PROGRAMS 'CELESTE' AND 'STELLA' FOR COMPUTATIONS IN SPECIAL RELATIVITY: EVALUATION OF THE CELESTIAL VIEW FROM AN INTERSTELLAR SPACECRAFT

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PROGRAM SUMMARY

Title of programs: CELESTE (batch-processing version); STELLA (time-sharing terminal version)

Catalogue number: AACI

Program obtainable from: CPC Program Library, Queen's University of Belfast, N. Ireland (see application form in this issue)

Computer: CDC Cyber 71/Cyber 170-720; Installation: University of Lowell Computer Center

Operating system: FORTRAN-IV EXTENDED (ANSI 1966)

Programming language used: FORTRAN-IV

High speed storage required: 22 Kwords

No. of bits in a word: 60

Peripherals used: terminal (LA36 DECwriter II) for STELLA; card reader (model 405), line printer (model 512) for CEL-ESTE; optional colour display console for direct display of astroscapes

No. of lines in combined program and test deck: program CEL-ESTE has 462 lines, STELLA has 470 lines; star data file NEARDAT has 92 lines, CONDAT has 35 lines, YALSTAR has 520 lines, STARDAT has 2289 lines

Keywords: astroscape, starscape, star plot, celestial view, special relativity, length contraction, time dilation, aberration, parallax, Doppler effect, Doppler shift, brightness, apparent magnitude, stellar temperature, spectral type, colour bolometric correction, spaceflight, interstellar travel, astronavigation

Nature of physical problem

CELESTE and STELLA have been compiled to evaluate the celestial fore and aft views from a spacecraft in relativistic motion, aimed in any specified direction and located at any given distance from the solar system (i.e., Earth). The calculations take account of the special-relativistic effects of space contraction, aberration, parallax, Doppler shift of wavelength (colour) [including shift of infra-red stellar sources into the visible region], and perceived brightness (i.e., apparent visual magnitude). The output may, at option, provide a printed astroscape diagram as well as a tabulation of numerical results. The output data may be fed to a colour display console for a direct visual display.

Method of solution

Using special-relativistic formulae [1,2], the programs convert input data for stars, e.g., visible and infra-red sources (stellar coordinates, distances, spectroscopic class, apparent visual and infra-red magnitudes) into a polar representation of the fore and aft view as a function of craft speed and direction and distance [3,4].

Restrictions on the complexity of the problem

While the programs have been designed to deal with infra-red as well as visible stellar sources, including appropriate bolometric corrections to determine the apparent visual magnitude (perceived brightness), they do not contain similar procedures for ultra-violet sources (since at present only piecemeal data on these are available). The input file for stellar data has been restricted to stars of 4th magnitude or brighter, in order to keep the length of the star catalogue to below 5 500 entries. It could, however, be expanded at will. The programs do not provide side views, but could readily be modified to furnish these if desired.

Typical running time

Less than 1 min in batch mode; 2-3 min in interactive-terminal mode when no plots are generated, 5 min in terminal mode with plots.

- R.W. Stimets and E. Sheldon, J. Brit. Interplanetary Soc. -Interstellar Studies 34 (1981) 83.
- [2] E. Sheldon and R.W. Stimets, Nukleonika (in press).
- [3] R.A. Schorn, Sky and Telescope 62 (1981) 530.
- [4] E. Sheldon and R.H. Giles, J. Brit. Interplanetary Soc. -Interstellar Studies 36 (1983) 99.

LONG WRITE-UP

1. Introduction

As an exercise in the application of relativistic physics and a possible anticipation of the future in manned interstellar space travel, undertaken at relativistic speeds in order that time dilation assists in keeping the spacecraft's inherent mission time to within a reasonable portion of the astronaut's lifespan, the evaluation of stellar "astroscapes", or star maps, via the programs "CEL-ESTE" or "STELLA" has attracted widespread interest. This description of the computational procedures and data handling has accordingly been prepared in order to make this resource more generally available. The findings are pedagogically informative, instructive and visually attractive.

