THE UNIVERSITY OF TEXAS CATALOG OF ULTRAVIOLET AND OPTICAL STELLAR DATA

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At the University of Texas we are working on the reduction and analysis of ultraviolet stellar spectra obtained with the S-019 experiment on Skylab (Karl Henize, principal investigator). Our objective prism photographs recorded nearly 10,000 stars at wavelengths shortward of 3000Å, many of them of 9th or 10th visual mag., and for proper analysis we need to assemble ground-based data into a workable master catalog. The most immediate application of this catalog will be computer simulation of the ultraviolet photographs in order to point out significant anomalies with respect to previous knowledge. We need to have a catalog, then, which is as complete as possible in terms of the existence of early-type stars to at least 10th mag., their spectral types, photometry, known peculiarities, duplicity, and so forth. Also the master catalog must contain only a single value for each magnitude and for the spectral type, rather than a listing of various determinations, in order to be useful for the simulation. This means that auxiliary data files are needed for recording data in more detail so that the master catalog may be kept at a workable size, while at the same time the basic data are readily available.

Another use we intend for this catalog is as a reference data base to which we can add quantitative measurements of the ultraviolet spectra in order to produce a convenient catalog of S-019 ultraviolet observations. Figure 1 shows examples of scans of widened

C. Jaschek and G. A. Wilkins (eds.), Compilation, Critical Evaluation, and Distribution of Stellar Data. 93-101.

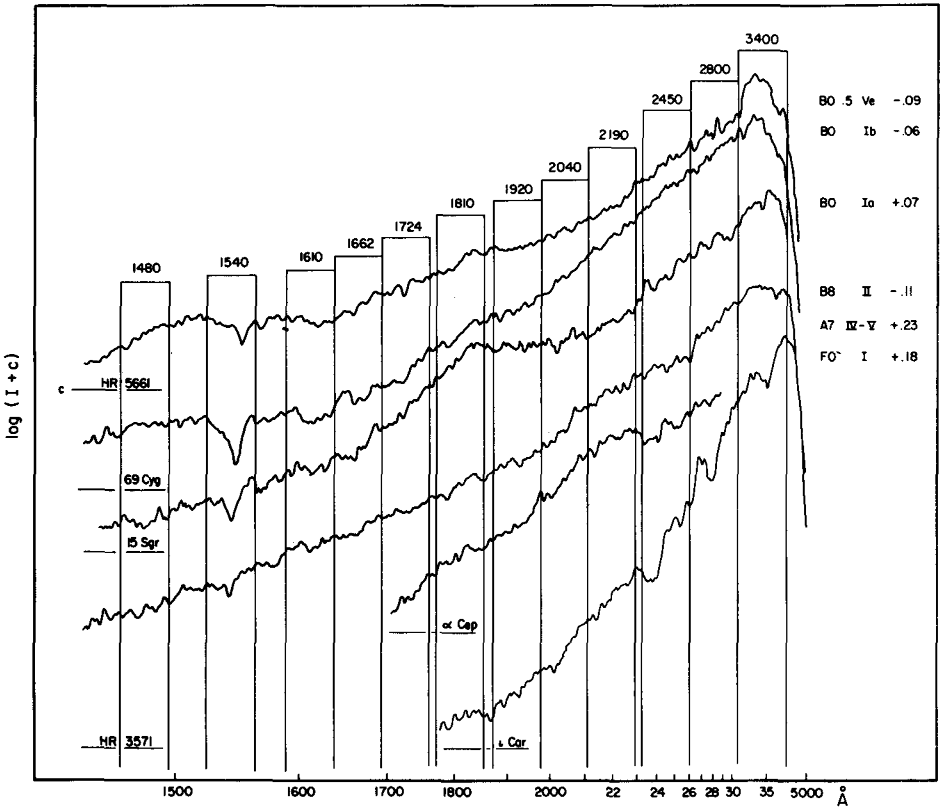

Fig. 1 -- Intensity scans of some S-019 objective prism spectra, showing proposed system of pass-band measurements. B-V color index is given after MK spectral type for each star.

spectra and a proposed system of up to 12 intermediate band measurements on each star. This is what we see as the optimum way to present the ultraviolet fluxes for these thousands of stars. We have scanned a few hundred of the widened spectra so far parallel to the dispersion, but the reduction to intensity is complex. For the unwidened spectra, it will be best to scan perpendicular to the dispersion. Such measurements on spectra which extend at least to 2100Å will allow clear separation of temperature from interstellar reddening, and we should be able to determine the spectral class of any early-type star to within 2 subclasses using only these measurements.

