APPARENT PLACES OF FUNDAMENTAL STARS 2024

for 64 Stars selected from the
Sixth Catalogue of Fundamental Stars

Astronomisches Rechen-Institut
Zentrum für Astronomie
der Universität Heidelberg

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PREFACE

This booklet, published annually, is the continuation of the series of volumes "Apparent Places of Fundamental Stars", (APFS) which was first published in 1941. The compilation and publication of the first nineteen volumes was undertaken by H. M. Nautical Office, Royal Greenwich Observatory. In accordance with a recommendation of the I.A.U. (Dublin meeting 1955) this task was taken over by the Astronomisches Rechen-Institut, Heidelberg, from the twentieth volume onwards. Starting with the edition of the year 2000, the extensively large books were replaced by the present small booklet. Starting in 2006 only the introductory remarks concerning the CIO-based (celestial intermediate origin) and the equinox-based method are provided. The apparent places for 64 stars reduced with the equinox-based method are given in the printed version; the data for 878 fundamental stars (FK6) and for Polaris are provided via the Internet in consideration of both methods (http://www.ari.uni-heidelberg.de/ariapfs). IAU 2000/2006 precession-nutation is used for intermediate and apparent positions. The underlying precession-nutation model is recommended by IAU 2006 Resolution B1.

Since the year 2000 the apparent and mean places have been based on the so-called single-star solution of the Sixth Catalogue of Fundamental Stars (FK6, Wielen et al., Veröff. Astron. Rechen-Institut, Heidelberg, No. 35, 1999). This catalogue is on the astrometric system defined by the HIPPARCOS catalogue (ESA SP-1200, 1997), which has been adopted as the primary celestial reference frame at optical wavelengths since 1998 (*Trans. IAU,* **23B**, 39, 1999). In FK6 we have improved the HIPPARCOS proper motions by combining the HIPPARCOS observations with the data given in FK5.

In the online version we provide the intermediate and apparent places reduced by the *CIO-based* and by the *equinox-based* method, which differ only in right ascension. The entries corresponding to sidereal days divisible by ten (corresponding in the printed volumes) are marked by an asterisk.

Intermediate and apparent places can also be obtained conveniently within the framework of the "German Astrophysical Virtual Observatory" (GAVO). The corresponding web page is accessible via the ARI APFS web pages or directly by http://vo.uni-hd.de/apfs. Apparent and intermediate places for 878 stars of the FK6 Part I and 3272 stars of the FK6 Part III can be retrieved conveniently. This service is completed by Hipparcos-based apparent and intermediate places of additional stars, and by using data from Gaia Data Release 3 (https://www.cosmos.esa.int/web/gaia/dr3; Gaia Data Release 3: Summary of the contents and survey properties, Gaia Collaboration (Vallenari, A., Brown, A. G. A., et al. 2023, A&A 674, A1). A facility to compute the Earth Rotation Angle (ERA), Greenwich Apparent Sidereal Time (GAST) and Greenwich Mean Sidereal Time (GMST) is available on a related web page. Some introductory remarks and references can be found in the corresponding service info. Any comments would be appreciated.

R. W. SCHMIDT E. K. GREBEL J. WAMBSGANSS

Heidelberg, October 2023
Astronomisches Rechen-Institut am Zentrum für Astronomie der Universität Heidelberg

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Preface
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CONTENTS

INTRODUCTION

This booklet provides examples for the reduction of 64 mean star places to apparent places for the year 2024. In view of the high accuracy of the mean positions and proper motions in the FK6 and in the HIPPARCOS catalogue we have increased the number of significant digits in the tabulated apparent places by one compared with the volumes before 2000. Since no "short period terms" are included in the apparent places following 2005 there exists no interpolation to intermediate dates based on the printed version. The internet version listing "daily" apparent places should be used for an approximate interpolation.

In this booklet we present apparent places for only a few fundamental stars as examples. The intermediate and apparent places for a large number of fundamental stars are provided by the Astronomisches Rechen-Institut at the URL:

http://www.ari.uni-heidelberg.de/ariapfs

We tabulate the intermediate and apparent places for *daily* upper culminations at Greenwich. Those entries that would have been published according to the conventions of the printed volumes are marked by an asterisk in the online version. It may be noted here that we can easily use the program for transits over other meridians just by subtracting the longitude of an observer from the Greenwich sidereal date of the transit.

At its 23rd General Assembly in 1997, the International Astronomical Union decided (*Trans. IAU* **23B** 39, 1999) to adopt an International Celestial Reference System (ICRS). The ICRS is realized at optical wavelengths by stars in the Hipparcos Catalogue, in particular by those having reliable proper motions. This subset - comprising more than 80 per cent of the stars of the Hipparcos Catalogue - constitutes the Hipparcos Celestial Reference Frame (HCRF).

The new highly accurate IERS-observing technique (VLBI) has recommended to adopt a new zero point for the equatorial system. Guinot's non-rotating origin (Guinot, B., 1979, In: McCarthy, D.D., Pilkington, J.D. (eds.), Time and the Earth's Rotation. D. Reidel Publ. Co., p. 7) was adopted for substituting the classical equinox. This origin is stable in such a way that there are merely motions of the new zero point in right angles to the instantaneous equator. With this new definition the rotation of the Earth is given directly as the difference between the non-rotating origin and the terrestrial origin. This difference is directly proportional to UT1 and no precession-nutation terms are included.

In addition to the CIO-based procedure we also give the apparent places using the classical equinox as the origin in right ascension; this older method may still be used in many applications. No differences in declination occur since the equator remains unchanged.

Precession and nutation reductions agree with IAU2000/2006 precession-nutation in accordance with IAU 2006 Resolution B1 (see e.g. Capitaine & Wallace, A&A 450, 855 (2006)).

DE430/LE430 ephemerides (ftp://ssd.jpl.nasa.gov/pub/eph/planets/README.txt) are used for GAVO.

Introduction
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From VLBI observations it has been found that there exists a "celestial pole offset" between a CIO-based and a J2000 right ascension that has to be applied before making use of the precession-nutation terms. This bias is described more explicitly in Feissel, M., Mignard, F. (A&A 331, L33 (1998)) and in Hilton, J.L., Hohenkerk, C.Y. (A&A 413, 765 (2004)). It is, however, included already in the SOFA subroutines, and no changes to the input files were applied.

The input data are the HIPPARCOS and the FK6 catalogue. The parallaxes used are those from the HIPPARCOS catalogues, and the radial velocities are taken from the machine readable version of the FK6.

In our work on the FK6 we have shown that the HIPPARCOS proper motions are "instantaneous motions" that may differ in many cases significantly from the mean (centre of mass) motion. With the combination of the HIPPARCOS data and the FK5 catalogue (reduced to the HIPPARCOS system) we have derived proper motions in the FK6 which describe much better the mean motion. As part of our reduction process we have also obtained additional information on possible double stars as well as on stars that can be regarded with high probability as single star candidates. Single star candidates are best suited to maintain the International Reference System, and from the year 2000 onwards we only give apparent places for the single star candidates (except Polaris, see p. 7-8). For comparison we provide the differences between the given SI-solution with respect to the HIPPARCOS data and to the long-term prediction (LTP) in the FK6. This table is given on pages 34-35.

Apparent Places of 10-Day Stars (Pages 11-25)

Examples for the apparent places of the stars with declinations between ±81° are given for every tenth upper transit at Greenwich on pages 11-25. The choice of the data is fixed by the moment for which the integral part of the Greenwich sidereal date is divisible by 10. In this booklet we give the equinox-based right ascension, which has a much larger difference from date to date than those determined with the CIO-based method. The CIO-based method is given additionally in the internet version.

The column U.T. gives the approximate time of transit for the first star on the page; it is rounded to the nearest tenth of a day. For transits over other meridians the column U.T. can be regarded as the "local" mean solar date for that transit. For transits of other stars on that page the right ascension difference of the star from the first star should be taken into account.

The right ascension and declination are referred to the true equator and equinox, or non-rotating origin in the CIO-based method. Since the equator does not change merely the right ascensions are affected and the declinations remain unchanged.

From 1984 onwards (see Preface to APFS 1984) the mean positions of the stars in the FK6 or the HIPPARCOS catalogue are freed from the term of elliptic aberration (E-terms), which depends on the eccentricity of the Earth's orbit. This term is now included in the reduction to the apparent place.

The hours and minutes of right ascension and the degrees and minutes of declination given at the head of the columns are adjusted so that the seconds never change sign, though this may involve their exceeding 60.

Immediately below the tabulated right ascension and declination we provide:

(I) the mean place for the middle of the year.
(II) sec δ and tan δ corresponding to the mean place.
(III) the day upon which the star transits twice in upper culmination.

In the volumes prior to 2006, examples were given for interpolating the apparent place for other meridians, including in particular the short period terms of nutation. In the present booklet we do not to give any interpolation and the user should enter his or her subroutine using the appropriate time. An approximate transit could also be obtained from the daily positions given in the internet version.

Apparent Places of Circumpolar Stars (Pages 26-33)

Examples for the apparent places of circumpolar stars with declinations exceeding $\pm 81°$ are given for every upper transit at Greenwich on pages 26-33. Polaris (HIPPARCOS No. 11767, FK6 No. 907) is not included in the FK6 Part I, because it is a binary. The apparent places given on pages 26 and 27 are based on the retrograde orbit derived by Wielen et al. (A&A **360**, 399, (2000)). Each two facing pages are devoted to a star. In the left hand column only the day of the month is given without the fraction of the day. The right ascension and declination are referred to the true equator and equinox (and additionally the non-rotating origin in the Internet version), short period terms of nutation are included. Three decimals of a second are only given for the right ascensions. On the one day during the year when there are two upper transits at Greenwich both are shown.

The values of sec δ and tan δ are given for every month and refer to the apparent place on the 16^{th} day of the month. The footnotes, repeated on each page, give the mean right ascension and declination in the middle of the year and the date of double lower transit.

Reduction to the HIPPARCOS catalogue
Reduction to the FK6 (Long-term prediction)
(Pages 34-35)

The FK6 is the result of combining the FK5 with the HIPPARCOS observations. Various solutions have been derived in the FK6, adopting different models for the star's kinematic behaviour, which leads to different weighting schemes in the least squares solutions. Two of these solutions are briefly mentioned here. For details please refer to the FK6.

The apparent places given in this booklet and in the internet version are based on the so-called single-star solution (abbreviated as SI) of the FK6 assuming that the star can be treated as a single star. Stars with no indication of a binary nature are best suited to maintain the International Celestial Reference System (ICRS). We have therefore restricted the stellar sample in this booklet mainly to such candidates, which are called "astrometrically excellent stars of the highest rank (***)" in the FK6. A few non-excellent stars are also included because of their brightness, their large foreshortening effects or their special importance (Polaris, a binary not included in the FK6, Part 1). Starting in 2006 we added ten other excellent stars, including two circumpolar stars.

In the FK6 long-term prediction (LTP) we admit a possible (but still undetected) binary nature of a star. In this case HIPPARCOS observed, more or less, an instantaneous proper motion, depending on the star's observational period. Combining the HIPPARCOS observations with highly-weighted FK5 data yields an FK6 proper motion that describes much better the star's position for epochs differing significantly from the HIPPARCOS epoch, about 1991.25. Examples can be found in the table on pages 34-35.

The table on pages 34-35 provides the differences of the FK6 single-star solution (SI) with the HIPPARCOS data on one hand, and with the long-term prediction in the FK6 (LTP) on the other hand. The data in the table hold for the middle of the year. Columns one and two list the FK6 and HIPPARCOS number, column three gives the difference in right ascension between the HIPPARCOS data and the single-star solution of the FK6 in units of 0.0001 seconds of time, column four is the proper motion difference in 0.0001 seconds of time per year, and columns five and six list the corresponding differences in declination in 0.001 arcsec and 0.001 arcsec/year, respectively. The differences between the long-term predicition and the single-star solutions in the FK6 are given similarly in the columns seven through ten. Polaris (FK6 No. 907) is a binary and needs a special treatment. The small table at the end of page 35 provides the data to reduce the apparent place of Polaris from the FK6 (p. 26-27) to the HIPPARCOS catalogue.

These data permit, for any date in the year, the computation of the corrections that have to be added to the tabulated apparent places in order to get the positions based on the HIPPARCOS catalogue or on the long-term prediction in the FK6 from the SI position.

Table UT–ST (Pages 36-39)
Sidereal Time at 0$^{\mathrm{h}}$ U.T.

On these pages are given in order of 0$^{\mathrm{h}}$ U.T. on each day of the year:

(I) the apparent (or true) sidereal time to $0\overset{\mathrm{s}}{.}001$
(II) the mean (or uniform) sidereal time, given as seconds and decimals only, the hours and minutes being the same as in the first column
(III) difference Apparent – Mean (app–mean) in units of $0\overset{\mathrm{s}}{.}001$

In the APFS volumes preceding 1960, the equation of equinoxes was designated as the nutation in right ascension.

Conversion of Mean Solar Time to Sidereal Time
Conversion of Sidereal Time to Mean Solar Time

The following relations derived from the expressions between mean solar time and mean sidereal time as given in *Trans. I.A.U.* **18B,** 72 (1983) are used. Both relations can be used in the following two examples.

$$1 \text{ mean solar day} = 24^{\mathrm{h}}03^{\mathrm{m}}56\overset{\mathrm{s}}{.}55536\,79 \quad \text{in mean sidereal time} \qquad (1a)$$
$$1 \text{ mean sidereal day} = 23^{\mathrm{h}}56^{\mathrm{m}}04\overset{\mathrm{s}}{.}09053\,08 \quad \text{in mean solar time} \qquad (1b)$$

The time dependence of these relations has been ignored, since it is of no practical importance in the present development.

In using the above relations for passing from mean solar time to apparent sidereal time and vice versa, we also must use the apparent sidereal time at 0$^{\mathrm{h}}$ taken from the last table on page 36-39. It must be remembered that a correction should be applied for the change of the equation of equinoxes between 0^{h} and the given U.T.

Thus the local apparent sidereal time at Heidelberg (Longitude = $0^{h}34^{m}53\overset{s}{.}190$) at U.T. $7^{h}\,21^{m}\,36\overset{s}{.}572$ on 2024 January 22 is obtained as:

Mean solar interval at 0^{h}		7^{h}	21^{m}	$36\overset{s}{.}572$
Correction to mean solar time to given sidereal time } (relation (1a))	+		1	12.445
	+			0.100
Apparent sidereal time at 0^{h} (Table p. 36)		8	03	24.015
Change in the equation of equinoxes from 0^{h} to 7^{h} (Table p. 36)	+			0.003
Sum = Greenwich apparent sidereal time		15	26	13.135
Longitude Heidelberg	+	0	34	53.190
Sum = Heidelberg apparent sidereal time		16	01	06.325

Similarly the U.T. on 2024, January 22 corresponding to an apparent sidereal time at Heidelberg of $16^{h}01^{m}06\overset{s}{.}325$ is obtained as:

Heidelberg apparent sidereal time		16^{h}	01^{m}	$06\overset{s}{.}325$
Longitude Heidelberg	–	0	34	53.190
Difference = Greenwich apparent sidereal time		15	26	13.135
Apparent sidereal time at 0^{h} (Table p. 36)		8	03	24.015
Sidereal interval		7	22	49.120
Correction to sidereal time to given mean solar time } (relation (1b))	–		1	12.445
	–			0.100
Change in the equation of equinoxes from 7^{h} to 0^{h} (Table p. 36)	–			0.003
Sum = required U.T.		7	21	36.572

Apparent places for different longitudes

Suppose the apparent position needs to be obtained for a star at upper transit in Heidelberg ($\lambda = +0^{h}\ 34^{m}53\overset{s}{.}190$, i.e. the star culminates 0.581 hours or 0.0242 days earlier than in Greenwich). We would use the apparent place subroutine for this, using as input date the Heidelberg transit which is 0.581 hours (or 0.0242 days) earlier than the corresponding transit in Greenwich. This information can be directly included in the subroutine.

For example the apparent position of 94 Piscium (FK6 No. 1039) may be required at upper transit in Heidelberg for 13th May 2024. We include the longitude of Heidelberg into the subroutine and we find an apparent position of

$$\alpha = \ 1^{h}\,27^{m}\,59\overset{s}{.}2562 \quad \text{(EQUINOX-based)}$$

$$\alpha = \ 1^{h}\,26^{m}\,44\overset{s}{.}6330 \quad \text{(CIO-based)}$$

$$\delta = 19^{\circ}\,21'\,50\overset{\prime\prime}{.}573 \quad \text{(CIO-based = EQUINOX-based)}$$

Diurnal Aberration

The diurnal aberration must be added to the right ascension for upper transits. Alternatively, it can be subtracted from the time of transit. In the case of lower transits the sign of the correction has to be reversed. With declination δ and latitude ϕ the given correction is

$$\text{Diurnal Aberration} = 0\overset{\text{s}}{.}0213\ \cos\phi \sec\delta$$

A remark concerning the history of the APFS at ARI

Many staff members have contributed to the APFS since the first volume for 1960 was published. We would like to mention in particular F. Gondolatsch, T. Lederle, H. Schwan and H. Lenhardt in addition to the former directors W. Fricke and R. Wielen.

