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National Space Science Data Center/
World Data Center A For Rockets and Satellites

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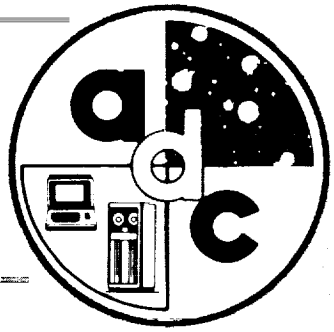
FIFTH FUNDAMENTAL CATALOGUE (FK5)

PART I. BASIC FUNDAMENTAL STARS

(Fricke, Schwan, and Lederle 1988)

Documentation for the Machine-Readable Version



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Documentation for the Machine-Readable Version

Wayne H. Warren Jr.

January 1990

National Space Science Data Center (NSSDC)/
World Data Center A for Rockets and Satellites (WDC-A-R&S)
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Abstract

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The Basic FK5 provides improved mean positions and proper motions for the 1535 classical fundamental stars that had been included in the FK3 and FK4 catalogs. The machine version of the catalog contains the positions and proper motions of the Basic FK5 stars for the epochs and equinoxes J2000.0 and B1950.0, the mean epochs of individual observed right ascensions and declinations used to determine the final positions, and the mean errors of the final positions and proper motions for the reported epochs. The cross identifications to other designations used for the FK5 stars that are given in the published catalog were not included in the original machine version, but the Durchmusterung numbers have been added at the Astronomical Data Center.

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1.0 Introduction

1.1 Description

The Basic FK5 is the successor to the FK4 and contains the 1535 classical fundamental stars used to define the latter system. It represents a revision of the FK4 and results from the determination of systematic and individual corrections to the mean positions and proper motions of the FK4, the elimination of the error in the FK4 equinox, and the introduction of the IAU (1976) system of astronomical constants. About 300 catalogs providing star positions obtained from throughout the world are included in the FK5.

This documentation describes the machine-readable version of the Basic FK5 as it is currently being distributed from the international network of astronomical data centers. It is intended to enable users to read and process the data without problems and guesswork, and it should be used only to supplement the information contained in the source reference. The latter should be consulted for more detailed information regarding the motivation for construction of the FK5, the determination of its equator and equinox, the expressions for general precession, a discussion of the FK5 system, systematic differences between the FK4 and FK5, the transformation of observational catalogs to the FK5 system and to the reference system J2000.0, and more thorough descriptions of the data contained in the FK5 catalog. In fact, the source reference should be consulted by all users before utilizing the FK5 data for astronomical applications. **A copy of this document should be transmitted to any recipient of the machine-readable catalog originating directly from the data centers.**

1.2 Source Reference

Fricke, W., Schwan, H., and Lederle, T. (in collaboration with Bastian, U., Bien, R., Burkhardt, G., du Mont, B., Hering, R., Jährling, R., Jahreiss, H., Röser, S., Schwerdtfeger, H. M., and Walter, H. G.) 1988, *Fifth Fundamental Catalogue* (FK5), Part I. The Basic Fundamental Stars, *Veröffentl. Astron. Rechen-Institut Heidelberg* No. 32.

2.0 Structure

2.1 File Summary

The machine version of the *Fifth Fundamental Catalogue (FK5). Part I* consists of a single data file only. Table 1 gives the machine-independent file attributes. All logical records are of fixed length, and, if the catalog is received on magnetic tape, it will contain blocks of fixed length (as noted below) except that the last block of the file may be short.

Fifth Fundamental Catalogue (FK5). Part I (Fricke *et al.* 1989)				
File	Contents	Record Format	Logical Record Length	Total Number of Logical Records
1	Data	FB	156	1535

Table 1. Summary Description of Catalog Files: FB = Fixed length blocks (last may be short)

The information contained in the above table is sufficient for a user to describe the indigenous characteristics of the machine-readable version of the *Fifth Fundamental Catalogue (FK5). Part I* to a computer. Information 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, density, number of tracks and character coding (ASCII, EBCDIC) for tapes, is not included, but should always accompany secondary copies if any are supplied to other users or installations.

