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DOCUMENTATION FOR THE MACHINE-READABLE VERSION
OF THE
REVISED S201 CATALOG OF FAR-ULTRAVIOLET OBJECTS

(PAGE, CARRUTHERS AND HECKATHORN 1982)

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November 1984

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ABSTRACT

A detailed description of the machine-readable revised catalog as it is currently being distributed from the Astronomical Data Center is given. This catalog of star images was compiled from imagery obtained by the Naval Research Laboratory (NRL) Far-Ultraviolet Camera/Spectrograph (Experiment S201) operated from 21 to 23 April 1972 on the lunar surface during the Apollo 16 mission. The documentation includes a detailed data format description, a table of indigenous characteristics of the magnetic tape file, and a sample listing of data records exactly as they are presented in the machine-readable version.

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SECTION 1 - INTRODUCTION AND SOURCE REFERENCE

The *Revised S201 Catalog of Far-Ultraviolet Objects* was compiled from images obtained by the NRL Far-Ultraviolet Camera/Spectrograph operated on the lunar surface from 21 to 23 April 1972 during the Apollo 16 mission. The catalog was prepared by scanning the images on a microdensitometer and recording its output on magnetic tape. The Revised Catalog differs from the first edition (Page, Carruthers and Hill 1978) in that the brightnesses of all detected objects have been transformed to an absolute scale of UV magnitudes based upon instrumental preflight calibrations. The positional errors of the detected images are ≤ 3 arcminutes.

This document describes the machine version of the Revised S201 Catalog as it is currently being distributed from the Astronomical Data Center (ADC). It is intended to enable users to read the tape and process the data without problems and guesswork. For a more detailed description of the instrumentation used to obtain the S201 imagery, the data reductions and analysis, comparison with stellar models, the Telescope Catalog stars (Davis, Deutschman and Haramundanis 1973), the OAO-2 Filter Photometry Catalog (Code, Holm and Bottemiller 1980) stars, and further discussion on other expected far-ultraviolet sources, the source reference (Page, Carruthers and Heckathorn 1982) should be consulted. A copy of this document should be supplied with any duplicate of the machine version of the catalog originally obtained from the ADC.

SOURCE REFERENCE

Page, T., Carruthers, G. R. and Heckathorn, H. M. 1982, *Revised S201 Catalog of Far-Ultraviolet Objects*, NRL Report 8487 (Washington, DC: Naval Research Laboratory). (Note: Table 22, p. 89 refers to the listing in the earlier catalog published as NRL Report 8173; see references.)

SECTION 2 - TAPE CONTENTS

The machine version of the *Revised S201 Catalog of Far-Ultraviolet Objects* is divided into eleven parts covering ten fields in the sky, although these parts are stored contiguously in a single file in the tape catalog. Table 1 gives field information for each group of logical records (objects) in the catalog.

Table 1. Star Field Information

Field	Field Center α (1950) δ		Number of Objects	Number of Frames
Cygnus	21h24m	+37°30'	1275	6
Capricorn	21 14	-14 30	178	5
Cetus	2 44	-14 30	83	5
Grus	23 44	-41 30*	139	8
Pavo	21 14	-52 12	86	3
Mensa	5 50	-74 00	919	4
Norma	17 24	-59 04	895	4
Aquarius	23 07†	-04 17†	252	11
Fornax	3 42	-27 20	85	5
Sagittarius West	18 34	-30 24	1404	6
Sagittarius East	18 34	-30 24	1080	6

* 23h34m to 23h54m, -42°30' to -40°30'

† 22 58 to 23 16, -05 06 to -03 12

Table 2 contains a byte-by-byte description of the data records. The suggested Fortran 77-type format specifications are for reference purposes only and may be modified depending upon individual data processing requirements; however, care must be exercised when processing fields which can contain valid zero values, but which are blank for missing data, e.g., magnitudes. It is recommended that data records be buffered in or read with an A format initially to check for blank fields before conversion to numerical data for searching or computations. Default values are always blanks for data having A-type (character) format specifications, but are given for numerical data fields unless valid data are always present. There are many mostly numerical fields which contain character data in some cases, e.g., the object identification, and visual and photographic magnitudes. The normal procedure for preparation of a machine-readable catalog for distribution would be to modify the data records to produce fields of purely numerical or character data; however, extensive format changes would be required to accommodate the separation of all numerical and character data contained in the mixed fields of this catalog; hence, it was decided not to modify the records. Considering that the most likely application of the machine catalog will be to search for object identifications after sorting by right ascension and declination, the mixed numerical/character data fields should not present a major problem for most users.

Table 2. Tape Contents. Revised S201 Catalog of Far-Ultraviolet Objects.