Of the eleven stars within 10 light-years (ly) of the Sun, only three (namely, Proxima Centauri, α Centauri A/B) lie at less than 5-ly distance, and the next nearest, Barnard's Star, lies at 6 ly. Barnard's Star has been proposed as the leading candidate for exploration in the Daedalus Project [1] in a 60-year one-way unmanned fly-by mission to be undertaken next century at subrelativistic speed ($\beta \equiv v/c = 0.122$). A further 31 stars lie within 10-15 ly of the solar system; even assuming all technical, physiological, communications and energy problems could be reliably overcome for manned 2-way round-trip missions, these would lie at the limits of accessibility within the astronauts' lifespan unless internal craft time could be "slowed down" through relativistic time dilation. However, relativistic influences affect time and space jointly, causing radical changes in the celestial view from a starship at such speeds. The astroscape at any given flight velocity v is determined by a combination of effects, including contraction of distance, aberration and parallax of apparent angular coordinates, Doppler shift of wavelength (i.e., of perceived colour), and intensity modification of brightness. The present computer programs take the entire totality of effects into consideration for the first time, demonstrating the drastic alteration in the appearance of the firmament at relativistic speeds, when visible sources appear to become extinguished through blue-shift in the forward direction (and red-shift in the rearward view) and hitherto-invisible infra-red sources ahead (or ultra-violet sources astern) are shifted into the visible part of the spectrum, while the entire field of view folds forward, like a closing petal, as a consequence of aberration. The navigational problem would thus take on entirely new aspects in relativistic space-flight, with mission distances seemingly shrinking enormously in the flight direction.

Illustrative examples of such astroscapes based upon conventional and newly-derived relativistic formulae and correction procedures, as cited in the present description of the calculational treatment. have been given for hypothetical flights toward the North Celestial Pole (i.e., to Polaris) by Stimets and Sheldon [2-4]. For this, and other flight directions, e.g., toward the South Celestial Pole and toward nearby stars at sub-relativistic and relativistic speeds, the astroscapes projected onto a colour display console terminal from the computer output were photographed as slides and assembled into an animated sequence on colour movie film, simulating the fore and aft views from a spacecraft in rapid flight. A further set of results has been prepared for publication [5], in which several of these astroscapes, and others indicating the changing appearance of a star during an overtaking fly-by manœuvre, when parallax effects are of significance, are depicted. The programs with display output constitute a particularly interesting and vivid demonstration that illustrates the unique capabilities of computer and graphics systems.

2. Previous studies

It has long been recognised that in lieu of attaining "suspended animation" during spaceflights on interstellar missions, astronauts could make avail of time dilation (see, e.g., refs. [6,7] and papers in refs. [8,9]). In an early study of spaceflight parameters, Sänger [7] pointed out that if a constant acceleration $a' = g = 9.81 \text{ m/s}^2$ could be maintained to the midpoint of a flight whose second half was undertaken with a constant deceleration $a' = -g = -9.81 \text{ m/s}^2$, relativistic speeds would be achieved during the first half-year of the mission, and a one-way flight under these conditions to even the farthest bounds of the visible Universe, covering a distance $s = 3 \times 10^9$ ly, could be accomplished within 41.9 astronaut-years (as measured within the craft's frame of reference). Using a hyperbolic representation, Sänger derived the formula for the mission duration (in the spacecraft frame; primes denote variables in the spacecraft system):

$$\tau' = (2c/a') \operatorname{arc} \cosh[1 + (a's/2c^2)],$$
 (1)

where c is the velocity of light. For large intragalactic and intergalactic distances s, this expression reduces to

$$\tau' = (2c/a') \ln(a's/c^2).$$
 (2)

The maximal velocity ratio $\beta_{max} \equiv v_{max}/c$, attained at the midpoint s/2, is

$$\beta_{\max} = \left\{ 1 - \left[1 + \left(\frac{a's}{2c^2} \right) \right]^{-2} \right\}^{1/2}.$$
 (3)