2.2 *Catalog (File 1 of 1)*

The file contains all data of the machine-readable *Fifth Fundamental Catalogue (FK5). Part I* in a format very similar to that of the published version. All data fields contain valid data; thus, there are no default values given in the format table following. The user should note, however, that the file is ordered by FK5 number, which means that the stars are not arranged by right ascension or declination.

Table 2 gives a byte-by-byte description of the contents of the data file. A suggested Fortran format specification for reading each data field is included and can be modified depending upon individual programming and processing requirements (Fortran 77 character string-type formats are used throughout). Only the last three data fields (magnitude flag, spectral types, and DM numbers) contain character data. Also note that many of the data fields contain preceding blanks that are included in the format specifications in order to save space in the table.

Byte(s)	Units	Suggested Format	Default Value	Data
1-4	---	I4	---	FK5 number
5-6	---	2X	---	Blank
7-8	hours	I2	---	Right ascension, α, J2000.0
9-11	min	I3	---	α
12-18	sec	F7.3	---	α
19-20	---	2X	---	Blank
21-27	sec	F7.3	---	Centennial proper motion, μ_α, J2000.0
28-29	---	2X	---	Blank
30-32	°	I3 (A1,I2)	---	Declination, δ, J2000.0
33-35	′	I3	---	δ
36-41	″	F6.2	---	δ
42-43	---	2X	---	Blank
44-50	″	F7.2	---	Centennial proper motion, μ_δ, J2000.0
51-52	---	2X	---	Blank
53-54	hours	I2	---	Right ascension, α, B1950.0
55-57	min	I3	---	α
58-64	sec	F7.3	---	α
65-66	---	2X	---	Blank
67-73	sec	F7.3	---	Centennial proper motion, μ_α, B1950.0
74-75	---	2X	---	Blank
76-78	°	I3 (A1,I2)	---	Declination, δ, B1950.0
79-81	′	I3	---	δ
82-87	″	F6.2	---	δ
88-89	---	2X	---	Blank
90-96	″	F7.2	---	Centennial proper motion, μ_δ, B1950.0
97-98	---	2X	---	Blank
99-103	years	F5.2	---	Epoch (α)
104	---	1X	---	Blank
105-108	0.001	F4.1	---	Mean error in α
109	---	1X	---	Blank
110-114	0.001	F5.1	---	Mean error in centennial μ_α
115-116	---	2X	---	Blank
117-121	years	F5.2	---	Epoch (δ)
122-123	---	2X	---	Blank
124-126	0.01	F3.1	---	Mean error in δ
127-128	---	2X	---	Blank
129-132	0.01	F4.1	---	Mean error in centennial μ_δ
133-135	---	3X	---	Blank
136-140	mag	F5.2	---	*V* magnitude
141	---	A1	---	Magnitude flag
142	---	1X	---	Blank
143-144	---	A2	---	Spectral type
145	---	1X	---	Blank
146-156	---	A11	---	DM number

Table 2. Data File Record Format

FK5 number Catalog number. These numbers have remained the same from the FK3 and FK4.

Equatorial coordinates These are given for the equinoxes and epochs J2000.0 and B1950.0, as indicated in the table. The terms of elliptic aberration have been eliminated from the mean positions. The B1950.0 data have been computed from the J2000.0 data using a procedure described in the source reference (Fricke *et al.* 1988) based on the IAU (1976) system of astronomical constants (see also Lieske 1979).

Proper motions Centennial values for J2000.0 and B1950.0, referred to one Julian century.

Epoch (α, δ)

Mean epoch (-1900.0) of the individual observed right ascensions and declinations.

Mean errors

The mean errors of the positions at the mean epoch and of the corresponding proper-motion components, as obtained from the solution of the normal equations within the derivations of individual positions and proper motions. (These mean errors do not include those of the FK5 system and of the equinox and equator.)

V magnitude

Photoelectric magnitudes on the *UBV* system, as taken from the catalogs of Nicolet (1975, 1978). Variability is indicated by a flag in byte 141. For physical double stars, the magnitudes of the brighter components are given (both are given in the published catalog).