Byte(s)	Units	Suggested Format	Default Value	Remarks
1	---	I1	blank	A "1" if the object is the last in this field.
2	---	1X	---	Blank
3- 6	---	I4	---	Running number of the object in the field.
7- 9	---	3X	---	Blank
10- 13	min	F4.1	---	Exposure time for the image. The numbers are not entirely uniform within this field (e.g., values of .25 are present) but all data contain decimals which will override the format specification anyway.
14	---	A1	---	Filter code (L for LiF, passband 1050-1600 Å; C for CaF ₂ , passband 1250-1600 Å). Using the exposure time and filter, a frame number can be determined from Table 1 of the source reference. Information on the two multiple-exposure fields (Grus, Aquarius) can be found there also.
15- 17	---	3X	---	Blank
18- 20	---	I3	blank	X scan coordinate of the object's peak intensity.
21- 22	---	2X	---	Blank
23- 25	---	I3	---	Y scan coordinate of the object's peak intensity.
26- 28	---	3X	---	Blank
29- 30	hours	I2	---	Right ascension, α , of the image, taken from the <i>SAO Catalog</i> (Smithsonian Astrophysical Observatory Staff 1966) or another source (see bytes 50-59 for additional information)

Table 2 (continued)

Byte(s)	Units	Suggested Format	Default Value	Remarks
31	---	1X	---	A colon (:) separator character.
32- 33	min	I2	---	α
34	---	1X	---	Colon separator.
35- 36	sec	I2	---	α
37	---	1X	---	Blank
38	---	A1	---	Sign of the image's declination.
39- 40	°	I2	---	Declination, δ , of the image (see bytes 29-30).
41	---	1X	---	Colon separator.
42- 43	'	I2	---	δ
44	---	1X	---	Colon separator.
45- 46	"	I2	blank	δ . Arcsecond data are not given for nebulous objects.
47- 49	---	3X	---	Blank
50- 59	---	A10	---	Object identification. In most cases this is the SAO number and no prefix is present, but numbers from the <i>Henry Draper Catalogue</i> (Cannon and Pickering 1918-1924) (prefixed by HD), <i>The Revised New General Catalog of Nonstellar Astronomical Objects</i> (RNGC, Sulentic and Tifft 1973) (prefixed by N) and the <i>Catalogue of Galactic Planetary Nebulae</i> (Perek and Kohoutek 1967) (prefixed by N) also occur. Character comments may be present with the following meanings: NO there is no SAO CATALOG APOLLO star within 10' of the measured image position and the same image is detected on other S201 frames; the coordinates given in this case are means of all the frames; NO LMC equivalent in Mensa; NO* star considered reliably identified in catalog(s) other than SAO;

Table 2 (continued)

Byte(s)	Units	Suggested Format	Default Value	Remarks
				BLANK if this field is blank, the image was recorded on one frame only;
				/,: following an SAO number denotes that the star is one of a pair or group too close to be resolved by the S201 camera (either star identifiable with image);
				? the measured position is 5-10' different from the catalog position (doubtful identification);
				* two images only; same LMC NEB,CL on two different frames;
				thus, a slash indicates "alternative", a question mark "positional discrepancy", and a colon "magnitude-spectrum discrepancy".
60	---	A1	---	Sign of the difference in α between measured and catalog coordinates (in the sense measured - catalog). When NO occurs in bytes 50-59, the difference is between the measured position and the mean position.
61	min	I1 (A1)	blank	$\Delta\alpha$
62	---	1X	---	Colon separator.
63- 64	sec	I2 (A2)	blank	$\Delta\alpha$
65	---	1X	---	Blank
66	---	A1	---	Sign of the difference in δ between measured and catalog coordinates (see also byte 60).
67- 68	'	I2	blank	$\Delta\delta$
69	---	1X	---	Colon separator
70- 71	"	I2	blank	$\Delta\delta$
72- 73	---	2X	---	Blank

Table 2 (continued)

Byte(s)	Units	Suggested Format	Default Value	Remarks
74- 78	---	A5	---	Spectral type of the object; however, miscellaneous descriptions, e.g., "PLAN", "GLOB?", "NER+*", "HII" can occur.
79- 83	mag	A5	---	Visual magnitude listed in the SAO Catalog. Some magnitudes are listed for nonstellar objects, but sources are not given. Character data can occur.
84- 90	mag	A7	---	Stated by the authors to be SAO photographic magnitude, but character data are present for nonstellar and LMC objects, e.g., "(GAL)", N numbers.
91- 92	---	2X	---	Blank
93- 95	0.010	I3	blank	Uncorrected peak density at scan coordinates X and Y given in bytes 18-20, 23-25. The measured α and δ of the image were derived from the scan coordinates of the peak position.
96	---	1X	---	Blank
97	---	A1	---	A left parenthesis "(" is present when the number of points datum (following) is surrounded by parentheses.
98-101	---	I4	blank	Number of points (pixels) > 20 units (0.20) above the local background in the object image.
102	---	A1	---	A right parenthesis ")" (see byte 97) or a query (?) when the datum in bytes 98-101 is considered uncertain.
103-104	---	2X	---	Blank

Table 2 (continued)