In a revised version of Sänger's graphs, Sagan (ref. [10] reproduced in ref. [9]) has presented plots of distance s and speed ratio β_{max} versus τ' for a' = g, 2g and 3g. As fig. 1, we depict the growth of spacecraft-time τ' and Earth-time τ_E with mission distance s, as well as of β_{max} versus s for a one-way boost/deceleration flight with a' = g. The data for these plots were obtained from approximation formulae that are in accord with the foregoing [2,3], viz., in the "g-boost mode",

$$s = (2c^2/a') \Big[(1 - \beta_{\max}^2)^{-1/2} - 1 \Big];$$
 (4)

$$\tau' = (c/a') \ln[(1 + \beta_{\max})/(1 - \beta_{\max})], \qquad (5)$$

$$\tau_{\rm E} = (2c/a')\beta_{\rm max} (1 - \beta_{\rm max}^2)^{-1/2}.$$
 (6)

Interstellar trips within an astronaut's lifespan would thus be entirely within the realm of feasibility if the technical means could be attained and other conditions satisfied.

In "optical relativity" the formulae have also long been available, except for the brightening, which has not been subjected to quantitative investigation. With the recognition of the Penrose-Terrell effect [11,12], the re-examination of visual relativistic phenomena received renewed impetus. Computer programs were compiled to evaluate the instantaneous appearance of transversely-moving rods and rectangular grids [13], cubes and other shapes [14]. Although this effect has, as it turns out, no bearing upon our present spaceflight considerations, its relationship to aberration, which does of course affect the views crucially, provides a connection with the approach that we pursue in this project. While examining the appearance of a self-luminous sphere when viewed in approach, recession and transverse passage, Scott and Van Driel [15] extended their computations to depict the views, fore, aft and athwart, from a relativistic spacecraft bound for Polaris in the direction of the North Celestial Pole. They also illustrated the appearance of a train of box-cars in transverse motion. The consequences of aberration in distorting the spatial geometry were particularly evident in these displays. For illustrative purposes, the astroscape results were taken over by Kaufmann [16]; a similar depiction of astroscapes in the course of an imaginary flight toward 45 Eridani, including a quantitative treatment of aberration and a qualitative treatment of the Doppler shift, was presented by Moskowitz [17], who also mentioned the occurrence of appreciable relativistic brightening and pointed out selective features of this. Among other writers who have given representations of star maps in which aberration was allowed for, Schroeder [18] showed fore and aft astroscapes as would be seen in the course of a flight toward the South Celestial Pole. In none of these, however, was parallax explicitly taken into consideration, nor was intensity enhancement incorporated into the calculations. Moskowitz [17] mentioned that stars whose radiation peaks in the infra-red (IR) part of the spectrum would appear bluer and brighter on approach, but failed to allow for IR sources to intrude into the forward astroscape (as ultra-violet [UV] sources enter into visibility in the rearward astroscape) when craft speeds proceed into the relativistic region.

These shortcomings are avoided in our programs, which take aberration, parallax, Doppler shift and intensity modification into account quantitatively for actual stellar sources as viewed in conjectured relativistic flight at any given speed in any specified direction. The underlying formulation upon which these programs are based is described in the next section, and a review of the programs themselves is presented in section 4.

3. Relativistic formulation and correction procedures

The treatment follows that given by Stimets and Sheldon [2,3], allowing for acceleration within the framework of special relativistic theory. The spacecraft thus passes through a succession of inertial reference frames, while the galactic system (i.e., the Earth) is taken as the rest frame. All quantities expressed in the spacecraft system are characterised by a prime; variables in the galactic system are unprimed. The proper acceleration a'of the spacecraft as determined in its own momentary inertial frame is related to the acceleration aas measured by Earth-based observers through the familiar expression

$$a' = \gamma^3 a \equiv \gamma^3 dv/dt = \gamma^3 c (d\beta/dt), \qquad (7)$$

in terms of the Einstein factor $\gamma \equiv (1 - \beta^2)^{-1/2}$. On substituting the time-dilation relation for dt, namely

$$dt = \gamma dt' \tag{8}$$

and integrating,

$$\int a' \mathrm{d}t' = \int \gamma^2 c \mathrm{d}\beta = c \int \left(1 - \beta^2\right)^{-1} \mathrm{d}\beta, \qquad (9)$$

one readily obtains the result (4) used to generate data for fig. 1.