Magnitude flag

Where magnitude ranges are given in the published catalog, the brighter magnitude is given and byte 141 contains an upper case "V". A lower case "v" is present if there is variability and that letter is present in the published catalog (amplitude exceeds 0^m3).

Spectral type

A one-dimensional spectral type taken from the FK4 catalog. These types are from the *Henry Draper Catalogue* (Cannon and Pickering 1918-24).

DM number

Identifier from one of the Durchmusterung (DM) catalogs. A catalog identifier occurs in bytes 146-147 and identifies the DM as one of the following:

BD *Bonner Durchmusterung* (Argelander 1859-62, Küstner 1903)

SD *Southern Durchmusterung* (Schönfeld 1886)

CD *Córdoba Durchmusterung* (Thome 1892-1932)

CP *Cape Photographic Durchmusterung* (Gill and Kapteyn 1895-1900)

The DM number is contained in bytes 148-156.

3.0 History

3.1 Remarks and Modifications

The machine-readable *Fifth Fundamental Catalogue (FK5). Part I* was received on magnetic tape from Dr. H. Schwan of the Astronomisches Rechen-Institut, Heidelberg on 13 November 1989. The logical record length of the catalog, as received, was 200 bytes, but since only 144 bytes contained data, the record length was revised initially to 144 bytes by removing the blanks. The format was very uniform as received and no changes were made initially. However, the *V*-magnitude data were modified to agree more with the published FK5; *i.e.*, the variable stars were not indicated in the original machine version and are now flagged. (It was not considered worthwhile to put magnitude ranges into the catalog because these are not primary FK5 data.)

As received, the machine version contained no cross identifiers to other catalogs, even though the published version includes GC, HD, and DM numbers. Since it is desirable to have a least one cross identification to a major catalog, DM numbers were added. A file of FK5 versus DM numbers was kindly made available by W. M. Owen, Jr. of NASA's Jet Propulsion Laboratory (JPL). The catalog abbreviations were edited into the file and the DM field was added to the FK5 data file using a simple Fortran program, thus increasing the logical record length to 156 bytes.

4.0 Acknowledgments and References

4.1 Acknowledgments

Dr. H. Schwan kindly supplied the *Fifth Fundamental Catalogue (FK5). Part I* on magnetic tape and colleagues at the Astronomisches Rechen-Institut generously reviewed a draft copy of this documentation prior to its final release for distribution with machine-readable copies of the catalog, and Dr. Schwan returned comments and corrections. Appreciation is expressed to Bill Owen of JPL for supplying the FK5, DM cross index in machine-readable form.

4.2 References

Argelander, F. W. A. 1859-62, *Bonner Sternverzeichniss*, erste bis dritte Sektion, *Astronomischen Beobachtungen auf der Sternwarte der Königlichen Rhein.*, Friedrich-Wilhelms-Universität zu Bonn, Bände 3-5.

Cannon, A. J. and Pickering, E. C. 1918-24, *The Henry Draper Catalogue*, *Ann. Astron. Obs. Harvard College* **91-99**.

Gill, D. and Kapteyn, J. C. 1895-1900, *Cape Photographic Durchmusterung, Ann. Cape Obs.* **3** (1895, Part I: zones −18° to −37°); **4** (1897, Part II: zones −38° to −52°); **5** (1900, Part III: zones −53° to −89°).

Küstner, F. 1903, *Bonner Durchmusterung des Nördlichen Himmels*, zweite berichtigte Auflage, Bonn Universitäts Sternwarte (Bonn: A. Marcus und E. Weber's Verlag).

Lieske, J. H. 1979, *Astron. Astrophys.* **73**, 282.

Nicolet, B. 1975, *Catalogue of Measurements in the Cape UBV Photometry on Magnetic Tape*, *Astron. Astrophys. Suppl.* **22**, 239.

Nicolet, B. 1978, *Catalogue of Homogeneous Data in the UBV Photoelectric Photometric System*, *Astron. Astrophys. Suppl.* **34**, 1.

