the "unfolded" spectrum. (This is not provided for LETG/HRC observations due to the unresolved overlapping orders). Summed over first orders and if HETG, HEG and MEG.

err_energy_flux The statistical error on the energy flux (scaled from the count rate error). (This is not provided for LETG/HRC observations due to the unresolved overlapping orders).

flag A non-zero value indicates that the band-pass is not fully covered by the instrument. A value of 1 means that the band-pass exceeds the instruments wavelength range. A value of 2 means that the effective area has values of 0.0 within the band. (e.g., the letgs_band is provided for all configurations, but for HETG/ACIS there is no response beyond about 30Å.)

5 Usage Scenarios

(NOTE: The following examples are schematic only; they are not complete nor expressed in any specific language's literal statements.)

5.1 SIMBAD Class and Band

Assume you wish to retrieve the Chandra Source Catalog "hard" band energy flux for all SIMBAD AGN galaxy-class observations (SIMBAD class 15.15.??.??). The file could be accessed as follows:

Retrieve column "energy_flux" as filtered by

```
(simbad_nclass/1000000==15) % major class => Galaxy
 &&((simbad_nclass/10000 mod 100)==15) %1st sub-class=>AGN
 &&(label=="csc_h")
```

Since there is no major class above 15, the class filter could also be obtained via:

```
( simbad_nclass >= 15150000 )
```

5.2 Approximate Net Ne X Flux

To appoximate a net line flux, we need to retrieve the integrated line band flux and wavelength limits, similar information for an appropriate continuum band, and then subtract the continuum band flux scaled to the same wavelength interval as the line. Assume we wish to do this for all SIMBAD single star types for the Ne X 12Å line:

1. Define the filters for line (f1) and continuum (f2):

   ```
   f1=(simbad_nclass/1000000==14) && (label=="Ne10")
   f2=(simbad_nclass/1000000==14) && (label=="c13200")
   ```

   Note: f1 and f2 will select the same number of rows, but in the first case, all rows for the Ne10 label, and in the second, for the desired continuum band.

2. Retrieve the photon flux and bandpass information for each:

   ```
   y1={photon_flux, wlo, whi} for f1, the Ne10 flux
   y2={photon_flux, wlo, whi} for f2, the continuum flux
   ```

3. subtract continuum flux scaled to the line band:

   ```
   net_flux=y1.photon_flux
           -y2.photon_flux/(y2.whi-y2.wlo)*(y1.whi-y1.wlo)
   ```

A Band Details

Label	Wmid	Wlo	Whi
heg_band	8.35	1.70	15.00
meg_band	13.35	1.70	25.00
letgs_band	81.00	2.00	160.00
letg_acis_band	26.00	2.00	50.00
c1750	1.75	1.70	1.80
Fe25	1.85	1.80	1.90
FeK	1.95	1.90	2.00
c2500	2.50	2.00	3.00
Ca19	3.20	3.10	3.30
c3500	3.50	3.30	3.70
Ar18	3.75	3.70	3.80
Ar17	4.00	3.90	4.10
c4500	4.50	4.30	4.70
S16	4.75	4.70	4.80
c4900	4.90	4.80	5.00
S15	5.08	5.00	5.15
c5700	5.70	5.40	6.00
Si14	6.17	6.10	6.25
c6425	6.42	6.30	6.55
Si13	6.70	6.60	6.80
c7800	7.80	7.40	8.20
Mg12	8.40	8.35	8.45
c8800	8.80	8.50	9.10
Mg11	9.25	9.10	9.40
Fe2x	11.20	10.40	12.00
Ne10	12.15	12.10	12.20
c13200	13.20	13.00	13.40
Ne9	13.60	13.40	13.80
Fe17a	15.00	14.95	15.05
c14925	14.93	14.90	14.95
O8b	16.00	15.95	16.05
c16450	16.45	16.20	16.70
Fe17b	17.07	17.00	17.15
O8a	18.98	18.90	19.05
c20200	20.20	19.20	21.20
O7	21.85	21.50	22.20
c23400	23.40	22.20	24.60
N7	24.80	24.70	24.90
c27500	27.50	25.00	30.00
csc_b	13.40	2.00	24.80
csc_u	42.40	24.80	60.00
csc_s	17.57	10.33	24.80
csc_m	8.27	6.20	10.33
csc_h	4.10	2.00	6.20
zeroth_order	-1.00	-1.00	-1.00