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	10		22		44		1039	
HIP-No.	1599		3419		5661		6732	
Name	ζ Tucanae		β Ceti		102 G. Sculptoris		94 Piscium	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	0h21m	**− 64°43′**	**0h44m**	**− 17°50′**	**1h13m**	**− 37°43′**	**1h27m**	**+ 19°21′**
12 24.d8	19.s1674	83.″432	47.s5291	86.″956	52.s0625	60.″323	59.s5933	56.″974
1 3.7	18.8058	83.006	47.4228	87.520	51.9099	60.962	59.4899	56.730
1 13.7	18.4418	81.887	47.3289	87.767	51.7562	61.125	59.4004	56.362
1 23.7	18.0712	80.413	47.2050	87.967	51.5703	61.048	59.2694	55.635
2 2.6	17.7582	78.558	47.0742	87.992	51.3845	60.596	59.1086	54.774
2 12.6	17.5353	75.901	47.0045	87.427	51.2543	59.404	59.0057	54.126
2 22.6	17.3293	72.926	46.9404	86.685	51.1245	57.928	58.9128	53.298
3 3.6	17.1505	69.953	46.8542	85.984	50.9795	56.377	58.7876	52.208
3 13.5	17.1060	66.448	46.8366	84.743	50.9090	54.182	58.7222	51.463
3 23.5	17.1434	62.672	46.8698	83.146	50.8902	51.606	58.7139	50.914
4 2.5	17.1983	59.004	46.9095	81.529	50.8787	49.030	58.7233	50.276
4 12.5	17.3604	55.295	46.9920	79.661	50.9211	46.193	58.7675	49.897
4 22.4	17.6346	51.614	47.1272	77.538	51.0280	43.132	58.8590	49.829
5 2.4	17.9708	47.925	47.3231	75.156	51.1947	39.912	59.0324	50.078
5 12.4	18.3521	44.574	47.5377	72.799	51.3884	36.807	59.2307	50.472
5 22.3	18.8023	41.710	47.7631	70.544	51.6113	33.888	59.4322	51.061
6 1.3	19.3551	38.863	48.0660	67.965	51.9185	30.769	59.7179	52.227
6 11.3	19.9227	36.425	48.3923	65.449	52.2524	27.878	60.0431	53.590
6 21.3	20.4738	34.782	48.6878	63.359	52.5686	25.556	60.3388	54.894
7 1.2	21.0964	33.449	49.0184	61.231	52.9338	23.313	60.6642	56.611
7 11.2	21.7355	32.506	49.3734	59.165	53.3283	21.301	61.0236	58.621
7 21.2	22.3017	32.264	49.6965	57.537	53.6920	19.909	61.3666	60.529
7 31.2	22.8431	32.643	49.9908	56.274	54.0372	19.003	61.6771	62.440
8 10.1	23.3709	33.537	50.2708	55.284	54.3774	18.495	61.9700	64.467
8 20.1	23.8347	34.738	50.5484	54.480	54.7082	18.333	62.2781	66.573
8 30.1	24.1869	36.534	50.7689	54.186	54.9788	18.809	62.5393	68.411
9 9.0	24.4506	38.965	50.9202	54.450	55.1862	19.920	62.7250	69.988
9 19.0	24.6798	41.354	51.0816	54.708	55.3968	21.100	62.9261	71.738
9 29.0	24.7940	43.907	51.2099	55.232	55.5604	22.633	63.1108	73.299
10 9.0	24.7580	46.910	51.2491	56.348	55.6285	24.791	63.2093	74.349
10 18.9	24.6882	49.708	51.2783	57.462	55.6815	26.914	63.2902	75.419
10 28.9	24.5626	52.218	51.3016	58.535	55.7164	28.976	63.3681	76.464
11 7.9	24.3073	54.613	51.2749	59.831	55.6834	31.230	63.4065	77.116
11 17.9	23.9974	56.706	51.2139	61.173	55.6088	33.414	63.4007	77.536
11 27.8	23.6725	58.383	51.1351	62.434	55.5130	35.374	63.3604	77.846
12 7.8	23.3185	59.345	51.0679	63.405	55.4117	36.916	63.3339	78.105
12 17.8	22.9137	59.836	50.9734	64.315	55.2712	38.242	63.2768	78.050
12 27.7	22.4893	60.029	50.8325	65.279	55.0853	39.418	63.1514	77.632
12 37.7	22.1299	59.338	50.7286	65.730	54.9312	39.873	63.0479	77.339
Mean Place	19.8755	51.673	49.0852	69.058	52.9752	37.971	61.3750	59.874
sec δ, tan δ	+2.343	−2.118	+1.051	−0.322	+1.264	−0.774	+1.060	+0.352
Dble. Trans.	September 26		October 1		October 9		October 12	

