Swift UVOT Serendipitous Source Catalogue (UVOTSSC) (Beta release)

1 Introduction

The first Beta release of the Swift UVOT Serendipitous Source Catalogue (UVOTSSC) has been produced by processing the data obtained from the Swift Ultraviolet and Optical Telescope (UVOT) from the beginning of the mission (2005) until 1st of October of 2010. The data processing was performed at the Mullard Space Science Laboratory (MSSL, University College London, U.K.) using Swift FTOOLS from NASA's High Energy Astrophysics Software (HEASoft-6.11), with some customising of the UVOT packages in order to get more complete source detection and properly apply quality flags to those sources that were detected within the UVOT image artefacts. The total number of observations included in the catalogue is 23 428, giving 6 200 016 sources of which 2 027 265 have multiple entries in the source table because they have been detected in more than one observation. The total number of entries in the source table is 13 860 569. The S/N ratio for all sources exceeds 5 for at least one UVOT filter, the rest of the filters having a S/N greater than 3.

2 Description

The UVOT source catalogue is compiled in the form of a FITS-file containing two tables:

- SOURCES – the main table containing UVOT sources
- SUMMARY – the auxiliary table containing information about each observation

The link between these two tables is made through the column N_SUMMARY which, for each source in the first table, gives the entry number of the observation in the SUMMARY table in which this source was detected. For each of the sources, there there is also the observation identification number given in the column "OBSID" which coincides with the OBSID in the SUMMARY table.

In total, the table SOURCES has 82 columns with the source parameters. The description of each column is given below. If more than one filter was used in the observation, any sources detected in more than one filter are matched, so that there is a single catalogue entry for each source for each observation. However, the same source could be detected in the exposures belonging to different observations, in which case it would have different entries in the catalogue table. Thus, among the 13 860 569 catalogue entries 6 200 016 unique sources are identified, whereas 2 027 265 sources have multiple entries.

The catalogue gives the AB and Vega magnitudes, as well as fluxes for each source and each filter (see Oke, J.B. 1974, ApJS, 27, 21) in units of $ergs\,sec^{-1}cm^{-2}\mathring{A}^{-1}$)

The catalogue is also available in six sections, each one covering 4 hours in RA, to make them smaller and more manageable. The SUMMARY table is the same and complete for all 6 sections.

3 Catalogue file format

3.1 Format of SOURCES table

The UVOTSSC **SOURCES** table contains the following columns which give the astrometric, photometric, source-parameterisation and source-flagging parameters.

3.1.1 IAUNAME

The column IAUNAME provides individual source identification strings in the conventions of the International Astronomical Union. For each source, its name starts from the string SWIFTUVOT characterising the sources as obtained from the NASA SWIFT mission with the UVOT telescope. This string is followed with the Right Ascension and Declination coordinates for the epoch J2000 in the form JHHMMSS.s±GGmmss.

3.1.2 N_SUMMARY

This column provides the reference number of the observation summary given in the auxiliary table SUMMARY (i.e., this is the entry number of the SUMMARY table).

3.1.3 OBSID

Gives the unique observation identification number corresponding to the observation in which the source was detected.

3.1.4 NFILT

This column gives the number of the UVOT filters included into this source observation.

3.1.5 SRCNUM

This column gives a unique source number throughout the UVOTSSC source catalogue (please, note that the number of entries in the SOURCES table is larger that the total number of individual sources).

3.1.6 RA and DEC

These columns contain the **Right Ascension** and **Declination** (**J2000**) of each source in degrees. All the entries in the table are in order of increasing RA value.

3.1.7 RA_ERR and DEC_ERR

These columns contain the standard errors (in arcseconds) of the source RA and DEC positions – i.e. $(1/n)\sqrt{\sum_{k=1}^{n} err_k^2}$, where err_k are the errors of the n source positions for different filters. Please, note that input errors from the individual source-list files are first converted from pixels to arcsecs.

3.1.8 filter_SRCDIST

These are 6 columns corresponding to different UVOT filters (UVW2, UVM2, UVW1, U, B and V) and giving the distance (in arcseconds) to the closest neighbouring detected in that filter (the search for the neighbouring sources was limited to 30 arcseconds radius).

3.1.9 N_OBSID

The number of individual observations (ObsIDs) in which the source was detected. This should correspond to the number of entries for that particular source in the SOURCES table.