With our 4 x 5° field of view, we covered about 9% of the sky during the manned Skylab missions. This

https://doi.org/10.1017/S0252921100052921 Published online by Cambridge University Press

included about 25% of the area within ±15° of the galactic equator. Our current work in developing a master catalog at a low level of funding is therefore restricted to the observed areas of sky in order to make the task manageable. Our starting point is the Celescope Identification Catalog which was assembled by the Celescope project prior to launch of the OAO-2 satellite. The CID contains data from 1000 references for 100,000 objects, although many of these are straight from the SAO Star Catalog. Material from the literature has been condensed in the CID into just a few data items - magnitudes, spectral type, and up to 21 characters representing different codes for spectral peculiarities, variability, duplicity, and the existence of certain data such as polarimetry and interstellar line measurements. Non-stellar objects were included from the NGC and IC catalogues and also from the literature. Although many checks were performed during the condensation process, the result suffered from the enormity of the undertaking. For example, it appears that HD types were averaged in with MK types. Also, stars in clusters were punched as non-stellar objects, often resulting in duplicate catalog entries. HD numbers were apparently deleted. Even so, this catalog is still the best one available for our purposes, but it needs a great deal of editing to make it useable.

We are now in the process of comparing and merging several other catalogs with the Celescope data base. Figure 2 outlines some of the characteristics of our major source catalogs. Our main needs are to have magnitudes, colors, spectral types, 1950 positions, and references to spectroscopic studies. We hope to draw on several other catalogs in the near future, particularly the compilation of best spectral types by Mercedes Jaschek, the Bibliographical Star Index, and the Michigan Spectral Catalogue. We have actually edited and merged only 7 declination strips so far, but this has included much software development over the last 5 months.

Figure 3 shows a few entries from our master catalog in the -24° declination strip. The University's CDC 6600/6400 system software uses 60-bit words, with 6 bits per character for alphanumeric data. It is easiest to work in terms of card image format, so that one line of 80 characters is 8 computer words. Thus we have set up the catalog as shown for the easiest manipulation and editing. The editing routine which we use, developed mainly by a student, Mr. Dwight West, searches most rapidly on any string of characters in the first word of

	Entries Year	Coords.	m_v, m_{pg}	UBV	HD type	MK type	literature references
Celescope Identification Cat. CID	100,000 1969	1950	—	+	—	+	✱
Celescope Ultraviolet Cat. CUV	5,000 1973	1950, 2000	—	✱ incl. Suppl.	—	+	✱
Cat. of Stellar Identifications CSI	403,000 1974	1950	+	•	+	•	•
Photoelectric Cat. (Blanco et al.) PEB	33,000 1968	1900, 1950	•	✱	—	+	✱
Cat. of UBV Phot. (Mermilliod) PEM	29,000 1974	•	•	✱	•	+	✱

✱ = always present; + = present if available; — = present if no better data available; • = not present

Fig. 2 -- Summary of data available from several major catalogs on magnetic tape.

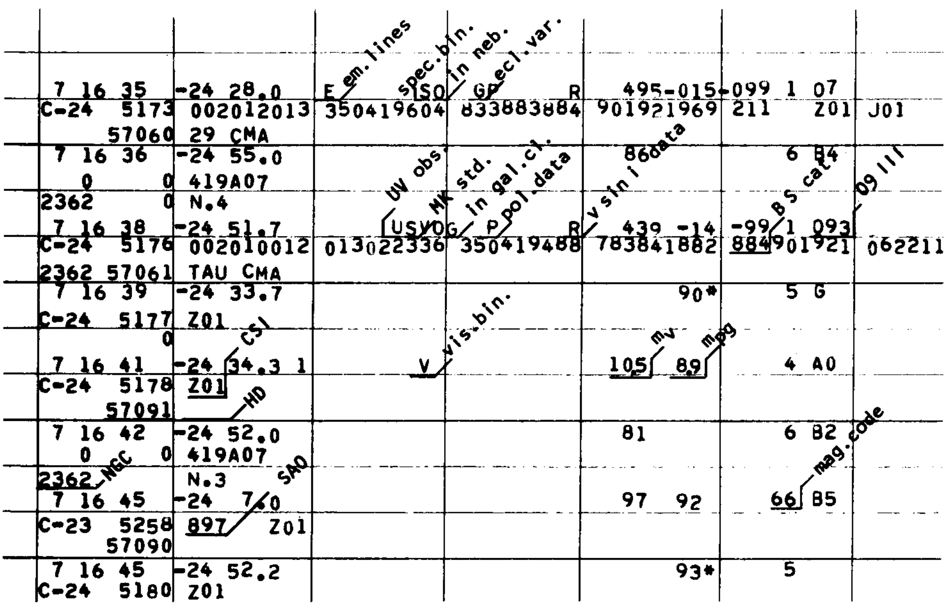

Fig. 3 -- Sample entries from master catalog. Three lines are used for each star, starting with 1950 R.A. and dec.