Apparent places of ten-day stars

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	1045		80		110		119	
HIP-No.	7513		10642		14240		15510	
Name	υ Andromedae		67 Ceti		μ Hor		92 G. Eridani	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	1h38m	**+ 41°31′**	**2h18m**	**– 6°18′**	**3h04m**	**– 59°38′**	**3h20m**	**– 42°58′**
12 24.8d	12.7225s	41.737″	11.3256s	45.584″	13.2459s	52.899″	54.5326s	51.192″
1 3.8	12.5665	42.106	11.2467	46.356	12.9758	54.627	54.4073	52.998
1 13.8	12.4274	42.130	11.1672	47.022	12.6503	55.930	54.2507	54.493
1 23.7	12.2411	41.558	11.0397	47.732	12.2701	56.850	54.0384	55.690
2 2.7	12.0124	40.644	10.8833	48.233	11.8803	57.126	53.8003	56.299
2 12.7	11.8475	39.705	10.7714	48.280	11.5004	56.603	53.5811	56.199
2 22.6	11.7036	38.352	10.6544	48.294	11.1018	55.715	53.3432	55.799
3 3.6	11.5268	36.552	10.5021	48.332	10.7007	54.503	53.0798	55.097
3 13.6	11.4140	34.918	10.4035	47.826	10.3594	52.462	52.8629	53.599
3 23.6	11.3736	33.322	10.3500	47.031	10.0640	49.947	52.6829	51.645
4 2.5	11.3675	31.517	10.3034	46.290	09.7877	47.355	52.5104	49.612
4 12.5	11.4023	29.876	10.2919	45.219	09.5841	44.291	52.3836	47.083
4 22.5	11.4932	28.552	10.3294	43.784	09.4693	40.820	52.3187	44.100
5 2.5	11.6852	27.533	10.4352	42.129	09.4196	37.225	52.3154	40.967
5 12.4	11.9142	26.656	10.5655	40.425	09.4309	33.649	52.3507	37.792
5 22.4	12.1462	26.057	10.7102	38.605	09.5252	30.044	52.4313	34.492
6 1.4	12.4745	26.124	10.9403	36.379	09.7190	26.234	52.6008	30.926
6 11.3	12.8580	26.499	11.2084	34.177	09.9698	22.699	52.8175	27.560
6 21.3	13.2129	26.980	11.4584	32.215	10.2632	19.636	53.0487	24.560
7 1.3	13.5947	28.046	11.7509	30.012	10.6416	16.577	53.3436	21.472
7 11.3	14.0175	29.587	12.0830	27.772	11.0789	13.815	53.6899	18.596
7 21.2	14.4312	31.225	12.4033	25.913	11.5227	11.786	54.0397	16.372
7 31.2	14.8052	33.070	12.7058	24.239	11.9921	10.220	54.3982	14.520
8 10.2	15.1536	35.255	13.0056	22.657	12.4940	09.057	54.7768	12.982
8 20.2	15.5242	37.713	13.3218	21.284	12.9914	08.484	55.1687	11.993
8 30.1	15.8470	40.087	13.5967	20.402	13.4517	08.705	55.5298	11.747
9 9.1	16.0795	42.404	13.8123	19.930	13.8840	09.583	55.8558	12.091
9 19.1	16.3236	45.054	14.0474	19.467	14.3042	10.745	56.1921	12.713
9 29.0	16.5545	47.638	14.2632	19.384	14.6633	12.549	56.4967	13.982
10 9.0	16.6894	49.835	14.3989	19.913	14.9344	15.126	56.7273	16.018
10 19.0	16.7925	52.130	14.5236	20.443	15.1668	17.790	56.9387	18.168
10 29.0	16.8869	54.441	14.6437	21.037	15.3451	20.603	57.1262	20.513
11 7.9	16.9403	56.362	14.7179	22.042	15.4192	23.860	57.2462	23.371
11 17.9	16.9346	58.010	14.7498	23.157	15.4198	27.115	57.3122	26.290
11 27.9	16.8761	59.491	14.7512	24.212	15.3674	30.142	57.3385	29.047
12 7.9	16.8292	60.803	14.7560	25.185	15.2461	32.925	57.3334	31.672
12 17.8	16.7463	61.639	14.7222	26.265	15.0411	35.552	57.2677	34.242
12 27.8	16.5759	61.957	14.6232	27.404	14.7720	37.876	57.1365	36.580
12 37.8	16.4183	62.197	14.5405	28.126	14.4806	39.422	56.9975	38.248
Mean Place	14.7503	37.547	12.4718	37.079	11.6593	36.320	54.3388	38.564
sec δ, tan δ	+1.336	+0.886	+1.006	–0.111	+1.979	–1.707	+1.367	–0.932
Dble. Trans.	October 15		October 25		November 6		November 10	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	120		153		1116		173	
HIP-No.	15863		19095		19513		22361	
Name	α Persei		174 G. Eridani		44 Tauri		Groombridge 848	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	3^h26^m	**+ 49°56′**	**4^h06^m**	**– 27°34′**	**4^h12^m**	**+ 26°32′**	**4^h52^m**	**+ 75°58′**
12 $24^d.9$	$03^s.5668$	54″.992	$37^s.9699$	74″.815	$18^s.5477$	39″.689	$10^s.3804$	62″.272
1 3.9	03.4741	56.514	37.9223	76.697	18.5456	40.220	10.2898	65.319
1 13.8	03.3740	57.637	37.8500	78.452	18.5322	40.518	10.1109	67.965
1 23.8	03.1862	58.208	37.7143	80.018	18.4399	40.549	09.6893	70.122
2 2.8	02.9208	58.536	37.5365	81.058	18.2833	40.639	09.0543	72.083
2 12.7	02.7018	58.679	37.3751	81.557	18.1590	40.750	08.4384	73.667
2 22.7	02.4751	58.204	37.1897	81.869	18.0117	40.490	07.7450	74.443
3 3.7	02.1831	57.226	36.9615	81.902	17.7989	40.009	06.8803	74.621
3 13.7	01.9445	56.237	36.7670	81.218	17.6246	39.723	06.0743	74.516
3 23.6	01.7698	54.994	36.6012	80.142	17.4886	39.344	05.3593	73.817
4 2.6	01.6186	53.269	36.4357	79.010	17.3534	38.619	04.6718	72.346
4 12.6	01.5047	51.534	36.2994	77.363	17.2414	38.031	04.0478	70.588
4 22.6	01.4526	49.926	36.2095	75.219	17.1741	37.655	03.5504	68.656
5 2.5	01.5178	48.274	36.1811	72.937	17.1905	37.212	03.2921	66.288
5 12.5	01.6274	46.554	36.1814	70.544	17.2333	36.726	03.1443	63.578
5 22.5	01.7506	45.059	36.2095	67.881	17.2858	36.514	03.0654	60.937
6 1.4	02.0010	44.016	36.3236	64.898	17.4363	36.571	03.2723	58.448
6 11.4	02.3306	43.055	36.4849	62.033	17.6515	36.588	03.6799	55.794
6 21.4	02.6464	42.203	36.6515	59.358	17.8526	36.646	04.1235	53.203
7 1.4	03.0179	41.945	36.8746	56.464	18.1074	37.162	04.7338	51.120
7 11.3	03.4621	42.083	37.1511	53.672	18.4241	37.875	05.5474	49.317
7 21.3	03.9202	42.287	37.4371	51.406	18.7503	38.445	06.4539	47.581
7 31.3	04.3574	42.828	37.7284	49.355	19.0667	39.193	07.3836	46.285
8 10.3	04.7935	43.858	38.0390	47.466	19.3932	40.234	08.3771	45.598
8 20.2	05.2817	45.150	38.3788	46.070	19.7668	41.261	09.5263	45.219
8 30.2	05.7356	46.460	38.6975	45.322	20.1146	42.105	10.6601	45.034
9 9.2	06.1081	47.999	38.9824	45.020	20.4068	43.017	11.6896	45.395
9 19.1	06.5169	49.989	39.2933	44.984	20.7418	44.138	12.8234	46.367
9 29.1	06.9255	51.974	39.5926	45.600	21.0797	45.040	13.9816	47.513
10 9.1	07.2349	53.823	39.8290	46.931	21.3417	45.671	14.9711	48.885
10 19.1	07.5192	56.015	40.0568	48.395	21.5991	46.523	15.9168	50.886
10 29.0	07.7994	58.367	40.2770	50.118	21.8630	47.410	16.8483	53.270
11 8.0	08.0314	60.453	40.4497	52.437	22.0894	47.944	17.6691	55.657
11 18.0	08.1897	62.511	40.5761	54.890	22.2653	48.468	18.3176	58.321
11 28.0	08.2796	64.670	40.6656	57.248	22.3976	49.147	18.7979	61.384
12 7.9	08.3701	66.722	40.7396	59.646	22.5350	49.743	19.2257	64.483
12 17.9	08.3977	68.395	40.7603	62.128	22.6205	50.088	19.4708	67.377
12 27.9	08.3018	69.803	40.7084	64.446	22.6094	50.388	19.4190	70.274
12 37.8	08.1974	71.209	40.6484	66.254	22.5974	50.869	19.2780	73.233
Mean Place	05.1169	46.643	38.0919	70.165	19.6813	34.296	10.8859	51.715
sec δ, tan δ	+1.554	+1.189	+1.128	–0.522	+1.118	+0.500	+4.128	+4.005
Dble. Trans.	November 11		November 22		November 23		December 3	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	201		203		210		223	
HIP-No.	25336		25769		26311		27628	
Name	γ Orionis		17 Cam		ϵ Orionis		β Col	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	5^h^26^m^	**+ 6°22′**	**5^h^32^m^**	**+ 63°04′**	**5^h^37^m^**	**– 1°10′**	**5^h^51^m^**	**– 35°45′**
12 25.^d^0	26.^s^0874	17.″564	28.^s^7115	72.″321	26.^s^8913	71.″367	49.^s^8422	31.″817
1 3.9	26.1493	16.879	28.8014	74.893	26.9572	72.516	49.8753	34.577
1 13.9	26.1927	16.060	28.8430	77.161	27.0031	73.780	49.8714	37.395
1 23.9	26.1567	15.244	28.7274	79.122	26.9709	74.984	49.7911	40.003
2 2.9	26.0565	14.777	28.4799	81.065	26.8755	75.777	49.6487	42.019
2 12.8	25.9731	14.470	28.2482	82.722	26.7932	76.360	49.4976	43.642
2 22.8	25.8540	14.034	27.9470	83.712	26.6743	76.996	49.3069	45.064
3 3.8	25.6654	13.694	27.5164	84.274	26.4874	77.448	49.0594	46.032
3 13.7	25.4996	13.726	27.1182	84.632	26.3200	77.460	48.8182	46.301
3 23.7	25.3540	13.826	26.7567	84.462	26.1698	77.330	48.5867	46.154
4 2.7	25.1960	13.754	26.3803	83.591	26.0065	77.297	48.3472	45.840
4 12.7	25.0498	13.986	26.0266	82.487	25.8533	76.891	48.1188	44.893
4 22.6	24.9361	14.543	25.7364	81.224	25.7305	76.098	47.9211	43.326
5 2.6	24.8878	15.014	25.5749	79.475	25.6695	75.354	47.7771	41.624
5 12.6	24.8566	15.509	25.4566	77.377	25.6248	74.537	47.6579	39.659
5 22.6	24.8342	16.318	25.3648	75.337	25.5895	73.364	47.5629	37.188
6 1.5	24.9038	17.351	25.4487	73.338	25.6426	71.958	47.5467	34.407
6 11.5	25.0219	18.269	25.6379	71.083	25.7432	70.658	47.5829	31.661
6 21.5	25.1324	19.214	25.8302	68.845	25.8386	69.330	47.6363	28.859
7 1.4	25.2986	20.505	26.1308	67.006	25.9884	67.670	47.7472	25.751
7 11.4	25.5258	21.821	26.5550	65.316	26.1982	66.008	47.9204	22.695
7 21.4	25.7679	22.842	27.0243	63.584	26.4245	64.672	48.1243	20.061
7 31.4	26.0114	23.936	27.5074	62.210	26.6546	63.293	48.3484	17.497
8 10.3	26.2759	25.168	28.0380	61.336	26.9073	61.823	48.6060	14.998
8 20.3	26.5911	26.112	28.6716	60.615	27.2103	60.711	48.9125	13.070
8 30.3	26.8925	26.714	29.2924	60.001	27.5024	59.995	49.2228	11.734
9 9.3	27.1582	27.273	29.8556	59.876	27.7631	59.378	49.5217	10.722
9 19.2	27.4735	27.761	30.5088	60.223	28.0727	58.917	49.8598	10.142
9 29.2	27.7989	27.803	31.1856	60.645	28.3932	58.976	50.2079	10.336
10 9.2	28.0673	27.468	31.7628	61.267	28.6610	59.474	50.5189	11.223
10 19.1	28.3425	27.181	32.3437	62.459	28.9363	59.999	50.8296	12.401
10 29.1	28.6308	26.748	32.9409	63.977	29.2243	60.739	51.1415	14.039
11 8.1	28.8904	25.838	33.4817	65.482	29.4851	62.018	51.4223	16.446
11 18.1	29.1106	24.885	33.9383	67.300	29.7082	63.382	51.6610	19.117
11 28.0	29.2975	24.090	34.3178	69.565	29.8991	64.622	51.8605	21.812
12 8.0	29.4888	23.144	34.6891	71.886	30.0927	66.051	52.0410	24.828
12 18.0	29.6309	22.021	34.9572	74.096	30.2377	67.662	52.1652	28.071
12 28.0	29.6865	21.051	35.0516	76.464	30.2991	69.100	52.2096	31.138
12 37.9	29.7373	20.357	35.1148	78.987	30.3536	70.253	52.2255	33.890
Mean Place	26.8000	11.666	29.4751	63.134	27.4783	77.407	49.4866	37.566
sec δ, tan δ	+1.006	+0.112	+2.209	+1.970	+1.000	–0.021	+1.232	–0.720
Dble. Trans.	December 12		December 13		December 15		December 18	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	1166		243		245		254	
HIP-No.	29134		30324		30438		32246	
Name	ν Doradus		β Canis Majoris		α Carinae		ϵ Geminorum	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	6^h08^m	**$-68°50'$**	**6^h23^m**	**$-17°57'$**	**6^h24^m**	**$-52°42'$**	**6^h45^m**	**$+25°06'$**
12 $25.^d0$	$38.^s8800$	$46.''420$	$46.^s5008$	$61.''943$	$31.^s1255$	$25.''780$	$25.^s5095$	$25.''157$
1 4.0	38.7946	49.779	46.5935	64.140	31.1597	29.105	25.6677	25.383
1 13.9	38.5901	53.223	46.6604	66.469	31.1345	32.559	25.8042	25.457
1 23.9	38.2770	56.437	46.6492	68.643	31.0232	35.803	25.8453	25.588
2 2.9	37.8708	59.021	46.5717	70.295	30.8361	38.443	25.8077	26.074
2 12.9	37.3689	61.198	46.4948	71.700	30.6107	40.730	25.7810	26.545
2 22.8	36.7999	63.112	46.3762	73.018	30.3356	42.781	25.7009	26.787
3 3.8	36.1890	64.482	46.1892	73.956	30.0037	44.295	25.5292	27.092
3 13.8	35.5355	65.093	46.0090	74.351	29.6557	45.092	25.3705	27.536
3 23.8	34.8712	65.207	45.8361	74.467	29.3054	45.417	25.2191	27.823
4 2.7	34.2196	65.060	45.6471	74.511	28.9501	45.487	25.0386	27.794
4 12.7	33.5885	64.188	45.4608	74.032	28.6007	44.846	24.8571	27.867
4 22.7	33.0037	62.606	45.2971	73.034	28.2782	43.501	24.6991	28.049
5 2.6	32.4735	60.824	45.1865	72.006	28.0055	41.970	24.6031	27.890
5 12.6	32.0155	58.690	45.0901	70.773	27.7668	40.077	24.5143	27.599
5 22.6	31.6481	55.964	45.0029	69.052	27.5651	37.567	24.4268	27.523
6 1.6	31.3624	52.889	44.9953	67.091	27.4372	34.717	24.4381	27.434
6 11.5	31.1763	49.798	45.0342	65.183	27.3736	31.831	24.4985	27.090
6 21.5	31.1018	46.589	45.0749	63.163	27.3532	28.784	24.5482	26.779
7 1.5	31.1219	43.053	45.1681	60.822	27.3964	25.392	24.6577	26.926
7 11.5	31.2456	39.560	45.3210	58.505	27.5128	22.019	24.8321	26.607
7 21.4	31.4730	36.480	45.4983	56.521	27.6846	19.018	25.0333	26.245
7 31.4	31.7911	33.467	45.6869	54.511	27.8976	16.043	25.2400	26.050
8 10.4	32.1983	30.537	45.9040	52.465	28.1607	13.112	25.4774	26.073
8 20.3	32.6754	28.229	46.1755	50.905	28.4840	10.783	25.7813	25.854
8 30.3	33.2165	26.549	46.4471	49.807	28.8350	09.038	26.0780	25.465
9 9.3	33.8139	25.232	46.7005	48.872	29.1989	07.607	26.3459	25.276
9 19.3	34.4321	24.439	47.0043	48.285	29.6012	06.695	26.6839	25.093
9 29.2	35.0651	24.501	47.3260	48.365	30.0235	06.621	27.0450	24.617
10 9.2	35.7024	25.324	47.6094	48.978	30.4297	07.268	27.3549	24.062
10 19.2	36.3062	26.540	47.9031	49.796	30.8305	08.310	27.6875	23.704
10 29.2	36.8671	28.318	48.2114	51.005	31.2255	09.922	28.0482	23.331
11 8.1	37.3689	30.959	48.4994	52.895	31.5909	12.395	28.3890	22.686
11 18.1	37.7882	33.950	48.7538	54.987	31.9075	15.228	28.6969	22.185
11 28.1	38.1181	37.043	48.9774	57.059	32.1728	18.177	28.9777	21.999
12 8.0	38.3360	40.551	49.2002	59.466	32.3968	21.579	29.2726	21.719
12 18.0	38.4405	44.338	49.3754	62.102	32.5522	25.285	29.5164	21.378
12 28.0	38.4356	47.972	49.4704	64.546	32.6201	28.849	29.6659	21.359
12 38.0	38.3018	51.337	49.5499	66.758	32.6284	32.196	29.8120	21.583
Mean Place	34.8365	54.335	46.7620	71.005	29.7679	35.616	26.3183	16.620
sec δ, tan δ	+2.771	–2.585	+1.051	–0.324	+1.651	–1.313	+1.104	+0.469
Dble. Trans.	December 23		December 26		December 27		January 2	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	306		323		348		354	
HIP-No.	39429		42452		45238		46390	
Name	ζ Puppis		Groombridge 1460		β Carinae		α Hydrae	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	8h04m	**− 40°04′**	**8h41m**	**+ 52°37′**	**9h13m**	**− 69°48′**	**9h28m**	**− 8°45′**
12 25.1d	26.7632s	04.505″	05.1707s	29.195″	28.8756s	37.579″	46.4353s	40.415″
1 4.1	26.9485	07.747	05.5487	30.283	29.2735	40.876	46.7017	42.638
1 14.0	27.1026	11.329	05.8899	31.427	29.6021	44.759	46.9605	45.108
1 24.0	27.1740	14.790	06.1025	32.921	29.8145	48.708	47.1430	47.345
2 3.0	27.1619	17.777	06.2169	34.921	29.8698	52.405	47.2521	49.122
2 12.9	27.1254	20.704	06.3256	36.864	29.8135	56.322	47.3610	50.958
2 22.9	27.0373	23.493	06.3326	38.673	29.6723	60.217	47.4173	52.669
3 3.9	26.8706	25.751	06.2022	40.646	29.4187	63.642	47.3836	53.880
3 13.9	26.6788	27.523	06.0658	42.549	29.0432	66.779	47.3368	54.852
3 23.8	26.4730	28.948	05.9010	44.110	28.5994	69.639	47.2737	55.673
4 2.8	26.2445	30.104	05.6586	45.276	28.1284	72.178	47.1705	56.324
4 12.8	25.9955	30.618	05.3899	46.293	27.5795	74.102	47.0389	56.582
4 22.7	25.7453	30.482	05.1281	47.088	26.9738	75.364	46.8970	56.476
5 2.7	25.5349	30.215	04.9068	47.211	26.3918	76.432	46.7869	56.471
5 12.7	25.3308	29.517	04.6661	46.954	25.8159	76.931	46.6614	56.221
5 22.7	25.1246	28.096	04.4192	46.629	25.2227	76.562	46.5118	55.470
6 1.6	24.9792	26.406	04.2825	45.834	24.6561	75.866	46.4219	54.753
6 11.6	24.8803	24.579	04.1852	44.498	24.1630	74.835	46.3587	54.058
6 21.6	24.7914	22.351	04.0704	43.041	23.7255	73.138	46.2746	53.037
7 1.6	24.7452	19.733	04.0437	41.491	23.3177	70.936	46.2261	51.841
7 11.5	24.7597	17.035	04.1041	39.607	22.9943	68.473	46.2264	50.704
7 21.5	24.8183	14.474	04.1881	37.406	22.7953	65.866	46.2469	49.672
7 31.5	24.8993	11.737	04.2974	35.275	22.6645	62.876	46.2713	48.471
8 10.4	25.0170	08.880	04.4701	33.232	22.6046	59.589	46.3210	47.178
8 20.4	25.2066	06.512	04.7363	30.873	22.6816	56.617	46.4381	46.312
8 30.4	25.4243	04.485	05.0064	28.463	22.8798	53.755	46.5656	45.604
9 9.4	25.6471	02.523	05.2740	26.400	23.1529	50.766	46.6836	44.789
9 19.3	25.9312	01.078	05.6565	24.327	23.5178	48.266	46.8764	44.420
9 29.3	26.2594	00.357	06.0813	22.131	24.0061	46.375	47.1133	44.552
10 9.3	26.5833	00.132	06.4679	20.215	24.5844	44.837	47.3362	44.855
10 19.3	26.9269	00.341	06.9191	18.639	25.1940	43.809	47.5985	45.444
10 29.2	27.2967	01.165	07.4301	17.225	25.8507	43.469	47.9066	46.469
11 8.2	27.6726	02.818	07.9315	15.909	26.5766	43.979	48.2314	48.003
11 18.2	28.0258	04.880	08.4189	15.049	27.2877	45.036	48.5522	49.721
11 28.1	28.3497	07.159	08.9041	14.763	27.9461	46.503	48.8671	51.494
12 8.1	28.6748	10.094	09.4190	14.617	28.5870	48.864	49.2163	53.761
12 18.1	28.9590	13.440	09.8754	14.753	29.1822	51.825	49.5426	56.225
12 28.1	29.1632	16.706	10.2324	15.569	29.6679	54.901	49.8018	58.434
12 38.0	29.3330	20.052	10.5951	16.745	30.0334	58.405	50.0625	60.721
Mean Place	26.7484	23.859	05.7427	25.159	27.5193	66.104	47.4750	57.325
sec δ, tan δ	+1.307	−0.841	+1.647	+1.309	+2.899	−2.721	+1.012	−0.154
Dble. Trans.	January 22		January 31		February 8		February 12	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	363		1260		1275		422	
HIP-No.	47594		49339		52098		54872	
Name	Groombridge 1564		193 G. Hydrae		37 LMi		δ Leonis	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	9^{h}44^m	**+ 69°07′**	**10^{h}05^m**	**– 24°23′**	**10^{h}40^m**	**+ 31°50′**	**11^{h}15^m**	**+ 20°23′**
12 25.^{d}1	18.^{s}4770	26.″605	27.^{s}7515	55.″821	04.^{s}3634	57.″936	23.^{s}0030	27.″438
1 4.1	19.1683	27.708	28.0453	58.502	04.7324	56.937	23.3542	25.794
1 14.1	19.7915	29.036	28.3363	61.569	05.0969	56.063	23.7107	24.211
1 24.1	20.2389	30.918	28.5553	64.502	05.3808	55.757	23.9988	23.161
2 3.0	20.5672	33.415	28.6967	67.091	05.5995	56.074	24.2272	22.675
2 13.0	20.8577	35.919	28.8339	69.850	05.8239	56.447	24.4660	22.218
2 23.0	20.9706	38.440	28.9212	72.494	05.9767	57.083	24.6449	22.086
3 4.0	20.8843	41.246	28.9183	74.628	06.0237	58.260	24.7271	22.552
3 13.9	20.7624	43.952	28.8922	76.564	06.0603	59.536	24.7989	23.140
3 23.9	20.5555	46.318	28.8448	78.307	06.0658	60.804	24.8432	23.816
4 2.9	20.1952	48.344	28.7588	79.776	06.0023	62.125	24.8261	24.686
4 12.8	19.7739	50.153	28.6355	80.791	05.9012	63.549	24.7703	25.749
4 22.8	19.3381	51.618	28.4909	81.361	05.7835	64.950	24.6931	26.883
5 2.8	18.9016	52.318	28.3741	81.915	05.6790	65.932	24.6280	27.734
5 12.8	18.4067	52.559	28.2381	82.078	05.5378	66.822	24.5255	28.635
5 22.7	17.9039	52.581	28.0685	81.612	05.3655	67.773	24.3847	29.694
6 1.7	17.5245	51.917	27.9479	81.092	05.2541	68.233	24.2942	30.338
6 11.7	17.1668	50.585	27.8518	80.430	05.1510	68.311	24.2082	30.733
6 21.7	16.7911	49.025	27.7329	79.277	05.0123	68.377	24.0818	31.224
7 1.6	16.5465	47.150	27.6391	77.870	04.9183	68.193	23.9871	31.495
7 11.6	16.4156	44.760	27.5894	76.404	04.8713	67.592	23.9297	31.413
7 21.6	16.3143	41.980	27.5640	74.892	04.8291	66.695	23.8741	31.121
7 31.5	16.2743	39.155	27.5409	73.117	04.7915	65.746	23.8155	30.800
8 10.5	16.3533	36.267	27.5393	71.182	04.7886	64.653	23.7810	30.326
8 20.5	16.5596	32.976	27.6091	69.611	04.8526	63.049	23.8085	29.358
8 30.5	16.7874	29.633	27.6972	68.118	04.9174	61.304	23.8358	28.284
9 9.4	17.0622	26.608	27.7791	66.480	04.9789	59.674	23.8536	27.280
9 19.4	17.5145	23.490	27.9368	65.325	05.1335	57.645	23.9572	25.778
9 29.4	18.0315	20.290	28.1488	64.661	05.3309	55.319	24.1050	23.948
10 9.4	18.5332	17.477	28.3593	64.171	05.5127	53.120	24.2409	22.195
10 19.3	19.1618	15.002	28.6111	64.086	05.7588	50.858	24.4369	20.236
10 29.3	19.8937	12.728	28.9136	64.545	06.0685	48.439	24.6953	18.006
11 8.3	20.6236	10.713	29.2465	65.595	06.3966	45.971	24.9797	15.640
11 18.2	21.3681	09.273	29.5814	66.976	06.7378	43.719	25.2806	13.353
11 28.2	22.1511	08.491	29.9117	68.588	07.0990	41.753	25.6020	11.190
12 8.2	22.9771	07.973	30.2818	70.871	07.5115	39.722	25.9799	08.829
12 18.2	23.7292	07.932	30.6375	73.494	07.9062	37.957	26.3501	06.641
12 28.1	24.3819	08.743	30.9288	76.016	08.2468	36.832	26.6736	04.973
12 38.1	25.0510	09.997	31.2183	78.825	08.6136	35.919	27.0258	03.379
Mean Place	18.2250	27.203	28.9440	77.768	05.5761	53.661	24.4870	20.707
sec δ, tan δ	+2.806	+2.622	+1.098	–0.454	+1.177	+0.621	+1.067	+0.372
Dble. Trans.	February 16		February 21		March 1		March 10	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	423		426		1307		455	
HIP-No.	54879		55282		57939		59747	
Name	ϑ Leonis		δ Crateris		Groombridge 1830		δ Crucis	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	11^h^15^m^	**+ 15°17′**	**11^h^20^m^**	**– 14°54′**	**11^h^54^m^**	**+ 37°32′**	**12^h^16^m^**	**– 58°52′**
12 25.^d^2	29.^s^8796	51.″388	32.^s^3265	22.″553	21.^s^4442	36.″901	24.^s^6848	36.″403
1 4.2	30.2215	49.608	32.6549	24.910	21.8614	35.224	25.2063	38.159
1 14.2	30.5703	47.839	32.9958	27.569	22.2851	33.796	25.7641	40.597
1 24.1	30.8521	46.560	33.2746	30.018	22.6426	33.076	26.2604	43.247
2 3.1	31.0737	45.812	33.4855	32.167	22.9494	33.009	26.6510	46.058
2 13.1	31.3061	45.065	33.7051	34.522	23.2664	33.084	27.0358	49.489
2 23.0	31.4817	44.627	33.8784	36.698	23.5138	33.618	27.3762	53.045
3 4.0	31.5624	44.782	33.9611	38.356	23.6601	34.823	27.6008	56.366
3 14.0	31.6325	45.060	34.0256	39.935	23.7942	36.161	27.7617	59.926
3 24.0	31.6767	45.441	34.0674	41.369	23.8895	37.603	27.8759	63.508
4 2.9	31.6630	46.036	34.0638	42.496	23.9069	39.271	27.9425	66.824
4 12.9	31.6108	46.851	34.0179	43.283	23.8789	41.071	27.9200	69.905
4 22.9	31.5369	47.776	33.9435	43.771	23.8230	42.835	27.8169	72.705
5 2.9	31.4770	48.456	33.8893	44.291	23.7628	44.255	27.7269	75.415
5 12.8	31.3811	49.232	33.8036	44.471	23.6516	45.635	27.5844	77.638
5 22.8	31.2461	50.217	33.6711	44.164	23.4984	47.005	27.3434	79.217
6 1.8	31.1603	50.833	33.5803	43.957	23.3890	47.798	27.1113	80.703
6 11.7	31.0801	51.252	33.5003	43.646	23.2701	48.222	26.8870	81.767
6 21.7	30.9597	51.816	33.3813	42.888	23.1045	48.589	26.6057	82.050