Schönfeld, E. 1886, *Bonner Sternverzeichniss*, vierte Sektion, *Astronomische Beobachtungen auf der Sternwarte der Königlichen Rheinischen Friedrich-Wilhelms-Universität zu Bonn* **8**, Part IV (Bonn: Adolph Marcus).

Thome, J. M. 1892-1932, *Córdoba Durchmusterung, Resultados del Observatorio Nacional Argentino* **16** (1892, Part I: −22° to −32°); **17** (1894, Part II: −32° to −42°); **18** (1900, Part III: −42° to −52°); **21** (Part I) (1914, Part IV, −52° to −62°); **21** (Part II) (1932, Part V: −62° to −90°).

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Appendix A. Sample Listing

The sample listing given on the following pages shows logical records exactly as they are recorded in the machine-readable version of the catalog. Groups of records from the beginning and end of the file are illustrated. The beginning of each record and the bytes within the record are indicated by the column heading index across the top of each page (digits read vertically).

LISTING OF RECORDS FROM DATA FILE

Data File Name: FK5 Basic (ARI 1988)

Records 1 to 35

Data File 52

Record Length 156 bytes

Input VOLSER ADC001

COLUMN HEADING INDEX

```
         1111111111222222222233333333334444444444555555555566666666667777777777888888888899999999990000000001111111112222222222333333333344444444445555555555666666666677777777778888888888999999999900000000011111111112222222223333333333444444444455555555556666666666777777777788888888889999999999000000000111111111122222222233333333334444444444555555555566666666667777777777888888888899999999990000000001111111111222222222333333333344444444445
123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345
```