After converting stellar coordinates (r, δ, α) in the galactic frame, where r is the distance, δ the declination (in degrees/arc-minutes) and α the right ascension (in h/min/s), to polar coordinates (r, θ, ϕ) and allowing for spacecraft flight in the angular direction $\hat{\beta} \equiv (\theta_s, \phi_s)$ which is taken to define the new z-axis, one obtains the new spherical polar coordinates of the star referred to this new direction as (r, Θ, Φ) , where

$$\Theta = \arccos[\sin\theta\sin\theta_s\cos(\phi - \phi_s) + \cos\theta\cos\theta_s],$$
(10)



Fig. 1. Comparison of time-duration in the spaceship frame of reference (left-hand scale) with that in the galactic (i.e., Earth) system for one-way boost/deceleration flights over a distance s. In the first half of the flight, to $\frac{1}{2}s$, a constant proper acceleration (as measured in the spacecraft system) a' = g = 9.81 m/s² is maintained, to reach a maximum speed $\beta_{max} \equiv v_{max}/c$, where c is the velocity of light. Thereafter, a constant deceleration at the rate a' = -g = -9.81 m/s² is maintained. Plots of β_{max} and the corresponding Einstein factor $\gamma_{max} \equiv (1 - \beta_{max}^2)^{-1/2}$ versus distance s are shown inset.

$$\Phi = \arctan[\sin\theta\sin(\phi - \phi_s)] / (\sin\theta\cos\theta_s\cos(\phi - \phi_s) - \cos\theta\sin\theta_s)].$$
(11)

Relativistic aberration is expressed through the relation between these and the angular coordinates (Θ', Φ') in the spacecraft frame:

$$\Theta' = \arccos\left[\frac{\beta + \cos\theta}{1 + \beta\cos\theta}\right],\tag{12}$$

$$\Phi' = \Phi. \tag{13}$$

The azimuthal coordinates are thus unchanged;

the shape of constellations is thereby simply scaled down or up (in the forward or rearward direction of observation) and the Penrose-Terrell effect is non-evident. Allowance for parallax after the spacecraft has moved a distance z along the z-axis from the origin results in a change in the sagittal angle at which a star at a distance r from the origin now has to be viewed; the new angle Θ_z is related to Θ through the simple trigonometric formula

$$\tan \Theta_z = \frac{\tan \Theta}{1 - (z/r) \sec \Theta} = \frac{\tan \Theta}{1 - K}$$
$$= \frac{\left(r^2 K^2 - z^2\right)^{1/2}}{z(1 - K)}, \qquad (14)$$

where K has been introduced as an abbreviation for $(z/r)\sec\Theta$, and use has been made of the identity $\tan^2\Theta \equiv \sec^2\Theta - 1$. The radial distance to the star (in the galactic frame) is

$$d = (r^2 - 2rz\cos\Theta + z^2)^{1/2}.$$
 (15)

It is straightforward to combine the aberration result (12) analytically with the parallax result (14), but in practice the computation is best performed sequentially, first calculating Θ_z from Θ and then substituting Θ_z throughout the right-hand side of formula (12) for numerical evaluation of Θ' . For the analytic combination, it is easier to use the first of two equivalent expressions in place of (12), namely

$$\sin \Theta' = \frac{\sin \Theta}{\gamma (1 + \beta \cos \Theta)}, \qquad (16)$$

from which, with eq. (12), one may deduce that

$$\tan(\Theta'/2) = \left[(1-\beta)/(1+\beta) \right]^{1/2} \tan(\Theta/2). (17)$$

For computational purposes, the conversion formula (16) suffers from the dichotomy of the arc sin function: for a given positive value of the expression on the right-hand side, two values of Θ' satisfy the relation, e.g., an angle in the first quadrant and its supplement in the second quadrant. In the computation, the former would automatically be adopted, even though the latter would be dictated by the problem. No such ambiguity arises with the transformation formulae (12) or (17). However, using (16) and (14), one obtains the aberration/parallax formula $\frac{1}{2}$

$$\sin \Theta' = \frac{\tan \Theta}{\gamma (1 + \beta \cos \Theta) \left[(1 - K)^2 + \tan^2 \Theta \right]^{1/2}}.$$
(18)

This is an amended form of the expression cited in ref. [3].