7 1.7	30.8684	52.204	33.2781	42.039	22.9726	48.540	26.2996	81.993
7 11.7	30.8134	52.286	33.2078	41.211	22.8734	47.974	26.0157	81.605
7 21.6	30.7613	52.196	33.1482	40.297	22.7675	47.094	25.7643	80.697
7 31.6	30.7047	52.109	33.0797	39.164	22.6604	46.043	25.4935	79.246
8 10.6	30.6698	51.899	33.0236	37.947	22.5831	44.678	25.2195	77.388
8 20.6	30.6969	51.212	33.0332	37.056	22.5645	42.741	25.0456	75.473
8 30.5	30.7250	50.441	33.0521	36.145	22.5434	40.652	24.9187	73.178
9 9.5	30.7404	49.759	33.0576	35.067	22.5225	38.561	24.7869	70.435
9 19.5	30.8401	48.546	33.1408	34.462	22.5943	35.942	24.7580	67.961
9 29.4	30.9851	47.002	33.2781	34.200	22.7087	33.028	24.8401	65.588
10 9.4	31.1188	45.518	33.4130	33.956	22.8162	30.237	24.9685	63.037
10 19.4	31.3101	43.800	33.5981	34.102	22.9980	27.263	25.1657	60.868
10 29.4	31.5626	41.775	33.8429	34.725	23.2517	24.079	25.4574	59.169
11 8.3	31.8423	39.572	34.1266	35.749	23.5343	20.910	25.8558	57.864
11 18.3	32.1376	37.397	34.4245	37.022	23.8461	17.938	26.2953	56.983
11 28.3	32.4513	35.296	34.7317	38.508	24.1957	15.183	26.7478	56.571
12 8.3	32.8213	32.939	35.0967	40.579	24.6098	12.396	27.2960	57.012
12 18.2	33.1847	30.700	35.4612	42.862	25.0216	09.974	27.8778	57.974
12 28.2	33.5007	28.928	35.7741	45.001	25.4004	08.211	28.4022	59.189
12 38.2	33.8439	27.177	36.1045	47.460	25.8207	06.653	28.9322	61.204
Mean Place	31.4034	42.984	34.0726	41.231	23.0624	33.862	27.6696	66.255
sec δ, tan δ	+1.037	+0.273	+1.035	–0.266	+1.261	+0.769	+1.935	–1.657
Dble. Trans.	March 10		March 12		March 20		March 26	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	464		468		479		1357	
HIP-No.	60823		61084		62131		67057	
Name	σ Centauri		γ Crucis		330 G. Hydrae		83 Vir	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	12^h29^m	**– 50°21′**	**12^h32^m**	**– 57°14′**	**12^h45^m**	**– 28°27′**	**13^h45^m**	**– 16°17′**
12 $25.^d3$	$19.^s6768$	30.″323	$29.^s2279$	31.″378	$16.^s6804$	08.″459	$46.^s6208$	52.″108
1 4.2	20.1281	32.094	29.7389	32.993	17.0457	10.448	46.9601	53.998
1 14.2	20.6168	34.480	30.2920	35.269	17.4452	12.840	47.3431	56.103
1 24.2	21.0505	37.017	30.7883	37.754	17.7960	15.174	47.6889	58.023
2 3.2	21.3963	39.681	31.1853	40.424	18.0822	17.470	47.9859	59.879
2 13.1	21.7498	42.916	31.5850	43.722	18.3890	20.154	48.3171	62.006
2 23.1	22.0647	46.221	31.9440	47.143	18.6608	22.728	48.6206	63.888
3 4.1	22.2752	49.261	32.1900	50.346	18.8427	24.911	48.8430	65.340
3 14.0	22.4425	52.525	32.3797	53.820	19.0052	27.213	49.0585	66.900
3 24.0	22.5747	55.791	32.5265	57.334	19.1447	29.437	49.2568	68.342
4 3.0	22.6620	58.773	32.6257	60.587	19.2402	31.317	49.4112	69.379
4 13.0	22.6763	61.528	32.6390	63.639	19.2833	32.959	49.5188	70.229
4 22.9	22.6264	64.029	32.5739	66.449	19.2836	34.385	49.5877	70.961
5 2.9	22.5925	66.450	32.5223	69.179	19.3005	35.764	49.6699	71.639
5 12.9	22.5103	68.405	32.4163	71.440	19.2747	36.744	49.7058	71.974
5 22.9	22.3415	69.769	32.2103	73.096	19.1807	37.261	49.6724	72.020
6 1.8	22.1899	71.086	32.0139	74.687	19.1145	37.859	49.6643	72.255
6 11.8	22.0427	72.017	31.8213	75.864	19.0484	38.200	49.6470	72.300
6 21.8	21.8369	72.221	31.5658	76.276	18.9253	37.982	49.5638	71.933
7 1.7	21.6140	72.150	31.2841	76.381	18.7978	37.671	49.4728	71.657
7 11.7	21.4106	71.802	31.0205	76.165	18.6886	37.262	49.3910	71.412
7 21.7	21.2257	70.975	30.7819	75.418	18.5817	36.542	49.2971	70.924
7 31.7	21.0172	69.659	30.5183	74.137	18.4500	35.508	49.1698	70.271
8 10.6	20.8030	67.997	30.2469	72.463	18.3139	34.321	49.0306	69.634
8 20.6	20.6729	66.310	30.0701	70.709	18.2417	33.252	48.9421	69.146
8 30.6	20.5711	64.264	29.9324	68.549	18.1763	31.948	48.8468	68.449
9 9.6	20.4544	61.811	29.7833	65.936	18.0878	30.381	48.7198	67.604
9 19.5	20.4299	59.649	29.7350	63.572	18.0786	29.203	48.6655	67.173
9 29.5	20.4949	57.586	29.7923	61.270	18.1311	28.179	48.6615	66.838
10 9.5	20.5862	55.342	29.8893	58.752	18.1859	27.015	48.6509	66.344
10 19.4	20.7398	53.481	30.0552	56.598	18.2958	26.242	48.6943	66.286
10 29.4	20.9775	52.076	30.3154	54.888	18.4763	25.907	48.8007	66.507
11 8.4	21.3018	51.023	30.6800	53.520	18.7159	25.857	48.9683	66.891
11 18.4	21.6612	50.363	31.0871	52.552	18.9830	26.110	49.1657	67.512
11 28.3	22.0357	50.148	31.5106	52.048	19.2682	26.719	49.3889	68.453
12 8.3	22.5005	50.732	32.0344	52.364	19.6333	27.973	49.6978	69.874
12 18.3	22.9943	51.775	32.5951	53.175	20.0185	29.504	50.0334	71.403
12 28.3	23.4372	53.029	33.1025	54.237	20.3619	31.084	50.3390	72.918
12 38.2	23.8981	55.035	33.6244	56.105	20.7370	33.229	50.6923	74.899
Mean Place	22.5678	57.772	32.4181	60.322	19.2472	28.948	49.4145	65.030
sec δ, tan δ	+1.568	–1.207	+1.849	–1.555	+1.137	–0.542	+1.042	–0.292
Dble. Trans.	March 29		March 30		April 2		April 17	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	509		529		1396		564	
HIP-No.	67301		70069		73996		74785	
Name	η Ursae Majoris		ν Cen		45 Bootis		β Librae	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	13h48m	**+ 49°10′**	**14h21m**	**– 56°29′**	**15h08m**	**+ 24°46′**	**15h18m**	**– 9°28′**
12 25.d3	28.s3858	83.″077	58.s6594	32.″023	20.s0934	26.″287	16.s5713	14.″185
1 4.3	28.8170	80.559	59.1575	32.346	20.3914	23.414	16.8628	15.935
1 14.3	29.2772	78.455	59.7393	33.182	20.7381	20.791	17.2123	17.720
1 24.2	29.7065	77.180	60.2907	34.241	21.0695	18.756	17.5413	19.264
2 3.2	30.1197	76.538	60.7712	35.680	21.3847	17.062	17.8398	20.808
2 13.2	30.5544	76.199	61.3008	37.789	21.7426	15.558	18.1894	22.500
2 23.2	30.9328	76.609	61.8127	40.048	22.0798	14.755	18.5260	23.825
3 4.1	31.2303	77.842	62.2208	42.272	22.3564	14.663	18.7955	24.747
3 14.1	31.5172	79.320	62.6043	44.987	22.6387	14.768	19.0729	25.761
3 24.1	31.7578	81.139	62.9616	47.889	22.9044	15.289	19.3430	26.595
4 3.0	31.9124	83.484	63.2717	50.606	23.1217	16.474	19.5755	26.946
4 13.0	32.0130	86.070	63.5013	53.384	23.3002	17.962	19.7687	27.158
4 23.0	32.0700	88.678	63.6524	56.210	23.4448	19.577	19.9273	27.334
5 3.0	32.0911	91.183	63.8180	59.017	23.5835	21.359	20.0987	27.367
5 12.9	32.0391	93.799	63.9130	61.513	23.6688	23.464	20.2221	27.078
5 22.9	31.9288	96.345	63.8845	63.713	23.6909	25.616	20.2732	26.679
6 1.9	31.8266	98.323	63.8618	66.003	23.7242	27.435	20.3445	26.501
6 11.9	31.6813	100.046	63.8195	67.934	23.7284	29.293	20.3975	26.132
6 21.8	31.4707	101.662	63.6740	69.253	23.6627	31.220	20.3742	25.495
7 1.8	31.2689	102.685	63.4826	70.463	23.5859	32.692	20.3341	25.105
7 11.8	31.0685	103.119	63.2837	71.416	23.5022	33.801	20.2904	24.818
7 21.7	30.8368	103.238	63.0709	71.768	23.3864	34.830	20.2192	24.318
7 31.7	30.5907	103.006	62.7968	71.658	23.2340	35.605	20.1014	23.803
8 10.7	30.3598	102.208	62.4826	71.231	23.0666	35.890	19.9577	23.476
8 20.7	30.1631	100.784	62.2402	70.539	22.9249	35.744	19.8490	23.262
8 30.6	29.9547	99.147	62.0003	69.270	22.7613	35.500	19.7179	22.858
9 9.6	29.7503	97.249	61.7121	67.515	22.5687	34.963	19.5416	22.462
9 19.6	29.6275	94.649	61.5184	65.828	22.4342	33.761	19.4261	22.467
9 29.6	29.5410	91.731	61.4140	63.893	22.3296	32.319	19.3481	22.475
10 9.5	29.4607	88.824	61.3232	61.501	22.2141	30.827	19.2525	22.327
10 19.5	29.4651	85.509	61.3064	59.313	22.1542	28.792	19.2071	22.581
10 29.5	29.5495	81.861	61.3917	57.332	22.1566	26.328	19.2253	23.149
11 8.4	29.6781	78.250	61.5857	55.326	22.2026	23.818	19.2934	23.671
11 18.4	29.8629	74.717	61.8372	53.536	22.2886	21.159	19.3920	24.408
11 28.4	30.1161	71.206	62.1260	52.133	22.4187	18.229	19.5255	25.505
12 8.4	30.4534	67.679	62.5526	51.293	22.6340	15.108	19.7526	26.898
12 18.3	30.8183	64.586	63.0442	50.750	22.8839	12.207	20.0161	28.262
12 28.3	31.1938	62.056	63.5046	50.476	23.1336	09.519	20.2630	29.649
12 38.3	31.6389	59.694	64.0296	51.004	23.4497	06.717	20.5741	31.436
Mean Place	30.2196	89.924	63.3717	52.334	22.6749	29.959	19.7226	18.428
sec δ, tan δ	+1.530	+1.158	+1.812	–1.511	+1.101	+0.462	+1.014	–0.167
Dble. Trans.	April 18		April 27		May 8		May 11	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No. / HIP-No. / Name	560 / 74946 / γ Trianguli A		588 / 77622 / ϵ Ser		603 / 79593 / δ Ophiuchi		622 / 81377 / ζ Ophiuchi	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	15^h21^m	**$-68°45'$**	**15^h51^m**	**$+4°24'$**	**16^h15^m**	**$-3°45'$**	**16^h38^m**	**$-10°36'$**
12 25.^{d}4	06.^{s}7099	47.″424	59.^{s}3291	18.″793	34.^{s}6728	21.″447	27.^{s}1815	55.″038
1 4.4	07.3558	46.589	59.5891	16.549	34.9190	23.274	27.4158	56.427
1 14.3	08.1467	46.195	59.9080	14.416	35.2294	25.025	27.7192	57.753
1 24.3	08.9295	46.083	60.2141	12.646	35.5290	26.504	28.0139	58.878
2 3.3	09.6446	46.502	60.5005	10.963	35.8091	28.007	28.2898	60.116
2 13.2	10.4533	47.639	60.8409	09.306	36.1490	29.545	28.6316	61.432
2 23.2	11.2630	49.020	61.1727	08.180	36.4856	30.633	28.9745	62.368
3 4.2	11.9524	50.554	61.4470	07.558	36.7659	31.323	29.2625	63.004
3 14.2	12.6245	52.744	61.7342	06.980	37.0632	32.046	29.5717	63.739
3 24.1	13.2701	55.269	62.0169	06.716	37.3609	32.517	29.8857	64.283
4 3.1	13.8585	57.734	62.2642	07.050	37.6274	32.441	30.1720	64.334
4 13.1	14.3396	60.463	62.4773	07.597	37.8617	32.217	30.4279	64.304
4 23.1	14.7077	63.450	62.6595	08.222	38.0662	31.963	30.6554	64.302
5 3.0	15.0866	66.490	62.8509	09.075	38.2850	31.477	30.9015	64.071
5 13.0	15.3585	69.361	62.9950	10.274	38.4580	30.663	31.1026	63.547
5 23.0	15.4449	72.144	63.0711	11.528	38.5603	29.823	31.2307	63.040
6 1.9	15.5185	75.095	63.1636	12.559	38.6808	29.178	31.3787	62.713
6 11.9	15.5430	77.739	63.2337	13.761	38.7801	28.327	31.5060	62.166
6 21.9	15.4031	79.879	63.2282	15.126	38.8001	27.303	31.5504	61.454
7 1.9	15.1751	81.995	63.2050	16.144	38.7993	26.593	31.5715	61.042
7 11.8	14.9080	83.867	63.1733	16.968	38.7885	26.021	31.5808	60.729
7 21.8	14.5957	85.091	63.1087	17.898	38.7426	25.276	31.5525	60.198
7 31.8	14.1753	85.871	62.9966	18.697	38.6440	24.621	31.4664	59.732
8 10.8	13.6729	86.334	62.8568	19.144	38.5119	24.265	31.3417	59.528
8 20.7	13.2438	86.374	62.7426	19.379	38.4045	24.021	31.2402	59.350
8 30.7	12.7986	85.717	62.6011	19.679	38.2659	23.642	31.1036	58.982
9 9.7	12.2689	84.516	62.4141	19.788	38.0747	23.408	30.9074	58.721
9 19.6	11.8520	83.197	62.2803	19.398	37.9345	23.580	30.7606	58.779
9 29.6	11.5454	81.407	62.1755	18.929	37.8224	23.743	30.6401	58.747
10 9.6	11.2520	78.991	62.0506	18.498	37.6855	23.816	30.4903	58.573
10 19.6	11.0584	76.610	61.9723	17.585	37.5925	24.316	30.3821	58.767
10 29.5	11.0049	74.236	61.9523	16.310	37.5568	25.121	30.3304	59.201
11 8.5	11.1086	71.591	61.9769	15.045	37.5664	25.859	30.3242	59.506
11 18.5	11.3062	69.016	62.0352	13.586	37.6081	26.773	30.3494	59.960
11 28.5	11.5707	66.741	62.1279	11.762	37.6813	28.063	30.4045	60.762
12 8.4	12.0450	64.838	62.3108	09.701	37.8480	29.582	30.5546	61.770
12 18.4	12.6353	63.116	62.5315	07.746	38.0552	31.016	30.7486	62.708
12 28.4	13.2120	61.681	62.7440	05.801	38.2525	32.510	30.9319	63.748
12 38.3	13.9068	61.025	63.0245	03.569	38.5207	34.341	31.1897	65.147
Mean Place	14.0374	62.655	62.3627	20.107	37.9197	20.294	30.6311	53.190
sec δ, tan δ	+2.761	–2.574	+1.003	+0.077	+1.002	–0.066	+1.017	–0.187
Dble. Trans.	May 12		May 19		May 25		May 31	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	625		635		1456		660	
HIP-No.	82273		83613		84862		86670	
Name	α Trianguli A		60 Herculis		72 Herculis		κ Scorpii	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	16^{h}51^m	**– 69°03′**	**17^{h}06^m**	**+ 12°42′**	**17^{h}21^m**	**+ 32°25′**	**17^{h}44^m**	**– 39°02′**
12 25.^{d}4	08.^{s}6985	65.″379	27.^{s}8092	25.″490	31.^{s}6722	67.″436	06.^{s}6102	29.″912
1 4.4	09.1995	63.586	28.0015	22.981	31.8432	64.120	06.8287	29.292
1 14.4	09.8750	61.968	28.2599	20.676	32.0823	61.077	07.1416	28.608
1 24.4	10.5685	60.550	28.5193	18.717	32.3363	58.459	07.4536	27.919
2 3.3	11.2386	59.692	28.7726	16.792	32.5983	55.958	07.7523	27.595
2 13.3	12.0561	59.393	29.0893	15.024	32.9229	53.753	08.1458	27.489
2 23.3	12.9025	59.290	29.4120	13.871	33.2596	52.305	08.5549	27.275
3 4.3	13.6541	59.455	29.6931	13.204	33.5682	51.464	08.9086	27.121
3 14.2	14.4434	60.301	29.9978	12.681	33.9004	50.921	09.3025	27.335
3 24.2	15.2411	61.532	30.3085	12.587	34.2372	50.966	09.7160	27.648
4 3.2	15.9920	62.781	30.5950	13.186	34.5513	51.838	10.1076	27.757
4 13.1	16.6674	64.463	30.8568	14.052	34.8420	53.109	10.4727	28.101
4 23.1	17.2593	66.608	31.0940	15.044	35.1063	54.621	10.8116	28.757
5 3.1	17.8747	68.852	31.3429	16.427	35.3709	56.638	11.1823	29.332
5 13.1	18.3840	71.119	31.5494	18.211	35.5909	59.142	11.5040	29.845
5 23.0	18.7127	73.609	31.6907	20.006	35.7468	61.701	11.7381	30.615
6 2.0	19.0440	76.378	31.8442	21.682	35.9011	64.196	11.9994	31.614
6 12.0	19.3112	78.982	31.9727	23.600	36.0211	66.964	12.2360	32.463
6 22.0	19.3869	81.359	32.0241	25.607	36.0649	69.795	12.3669	33.255
7 1.9	19.3736	83.913	32.0509	27.245	36.0772	72.233	12.4646	34.351
7 11.9	19.3033	86.363	32.0606	28.699	36.0620	74.450	12.5422	35.486
7 21.9	19.1429	88.281	32.0295	30.235	36.0004	76.675	12.5656	36.306
7 31.8	18.8419	89.944	31.9435	31.536	35.8837	78.572	12.5080	37.129
8 10.8	18.4316	91.463	31.8193	32.377	35.7260	79.897	12.3911	38.093
8 20.8	18.0557	92.511	31.7072	33.022	35.5687	80.922	12.2918	38.803
8 30.8	17.6091	92.896	31.5585	33.653	35.3739	81.808	12.1371	39.129
9 9.7	17.0325	92.858	31.3551	33.915	35.1296	82.162	11.8940	39.392
9 19.7	16.5453	92.576	31.1901	33.667	34.9141	81.881	11.6993	39.620
9 29.7	16.1225	91.671	31.0428	33.326	34.7108	81.380	11.5253	39.438
10 9.7	15.6596	90.081	30.8678	32.888	34.4857	80.624	11.3016	38.865
10 19.6	15.2837	88.367	30.7291	31.908	34.2955	79.200	11.1180	38.345
10 29.6	15.0325	86.448	30.6391	30.542	34.1506	77.283	10.9944	37.750
11 8.6	14.9074	83.984	30.5881	29.174	34.0448	75.260	10.9191	36.720
11 18.5	14.8704	81.392	30.5681	27.553	33.9758	72.900	10.8767	35.635
11 28.5	14.9104	78.947	30.5806	25.487	33.9462	70.024	10.8674	34.754
12 8.5	15.1745	76.530	30.6808	23.247	34.0018	66.952	10.9767	33.816
12 18.5	15.5624	74.048	30.8231	21.119	34.1060	63.992	11.1388	32.710
12 28.4	15.9559	71.778	30.9652	18.890	34.2257	60.924	11.2897	31.750
12 38.4	16.5173	70.066	31.1806	16.415	34.4216	57.661	11.5401	31.134
Mean Place	16.8544	68.315	30.9282	31.959	34.6567	75.460	11.0749	24.220
sec δ, tan δ	+2.799	–2.614	+1.025	+0.226	+1.185	+0.636	+1.287	–0.811
Dble. Trans.	June 3		June 7		June 11		June 17	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	671		691		700		699	
HIP-No.	87585		90422		90647		91262	
Name	ξ Draconis		α Telescopii		Groombridge 2655		α Lyrae	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	$17^{\rm h}53^{\rm m}$	**$+56^\circ 51'$**	**$18^{\rm h}28^{\rm m}$**	**$-45^\circ 57'$**	**$18^{\rm h}28^{\rm m}$**	**$+77^\circ 33'$**	**$18^{\rm h}37^{\rm m}$**	**$+38^\circ 47'$**
12 $25^{\rm d}.5$	$54^{\rm s}.0355$	$60''.704$	$42^{\rm s}.5507$	$18''.925$	$28^{\rm s}.3317$	$43''.597$	$42^{\rm s}.9953$	$78''.873$
1 4.5	54.1502	56.895	42.7287	17.705	28.2481	39.862	43.0686	75.536
1 14.4	54.3515	53.363	43.0108	16.307	28.3409	36.339	43.2180	72.420
1 24.4	54.6120	50.230	43.2983	14.897	28.6673	33.090	43.3977	69.556
2 3.4	54.9199	47.202	43.5822	13.873	29.1880	29.833	43.5958	66.652
2 13.3	55.2986	44.544	43.9771	13.001	29.8269	26.915	43.8662	64.065
2 23.3	55.7150	42.702	44.3965	12.050	30.6127	24.742	44.1698	62.177
3 4.3	56.1407	41.495	44.7659	11.251	31.5465	23.114	44.4658	60.771
3 14.3	56.5942	40.692	45.1908	10.837	32.5298	21.878	44.7965	59.709
3 24.2	57.0536	40.590	45.6462	10.573	33.5310	21.344	45.1476	59.294
4 3.2	57.4986	41.412	46.0843	10.192	34.5549	21.726	45.4970	59.731
4 13.2	57.9222	42.733	46.5040	10.136	35.5618	22.616	45.8355	60.614
4 23.2	58.3103	44.401	46.9055	10.490	36.4924	23.888	46.1556	61.823
5 3.1	58.6718	46.716	47.3454	10.802	37.3027	25.891	46.4857	63.719
5 13.1	58.9795	49.612	47.7371	11.165	38.0206	28.520	46.7826	66.188
5 23.1	59.2158	52.620	48.0410	11.924	38.6208	31.300	47.0191	68.758
6 2.0	59.4098	55.683	48.3780	12.939	39.0234	34.254	47.2500	71.478
6 12.0	59.5412	59.104	48.6881	13.880	39.2542	37.657	47.4497	74.620
6 22.0	59.5881	62.602	48.8840	14.896	39.3502	41.182	47.5746	77.854
7 2.0	59.5741	65.747	49.0455	16.271	39.2599	44.444	47.6575	80.817
7 11.9	59.4976	68.711	49.1830	17.727	38.9664	47.628	47.7041	83.703
7 21.9	59.3538	71.681	49.2549	18.926	38.5179	50.888	47.7004	86.668
7 31.9	59.1432	74.285	49.2351	20.199	37.9413	53.826	47.6323	89.319
8 10.9	58.8718	76.275	49.1471	21.654	37.2113	56.208	47.5078	91.435
8 20.8	58.5678	77.949	49.0679	22.816	36.3238	58.364	47.3706	93.364
8 30.8	58.2192	79.410	48.9182	23.615	35.3582	60.331	47.1884	95.136
9 9.8	57.8242	80.224	48.6650	24.385	34.3389	61.646	46.9432	96.290
9 19.7	57.4306	80.349	48.4544	25.023	33.2199	62.335	46.7067	96.882
9 29.7	57.0366	80.179	48.2534	25.180	32.0582	62.754	46.4716	97.262
10 9.7	56.6348	79.618	47.9869	24.923	30.9354	62.742	46.2066	97.259
10 19.7	56.2631	78.293	47.7560	24.608	29.8268	61.964	45.9586	96.557
10 29.6	55.9310	76.391	47.5813	24.097	28.7435	60.604	45.7411	95.338
11 8.6	55.6467	74.284	47.4476	23.033	27.7529	59.003	45.5571	93.937
11 18.6	55.4182	71.735	47.3440	21.810	26.8951	56.892	45.4024	92.080
11 28.6	55.2487	68.567	47.2742	20.693	26.1723	54.089	45.2768	89.577
12 8.5	55.1691	65.160	47.3288	19.348	25.5771	51.011	45.2308	86.850
12 18.5	55.1657	61.803	47.4395	17.741	25.1761	47.892	45.2374	84.111
12 28.5	55.2221	58.244	47.5407	16.262	25.0015	44.442	45.2627	81.047
12 38.4	55.3708	54.481	47.7538	14.999	24.9930	40.724	45.3631	77.733
Mean Place	57.2066	70.019	47.3208	0 8.179	33.1695	51.743	46.1337	87.992
sec δ, tan δ	+1.830	+1.532	+1.438	–1.034	+4.644	+4.535	+1.283	+0.804
Dble. Trans.	June 19		June 28		June 28		June 30	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	725		1517		748		1533	
HIP-No.	94834		97290		98495		101101	
Name	ω Aql		56 Sagittarii		ϵ Pavonis		69 Aquilae	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	19h18m	**+ 11°38′**	**19h47m**	**– 19°42′**	**20h03m**	**– 72°50′**	**20h30m**	**– 2°48′**
12 25.d5	54.s8043	17.″494	43.s8389	17.″112	15.s2296	54.″392	52.s6132	24.″186
1 4.5	54.8658	15.433	43.9008	17.290	15.2353	51.718	52.6235	25.227
1 14.5	54.9990	13.596	44.0456	16.972	15.4303	48.592	52.7033	25.970
1 24.5	55.1429	11.893	44.1727	16.924	15.6786	45.391	52.7870	26.650
2 3.4	55.2884	10.021	44.3141	16.925	16.0010	42.530	52.8688	27.567
2 13.4	55.5116	08.389	44.5451	16.748	16.5614	39.636	53.0354	28.215
2 23.4	55.7624	07.275	44.8019	16.252	17.2018	36.720	53.2331	28.470
3 4.4	55.9913	06.415	45.0277	15.747	17.8190	34.142	53.4093	28.657
3 14.3	56.2621	05.747	45.3075	15.268	18.6000	31.958	53.6378	28.694
3 24.3	56.5619	05.537	45.6236	14.616	19.4783	30.059	53.9062	28.387
4 3.3	56.8629	05.971	45.9388	13.627	20.3469	28.284	54.1838	27.624
4 13.2	57.1590	06.657	46.2531	12.695	21.2393	27.051	54.4669	26.745
4 23.2	57.4478	07.496	46.5674	11.918	22.1541	26.461	54.7552	25.827
5 3.2	57.7687	08.910	46.9255	10.828	23.1346	25.993	55.0908	24.408
5 13.2	58.0655	10.732	47.2592	09.634	24.0460	25.887	55.4124	22.744
5 23.1	58.3070	12.513	47.5363	08.758	24.8458	26.509	55.6871	21.264
6 2.1	58.5692	14.416	47.8506	07.932	25.7094	27.498	55.9978	19.645
6 12.1	58.8171	16.676	48.1542	06.958	26.5065	28.665	56.3049	17.757
6 22.1	58.9919	18.949	48.3760	06.153	27.1030	30.250	56.5421	15.998
7 2.0	59.1388	20.964	48.5771	05.696	27.6489	32.339	56.7595	14.484
7 12.0	59.2661	22.937	48.7643	05.351	28.1305	34.660	56.9648	13.005
7 22.0	59.3497	25.025	48.9019	04.921	28.4467	36.922	57.1277	11.464
7 31.9	59.3686	26.837	48.9674	04.767	28.5853	39.440	57.2239	10.228
8 10.9	59.3343	28.203	48.9776	05.002	28.5889	42.246	57.2661	09.408
8 20.9	59.2996	29.541	48.9901	05.122	28.5376	44.725	57.3080	08.522
8 30.9	59.2155	30.821	48.9408	05.184	28.3007	46.933	57.2929	07.705
9 9.8	59.0557	31.595	48.8017	05.587	27.8540	49.183	57.1913	07.383
9 19.8	58.9130	32.033	48.6856	06.048	27.4250	51.086	57.1031	07.207
9 29.8	58.7711	32.440	48.5655	06.293	26.9340	52.383	57.0075	06.965
10 9.8	58.5816	32.605	48.3803	06.521	26.2699	53.215	56.8488	06.936
10 19.7	58.4050	32.284	48.2091	06.904	25.6343	53.700	56.6935	07.202
10 29.7	58.2563	31.653	48.0677	07.275	25.0521	53.691	56.5572	07.598
11 8.7	58.1313	31.017	47.9435	07.331	24.4752	52.858	56.4322	07.879
11 18.6	58.0209	30.067	47.8288	07.403	23.9318	51.579	56.3090	08.347
11 28.6	57.9251	28.601	47.7275	07.711	23.4567	50.103	56.1893	09.186
12 8.6	57.9072	27.068	47.7120	07.789	23.1750	47.972	56.1414	09.896
12 18.6	57.9276	25.578	47.7311	07.635	22.9846	45.313	56.1223	10.497
12 28.5	57.9419	23.755	47.7353	07.677	22.8204	42.618	56.0853	11.415
12 38.5	58.0272	21.723	47.8233	07.766	22.8925	39.789	56.1176	12.395
Mean Place	58.0019	28.547	47.3405	0 1.049	22.8972	31.839	55.7478	0 9.031
sec δ, tan δ	+1.021	+0.206	+1.062	–0.358	+3.390	–3.239	+1.001	–0.049
Dble. Trans.	July 11		July 18		July 22		July 29	