Record	1	1	0	8	23.265	+ 1.039	+29	5	25.58	- 16.33	0	5	47.877	+ 1.036	+28	48	51.96	- 16.33	43.31	0.7	2.0	33.00	1.3	3.1	2.06	A0	BD+28	4
Record	2	2	0	9	10.695	+ 6.827	+59	8	59.18	- 18.09	0	6	29.765	+ 6.774	+58	52	26.54	- 18.06	54.34	1.4	5.0	42.22	1.6	4.2	2.27	F5	BD+58	3
Record	3	3	0	9	24.659	+ 1.186	-45	44	50.79	- 18.11	0	6	52.788	+ 1.192	-4e	1	23.36	- 18.11	58.56	2.5	9.3	45.98	3.6	11.1	3.88	K0	CD-46	18
Record	4	4	0	10	19.257	+ 0.074	+46	4	20.21	+ 0.03	0	7	42.779	+ 0.074	+45	47	38.71	+ 0.03	56.07	1.1	4.4	47.67	1.8	6.0	5.03	F0	BD+45	17
Record	5	5	0	11	34.437	+ 0.079	-27	47	59.12	+ 1.65	0	9	2.265	+ 0.079	-28	4	41.19	+ 1.65	56.47	1.6	6.5	46.63	2.9	9.7	5.42	K0	CD-28	26
Record	6	6	0	11	44.014	+ 1.412	-35	7	59.17	+ 11.86	0	9	11.739	+ 1.417	-35	26	46.32	+ 11.86	57.75	2.2	8.1	45.78	3.2	10.3	5.25	F5	CD-35	42
Record	7	7	0	13	14.154	+ 0.019	+15	11	0.80	- 1.20	0	10	39.483	+ 0.019	+14	54	20.50	- 1.20	43.14	0.6	1.9	31.35	1.3	3.4	2.83	B2	BD+14	14
Record	8	9	0	19	25.674	- 0.093	-	8	49	26.14	- 3.61	0	16	52.829	- 0.093	-	9	6	3.45	- 3.61	43.93	0.8	2.5	32.95	1.6	4.8	3.56	K0	SD-09	48
Record	9	10	0	20	4.251	+26.778	-64	52	29.25	+116.39	0	17	28.799	+27.076	-65	10	6.35	+116.41	57.53	4.0	15.8	44.61	3.2	10.3	4.23	F8	CP-65	13
Record	10	11	0	25	45.056	+66.919	-77	15	15.40	+ 32.37	0	23	9.318	+68.429	-77	32	8.15	+ 32.37	43.89	6.4	17.2	28.53	2.6	6.8	2.80	G0	CP-77	16
Record	11	12	0	26	17.030	+ 1.833	-42	18	21.81	- 39.57	0	23	49.051	+ 1.844	-42	34	38.31	- 39.57	58.62	2.1	7.5	49.96	3.0	9.1	2.59	K0	CD-42	116
Record	12	13	0	30	2.362	+ 0.074	-	3	57	26.39	- 1.23	0	27	29.198	+ 0.074	-	4	14	0.15	- 1.23	42.48	0.7	2.4	30.56	1.5	4.5	5.72	K5	SD-04	54
Record	13	14	0	30	22.661	- 0.177	-23	47	15.72	+ 1.27	0	27	52.782	- 0.177	-24	3	50.53	+ 1.27	53.36	1.4	5.1	46.67	2.6	8.5	5.19	A3	CD-24	179
Record	14	15	0	31	24.988	+ 1.449	-48	48	12.67	+ 1.75	0	29	0.619	+ 1.457	-49	4	47.11	+ 1.76	61.25	2.6	12.0	50.27	3.2	11.6	4.77	A2	CD-49	115
Record	15	16	0	32	59.982	+ 0.044	+62	55	54.40	- 0.33	0	30	8.387	+ 0.044	+62	39	21.80	- 0.33	51.76	1.7	6.0	41.93	1.7	4.9	4.16	B0	BD+62	102
Record	16	17	0	36	58.291	+ 0.219	+53	53	48.92	- 0.91	0	34	10.364	+ 0.218	+53	37	19.16	- 0.91	55.12	1.2	4.6	42.60	1.7	5.0	3.66	B3	BD+53	105
Record	17	18	0	36	52.858	+ 0.124	+33	43	9.63	- 0.40	0	34	12.218	+ 0.124	+33	26	39.60	- 0.40	53.90	0.9	3.4	45.10	1.8	5.6	4.36	B3	BD+32	101
Record	18	19	0	38	33.350	- 1.739	+29	18	42.30	- 25.41	0	35	54.458	- 1.732	+29	2	25.94	- 25.42	52.82	0.8	3.1	45.56	1.5	5.1	4.37	G5	BD+28	103