The general Doppler formula for the shift in wavelength, relating the received wavelength λ' (in the spacecraft system) to the emitted wavelength λ (in the galactic system) for a craft viewing starlight at an angle Θ_z , is

$$\lambda' = \left[\gamma (1 + \beta \cos \Theta_z)\right]^{-1} \lambda. \tag{19}$$

Since the effective Planck temperature $T \equiv hc/k\lambda$ (where h is Planck's constant and k is Boltzmann's constant) is inversely proportional to the wavelength, it follows from eq. (19) that the apparent stellar temperature T' may be calculated from the actual temperature T with the aid of the relation

$$T' = \gamma (1 + \beta \cos \Theta_z) T.$$
 (20)

In this approach, starlight is considered to have a black-body spectrum: the observed radiation accordingly also has a black-body spectrum corresponding to the transformed temperature T'. The power flux per unit solid angle is proportional to T^4 (according to Stefan's law), and the solid angle transformation ensues from eqs. (12) and (17) as

$$d\Omega' = [\gamma(1 + \beta \cos \Theta)]^{-2} d\Omega, \qquad (21)$$

where

 $d\Omega' = \sin \Theta' d\Theta' d\Phi'$ and $d\Omega = \sin \Theta d\Theta d\Phi$. (22)

Using the concept of apparent visual magnitude m_v as a measure of the perceived brightness for radiation at the wavelength $\lambda = 0.5556 \ \mu m$, one obtains the observed brightness in the spacecraft system as the apparent magnitude

$$m'_{v} = m_{v} - 2.5 \log[\gamma (1 + \beta \cos \Theta_{z})]^{2} + B.C. - B.C.', \qquad (23)$$

where B.C. denotes the bolometric correction, defined as the difference between the apparent

bolometric magnitude m and the apparent visual magnitude:

B.C.
$$= m - m_v$$
 and B.C. $= m' - m'_v$. (24)

In the classification of brightness of stellar sources that emit mainly in the IR region, the apparent magnitudes m_1 and m_K are used as a measure of luminosity at $\lambda = 0.84 \ \mu m$ and $\lambda = 2.20 \ \mu m$, respectively. These magnitudes have been listed in the Two-Micron Sky Survey catalogue compiled by Neugebauer and Leighton [19]; the authors also describe how to correct the m_1 values to be in accord with those tabulated by Johnson [20] for the nearby wavelength $\lambda = 0.90 \ \mu m$. For our calculations, we assembled an IR data file from the Neugebauer-Leighton catalogue, including all sources with $m_K \leq 2$.

In our programs, the bolometric correction procedure is varied according to the category of the star under consideration. We distinguish between three categories:

(a) For visible stars in the spectral classes O, B, A, F, or G (for all subclasses 0-9) the black-body temperature T is taken to be the typical effective stellar temperature appropriate to the respective spectral type in accord with Allen's classification [21], and the corresponding bolometric correction (B.C.) is taken from Johnson's tabulation [20]. The transformed bolometric correction (B.C.') is either extracted by interpolation within Johnson's tabulation [20] for T' or, if the apparent temperature T' exceeds 12 500 K, from the extrapolated approximation formula

B.C.' =
$$-5.468 \log T' + 21.939.$$
 (25)

(b) For visible stars in the spectral classes K, M, N, S or C (for all subclasses 0-9), the temperature assignment T is made on the basis of Johnson's tabulation [20] for *giant* stars. However, to correct for the diminution of visual brightness due to possible molecular blanketing effects, a modified procedure has been adopted as a means of obtaining more realistic bolometric corrections. For any given effective temperature T the bolometric correction (B.C.) is deduced by interpolation in data listed by Johnson [20,22] and Allen [21], and plotted as a calibration curve in fig. 2. These data are built into the programs as data file blocks. To arrive at the value of B.C.' the same procedure as in (a) is followed, and thence the observed apparent visual magnitude m'_{v} is determined from the input m_{v} in accordance with eq. (23).