APPARENT PLACES OF STARS, 2024

TEN-DAY STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK5-No.	777		1546		1577		855	
HIP-No.	102098		102978		108036		112029	
Name	α Cygni		ω Capricorni		μ Capricorni		ζ Pegasi	
U.T.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	20h42m	**+ 45°21′**	**20h53m**	**– 26°49′**	**21h54m**	**– 13°26′**	**22h42m**	**+ 10°57′**
12 25.d6	12.s8442	62.″159	13.s4285	54.″168	34.s9487	26.″971	38.s5325	23.″952
1 4.6	12.7433	59.407	13.4274	53.891	34.8992	27.366	38.4403	22.851
1 14.5	12.7220	56.694	13.5002	53.179	34.9111	27.355	38.4029	21.933
1 24.5	12.7403	53.854	13.5734	52.373	34.9199	27.289	38.3620	20.855
2 3.5	12.7760	50.688	13.6451	51.743	34.9260	27.386	38.3092	19.506
2 13.5	12.8952	47.762	13.8161	50.781	35.0297	27.097	38.3321	18.496
2 23.4	13.0771	45.263	14.0177	49.540	35.1309	26.502	38.3913	17.716
3 4.4	13.2759	42.922	14.1939	48.372	35.2343	25.916	38.4373	16.844
3 14.4	13.5263	40.901	14.4350	47.173	35.3976	25.136	38.5383	16.244
3 24.4	13.8270	39.475	14.7229	45.819	35.6100	24.065	38.6926	16.034
4 3.3	14.1661	38.766	15.0171	44.232	35.8390	22.701	38.8781	16.181
4 13.3	14.5192	38.489	15.3223	42.751	36.0853	21.292	39.0847	16.540
4 23.3	14.8739	38.621	15.6410	41.467	36.3516	19.894	39.3125	17.121
5 3.2	15.2710	39.610	16.0137	39.906	36.6785	18.070	39.6091	18.324
5 13.2	15.6656	41.216	16.3713	38.361	37.0036	16.161	39.9167	19.807
5 23.2	16.0125	43.016	16.6835	37.241	37.2958	14.546	40.1972	21.254
6 2.2	16.3644	45.313	17.0444	36.158	37.6398	12.773	40.5280	23.147
6 12.1	16.7074	48.228	17.4016	35.023	37.9919	10.859	40.8785	25.402
6 22.1	16.9868	51.312	17.6820	34.213	38.2833	09.244	41.1811	27.556
7 2.1	17.2180	54.421	17.9493	33.772	38.5668	07.868	41.4732	29.732
7 12.1	17.4126	57.747	18.2077	33.485	38.8483	06.565	41.7660	32.067
7 22.0	17.5632	61.301	18.4154	33.232	39.0911	05.334	42.0330	34.448
8 1.0	17.6400	64.669	18.5506	33.346	39.2706	04.489	42.2418	36.574
8 11.0	17.6403	67.714	18.6306	33.891	39.3999	04.070	42.3988	38.430
8 20.9	17.6179	70.827	18.7082	34.329	39.5285	03.586	42.5582	40.411
8 30.9	17.5434	73.821	18.7157	34.806	39.5950	03.281	42.6656	42.194
9 9.9	17.3804	76.212	18.6257	35.699	39.5692	03.520	42.6830	43.423
9 19.9	17.1979	78.288	18.5514	36.567	39.5518	03.785	42.7006	44.613
9 29.8	17.0018	80.220	18.4616	37.220	39.5172	03.988	42.7041	45.753
10 9.8	16.7563	81.646	18.2923	37.915	39.4051	04.460	42.6361	46.436
10 19.8	16.4928	82.455	18.1270	38.656	39.2859	05.075	42.5491	46.849
10 29.8	16.2304	82.803	17.9810	39.280	39.1742	05.682	42.4594	47.110
11 8.7	15.9860	82.863	17.8371	39.539	39.0571	06.127	42.3646	47.260
11 18.7	15.7455	82.333	17.6913	39.725	38.9270	06.645	42.2485	47.090
11 28.7	15.5015	81.047	17.5507	40.024	38.7880	07.366	42.1083	46.512
12 8.6	15.3188	79.493	17.4869	39.919	38.7083	07.761	42.0144	46.013
12 18.6	15.1818	77.681	17.4486	39.501	38.6435	07.968	41.9311	45.416
12 28.6	15.0474	75.219	17.3893	39.226	38.5492	08.417	41.8098	44.337
12 38.6	14.9724	72.412	17.4116	38.821	38.5179	08.701	41.7325	43.253
Mean Place	16.0712	67.894	16.7212	33.154	37.7414	0 7.420	41.0904	35.544
sec δ, tan δ	+1.423	+1.013	+1.121	–0.506	+1.028	–0.239	+1.019	+0.194
Dble. Trans.	August 1		August 4		August 19		September 1	

APPARENT PLACES OF STARS, 2024

NORTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 907 = Hipparcos Star No. 11767 = α Ursae Minoris (Polaris)

Day	January		February		March		April		May		June	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	03^h02^m	$+89°22'$	03^h01^m	$+89°22'$	03^h00^m	$+89°22'$	03^h00^m	$+89°21'$	03^h00^m	$+89°21'$	03^h01^m	$+89°21'$
1	85.138	10.581	92.017	15.425	97.321	14.462	54.780	68.257	41.965	59.653	01.336	51.028
2	83.496	10.807	90.197	15.441	95.817	14.311	53.955	68.041	41.836	59.392	02.389	50.740
3	81.895	11.014	88.481	15.460	94.374	14.175	53.015	67.831	41.671	59.109	03.646	50.449
4	80.367	11.205	86.842	15.490	92.939	14.057	51.952	67.615	41.557	58.798	05.097	50.168
5	78.933	11.389	85.229	15.536	91.448	13.956	50.801	67.378	41.584	58.462	06.684	49.909
6	77.600	11.571	83.574	15.602	89.842	13.866	49.641	67.111	41.820	58.109	08.327	49.680
7	76.350	11.762	81.805	15.684	88.086	13.776	48.574	66.810	42.282	57.756	09.942	49.479
8	75.141	11.970	79.865	15.771	86.190	13.669	47.695	66.482	42.933	57.418	11.470	49.299
9	73.904	12.199	77.742	15.847	84.220	13.531	47.048	66.142	43.691	57.105	12.882	49.131
10	72.562	12.447	75.483	15.895	82.281	13.354	46.617	65.807	44.467	56.820	14.182	48.965
11	71.045	12.707	73.186	15.904	80.482	13.142	46.331	65.490	45.187	56.557	15.399	48.791
12	69.322	12.964	70.960	15.874	78.891	12.908	46.100	65.197	45.807	56.309	16.575	48.607
13	67.417	13.200	68.887	15.815	77.512	12.668	45.844	64.925	46.321	56.065	17.754	48.407
14	65.406	13.404	66.995	15.741	76.294	12.437	45.511	64.668	46.744	55.816	18.983	48.194
15	63.389	13.570	65.262	15.667	75.159	12.224	45.080	64.417	47.112	55.557	20.299	47.970
16	61.453	13.704	63.631	15.603	74.029	12.029	44.554	64.164	47.467	55.282	21.733	47.740
17	59.651	13.816	62.033	15.554	72.846	11.849	43.957	63.901	47.854	54.992	23.302	47.510
18	57.993	13.919	60.405	15.520	71.573	11.677	43.325	63.624	48.315	54.687	25.009	47.289
19	56.450	14.026	58.699	15.496	70.200	11.505	42.699	63.328	48.886	54.371	26.836	47.083
20	54.968	14.144	56.886	15.476	68.737	11.326	42.123	63.014	49.594	54.049	28.748	46.900
21	53.484	14.277	54.960	15.452	67.208	11.132	41.639	62.684	50.452	53.728	30.689	46.744
22	51.938	14.424	52.932	15.417	65.649	10.920	41.281	62.342	51.454	53.417	32.593	46.616
23	50.285	14.580	50.831	15.365	64.104	10.687	41.070	61.993	52.572	53.123	34.400	46.511
24	48.500	14.739	48.696	15.291	62.617	10.432	41.011	61.646	53.761	52.852	36.072	46.417
25	46.580	14.892	46.571	15.193	61.228	10.160	41.091	61.308	54.961	52.607	37.611	46.321
26	44.544	15.031	44.501	15.073	59.966	09.874	41.275	60.987	56.111	52.385	39.057	46.211
27	42.422	15.151	42.521	14.933	58.849	09.581	41.513	60.687	57.161	52.180	40.486	46.079
28	40.259	15.248	40.660	14.780	57.875	09.289	41.748	60.409	58.090	51.979	41.983	45.924
29	38.099	15.321	38.928	14.621	57.023	09.006	41.925	60.149	58.911	51.772	43.620	45.751
30	35.984	15.372	37.321	14.462	56.259	08.738	42.002	59.901	59.674	51.548	45.439	45.573
31	33.949	15.405			55.530	08.488	41.965	59.653	60.454	51.300	47.438	45.401
32	32.017	15.425			54.780	08.257			61.336	51.028		
	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)
	91.02	91.01	91.09	91.09	90.95	90.94	90.63	90.63	90.28	90.28	89.99	89.98

Mean R.A. $03^h03^m40\overset{s}{.}462$ Double lower transit May 7 Mean Dec. $+89°21'56\overset{''}{.}421$

APPARENT PLACES OF STARS, 2024

NORTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 907 = Hipparcos Star No. 11767 = α Ursae Minoris (Polaris)