Record	19	20	0	39	19.697	+ 1.060	+30	51	39.43	- 9.15	0	36	38.890	+ 1.058	+30	35	15.48	- 9.14	49.10	1.0	3.2	39.99	1.8	5.4	3.27	K2	BD+30	91
Record	20	21	0	40	30.450	+ 0.636	+56	32	14.46	- 3.19	0	37	39.341	+ 0.632	+56	15	48.33	- 3.18	50.70	1.2	3.8	32.85	1.5	3.4	2.23	K0	BD+55	139
Record	21	22	0	43	35.372	+ 1.637	-17	59	11.82	+ 3.25	0	41	4.844	+ 1.639	-18	16	38.66	+ 3.27	36.70	0.8	2.4	25.46	1.6	4.5	2.04	K0	BD-18	115
Record	22	23	0	43	21.223	- 0.078	-57	27	47.05	+ 1.12	0	41	6.829	- 0.079	-57	44	12.90	+ 1.12	60.52	3.0	13.6	49.35	3.2	11.0	4.36	A0	CP-58	42
Record	23	24	0	45	39.044	- 0.458	+74	59	16.95	- 2.55	0	42	18.474	- 0.448	+74	42	54.34	- 2.56	50.49	3.2	11.2	38.74	1.7	5.2	5.66v	A2	BD+74	27
Record	24	25	0	44	43.524	+ 0.195	+48	17	3.73	- 0.80	0	41	55.683	+ 0.194	+48	0	39.72	- 0.80	57.08	1.1	4.8	44.52	1.8	5.6	4.54	B2	BD+47	183
Record	25	26	0	44	12.095	+ 2.077	-38	25	18.28	+ 11.28	0	41	47.263	+ 2.084	-38	41	48.68	+ 11.31	62.31	2.2	9.5	52.57	3.3	11.1	5.90	K0	CD-39	101
Record	26	27	0	47	20.330	- 0.731	+24	16	1.76	- 8.30	0	44	41.000	- 0.729	+23	59	43.78	- 8.31	53.18	0.8	2.9	42.78	1.6	5.1	4.06	K0	BD+23	106
Record	27	28	0	48	40.950	+ 0.572	+	7	35	6.14	- 5.24	0	46	5.145	+ 0.572	+	7	18	47.84	- 5.23	43.43	0.9	2.9	30.88	1.7	5.0	4.43	K5	BD+06	107
Record	28	29	0	50	43.603	+ 0.453	+64	14	51.15	- 1.23	0	47	40.325	+ 0.449	+63	58	32.51	- 1.22	54.53	2.0	8.1	45.05	2.0	6.6	5.39	F2	BD+63	99
Record	29	30	0	50	7.596	- 1.531	-10	38	39.54	- 22.87	0	47	37.328	- 1.531	-10	54	47.66	- 22.89	52.77	1.1	4.1	48.77	2.2	7.7	5.19	F5	BD-11	153
Record	30	31	0	48	35.395	+ 3.330	-74	55	24.25	- 3.30	0	46	51.758	+ 3.393	-75	11	43.22	- 3.25	56.75	6.2	22.1	45.96	3.1	10.1	5.07	K5	CP-75	64
Record	31	32	0	56	42.525	+ 0.355	+e0	43	0.19	- 0.53	0	53	40.363	+ 0.352	+60	26	47.11	- 0.52	52.44	1.5	5.4	40.53	1.6	4.5	1.6 V	B0	BD+59	144
Record	32	33	0	56	45.215	+ 1.297	+38	29	57.60	+ 3.27	0	53	58.190	+ 1.292	+38	13	42.80	+ 3.29	48.26	1.0	3.5	36.21	1.8	5.0	3.87	A2	BD+37	175
Record	33	34	0	55	0.291	+ 0.115	-e9	31	37.49	- 4.54	0	53	8.e4e	+ 0.119	-e9	47	49.71	- 4.54	61.87	5.0	23.0	49.49	3.3	11.4	5.45	K0	CP-70	40
Record	34	35	0	58	3e.3e3	+ 0.1ee	-29	21	26.89	+ 0.37	0	5e	11.921	+ 0.1ee	-29	37	38.06	+ 0.37	53.e3	1.5	5.2	42.99	2.5	7.6	4.31	B5	CD-30	297
Record	35	36	1	2	5e.e13	- 0.527	+	7	53	24.31	+ 2.25	1	0	20.735	- 0.527	+	7	37	1e.96	+ 2.24	45.15	0.7	2.1	33.17	1.5	3.7	4.28	K0	BD+07	153