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a line; thus we have started the 3 lines per star with the 1950 right ascension, the DM number, and the HD and/ or NGC number. An HD star can be located by keying in a one-character command and the HD number, but one has to know or at least guess which declination file to call up. Some examples of the peculiarity codes and notes are shown here.

There is room for three magnitude values, with a magnitude code to tell the user what they represent. For example, a 1 means V, B-V, and U-B values, while a 4 means m_V and m_{pg}. The de lination word has room for designating the component of a multiple star system. The 3-character spectral and luminosity classes are taken directly from the CID, while more detailed representations are being added in words 7 and 8 as they are found in the photoelectric catalogues. We intend to keep the 3-character representation as the working value, modified when appropriate, while words 7 and 8 will be used to show the range in MK classification. Most of the second line is available for a string of 3-character reference codes. The 2nd and 3rd words of the third line are used for remarks, such as a Flamsteed designation or alternate DM number. This latter is entered automatically if available from the CSI and if the star has no HD number. The rest of the 3rd line is available for future expansion.

Figure 4 gives a few examples of references and their codes which are being added to our data base. The format is quite similar to that of Celescope. We are trying to have somewhat mnemonic codes, e.g. C for classification and G for studies of specific groups or clusters. We are adding to this bibliographical data file as we find relevant articles in the literature, although we will have to complete the basic work on the other declination strips before data from the articles can be effectively entered into the master catalog.

Our procedure for handling the merger of the several catalogs is significantly affected by the advantages and limitations of the available computer system. We have to use tapes much of the time, although it is costly. The maximum disk file we can work with is 64000 words (8000 card images), while the practical limit for efficient turn-around time with the interactive editing routine is about 2000 card images or less than 700 stars. So far our declination strips, with stars excluded if outside of our observed sky or if much fainter than our limiting

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AAB. DEUTSCHMAN, W.A., DAVIS, R.J., AND SCHILD, R.E.                      1976
AAB. THE GALACTIC DISTRIBUTION OF INTERSTELLAR ABSORPTION AS DETERMINED
AAB. FROM THE CELESCOPE CATALOG OF ULTRAVIOLET STELLAR OBSERVATIONS AND
AAB. A NEW CATALOG OF UBV, H-BETA PHOTOELECTRIC OBSERVATIONS.
AAB. ASTROPHYS. J. SUPPL. 30, PP.97-225.

C02. WALBORN, N.R.                                                        1973
C02. THE SPACE DISTRIBUTION OF THE O STARS IN THE SOLAR NEIGHBORHOOD.
C02. ASTR. J. 78, PP.1067-1073.

C03. BIDELMAN, W.P., AND MACCONNELL, D.J.                                 1973
C03. THE BRIGHTER STARS OF ASTROPHYSICAL INTEREST IN THE SOUTHERN SKY.
C03. ASTR. J. 78, PP.687-733.

D21. GREENSTEIN, J.L.                                                     1974
D21. A NEW LIST OF 52 DEGENERATE  STARS. VII.  ASTROPHYS. J. 189, PP.
D21. L131-L133.

G02. HILTNER, W.A., MORGAN, W.W., AND NEFF, J.S.                          1965
G02. STUDIES IN SPECTRAL CLASSIFICATION, II. THE H-R DIAGRAM OF NGC
G02. 6530.  ASTROPHYS. J. 141, PP.183-186.

J01. MERMILLIOD, J.-CL.                                                   1973
J01. A CATALOGUE OF UBV PHOTOELECTRIC PHOTOMETRY.  C.D.S. INF. BULL.
J01. (STRASBOURG), NO. 4, PP.20-21 (1974 TAPE EDITION).
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Fig. 4 -- Sample of references in bibliographical data file, which adds to the references given in the Celescope Catalog of Ultraviolet Stellar Observations.

magnitudes, are within the working limits. But our procedures would be much simpler if bulk storage were available so that random access from several catalogs could be carried out at the same time.