Day	July		August		September		October		November		December	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	03^h01^m	+ $89°21'$	03^h02^m	+ $89°21'$	03^h03^m	+ $89°21'$	03^h04^m	+ $89°21'$	03^h05^m	+ $89°22'$	03^h05^m	+ $89°22'$
1	47.438	45.401	51.468	44.130	56.841	47.819	50.142	55.252	24.919	05.616	30.929	16.903
2	49.577	45.250	53.754	44.210	58.591	48.029	51.424	55.528	25.716	05.941	30.765	17.276
3	51.787	45.126	55.908	44.301	60.302	48.224	52.764	55.795	26.564	06.278	30.479	17.664
4	53.992	45.032	57.937	44.393	62.020	48.407	54.184	56.057	27.425	06.633	30.033	18.061
5	56.126	44.962	59.866	44.480	63.787	48.577	55.687	56.322	28.253	07.009	29.413	18.456
6	58.145	44.911	61.739	44.555	65.630	48.741	57.265	56.598	28.997 29.611	07.405 07.817	28.635	18.839
7	60.040	44.866	63.601	44.617	67.566	48.905	58.890	56.890	30.065	08.238	27.746	19.200
8	61.826	44.820	65.497	44.666	69.595	49.076	60.525	57.202	30.349	08.658	26.816	19.532
9	63.539	44.764	67.465	44.706	71.703	49.260	62.122	57.538	30.485	09.066	25.927	19.836
10	65.225	44.696	69.528	44.742	73.861	49.463	63.630	57.897	30.526	09.452	25.149	20.119
11	66.931	44.615	71.698	44.781	76.027	49.691	65.006	58.272	30.554	09.810	24.522	20.392
12	68.698	44.521	73.973	44.830	78.151	49.945	66.218	58.657	30.658	10.142	24.036	20.670
13	70.559	44.421	76.334	44.896	80.177	50.223	67.263	59.040	30.908	10.457	23.632	20.968
14	72.536	44.318	78.746	44.985	82.057	50.519	68.175	59.407	31.326	10.773	23.218	21.290
15	74.637	44.222	81.160	45.102	83.767	50.820	69.029	59.748	31.870	11.104	22.701	21.636
16	76.853	44.139	83.516	45.247	85.321	51.113	69.923	60.062	32.450	11.462	22.012	21.998
17	79.159	44.076	85.754	45.415	86.779	51.384	70.951	60.353	32.963	11.850	21.125	22.361
18	81.509	44.040	87.833	45.596	88.243	51.627	72.158	60.638	33.323	12.259	20.056	22.715
19	83.845	44.032	89.746	45.776	89.814	51.845	73.524	60.935	33.492	12.678	18.847	23.051
20	86.099	44.052	91.539	45.939	91.560	52.050	74.971	61.257	33.468	13.096	17.554	23.363
21	88.218	44.090	93.300	46.077	93.481	52.261	76.394	61.610	33.283	13.503	16.229	23.651
22	90.179	44.134	95.132	46.188	95.520	52.492	77.707	61.989	32.983	13.893	14.919	23.917
23	92.007	44.169	97.115	46.282	97.591	52.752	78.855	62.385	32.619	14.262	13.660	24.166
24	93.769	44.182	99.275	46.373	99.606	53.041	79.823	62.789	32.239	14.611	12.472	24.403
25	95.558	44.170	101.587	46.478	101.501	53.353	80.625	63.189	31.883	14.943	11.363	24.636
26	97.461	44.138	103.985	46.607	103.243	53.680	81.295	63.578	31.582	15.262	10.325	24.872
27	99.530	44.095	106.392	46.765	104.827	54.012	81.877	63.953	31.351	15.576	09.335	25.116
28	101.773	44.056	108.737	46.950	106.271	54.340	82.418	64.310	31.193	15.890	08.352	25.375
29	104.154	44.034	110.967	47.157	107.610	54.658	82.961	64.650	31.094	16.212	07.327	25.651
30	106.611	44.038	113.058	47.376	108.885	54.963	83.545	64.978	31.021	16.549	06.205	25.942
31	109.071	44.071	115.009	47.600	110.142	55.252	84.193	65.298	30.929	16.903	04.937	26.242
32	111.468	44.130	116.841	47.819			84.919	65.616			03.498	26.542
	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)
	89.84	89.84	89.89	89.88	90.12	90.11	90.47	90.47	90.93	90.92	91.35	91.34

Mean R.A. $03^h03^m40^s.462$ Double lower transit May 7 Mean Dec. $+89°21'56''.421$

APPARENT PLACES OF STARS, 2024

NORTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 1644 = Hipparcos Star No. 72573 = Grb 2196 UMi

Day	January		February		March		April		May		June	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	14^h48^m	$+82°24'$	14^h48^m	$+82°24'$	14^h49^m	$+82°24'$	14^h49^m	$+82°24'$	14^h49^m	$+82°24'$	14^h49^m	$+82°24'$
1	50.737	21.123	55.653	16.156	00.446	17.187	04.101	23.609	05.259	32.466	03.714	41.585
2	50.888	20.885	55.815	16.142	00.578	17.348	04.177	23.840	05.272	32.729	03.616	41.882
3	51.036	20.667	55.971	16.127	00.708	17.497	04.259	24.060	05.286	33.010	03.504	42.173
4	51.179	20.466	56.123	16.105	00.837	17.630	04.350	24.281	05.295 05.294	33.317 33.652	03.383	42.446
5	51.315	20.276	56.274	16.068	00.972	17.744	04.445	24.517	05.277	34.007	03.258	42.692
6	51.446	20.090	56.429	16.013	01.114	17.845	04.540	24.780	05.244	34.369	03.136	42.909
7	51.572	19.899	56.592	15.940	01.265	17.941	04.627	25.076	05.198	34.722	03.020	43.100
8	51.697	19.695	56.767	15.858	01.426	18.047	04.701	25.402	05.144	35.054	02.912	43.276
9	51.825	19.471	56.954	15.780	01.590	18.179	04.758	25.748	05.089	35.358	02.812	43.446
10	51.962	19.227	57.149	15.723	01.752	18.347	04.798	26.095	05.038	35.636	02.716	43.620
11	52.111	18.968	57.346	15.701	01.902	18.553	04.829	26.429	04.995	35.897	02.622	43.804
12	52.274	18.706	57.537	15.720	02.037	18.787	04.855	26.741	04.958	36.149	02.527	44.002
13	52.449	18.458	57.716	15.773	02.156	19.034	04.884	27.029	04.927	36.403	02.427	44.213
14	52.631	18.239	57.882	15.847	02.264	19.277	04.918	27.300	04.899	36.665	02.320	44.437
15	52.812	18.056	58.035	15.926	02.365	19.505	04.959	27.561	04.871	36.941	02.204	44.669
16	52.986	17.909	58.182	16.000	02.467	19.715	05.005	27.821	04.838	37.232	02.078	44.902
17	53.150	17.788	58.327	16.060	02.572	19.908	05.056	28.088	04.800	37.539	01.943	45.131
18	53.304	17.682	58.474	16.104	02.684	20.090	05.108	28.369	04.752	37.858	01.800	45.346
19	53.450	17.577	58.627	16.137	02.803	20.270	05.158	28.666	04.695	38.186	01.653	45.541
20	53.592	17.463	58.788	16.163	02.927	20.454	05.203	28.982	04.627	38.514	01.505	45.710
21	53.735	17.336	58.956	16.190	03.054	20.650	05.241	29.315	04.550	38.837	01.359	45.850
22	53.883	17.193	59.131	16.226	03.182	20.863	05.269	29.662	04.465	39.145	01.221	45.966
23	54.039	17.040	59.309	16.277	03.308	21.097	05.287	30.018	04.376	39.432	01.093	46.065
24	54.204	16.882	59.488	16.349	03.429	21.352	05.293	30.375	04.287	39.693	00.973	46.160
25	54.379	16.727	59.666	16.444	03.541	21.626	05.291	30.725	04.202	39.931	00.858	46.265
26	54.560	16.583	59.838	16.562	03.644	21.916	05.282	31.062	04.124	40.148	00.744	46.388
27	54.747	16.457	60.003	16.701	03.737	22.216	05.270	31.380	04.054	40.355	00.624	46.535
28	54.936	16.353	60.159	16.856	03.820	22.517	05.259	31.675	03.991	40.564	00.493	46.702
29	55.123	16.273	60.307	17.021	03.894	22.813	05.252	31.950	03.931	40.786	00.349	46.880
30	55.306	16.216	60.446	17.187	03.964	23.096	05.252	32.211	03.868	41.030	00.192	47.056
31	55.483	16.179			04.032	23.362	05.259	32.466	03.798	41.298	00.026	47.216
32	55.653	16.156			04.101	23.609			03.714	41.585		
	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)
	7.57	7.50	7.57	7.50	7.57	7.50	7.57	7.50	7.57	7.50	7.57	7.51

Mean R.A. $14^h48^m51^s.202$ Double lower transit November 2 Mean Dec. $+82°24'34''.946$

APPARENT PLACES OF STARS, 2024

NORTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 1644 = Hipparcos Star No. 72573 = Grb 2196 UMi

Day	July		August		September		October		November		December	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	14^h48^m	$+82°24'$	14^h48^m	$+82°24'$	14^h48^m	$+82°24'$	14^h48^m	$+82°24'$	14^h48^m	$+82°24'$	14^h48^m	$+82°24'$
1	60.026	47.216	54.994	48.238	49.946	44.144	45.974	36.192	43.721	25.239	44.015	13.831
2	59.855	47.351	54.827	48.143	49.811	43.930	45.874	35.905	43.674	24.889	44.058	13.453
3	59.685	47.456	54.669	48.043	49.676	43.730	45.769	35.624	43.627	24.523	44.111	13.058
4	59.520	47.534	54.516	47.947	49.536	43.542	45.659	35.343	43.585	24.138	44.176	12.653
5	59.364	47.591	54.367	47.859	49.390	43.362	45.544	35.054	43.551	23.732	44.253	12.245
6	59.217	47.636	54.218	47.785	49.239	43.184	45.428	34.750	43.527	23.308	44.341	11.846
7	59.077	47.680	54.065	47.724	49.081	43.002	45.313	34.427	43.515	22.873	44.435	11.466
8	58.941	47.730	53.906	47.673	48.919	42.809	45.203	34.081	43.515	22.435	44.532	11.113
9	58.805	47.792	53.741	47.627	48.755	42.598	45.101	33.713	43.525	22.006	44.626	10.788
10	58.667	47.867	53.568	47.581	48.593	42.364	45.008	33.325	43.541	21.595	44.712	10.489
11	58.524	47.954	53.388	47.528	48.435	42.105	44.928	32.925	43.558	21.211	44.788	10.203
12	58.373	48.051	53.204	47.459	48.285	41.820	44.860	32.523	43.569	20.853	44.856	09.919
13	58.214	48.151	53.018	47.370	48.146	41.515	44.800	32.131	43.571	20.516	44.918	09.620
14	58.047	48.247	52.833	47.254	48.019	41.200	44.744	31.761	43.562	20.186	44.983	09.298
15	57.872	48.334	52.653	47.110	47.903	40.886	44.685	31.418	43.545	19.846	45.056	08.951
16	57.692	48.402	52.483	46.940	47.793	40.590	44.617	31.101	43.527	19.482	45.142	08.585
17	57.511	48.445	52.323	46.753	47.682	40.319	44.537	30.796	43.515	19.089	45.242	08.213
18	57.331	48.460	52.175	46.560	47.563	40.076	44.447	30.487	43.515	18.671	45.355	07.847
19	57.158	48.447	52.035	46.378	47.432	39.851	44.351	30.156	43.529	18.239	45.476	07.497
20	56.995	48.411	51.896	46.219	47.288	39.627	44.259	29.796	43.557	17.804	45.603	07.169
21	56.842	48.363	51.752	46.086	47.137	39.387	44.175	29.407	43.596	17.378	45.731	06.866
22	56.699	48.319	51.596	45.975	46.985	39.121	44.105	28.997	43.643	16.968	45.856	06.586
23	56.559	48.291	51.428	45.872	46.837	38.825	44.048	28.577	43.693	16.578	45.978	06.326
24	56.416	48.288	51.249	45.761	46.700	38.503	44.002	28.156	43.743	16.209	46.095	06.079
25	56.264	48.308	51.064	45.630	46.574	38.163	43.966	27.744	43.792	15.858	46.206	05.840
26	56.100	48.343	50.880	45.470	46.460	37.815	43.935	27.347	43.836	15.521	46.314	05.601
27	55.923	48.379	50.702	45.282	46.355	37.468	43.906	26.966	43.876	15.193	46.420	05.355
28	55.737	48.402	50.532	45.070	46.257	37.128	43.877	26.603	43.912	14.867	46.527	05.096
29	55.546	48.402	50.373	44.842	46.163	36.801	43.844	26.254	43.946	14.535	46.639	04.823
30	55.356	48.374	50.223	44.606	46.070	36.489	43.808	25.914	43.979	14.191	46.758	04.533
31	55.171	48.318	50.082	44.371	45.974	36.192	43.766	25.578	44.015	13.831	46.888	04.232
32	54.994	48.238	49.946	44.144			43.721	25.239			47.030	03.927
	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)
	7.57	7.51	7.57	7.51	7.57	7.51	7.57	7.50	7.57	7.50	7.56	7.50

Mean R.A. $14^h48^m51^s.202$ Double lower transit November 2 Mean Dec. $+82°24'34''.946$

APPARENT PLACES OF STARS, 2024

SOUTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 1662 = Hipparcos Star No. 30678 = A Octantis

Day	January		February		March		April		May		June	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	06^h04^m	$-88°45'$	06^h03^m	$-88°45'$	06^h03^m	$-88°45'$	06^h02^m	$-88°45'$	06^h02^m	$-88°45'$	06^h02^m	$-88°44'$
1	44.741	04.039	83.910	12.837	53.059	17.713	75.448	18.393	42.305	14.447	18.576	66.704
2	44.447	04.346	83.045	13.111	51.852	17.856	74.123	18.310	41.345	14.194	18.152	66.437
3	44.139	04.672	82.110	13.387	50.583	17.984	72.833	18.200	40.465	13.947	17.696	66.191
4	43.797	05.014	81.099	13.655	49.265	18.088	71.608	18.070	39.645	13.718	17.186	65.956
5	43.401	05.370	80.016	13.904	47.921	18.161	70.461	17.934	38.850	13.516	16.621	65.714
6	42.932	05.736	78.882	14.125	46.585	18.202	69.388	17.811	38.038	13.341	16.016	65.454
7	42.379	06.101	77.729	14.313	45.293	18.216	68.359	17.712	37.175	13.183	15.403	65.168
8	41.741	06.454	76.599	14.469	44.074	18.215	67.329	17.642	36.247	13.026	14.815	64.854
9	41.032	06.785	75.529	14.604	42.934	18.219	66.255	17.595	35.263	12.854	14.281	64.518
10	40.283	07.085	74.534	14.736	41.850	18.243	65.113	17.557	34.251	12.657	13.818	64.167
11	39.534	07.353	73.602	14.883	40.781	18.296	63.904	17.509	33.245	12.431	13.430	63.811
12	38.826	07.597	72.697	15.056	39.680	18.376	62.648	17.439	32.276	12.177	13.114	63.458
13	38.181	07.831	71.775	15.257	38.514	18.470	61.378	17.341	31.366	11.902	12.858	63.117
14	37.600	08.073	70.798	15.477	37.276	18.562	60.125	17.213	30.526	11.616	12.645	62.791
15	37.056	08.337	69.749	15.704	35.977	18.638	58.913	17.061	29.755	11.326	12.456	62.483
16	36.511	08.628	68.628	15.923	34.642	18.688	57.757	16.891	29.047	11.041	12.270	62.192
17	35.928	08.942	67.451	16.124	33.300	18.711	56.662	16.711	28.389	10.767	12.069	61.917
18	35.280	09.272	66.240	16.300	31.975	18.707	55.628	16.530	27.763	10.507	11.837	61.651
19	34.555	09.606	65.020	16.450	30.687	18.681	54.646	16.354	27.150	10.263	11.562	61.387
20	33.755	09.930	63.814	16.575	29.448	18.639	53.702	16.189	26.530	10.035	11.244	61.115
21	32.898	10.236	62.639	16.680	28.261	18.590	52.777	16.038	25.884	09.817	10.894	60.826
22	32.004	10.518	61.506	16.772	27.125	18.541	51.853	15.902	25.198	09.605	10.535	60.513
23	31.100	10.775	60.418	16.859	26.030	18.499	50.909	15.778	24.466	09.388	10.198	60.173
24	30.208	11.010	59.370	16.948	24.959	18.468	49.929	15.662	23.694	09.158	09.917	59.810
25	29.344	11.228	58.350	17.046	23.896	18.451	48.902	15.546	22.896	08.905	09.717	59.434
26	28.517	11.436	57.343	17.157	22.819	18.448	47.826	15.422	22.100	08.626	09.607	59.060
27	27.728	11.643	56.329	17.281	21.710	18.455	46.711	15.279	21.336	08.319	09.578	58.701
28	26.969	11.856	55.287	17.418	20.555	18.466	45.573	15.111	20.633	07.991	09.601	58.369
29	26.226	12.079	54.202	17.565	19.346	18.474	44.441	14.915	20.010	07.652	09.640	58.065
30	25.481	12.318	53.059	17.713	18.083	18.470	43.342	14.691	19.472	07.317	09.660	57.787
31	24.716	12.571			16.777	18.445	42.305	14.447	19.003	06.998	09.637	57.523
32	23.910	12.837			15.448	18.393			18.576	06.704		
	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$
	45.93	45.92	46.00	45.99	46.03	46.02	46.01	46.00	45.95	45.94	45.86	45.85

Mean R.A. $06^h03^m07\overset{s}{.}010$ Double lower transit June 21 Mean Dec. $-88°45'08\overset{''}{.}977$

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APPARENT PLACES OF STARS, 2024

SOUTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 1662 = Hipparcos Star No. 30678 = A Octantis

Day	July		August		September		October		November		December	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	06^h02^m	$-88°44'$	06^h02^m	$-88°44'$	06^h02^m	$-88°44'$	06^h03^m	$-88°44'$	06^h03^m	$-88°44'$	06^h03^m	$-88°44'$
1	09.637	57.523	16.079	48.389	36.805	41.959	04.415	40.596	30.772	45.000	44.305	53.588
2	09.562	57.261	16.438	48.109	37.713	41.787	05.487	40.642	31.495	45.273	44.390	53.944
3	09.444	56.988	16.848	47.812	38.672	41.631	06.552	40.713	32.152	45.552	44.427	54.282
4	09.307	56.694	17.327	47.508	39.668	41.497	07.591	40.808	32.745	45.827	44.440	54.600
5	09.183	56.376	17.877	47.206	40.679	41.388	08.588	40.920	33.284	46.092	44.454	54.897
6	09.099	56.035	18.495	46.913	41.687	41.303	09.532	41.044	33.787	46.340	44.494	55.179
7	09.080	55.678	19.166	46.638	42.672	41.238	10.419	41.172	34.277	46.571	44.574	55.458
8	09.136	55.314	19.874	46.384	43.619	41.190	11.253	41.296	34.779	46.785	44.697	55.744
9	09.267	54.953	20.597	46.153	44.521	41.151	12.045	41.410	35.315	46.990	44.849	56.049
10	09.464	54.602	21.317	45.943	45.374	41.114	12.815	41.507	35.897	47.196	45.002	56.383
11	09.712	54.268	22.015	45.752	46.184	41.069	13.586	41.587	36.526	47.417	45.121	56.746
12	09.992	53.954	22.678	45.573	46.965	41.010	14.385	41.653	37.184	47.664	45.168	57.134
13	10.284	53.660	23.298	45.399	47.738	40.934	15.235	41.714	37.835	47.946	45.119	57.533
14	10.568	53.385	23.875	45.221	48.534	40.838	16.148	41.782	38.437	48.263	44.972	57.927
15	10.828	53.124	24.417	45.031	49.382	40.730	17.115	41.873	38.953	48.604	44.746	58.302
16	11.050	52.870	24.944	44.822	50.304	40.622	18.108	42.001	39.367	48.951	44.478	58.648
17	11.229	52.616	25.486	44.590	51.303	40.531	19.080	42.169	39.693	49.288	44.207	58.966
18	11.369	52.351	26.077	44.340	52.357	40.473	19.989	42.370	39.962	49.602	43.964	59.263
19	11.486	52.067	26.746	44.081	53.423	40.455	20.807	42.587	40.216	49.889	43.768	59.549
20	11.606	51.759	27.506	43.830	54.454	40.475	21.539	42.803	40.489	50.154	43.617	59.835
21	11.766	51.426	28.342	43.604	55.417	40.519	22.210	43.003	40.803	50.408	43.504 43.409	60.130 60.441
22	11.998	51.078	29.220	43.415	56.304	40.570	22.857	43.180	41.164	50.658	43.312	60.771
23	12.321	50.727	30.095	43.262	57.131	40.612	23.515	43.337	41.567	50.917	43.192	61.119
24	12.734	50.390	30.929	43.138	57.927	40.637	24.208	43.479	41.999	51.190	43.030	61.483
25	13.213	50.080	31.703	43.029	58.724	40.642	24.949	43.616	42.442	51.483	42.811	61.859
26	13.718	49.803	32.421	42.919	59.549	40.631	25.739	43.758	42.875	51.797	42.523	62.240
27	14.212	49.557	33.100	42.797	60.421	40.610	26.571	43.911	43.280	52.132	42.160	62.618
28	14.665	49.331	33.768	42.657	61.347	40.588	27.430	44.084	43.637	52.485	41.727	62.985
29	15.066	49.113	34.452	42.497	62.328	40.573	28.299	44.279	43.931	52.850	41.237	63.333
30	15.422	48.889	35.177	42.323	63.356	40.574	29.159	44.498	44.154	53.221	40.710	63.657
31	15.750	48.650	35.959	42.141	64.415	40.596	29.989	44.739	44.305	53.588	40.177	63.956
32	16.079	48.389	36.805	41.959			30.772	45.000			39.663	64.234
	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)	sec(δ)	tan(δ)
	45.77	45.76	45.69	45.68	45.64	45.63	45.66	45.65	45.73	45.72	45.83	45.82