LISTING OF RECORDS FROM DATA FILE

Data File Name: FK5 Basic (ARI 1988)
Records 1501 to 1535
Data File S2
Record Length 156 bytes
Input VOLSER ADC001

COLUMN HEADING INDEX

```
         1111111111222222222233333333334444444444555555555566666666667777777777888888888999999999900000000011111111112222222222333333333344444444445555555555666666666677777777778888888889999999999000000
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345
```

Record	1501	1628	23 56 41.502	- 0.162	+22 38 53.16	- 0.53	23 54 8.411	- 0.162	+22 22 11.36	- 0.53	57.90	0.9	4.6	50.85	2.0	8.0	6.15	M0	BD+21	4999
Record	1502	1629	23 57 45.535	- 0.247	+25 8 28.98	- 3.32	23 55 12.411	- 0.246	+24 51 48.50	- 3.32	60.86	0.9	4.4	49.71	1.8	6.3	4.66	M0	BD+24	4865
Record	1503	1630	0 1 57.631	+ 0.342	- 6 0 50.70	- 4.11	23 59 23.756	+ 0.342	- 6 17 30.90	- 4.11	49.94	0.9	3.1	39.84	1.8	5.5	4.41	M3	SD-06	6345
Record	1504	1635	2 16 45.608	+ 3.412	+83 33 41.12	- 4.22	2 8 51.749	+ 3.349	+83 19 44.51	- 4.08	54.66	8.5	35.3	44.76	2.0	7.9	6.43	K0	BD+82	51
Record	1505	1636	3 32 20.108	+ 4.702	+84 54 39.79	- 13.60	3 20 6.055	+ 4.965	+84 44 23.21	- 13.32	54.22	11.0	45.7	42.46	1.9	6.7	5.61	K0	BD+84	59
Record	1506	1637	5 31 48.047	+ 1.264	+85 56 18.53	- 7.90	5 13 49.749	+ 1.743	+85 53 40.46	- 7.79	52.53	14.2	58.8	38.16	2.0	7.7	6.51	A5	BD+85	74
Record	1507	1638	6 1 20.177	+ 0.856	+85 10 55.81	+ 0.01	5 45 34.145	+ 0.853	+85 10 27.15	+ 0.07	51.35	12.2	45.6	32.26	1.8	6.4	6.11	K0	BD+85	80
Record	1508	1639	8 16 53.775	- 0.818	+84 3 27.60	- 1.81	8 5 13.617	- 0.791	+84 12 31.05	- 1.86	55.56	9.9	45.1	41.26	1.9	7.1	6.49	A0	BD+84	169
Record	1509	1640	9 15 21.239	+ 1.807	+84 10 51.66	+ 1.46	9 5 16.296	+ 1.839	+84 23 10.88	+ 1.55	49.79	9.9	36.7	42.11	2.0	7.6	6.33	F0	BD+84	196
Record	1510	1641	11 14 30.135	- 3.489	+85 38 24.41	+ 0.82	11 8 48.785	- 3.731	+85 54 44.08	+ 0.77	53.94	14.4	65.1	42.00	2.1	8.2	7.34	A2	BD+86	161
Record	1511	1642	12 4 28.100	- 4.890	+85 35 13.66	+ 9.18	12 2 9.831	- 5.207	+85 51 51.22	+ 9.19	55.72	14.7	65.6	35.59	2.0	6.7	6.27	F5	BD+86	176
Record	1512	1643	13 42 23.092	+ 1.831	+82 45 8.62	- 4.12	13 43 40.846	+ 1.858	+83 0 13.40	- 4.18	56.42	8.6	41.5	40.97	1.9	6.5	5.98	G5	BD+83	397
Record	1513	1644	14 50 20.403	+ 9.018	+82 30 42.97	- 22.25	14 53 33.710	+ 8.971	+82 43 7.42	- 22.69	56.98	8.0	44.5	42.66	2.0	7.2	5.64	G0	BD+83	431
Record	1514	1645	15 43 27.066	+ 0.497	+82 56 50.23	+ 0.11	15 48 28.434	+ 0.510	+83 6 3.58	+ 0.08	52.67	8.5	32.9	44.13	2.1	7.5	7.47	A2	BD+83	453
Record	1515	1646	18 24 9.175	+ 0.829	+83 10 31.21	- 2.65	18 30 48.038	+ 0.764	+83 8 32.65	- 2.71	54.24	8.3	30.4	45.35	2.1	8.1	6.17	A2	BD+83	536
Record	1516	1647	19 59 19.927	- 0.451	+84 40 7.06	- 4.34	20 6 53.544	- 0.573	+84 31 36.23	- 4.31	51.38	9.8	31.6	44.67	2.0	7.3	6.83	A2	BD+84	451