Byte(s)	Units	Suggested Format	Default Value	Remarks
105-107	---	I3	---	The local background surrounding an object image, determined by averaging 5 pixels outside the image.
108	---	A1	---	A query (?) if the local background value is uncertain, normally because of irregularities near the image.
109-110	---	2X	---	Blank
111-116	---	I6	blank	Sum of the measured density minus background for the number of pixels within the image "boundary". [Denoted by V_M in parts of the source reference text, while V_G is used for the first-stage corrected density-volume (D-V) value.]
117	---	A1	---	Query (?) if the value for D-V is uncertain due to overexposure or irregular background.
118	---	A1	---	Density-Volume code: D overlapping images; H, L denote that the D-V is too large (High) or too small (Low) for the identified star. If the value of the D-V is more than twice as large as the average for an object's visual magnitude and spectral type, the entry in bytes 111-116 is flagged with an H here. Occasionally, these flags may augur mis-identifications, but in most cases the H flags indicate objects having particularly high far-UV fluxes and worthy of further study. If the D-V

Table 2 (concluded)

Byte(s)	Units	Suggested Format	Default Value	Remarks
				is less than half the average, the L code is present here. The H and L flags are not precise, but are based on trends of D-V divided by exposure with magnitude and spectral type rather than on comparison with stellar models.
119-124	.01D min ⁻¹	I6	blank	The fully corrected D-V divided by exposure time. Corrections for nonlinearity, PDS microdensitometer lag, truncation and over-under image density have been made (as explained in the data analysis section of the source reference).
125	---	A1	---	Usually blank, but the characters "*" and "E" can occur. * V _C /E values for two close images have been combined; the two images were really one. Preceded or followed by a blank for V _C /E of the weaker image; E image at edge of field and partially missing; hence, V _C /E is a lower limit.
126-127	---	2X	---	Blank
128-132	mag	F5.2	blank	The ultraviolet (UV) magnitude, as converted from the datum in bytes 119-124 using equations (12a) and (12b) of the source reference.

SECTION 3 - TAPE CHARACTERISTICS

The information contained in Table 2 is sufficient for a user to describe the indigenous characteristics of the magnetic tape version of the *Revised S201 Catalog of Far-Ultraviolet Objects* to a computer. Information which is easily varied from installation to installation, such as block size (physical record length), blocking factor (number of logical records per physical record), total number of blocks, tape density, and coding (EBCDIC, ASCII, etc.) is not included: this information should always be supplied if secondary tape copies of the catalog are transmitted to other users or installations.

Table 3. Tape Characteristics. *Revised S201 Catalog of Far-Ultraviolet Objects.*

NUMBER OF FILES	1
LOGICAL RECORD LENGTH (BYTES)	132
RECORD FORMAT	FB*
TOTAL NUMBER OF LOGICAL RECORDS	6396

* Fixed block length (last block may be short)

SECTION 4 - REMARKS, MODIFICATIONS, ACKNOWLEDGMENTS AND REFERENCES

A magnetic tape of the *Revised S201 Catalog of Far-Ultraviolet Objects* was received from Dr. Thornton L. Page on 17 December 1981. The tape had been prepared in ASCII coding on a Univac 1110 computer and was written in a special format appropriate for producing the printed catalog published in the source reference. The original tape contained eleven files, one each for the fields listed in Table 1. The Univac tape was first converted on a MODCOMP IV computer to a uniformly formatted ASCII tape with the special coding removed and the eleven files concatenated to a single file of 15,191 x 132-byte logical records. The following modifications were then made to the single file catalog to produce the homogeneous data file described in this document:

1. All header information and blank (spacing) records were removed to produce a uniform data file processable with a single format specification. To separate the observed star fields, a "1" flag was added to the last record of each field, as described in Table 2. Thus, 8795 records were removed to leave the 6396 records of the final catalog.
2. The right ascension and declination fields were homogenized by the addition of preceding zeros to all subfields and of plus (+) signs to positive declinations. Minus signs were moved to always occur in byte 38.
3. The data field containing the photographic magnitude from the SAO Catalog (and character data in many cases) had ".00" for missing data in cases where an SAO visual magnitude is given. These fields were converted to blanks.
4. Certain object-identification character data (bytes 50-59) extended into the sign field for $\Delta\alpha$ (byte 60). The abbreviations in these fields were shortened in six cases to eliminate the field overlap. This problem also occurred in the spectral-type field, which extended into the visual magnitude area, but only data shifting was required to fix these cases.
5. Plus signs were added to all positive $\Delta\alpha$ and $\Delta\delta$ fields and minus signs for $\Delta\delta$ were moved to always occur in byte 66.
6. A left parenthesis occurred inside the number of points field (bytes 98-101) in two cases (both in the Sagittarius West star field, stars SAO 186233, 186324). The character was moved to byte 97 in both cases to isolate it from the purely numerical data field.

ACKNOWLEDGMENTS

Appreciation is expressed to Thornton Page for supplying the magnetic tape of the Revised S201 Catalog. Drs. Page, Carruthers and Heckathorn kindly reviewed a draft copy of this document before its final printing for distribution with magnetic tape copies of the catalog. Dr. Page made many useful comments and provided additional information which has improved this document.

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SECTION 5 - SAMPLE LISTING

The sample listing given on the following pages contains logical data records exactly as they are recorded on the tape. Sample records for objects at the beginning and the end of the data file are listed. The beginning of each record and bytes within the record are indicated by the column heading index across the top of each page (digits read vertically).