Mean R.A. $06^h03^m07\overset{s}{.}010$ Double lower transit June 21 Mean Dec. $-88°45'08\overset{''}{.}977$

APPARENT PLACES OF STARS, 2024

SOUTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 1666 = Hipparcos Star No. 76996 = ρ Oct

Day	January		February		March		April		May		June	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	15^h48^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$
1	55.586	09.550	03.277	06.496	11.288	08.231	18.995	14.366	24.182	23.340	26.190	34.011
2	55.765	09.374	03.545	06.435	11.575	08.326	19.241	14.657	24.292	23.719	26.182	34.288
3	55.949	09.185	03.831	06.382	11.875	08.440	19.471	14.970	24.381	24.085	26.192	34.559
4	56.145	08.986	04.133	06.344	12.181	08.581	19.680	15.294	24.456	24.427	26.219	34.838
5	56.357	08.780	04.449	06.330	12.487	08.751	19.865	15.617	24.529	24.742	26.257	35.136
6	56.587	08.576	04.771	06.347	12.784	08.950	20.031	15.922	24.611	25.031	26.294	35.458
7	56.839	08.383	05.090	06.397	13.062	09.170	20.188	16.201	24.712	25.307	26.319	35.803
8	57.109	08.209	05.396	06.474	13.316	09.398	20.349	16.451	24.833	25.584	26.327	36.162
9	57.392	08.064	05.679	06.568	13.548	09.617	20.526	16.681	24.969	25.879	26.312	36.526
10	57.678	07.953	05.939	06.659	13.765	09.812	20.726	16.907	25.110	26.198	26.276	36.885
11	57.957	07.872	06.181	06.733	13.982	09.977	20.944	17.146	25.245	26.544	26.221	37.232
12	58.218	07.813	06.418	06.779	14.211	10.119	21.172	17.408	25.364	26.910	26.153	37.560
13	58.457	07.759	06.663	06.799	14.462	10.250	21.399	17.697	25.463	27.289	26.077	37.867
14	58.677	07.693	06.926	06.805	14.732	10.389	21.616	18.011	25.541	27.669	26.000	38.154
15	58.888	07.605	07.210	06.810	15.018	10.547	21.816	18.344	25.598	28.043	25.926	38.423
16	59.101	07.492	07.512	06.828	15.308	10.731	21.995	18.685	25.638	28.405	25.862	38.678
17	59.329	07.359	07.826	06.870	15.594	10.942	22.155	19.027	25.668	28.749	25.809	38.927
18	59.576	07.218	08.142	06.937	15.869	11.176	22.297	19.362	25.693	29.075	25.769	39.178
19	59.844	07.082	08.454	07.031	16.127	11.425	22.426	19.685	25.719 25.750	29.383 29.677	25.741	39.439
20	60.130	06.962	08.756	07.146	16.367	11.682	22.547	19.993	25.792	29.962	25.719	39.717
21	60.428	06.866	09.042	07.275	16.589	11.939	22.666	20.284	25.846	30.246	25.697	40.017
22	60.729	06.796	09.312	07.411	16.797	12.190	22.787	20.561	25.913	30.537	25.665	40.339
23	61.025	06.751	09.566	07.547	16.994	12.429	22.917	20.827	25.989	30.843	25.615	40.676
24	61.311	06.727	09.808	07.675	17.185	12.654	23.059	21.089	26.069	31.170	25.541	41.016
25	61.583	06.716	10.043	07.792	17.378	12.864	23.213	21.355	26.143	31.522	25.443	41.346
26	61.841	06.709	10.276	07.896	17.576	13.063	23.379	21.632	26.205	31.893	25.326	41.654
27	62.085	06.700	10.512	07.987	17.785	13.255	23.553	21.929	26.246	32.278	25.201	41.931
28	62.321	06.682	10.757	08.070	18.006	13.447	23.728	22.250	26.264	32.664	25.077	42.177
29	62.552	06.652	11.015	08.149	18.242	13.647	23.896	22.595	26.259	33.039	24.966	42.400
30	62.785	06.610	11.288	08.231	18.488	13.862	24.049	22.961	26.239	33.391	24.871	42.610
31	63.025	06.557			18.742	14.101	24.182	23.340	26.212	33.715	24.794	42.822
32	63.277	06.496			18.995	14.366			26.190	34.011		
	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$
	10.50	10.45	10.50	10.45	10.50	10.45	10.51	10.46	10.51	10.46	10.52	10.47

Mean R.A. $15^h49^m18^s.454$ Double lower transit November 17 Mean Dec. $-84°32'23''.106$

APPARENT PLACES OF STARS, 2024

SOUTHERN CIRCUMPOLAR STARS AT UPPER TRANSIT AT GREENWICH

EQUINOX BASED RIGHT ASCENSION – WHOLE NUTATION

FK6 Star No. 1666 = Hipparcos Star No. 76996 = ρ Oct

Day	July		August		September		October		November		December	
	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$	15^h49^m	$-84°32'$
1	24.794	42.822	20.468	48.887	14.320	50.216	08.736	46.269	05.695	38.027	06.855	28.920
2	24.729	43.047	20.304	49.050	14.080	50.182	08.551	46.030	05.678	37.684	06.998	28.638
3	24.668	43.292	20.121	49.213	13.837	50.124	08.379	45.774	05.677	37.351	07.142	28.379
4	24.601	43.558	19.919	49.366	13.597	50.041	08.225	45.508	05.689	37.036	07.281	28.140
5	24.519	43.839	19.701	49.501	13.364	49.937	08.088	45.237	05.707	36.741	07.408	27.914
6	24.418	44.128	19.474	49.614	13.144	49.816	07.968	44.970	05.724	36.466	07.521	27.691
7	24.295	44.415	19.243	49.703	12.938	49.684	07.862	44.713	05.734	36.205	07.622	27.459
8	24.153	44.690	19.014	49.768	12.749	49.550	07.766	44.472	05.732	35.953	07.717	27.209
9	23.996	44.946	18.792	49.812	12.574	49.420	07.674	44.249	05.717	35.697	07.815	26.935
10	23.829	45.180	18.583	49.842	12.411	49.301	07.577	44.043	05.691	35.427	07.927	26.639
11	23.659	45.390	18.386	49.864	12.255	49.198	07.471	43.848	05.661	35.133	08.061	26.329
12	23.493	45.580	18.205	49.886	12.097	49.113	07.351	43.656	05.638	34.810	08.223	26.018
13	23.333	45.752	18.035	49.916	11.932	49.043	07.215	43.453	05.635	34.461	08.411	25.722
14	23.185	45.914	17.874	49.959	11.750	48.981	07.068	43.227	05.659	34.099	08.617	25.453
15	23.051	46.071	17.715	50.021	11.550	48.914	06.921	42.968	05.714	33.741	08.829	25.216
16	22.929	46.233	17.549	50.102	11.333	48.827	06.786	42.676	05.793	33.403	09.035	25.008
17	22.817	46.407	17.368	50.195	11.106	48.706	06.677	42.358	05.884	33.093	09.227	24.820
18	22.710	46.600	17.166	50.290	10.885	48.548	06.597	42.034	05.974	32.812	09.402	24.639
19	22.598	46.814	16.942	50.371	10.681	48.357	06.543	41.719	06.054	32.552	09.560	24.454
20	22.473	47.045	16.701	50.423	10.503	48.149	06.506	41.427	06.118	32.302	09.709	24.256
21	22.327	47.285	16.457	50.437	10.351	47.940	06.473	41.159	06.167	32.050	09.853	24.043
22	22.157	47.519	16.221	50.415	10.217	47.746	06.433	40.913	06.203	31.787	10.000	23.813
23	21.965	47.732	16.005	50.369	10.091	47.572	06.379	40.678	06.233	31.509	10.156	23.569
24	21.760	47.913	15.811	50.313	09.962	47.418	06.310	40.444	06.264	31.212	10.325	23.317
25	21.556	48.059	15.636	50.262	09.823	47.278	06.228	40.202	06.300	30.897	10.511	23.061
26	21.362	48.176	15.473	50.226	09.668	47.142	06.136	39.945	06.349	30.568	10.715	22.809
27	21.187	48.275	15.312	50.208	09.499	47.002	06.040	39.668	06.413	30.229	10.937	22.569
28	21.030	48.370	15.143	50.207	09.316	46.850	05.946	39.371	06.496	29.888	11.174	22.348
29	20.887	48.474	14.962	50.216	09.124	46.679	05.860	39.053	06.599	29.551	11.421	22.152
30	20.752	48.594	14.764	50.226	08.929	46.485	05.787	38.720	06.720	29.226	11.671	21.983
31	20.615	48.733	14.549	50.228	08.736	46.269	05.732	38.375	06.855	28.920	11.916	21.839
32	20.468	48.887	14.320	50.216			05.695	38.027			12.149	21.713
	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$	$\sec(\delta)$	$\tan(\delta)$
	10.52	10.47	10.52	10.48	10.52	10.48	10.52	10.47	10.51	10.47	10.51	10.46

Mean R.A. $15^h49^m18^s.454$ Double lower transit November 17 Mean Dec. $-84°32'23''.106$

REDUCTION TO HIPPARCOS AND FK6(LONG TERM) 2024
FOR MEAN EPOCH AND EQUINOX 2024.5

FK6-No.	HIP-No.	Hipparcos – FK6 (SI)				FK6: LTP – SI			
		$\Delta\alpha$	$\Delta\mu_\alpha$	$\Delta\delta$	$\Delta\mu_\delta$	$\Delta\alpha$	$\Delta\mu_\alpha$	$\Delta\delta$	$\Delta\mu_\delta$
10	1599	10.2	0.3	11.0	0.3	-15.9	-0.5	-10.4	-0.3
22	3419	-15.3	-0.5	6.0	0.2	2.0	0.0	-5.0	-0.1
44	5661	4.2	0.1	8.4	0.3	-6.1	-0.1	-12.8	-0.3
80	10642	41.7	1.3	-0.6	0.0	-3.8	-0.1	-0.6	0.1
110	14240	4.4	0.1	13.6	0.4	-20.1	-0.6	-17.1	-0.6
119	15510	-5.8	-0.2	0.2	0.0	20.2	0.4	4.1	0.0
120	15863	-1.5	0.0	-27.8	-0.8	-6.6	-0.2	8.1	0.2
153	19095	-5.4	-0.2	16.3	0.5	8.7	0.2	0.2	-0.3
173	22361	27.0	0.8	19.5	0.6	-36.9	-0.8	-10.6	-0.3
201	25336	-12.7	-0.4	-36.8	-1.1	-10.1	-0.1	-5.6	0.1
203	25769	11.8	0.4	8.2	0.2	-5.5	-0.2	-2.5	-0.1
210	26311	2.5	0.1	15.1	0.4	0.3	0.0	-2.6	-0.1
223	27628	-1.7	-0.1	3.9	0.1	3.0	0.0	-11.9	-0.2
243	30324	10.7	0.3	-16.3	-0.5	-12.3	-0.2	5.2	0.1
245	30438	22.5	0.7	13.2	0.4	-1.7	-0.3	-4.2	-0.2
254	32246	-49.1	-1.5	-20.4	-0.6	-1.5	0.0	-4.0	-0.1
306	39429	-11.8	-0.4	12.6	0.4	8.9	0.3	-13.4	-0.4
323	42452	-6.6	-0.2	-31.1	-0.9	-1.7	-0.1	15.7	0.5
348	45238	77.5	2.3	26.6	0.8	-67.7	-1.6	-17.4	-0.7
354	46390	13.1	0.4	-15.3	-0.5	12.6	0.1	-10.2	-0.1
363	47594	4.6	0.1	21.1	0.6	10.9	0.2	-9.3	-0.3
422	54872	11.0	0.3	-17.1	-0.5	-21.6	-0.2	3.1	0.1
423	54879	30.1	0.9	-20.8	-0.6	-12.5	-0.2	0.3	0.1
426	55282	-16.0	-0.5	-8.4	-0.2	-5.5	0.0	3.2	0.1
455	59747	-8.6	-0.3	-11.4	-0.3	7.6	0.3	14.8	0.4
464	60823	-10.1	-0.3	-1.0	0.0	17.0	0.4	-5.2	-0.1
468	61084	-1.6	0.0	-10.9	-0.3	-10.1	-0.2	26.8	0.6
479	62131	-27.6	-0.8	3.1	0.1	12.0	0.4	14.2	0.4
509	67301	43.9	1.3	-43.3	-1.3	-17.1	-0.4	36.4	0.4
529	70069	12.9	0.4	-2.0	-0.1	-20.7	-0.7	3.4	0.1
560	74946	13.5	0.4	-6.3	-0.2	-40.2	-1.2	8.5	0.3
564	74785	27.2	0.8	-25.0	-0.7	10.8	0.1	5.1	0.1
588	77622	20.5	0.6	-5.1	-0.1	2.8	0.0	22.6	0.2
603	79593	-15.6	-0.5	29.7	0.9	-1.9	0.0	11.5	0.1
622	81377	21.8	0.7	-4.3	-0.1	-4.6	-0.1	-1.4	0.0
625	82273	-12.7	-0.4	23.8	0.7	4.6	0.2	-13.7	-0.4
635	83613	16.3	0.5	13.1	0.4	-12.6	-0.2	15.4	0.1
660	86670	1.0	0.0	-16.0	-0.5	-2.0	0.0	9.5	0.3
671	87585	24.9	0.7	13.9	0.4	-12.1	-0.3	-6.9	-0.2
691	90422	-0.3	0.0	8.9	0.3	-4.6	-0.1	-4.7	-0.4

Units: $0^{s}.0001$ for $\Delta\alpha$ $0^{s}.0001/yr$ for $\Delta\mu_\alpha$

$0''.001$ for $\Delta\delta$ $0''.001/yr$ for $\Delta\mu_\delta$

REDUCTION TO HIPPARCOS AND FK6(LONG TERM) 2024

FOR MEAN EPOCH AND EQUINOX 2024.5

FK6-No.	HIP-No.	Hipparcos – FK6 (SI)				FK6: LTP – SI			
		$\Delta\alpha$	$\Delta\mu_\alpha$	$\Delta\delta$	$\Delta\mu_\delta$	$\Delta\alpha$	$\Delta\mu_\alpha$	$\Delta\delta$	$\Delta\mu_\delta$
699	91262	-19.3	-0.6	26.6	0.8	-26.3	-0.2	-47.2	-0.4
700	90647	82.3	2.5	-25.8	-0.8	-37.1	-1.2	9.0	0.3
725	94834	-14.9	-0.4	-19.0	-0.6	-3.3	0.0	2.0	0.1
748	98495	2.2	0.1	9.0	0.3	3.6	-0.3	-11.9	-0.4
777	102098	-6.7	-0.2	14.5	0.4	1.0	0.0	-2.5	-0.1
855	112029	-2.8	-0.1	17.7	0.5	5.4	0.1	-7.5	-0.1
1039	6732	-10.9	-0.3	-6.3	-0.2	-4.5	0.0	-11.0	-0.1
1045	7513	-11.5	-0.4	14.1	0.4	-6.3	0.0	-7.5	-0.3
1116	19513	16.1	0.5	-27.5	-0.8	-4.5	-0.1	4.1	0.2
1166	29134	-1.8	-0.1	0.0	0.0	7.4	0.2	-1.6	0.0
1260	49339	4.2	0.1	52.4	1.6	4.2	0.0	-18.5	-0.5
1275	52098	7.5	0.2	-11.2	-0.3	-0.1	0.0	1.5	0.1
1307	57939	11.9	0.4	13.9	0.4	-20.7	-0.3	24.1	0.1
1357	67057	-6.5	-0.2	-7.7	-0.2	2.4	0.1	1.0	0.1
1396	73996	-4.1	-0.1	9.8	0.3	-5.8	-0.1	-27.5	-0.3
1456	84862	-4.0	-0.1	15.6	0.5	-2.9	0.0	-7.1	-0.2
1517	97290	0.0	0.0	-5.6	-0.2	-1.2	0.0	5.0	0.1
1533	101101	14.1	0.4	-14.6	-0.4	-5.6	-0.1	14.1	0.2
1546	102978	17.2	0.5	-42.6	-1.3	-4.1	-0.1	12.0	0.4
1577	108036	35.1	1.1	24.4	0.7	-3.8	-0.1	-14.0	-0.3
1644	72573	86.6	2.6	-7.3	-0.2	-46.5	-2.2	1.7	0.1
1662	30678	-131.0	-4.0	0.5	0.0	162.3	3.1	1.8	0.0
1666	76996	87.3	2.7	23.4	0.7	-148.3	-4.4	-15.5	-0.5

Units: $0^s.0001$ for $\Delta\alpha$ $0^s.0001/yr$ for $\Delta\mu_\alpha$

$0''.001$ for $\Delta\delta$ $0''.001/yr$ for $\Delta\mu_\delta$

Polaris (FK6 star No. 907) is not included in the list above because it is a double star. In the following table we give for Polaris the corrections from the apparent position based on the FK6 (see p. 26 and 27 of this publication) to the corresponding position based on the HIPPARCOS catalogue for the first day of each month. The corrections for intermediate days may be obtained by interpolation. The HIPPARCOS apparent place is obtained by adding the tabulated data to the FK6-position.