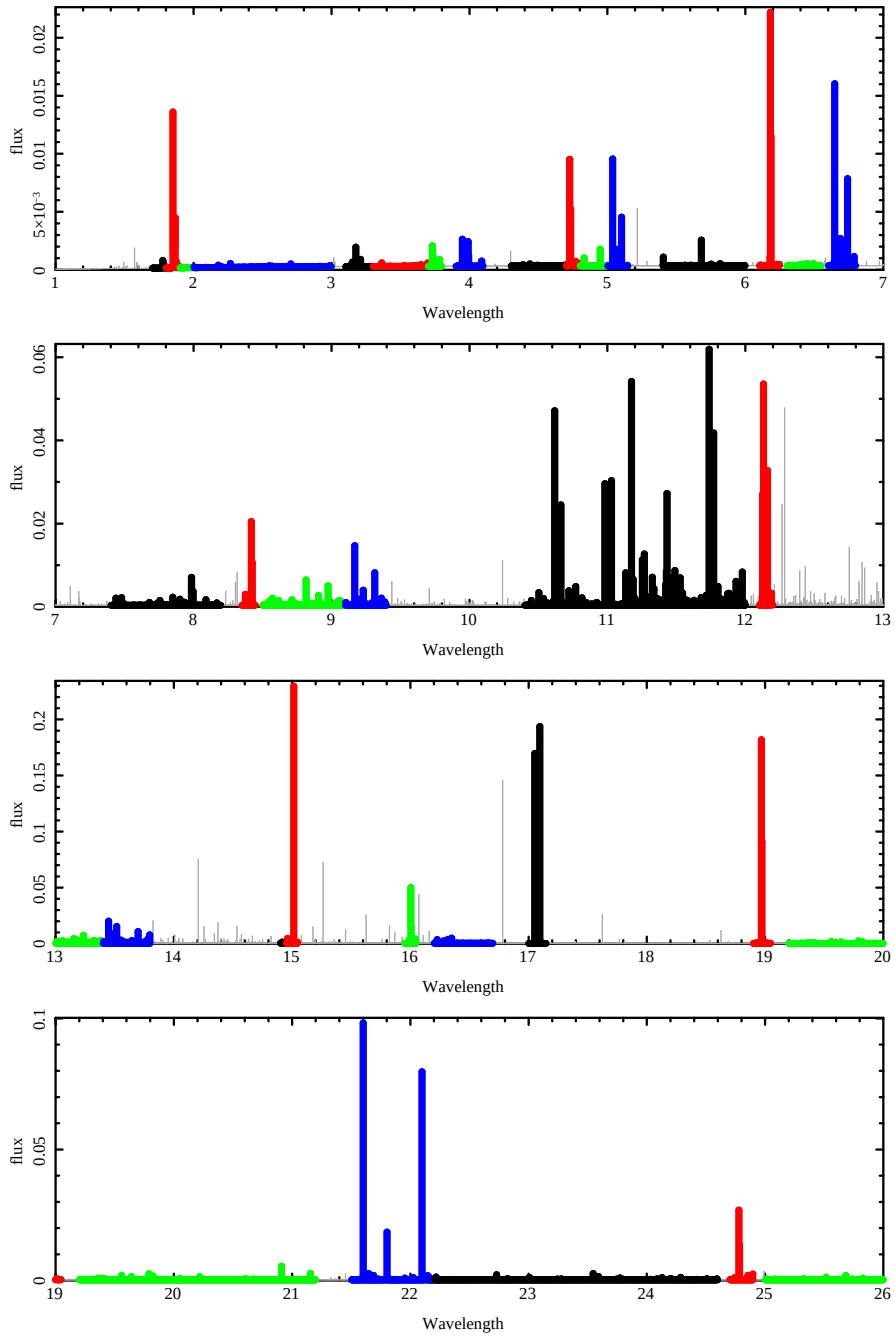

Figure 1: The fprops line and continuum bands, with arbitrary coloring in black, red, green, and blue, on a thermal plasma's model spectrum.

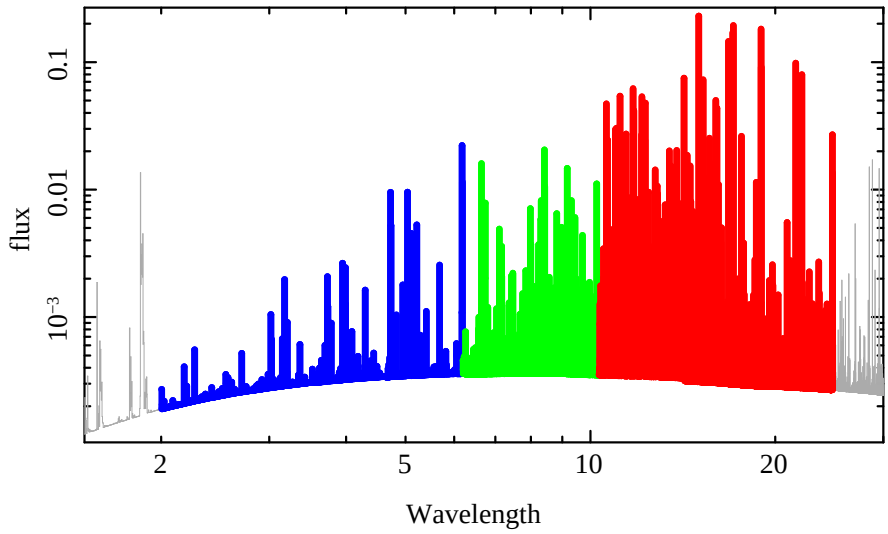

Figure 2: The Chandra Source Catalog's bands, colored on a thermal plasma's model spectrum; hard: blue; medium: green; soft: red.