The next two figures outline our present operations. Figure 5 shows that we begin by rewriting the given tapes so that unneeded stars are eliminated and the formats are compatible. The condensed CID tape has one file for each 1950 declination strip, so a few files at a time are transferred to disk storage. Before we can do any merging, a CID file must be compared with the CSI in order to check the coordinates and the compatibility of other data for the star, and obtain the HD number if there is one. To accomplish this, the condensed CSI tape, arranged by DM number, is searched over the 3 relevant DM zones for stars having the right declination. These then have to be sorted by R.A. and stored on disk. An interactive program operated at a CRT terminal searches that file for all entries within 1!5 of a given CID entry and displays them. If the coordinates are within 0!1, the DM numbers identical, and the magnitudes and spectral class similar, the program automatically inserts the HD number in the CID. Otherwise it waits for judgement by the operator. The resulting CID file can then be merged with the relevant stars from the CSI. In this batch job,

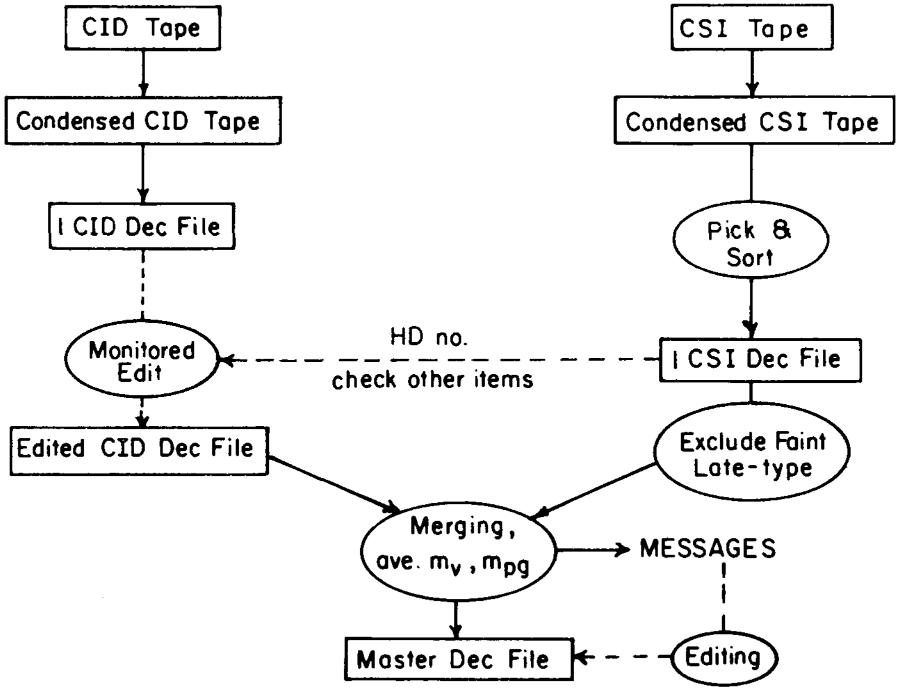

Fig. 5 -- Flowchart for the creation of a master file for each declination strip, following a rewrite of the CID and CSI tapes. Solid lines represent batch processes while dashed line represent interactive processes.

tight requirements are again applied in testing for matching stars, and a message is printed in case of an inconsistency or of a multiple star.

Figure 6 shows schematically what happens next. Information from other catalogs is entered into this declination file mainly in batch jobs which print out messages whenever individual attention and possible subsequent editing are called for. These jobs require first that the catalog tapes be rewritten into compatible format for comparison with the master catalog. For individual journal articles, it will depend on the nature of the contents whether it is better to call up the appropriate master declination file to enter new information, or to enter data into buffer disk files which are arranged by HD or DM number. These files act as a free-format repository of miscellaneous data, which can later be used to create or modify entries in the master catalog.