Record	1517	1648	22 13 10.580	+ 5.064	+86 6 20.68	+ 4.54	22 17 33.804	+ 4.883	+85 51 26.73	+ 4.58	52.71	13.0	45.4	36.36	1.8	5.8	5.27	A0	BD+85	383
Record	1518	1649	22 54 24.765	+ 6.239	+84 20 46.49	+ 2.61	22 54 53.423	+ 5.980	+84 4 43.40	+ 2.49	56.02	9.2	41.1	48.39	1.8	6.3	4.71	K5	BD+83	640
Record	1519	1650	23 56 27.723	+ 2.626	+83 11 28.17	+ 0.73	23 54 4.039	+ 2.524	+82 54 45.76	+ 0.73	57.28	7.7	40.9	45.47	1.8	6.9	6.59	A0	BD+82	743
Record	1520	1655	8 12 33.926	+ 3.282	-88 21 46.56	- 0.22	8 12 16.828	+ 3.959	-88 38 27.25	- 0.21	34.33	66.2	177.6	27.65	2.6	8.6	7.26	A0	CP-89	1
Record	1521	1656	2 21 40.603	+ 0.131	-85 43 4.87	- 2.44	2 28 8.456	+ 0.229	-85 56 32.31	- 2.43	51.26	24.5	84.1	34.68	2.8	9.6	7.86	F0	CP-86	28
Record	1523	1658	4 22 50.891	- 0.967	-82 53 56.74	+ 0.36	4 28 33.216	- 0.988	-83 0 37.81	+ 0.27	49.24	12.5	40.6	33.24	2.6	9.8	6.76	A2	CP-83	91
Record	1524	1659	5 30 13.883	- 0.570	-84 47 6.39	+ 4.61	5 39 50.504	- 0.754	-84 48 57.68	+ 4.56	53.96	17.8	65.5	34.11	2.7	9.2	6.20v	A0	CP-84	75
Record	1525	1660	5 39 59.240	- 1.938	-85 54 51.57	+ 0.69	5 53 2.382	- 1.986	-85 55 50.86	+ 0.55	48.66	21.4	71.8	32.43	2.5	8.8	6.79	K0	CP-85	77
Record	1526	1661	6 46 58.718	+ 0.727	-87 1 29.89	+ 0.44	7 4 58.591	+ 0.658	-86 57 27.50	+ 0.49	45.97	28.0	87.5	30.57	2.5	8.5	6.47	F2	CP-86	105
Record	1527	1662	6 26 47.779	+ 0.384	-88 46 37.26	+ 1.77	7 12 45.300	- 0.721	-88 41 0.97	+ 1.76	39.64	72.5	207.7	26.17	2.7	9.1	7.38	A0	CP-88	68
Record	1528	1663	10 30 49.267	- 0.152	-86 5 26.35	+ 0.10	10 34 8.312	- 0.145	-85 49 56.26	+ 0.10	50.73	20.9	77.0	32.42	2.5	9.1	6.67	A0	CP-85	245
Record	1529	1664	10 59 13.777	- 4.801	-84 35 37.91	- 0.49	10 59 42.221	- 4.569	-84 19 30.12	- 0.58	49.33	14.4	46.2	31.19	2.5	8.3	6.19	A0	CP-83	386
Record	1530	1665	13 40 55.460	- 8.209	-85 47 9.66	- 1.83	13 32 25.350	- 7.781	-85 31 54.32	- 1.59	44.00	19.8	57.2	27.79	2.4	7.9	5.58	A2	CP-85	384
Record	1531	1666	15 43 16.844	+ 9.072	-84 27 54.93	+ 9.75	15 31 26.378	+ 9.075	-84 18 15.26	+ 9.21	44.68	14.3	42.2	26.03	2.5	9.0	5.57	A2	CP-84	510
Record	1532	1667	19 56 1.516	+ 0.405	-81 20 59.45	- 0.11	19 46 56.322	+ 0.408	-81 28 47.97	- 0.14	51.80	9.6	33.6	37.46	2.6	8.9	6.39	K0	CP-81	868
Record	1533	1668	20 42 33.714	+ 3.622	-84 24 25.67	- 2.58	20 31 0.852	+ 3.604	-84 34 57.87	- 2.79	57.81	16.4	67.4	40.77	2.8	9.9	6.87	A0	CP-84	4484
Record	1534	1669	22 45 28.562	+ 5.333	-88 49 6.16	- 4.00	22 20 22.855	+ 5.167	-89 4 36.04	- 4.14	22.44	98.9	274.5	21.72	2.7	9.4	6.57	A5	CP-89	53
Record	1535	1670	22 31 37.390	- 3.899	-85 58 2.30	+ 5.88	22 22 39.721	- 3.995	-86 13 26.47	+ 5.99	37.44	23.0	62.9	26.51	2.5	8.0	5.77	K0	CP-86	406