3.1.10 filter_SIGNIF

For each filter there is a column for the source significances (signal-to-noise).

3.1.11 filter_VEGAMAG

For each filter there is a column for the source Vega-system magnitudes.

3.1.12 filter_ABMAG

For each filter there is a column for the source AB magnitudes. These values are computed from the Vega magnitudes.

3.1.13 filter_MAG_ERR

For each filter this column gives the error on the magnitude, a single error value being appropriate for both Vega magnitudes and AB magnitudes.

3.1.14 filter_FLUX and filter_FLUX_ERR

For each filter there is a column for the source fluxes and their standard errors in units of $erg/s/cm^2/Angstrom$.

3.1.15 filter_MAJOR

This column gives the computed value for the mean full-width-half-maximum of the source along the major-axis (in arcseconds), for each filter.

3.1.16 filter_MINOR

For each filter there is a column for the computed full-width-half-maximum of the source along the minor-axis (in arcseconds).

3.1.17 filter_POSANG

For each filter, this column gives the computed value for the position-angle of the major-axis source (measured in degrees anti-clock wise from the Right-Ascension axis).

3.1.18 filter_EXTENDED

For each filter there is a column to show if the source is considered extended, which was determined by comparing the source major axis with the size of the UVOT point spread function.

3.1.19 filter_QUALITY_FLAG

For each filter there is a column for the quality for each source, as determined from all the merged sources for that filter (see next section).

3.2 Quality flag

Each source has an associated "Quality flag" which is given in the final columns of the **SOURCES** table. The flag bit values are shown in the following table.

Table 1: Quality flag values for the UVOTSSC source catalogue

Bit number	Reason	Integer value
0	Cosmetic defects (BAD PIXELS) within the source region	1
1	Source on a READOUT STREAK	2
2	Source on a "SMOKE RING"	4
3	Source on a DIFFRACTION SPIKE	8
4	Source affected by MOD-8 noise pattern	16
5	Source within a "HALO RING"	32
6	Source near to a BRIGHT source	64
7	MULTIPLE EXPOSURE values within photometry aperture	128
8	Source within an EXTENDED FEATURE	256
9	Source COUNT RATE exceeds 0.96 counts/frame	512

3.2.1 Examples of usage

1. Quality flag = 1 - Source contains one or more bad pixels
2. Quality flag = 3 - Source contains one or more bad pixels and lies on a read-out streak
3. Quality flag = 7 - Source contains one or more bad pixels and lies on a read-out streak and lies within a "smoke-ring" region.

3.2.2 Notes on individual quality flags

1. **Bad Pixels** (Quality bit number 1) A point-source will have this flag set if any pixel within the photometry aperture, or any within the background annulus, has a corresponding pixel in the quality image with a non-zero value. Similarly, an extended source will have this flag set if any corresponding pixel in the quality image has a non-zero value.
2. **Count Rate** (Quality bit number 9) If the count per frame exceeds this rate, it cannot be corrected for coincidence loss and the magnitude will be suspect.

3.3 Format of SUMMARY table

The UVOTSSC **SUMMARY** table contains information on each observation included in the catalogue, with the following columns.

3.3.1 N_SUMMARY

This column provides the link to the **SOURCES** table. Each source can be linked to the observation details in the SUMMARY table via this number.

3.3.2 OBSID

This gives the unique observation identification number.

3.3.3 TARGET_ID

This is the name of the target given by the proposer of the observation.

3.3.4 FILTERS

This lists the filters used in the observation.

3.3.5 DATE_MIN

This is the date when the first exposures for this observation started to be taken.

3.3.6 RA_PNT

The Right Ascension for the telescope pointing direction in decimal degrees.

3.3.7 DEC_PNT

The Declination for the telescope pointing direction in decimal degrees.

3.3.8 PA_PNT

Position Angle for the telecope pointing in degrees.

3.3.9 EXP_filter

The total exposure time in seconds for each filter summed together before detecting sources.

3.3.10 NSOURCES_filter

The total number of sources detected in this filter for this observation.

3.3.11 VEGAMAG_LIM_filter

The three sigma detection limiting magnitude in this filter for this observation, in the Vega photometry system.

3.3.12 ABMAG_LIM_filter

The three sigma detection limiting magnitude in this filter for this observation, in the AB photometry system.

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