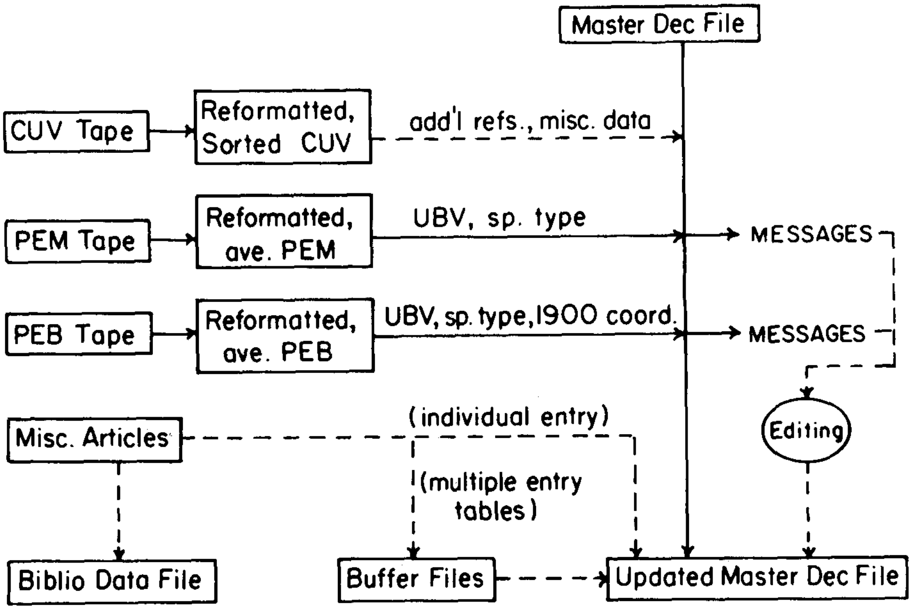

Fig. 6 -- Schematic representation of addition of data to the master file for each declination strip. Solid and dashed lines represent batch and interactive processes.

We urge that in the publication of data, astronomers bear in mind two things: 1) Be sure the title of the paper has a high information content: useful searches can be performed on titles if they are specific enough. 2) Strive for redundancy in the identifications of objects and give at least approximate coordinates for any non-DM stars. An HD number is normally sufficient identification, but one or more digits can get changed during the publication process. We suggest that the DM number always be given for an HD star; in addition to the useful redundancy, it will allow us to locate the star easily in our system of declination strips. Definitely refrain from listing a star only by an identification number referring to a chart in an obscure publication.

The buffer files are similar to W. P. Bidelman's card file of stellar data, although his is arranged strictly by 1900 coordinates. His file covers especially the early work on stellar spectra; he searched major journals up to 1950 and most observatory publications up through 1961; data from selected articles since then have also been entered. We purchased a bulky Xerox copy of his card file and began to punch the data, as shown in Figure 7. But our funding for the Skylab data analysis has dropped to the point where we cannot continue this

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6100 +1128                  11.0 P             +11 1084  LS VI +11 2
6100 +1128 OB H
6100 -1930          MA  7.9           43236   -19 1391
6100 -1930 M3 III*APJ112,48 / *CIR
6101 +2854          A2P 7.3           43246   +28 1062  AS(MWC) 122
6101 +2854 F0*APJ81,187 (MV2.1) / COMP.*BI / *JRASC42,140 / *APJ112,72 / *AJ52,
6101 +2854 128(2 SP) / RV VAR.*APJ88,50 /*HA56,82 /*APJ SUPP1,216(N.7) / *DAO13
6101 +2854 ,119(ORB)
6101 +2250                                                  N. 172
6101 +2250 OB*T+T BOL,N.13,6
6101 +0707                   9.0 I
6101 +0707 C*APJ125,195
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R.A. (1900) DEC        (1950)       VIS   OTHER  M(MIN)                    NAMES                   SP(HD)

 6 10.0  +11 28.   6 12.8  11 27       V 11.0 P      HD        DM +11 1084  LS VI +11 2
  OB H

 6 10.0  -19 30.   6 12.2 -19 30   7.9 V             HD43236   DM -19 1391                              MA
  M3 III           APJ  112,48                                              CIR

 6 10.1  +28 54.   6 13.3  28 53   7.3 V             HD43246   DM +28 1062  AS(MWC) 122                 A2P
  F0               APJ  81,187    (MV2.1)                     COMP.         BI
                   JRASC  42,140                                            APJ  112,72
                   AJ  52,128   (2 SP)                        RV VAR.       APJ  88,50
                   HA  56,82                                                APJ SUPP  1,216   (N.7)
                   DAO  13,119    (ORB)

 6 10.1  +22 50.   6 13.1  22 49       V             HD        DM           N. 172
  OB               T+T BOL   ,N.13,6

 6 10.1  + 7  7.   6 12.8   7  6       V  9.0 I      HD        DM
  C                APJ  125,195
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Fig. 7 -- Sample of cards punched from Bidelman's stellar data file. Upper section shows listing of actual cards; lower section shows printout from a program which checks the formatting and precesses coordinates to 1950.

project. The first line per star contains items for its identification, while succeeding cards contain data and references in free format. The lower section shows printout generated from the cards by a proof-reading program. We have applied for funding from the N.S.F. to complete the punching and prepare a tape for distribution. It will take two years of steady half-time punching to finish the job, but it will be an excellent complementary file to the Bibliographical Star Index, the CSI, and the catalogs of spectral classifications.

We hope that these efforts will lead to a more general data base in the next few years. We are optimistic about surveying the whole sky in the ultraviolet from a payload on the Shuttle spacecraft. Such a survey will demand a highly useable and comprehensive data base for its interpretation if a large scientific return is to be expected within a few years of the observations.

This work was supported by NASA under contract NAS 8-31459.