Reduction to HIPPARCOS for Polaris, 2024

Day	Month	Year	$\Delta\alpha[0^s.001]$	$\Delta\delta[0''.001]$
1	1	2024	712	87
1	2	2024	712	88
1	3	2024	712	88
1	4	2024	709	88
1	5	2024	706	88
1	6	2024	705	88
1	7	2024	706	88
1	8	2024	709	87
1	9	2024	714	86
1	10	2024	720	86
1	11	2024	726	85
1	12	2024	732	85
1	1	2025	737	85

TABLE UT – ST, 2024

SIDEREAL TIME AT 0^h U.T.

Date	Sidereal Time Apparent	Sidereal Time Mean	Equation of Equinox app–mean	Date	Sidereal Time Apparent	Sidereal Time Mean	Equation of Equinox app–mean
			($0^s.001$)				($0^s.001$)
	h m s	s			h m s	s	
Jan. 0	6 36 39.745	40.072	– 328	Feb. 15	9 38 01.364	01.619	– 255
1	6 40 36.300	36.628	– 328	16	9 41 57.919	58.175	– 256
2	6 44 32.853	33.183	– 330	17	9 45 54.477	54.730	– 253
3	6 48 29.405	29.738	– 333	18	9 49 51.037	51.285	– 248
4	6 52 25.957	26.294	– 337	19	9 53 47.599	47.841	– 242
5	6 56 22.510	22.849	– 339	20	9 57 44.160	44.396	– 236
6	7 00 19.064	19.405	– 340	21	10 01 40.720	40.952	– 232
7	7 04 15.622	15.960	– 338	22	10 05 37.277	37.507	– 230
8	7 08 12.183	12.515	– 333	23	10 09 33.832	34.062	– 230
9	7 12 08.747	09.071	– 324	24	10 13 30.384	30.618	– 234
10	7 16 05.314	05.626	– 312	25	10 17 26.934	27.173	– 239
11	7 20 01.882	02.181	– 300	26	10 21 23.481	23.728	– 247
12	7 23 58.448	58.737	– 289	27	10 25 20.028	20.284	– 255
13	7 27 55.011	55.292	– 281	28	10 29 16.576	16.839	– 263
14	7 31 51.570	51.848	– 278	29	10 33 13.124	13.394	– 270
15	7 35 48.124	48.403	– 279	Mar. 1	10 37 09.675	09.950	– 275
16	7 39 44.675	44.958	– 283	2	10 41 06.229	06.505	– 277
17	7 43 41.226	41.514	– 287	3	10 45 02.785	03.061	– 275
18	7 47 37.778	38.069	– 291	4	10 48 59.345	59.616	– 271
19	7 51 34.333	34.624	– 291	5	10 52 55.906	56.171	– 265
20	7 55 30.891	31.180	– 289	6	10 56 52.468	52.727	– 258
21	7 59 27.452	27.735	– 283	7	11 00 49.029	49.282	– 253
22	8 03 24.015	24.290	– 275	8	11 04 45.587	45.837	– 250
23	8 07 20.579	20.846	– 266	9	11 08 42.140	42.393	– 252
24	8 11 17.143	17.401	– 258	10	11 12 38.690	38.948	– 258
25	8 15 13.705	13.957	– 252	11	11 16 35.236	35.504	– 267
26	8 19 10.265	10.512	– 247	12	11 20 31.783	32.059	– 276
27	8 23 06.821	07.067	– 246	13	11 24 28.331	28.614	– 283
28	8 27 03.375	03.623	– 247	14	11 28 24.883	25.170	– 287
29	8 30 59.927	60.178	– 251	15	11 32 21.439	21.725	– 286
30	8 34 56.477	56.733	– 256	16	11 36 17.998	18.280	– 283
31	8 38 53.027	53.289	– 262	17	11 40 14.558	14.836	– 278
Feb. 1	8 42 49.577	49.844	– 267	18	11 44 11.118	11.391	– 273
2	8 46 46.129	46.400	– 271	19	11 48 07.677	07.946	– 269
3	8 50 42.683	42.955	– 272	20	11 52 04.234	04.502	– 268
4	8 54 39.240	39.510	– 271	21	11 56 00.789	01.057	– 269
5	8 58 35.800	36.066	– 266	22	11 59 57.340	57.613	– 272
6	9 02 32.363	32.621	– 258	23	12 03 53.889	54.168	– 279
7	9 06 28.928	29.176	– 249	24	12 07 50.437	50.723	– 287
8	9 10 25.492	25.732	– 239	25	12 11 46.983	47.279	– 296
9	9 14 22.055	22.287	– 232	26	12 15 43.529	43.834	– 305
10	9 18 18.613	18.842	– 230	27	12 19 40.077	40.389	– 313
11	9 22 15.166	15.398	– 231	28	12 23 36.626	36.945	– 318
12	9 26 11.716	11.953	– 237	29	12 27 33.179	33.500	– 321
13	9 30 08.264	08.509	– 244	30	12 31 29.734	30.056	– 321
14	9 34 04.813	05.064	– 251	31	12 35 26.292	26.611	– 319
15	9 38 01.364	01.619	– 255	Apr. 1	12 39 22.853	23.166	– 314

Table UT-ST – Sidereal Time at 0^h UT

TABLE UT – ST, 2024

SIDEREAL TIME AT 0^h U.T.

Date	Sidereal Time		Equation of Equinox	Date	Sidereal Time		Equation of Equinox
	Apparent	Mean	app–mean		Apparent	Mean	app–mean
			($0^s.001$)				($0^s.001$)
	h m s	s			h m s	s	
Apr. 1	12 39 22.853	23.166	– 314	May 17	15 40 44.416	44.713	– 297
2	12 43 19.414	19.722	– 308	18	15 44 40.967	41.269	– 302
3	12 47 15.975	16.277	– 302	19	15 48 37.517	37.824	– 307
4	12 51 12.533	12.832	– 299	20	15 52 34.067	34.379	– 312
5	12 55 09.088	09.388	– 299	21	15 56 30.619	30.935	– 315
6	12 59 05.639	05.943	– 304	22	16 00 27.174	27.490	– 316
7	13 03 02.187	02.498	– 311	23	16 04 23.732	24.045	– 313
8	13 06 58.734	59.054	– 320	24	16 08 20.293	20.601	– 308
9	13 10 55.281	55.609	– 328	25	16 12 16.857	17.156	– 299
10	13 14 51.832	52.165	– 332	26	16 16 13.422	13.712	– 289
11	13 18 48.387	48.720	– 333	27	16 20 09.987	10.267	– 280
12	13 22 44.946	45.275	– 329	28	16 24 06.551	06.822	– 271
13	13 26 41.508	41.831	– 323	29	16 28 03.112	03.378	– 266
14	13 30 38.069	38.386	– 317	30	16 31 59.668	59.933	– 265
15	13 34 34.631	34.941	– 311	31	16 35 56.222	56.488	– 266
16	13 38 31.190	31.497	– 307	June 1	16 39 52.773	53.044	– 271
17	13 42 27.746	28.052	– 306	2	16 43 49.324	49.599	– 275
18	13 46 24.300	24.608	– 308	3	16 47 45.877	46.154	– 278
19	13 50 20.851	21.163	– 312	4	16 51 42.432	42.710	– 278
20	13 54 17.400	17.718	– 319	5	16 55 38.992	39.265	– 273
21	13 58 13.948	14.274	– 326	6	16 59 35.556	35.821	– 265
22	14 02 10.495	10.829	– 334	7	17 03 32.121	32.376	– 255
23	14 06 07.044	07.384	– 340	8	17 07 28.688	28.931	– 244
24	14 10 03.595	03.940	– 345	9	17 11 25.253	25.487	– 234
25	14 14 00.148	00.495	– 347	10	17 15 21.816	22.042	– 226
26	14 17 56.704	57.050	– 346	11	17 19 18.375	18.597	– 222
27	14 21 53.264	53.606	– 342	12	17 23 14.932	15.153	– 221
28	14 25 49.825	50.161	– 336	13	17 27 11.486	11.708	– 222
29	14 29 46.388	46.717	– 328	14	17 31 08.039	08.264	– 225
30	14 33 42.951	43.272	– 321	15	17 35 04.590	04.819	– 229
May 1	14 37 39.512	39.827	– 315	16	17 39 01.142	01.374	– 233
2	14 41 36.070	36.383	– 313	17	17 42 57.695	57.930	– 235
3	14 45 32.624	32.938	– 314	18	17 46 54.250	54.485	– 235
4	14 49 29.174	29.493	– 319	19	17 50 50.808	51.040	– 233
5	14 53 25.723	26.049	– 326	20	17 54 47.369	47.596	– 227
6	14 57 22.272	22.604	– 332	21	17 58 43.933	44.151	– 218
7	15 01 18.824	19.160	– 336	22	18 02 40.499	40.706	– 207
8	15 05 15.379	15.715	– 336	23	18 06 37.066	37.262	– 196
9	15 09 11.939	12.270	– 331	24	18 10 33.631	33.817	– 186
10	15 13 08.502	08.826	– 324	25	18 14 30.193	30.373	– 179
11	15 17 05.066	05.381	– 315	26	18 18 26.752	26.928	– 176
12	15 21 01.631	01.936	– 306	27	18 22 23.307	23.483	– 177
13	15 24 58.193	58.492	– 299	28	18 26 19.859	20.039	– 180
14	15 28 54.753	55.047	– 294	29	18 30 16.410	16.594	– 184
15	15 32 51.310	51.602	– 293	30	18 34 12.962	13.149	– 187
16	15 36 47.864	48.158	– 294	July 1	18 38 09.517	09.705	– 187
17	15 40 44.416	44.713	– 297	2	18 42 06.076	06.260	– 184

TABLE UT – ST, 2024

SIDEREAL TIME AT 0^h U.T.

Date	Sidereal Time		Equation of Equinox	Date	Sidereal Time		Equation of Equinox
	Apparent	Mean	app–mean		Apparent	Mean	app–mean
			$(0\overset{s}{.}001)$				$(0\overset{s}{.}001)$
	h m s	s			h m s	s	
July 1	18 38 09.517	09.705	– 187	Aug. 16	21 39 31.160	31.252	– 92
2	18 42 06.076	06.260	– 184	17	21 43 27.723	27.807	– 84
3	18 46 02.638	02.816	– 177	18	21 47 24.285	24.363	– 78
4	18 49 59.203	59.371	– 168	19	21 51 20.843	20.918	– 75
5	18 53 55.769	55.926	– 157	20	21 55 17.397	17.473	– 76
6	18 57 52.335	52.482	– 147	21	21 59 13.947	14.029	– 81
7	19 01 48.898	49.037	– 139	22	22 03 10.495	10.584	– 89
8	19 05 45.459	45.592	– 134	23	22 07 07.043	07.139	– 97
9	19 09 42.016	42.148	– 132	24	22 11 03.593	03.695	– 102
10	19 13 38.571	38.703	– 133	25	22 15 00.146	00.250	– 104
11	19 17 35.123	35.258	– 136	26	22 18 56.703	56.805	– 103
12	19 21 31.674	31.814	– 140	27	22 22 53.263	53.361	– 98
13	19 25 28.225	28.369	– 144	28	22 26 49.824	49.916	– 92
14	19 29 24.777	24.925	– 148	29	22 30 46.386	46.472	– 86
15	19 33 21.330	21.480	– 150	30	22 34 42.946	43.027	– 81
16	19 37 17.886	18.035	– 149	31	22 38 39.504	39.582	– 78
17	19 41 14.445	14.591	– 146	Sept. 1	22 42 36.059	36.138	– 79
18	19 45 11.007	11.146	– 139	2	22 46 32.611	32.693	– 82
19	19 49 07.572	07.701	– 130	3	22 50 29.160	29.248	– 88
20	19 53 04.137	04.257	– 119	4	22 54 25.708	25.804	– 96
21	19 57 00.703	00.812	– 110	5	22 58 22.254	22.359	– 105
22	20 00 57.265	57.368	– 102	6	23 02 18.801	18.915	– 113
23	20 04 53.824	53.923	– 99	7	23 06 15.349	15.470	– 120
24	20 08 50.379	50.478	– 100	8	23 10 11.900	12.025	– 126
25	20 12 46.930	47.034	– 104	9	23 14 08.453	08.581	– 128
26	20 16 43.480	43.589	– 109	10	23 18 05.008	05.136	– 128
27	20 20 40.030	40.144	– 114	11	23 22 01.567	01.691	– 125
28	20 24 36.583	36.700	– 117	12	23 25 58.127	58.247	– 120
29	20 28 33.139	33.255	– 116	13	23 29 54.688	54.802	– 114
30	20 32 29.699	29.811	– 112	14	23 33 51.248	51.357	– 109
31	20 36 26.261	26.366	– 104	15	23 37 47.806	47.913	– 106
Aug. 1	20 40 22.825	22.921	– 96	16	23 41 44.361	44.468	– 107
2	20 44 19.389	19.477	– 88	17	23 45 40.911	41.024	– 112
3	20 48 15.951	16.032	– 81	18	23 49 37.458	37.579	– 121
4	20 52 12.510	12.587	– 77	19	23 53 34.004	34.134	– 130
5	20 56 09.067	09.143	– 76	20	23 57 30.552	30.690	– 138
6	21 00 05.620	05.698	– 78	21	0 01 27.103	27.245	– 143
7	21 04 02.171	02.253	– 83	22	0 05 23.658	23.800	– 143
8	21 07 58.720	58.809	– 89	23	0 09 20.216	20.356	– 139
9	21 11 55.269	55.364	– 95	24	0 13 16.777	16.911	– 134
10	21 15 51.818	51.920	– 102	25	0 17 13.339	13.467	– 128
11	21 19 48.369	48.475	– 106	26	0 21 09.899	10.022	– 123
12	21 23 44.922	45.030	– 109	27	0 25 06.456	06.577	– 121
13	21 27 41.477	41.586	– 108	28	0 29 03.011	03.133	– 121
14	21 31 38.036	38.141	– 105	29	0 32 59.563	59.688	– 125
15	21 35 34.597	34.696	– 99	30	0 36 56.113	56.243	– 131
16	21 39 31.160	31.252	– 92	Oct. 1	0 40 52.660	52.799	– 139

TABLE UT – ST, 2024

SIDEREAL TIME AT 0^h U.T.

Date	Sidereal Time		Equation of Equinox	Date	Sidereal Time		Equation of Equinox
	Apparent	Mean	app–mean		Apparent	Mean	app–mean
			(0ˢ001)				(0ˢ001)
	h m s	s			h m s	s	
Oct. 1	0 40 52.660	52.799	– 139	Nov. 16	3 42 14.178	14.346	– 168
2	0 44 49.207	49.354	– 147	17	3 46 10.742	10.901	– 159
3	0 48 45.753	45.909	– 156	18	3 50 07.308	07.456	– 149
4	0 52 42.301	42.465	– 164	19	3 54 03.874	04.012	– 138
5	0 56 38.850	39.020	– 170	20	3 58 00.439	00.567	– 128
6	1 00 35.402	35.576	– 173	21	4 01 57.000	57.123	– 122
7	1 04 31.957	32.131	– 174	22	4 05 53.559	53.678	– 119
8	1 08 28.515	28.686	– 171	23	4 09 50.114	50.233	– 119
9	1 12 25.074	25.242	– 167	24	4 13 46.667	46.789	– 122
10	1 16 21.635	21.797	– 162	25	4 17 43.218	43.344	– 126
11	1 20 18.196	18.352	– 157	26	4 21 39.769	39.899	– 131
12	1 24 14.755	14.908	– 153	27	4 25 36.320	36.455	– 135
13	1 28 11.311	11.463	– 152	28	4 29 32.873	33.010	– 137
14	1 32 07.863	08.019	– 155	29	4 33 29.429	29.565	– 137
15	1 36 04.412	04.574	– 162	30	4 37 25.987	26.121	– 134
16	1 40 00.959	01.129	– 170	Dec. 1	4 41 22.548	22.676	– 128
17	1 43 57.507	57.685	– 178	2	4 45 19.111	19.232	– 120
18	1 47 54.057	54.240	– 183	3	4 49 15.677	15.787	– 110
19	1 51 50.611	50.795	– 184	4	4 53 12.242	12.342	– 100
20	1 55 47.170	47.351	– 181	5	4 57 08.806	08.898	– 92
21	1 59 43.732	43.906	– 174	6	5 01 05.368	05.453	– 85
22	2 03 40.296	40.461	– 166	7	5 05 01.927	02.008	– 82
23	2 07 36.858	37.017	– 159	8	5 08 58.482	58.564	– 82
24	2 11 33.419	33.572	– 154	9	5 12 55.035	55.119	– 85
25	2 15 29.976	30.128	– 151	10	5 16 51.586	51.675	– 88
26	2 19 26.531	26.683	– 152	11	5 20 48.139	48.230	– 91
27	2 23 23.082	23.238	– 156	12	5 24 44.694	44.785	– 91
28	2 27 19.632	19.794	– 162	13	5 28 41.253	41.341	– 87
29	2 31 16.180	16.349	– 169	14	5 32 37.817	37.896	– 79
30	2 35 12.728	12.904	– 176	15	5 36 34.384	34.451	– 67
31	2 39 09.278	09.460	– 182	16	5 40 30.952	31.007	– 55
Nov. 1	2 43 05.829	06.015	– 187	17	5 44 27.520	27.562	– 43
2	2 47 02.382	02.571	– 188	18	5 48 24.084	24.117	– 33
3	2 50 58.938	59.126	– 187	19	5 52 20.646	20.673	– 27
4	2 54 55.498	55.681	– 184	20	5 56 17.204	17.228	– 25
5	2 58 52.059	52.237	– 178	21	6 00 13.759	13.784	– 25
6	3 02 48.622	48.792	– 170	22	6 04 10.312	10.339	– 27
7	3 06 45.184	45.347	– 163	23	6 08 06.864	06.894	– 31
8	3 10 41.746	41.903	– 157	24	6 12 03.416	03.450	– 34
9	3 14 38.305	38.458	– 153	25	6 15 59.969	60.005	– 36
10	3 18 34.860	35.013	– 153	26	6 19 56.525	56.560	– 36
11	3 22 31.413	31.569	– 156	27	6 23 53.083	53.116	– 33
12	3 26 27.963	28.124	– 161	28	6 27 49.644	49.671	– 27
13	3 30 24.512	24.680	– 167	29	6 31 46.208	46.227	– 19
14	3 34 21.063	21.235	– 171	30	6 35 42.773	42.782	– 9
15	3 38 17.618	17.790	– 172	31	6 39 39.339	39.337	+ 2
16	3 42 14.178	14.346	– 168	32	6 43 35.905	35.893	+ 12

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