(c) For IR sources, the magnitude difference $m_{\rm I} - m_{\rm K}$ is used to arrive at the appropriate temperature *T*, as indicated on the calibration curve, fig. 2. Thence *T'* is calculated with the transformation formula (20), and the bolometric corrections B.C. and B.C.' are deduced as above. This enables $m'_{\rm v}$ to be computed from eq. (23).



Fig. 2. Plot of infra-red (IR) apparent magnitude differences $(m_1 - m_K)$ and bolometric corrections $(m - m_v)$ versus blackbody Planck temperature T and $\log_{10}T$, as used for the calculation of perceived apparent magnitude m'_v with the aid of the data block INFR1. m is the bolometric magnitude, m_v is the visual magnitude (at $\lambda = 0.5556 \mu$ m), m_I is the shortwave IR magnitude (at $\lambda = 0.84 \mu$ m), and m_K is the longwave IR magnitude (at $\lambda = 2.20 \mu$ m).

4. Program review

The FORTRAN-IV programs "CELESTE" and "STELLA" are identical in structure and composition, with the same variables, functions, procedures and subroutines. The only distinction between them is the fact that "CELESTE" is designed for batch-mode operation (with a non-interactive input data package), while "STELLA" has been compiled for running from an interactive time-sharing terminal (such as the model LA36 DECwriter II with 300 BAUD that we have used principally).

4.1. Data files used in input

Various catalogue files have been prepared for input purposes, listing various categories of stars and their characteristic data. The most comprehensive of these, STARDAT, comprises 2288 entries, made up of the 519 brightest visible stars (with $m_v \leq 4$) from the Yale Catalogue of Bright Stars [23] together with 1313 northern-hemisphere and 456 southern-hemisphere Neugebauer-Leighton IR sources [19] with $m_{\rm K} \leq 2$. The 519 brightest visible stars alone are listed, with their characteristic data, in the input file YALSTAR. Considerably less voluminous than these are such alternative specific files as CONDAT, which lists 34 of the brightest $(m_v \le 4)$ of the visible stars to be found in the principal northern and southern-hemisphere constellations (Aps, Boo, CaM, Car, Cas, Cen, Cru, Hyi, Per, Sco, UMa and UMi), and NEAR-DAT, which lists a selection of 91 near and prominent stars (essentially, the 66 nearest with $r \le 6.1$ pc down to 14th magnitude, and the 25 brightest, with $m_v \le 1.65$ and r < 490 pc). For each of these input files for stellar data, the following characteristics are specified in the following sequence and format:

Identification, Location (right ascension α in a h/min/s and declination δ in deg/arc-min), Brightness (as apparent magnitudes m_K, m_I, m_v), Spectral class and Distance (r in pc), viz.

ID1, ID2, IHOUR, MIN, ISEC, IDEG, SMIN, AMK, AMI, AMV, A, B, C, R [FORMAT (A1,

A6, I2, X, I2, X, I2, 2X, I3, F5.1, 3F5.2, 3X, 3A1, 8X, F6.1)].

These data are as follows:

Identification

- ID1 = B (for a visible bright star, or I for an IR source, or U for a UV source, or any other characteristic designation) [FOR-MAT A1]
- ID2 =Alphanumeric sequential designation [FORMAT A6], (e.g., Y00001 for 1st star from Yale catalog, or N00003 for 3rdnearest star, etc.);

Location

- IHOUR, MIN, ISEC = Right ascension α in h/min/s [FORMAT (I2, X, I2, X, I2, 2X)]
- IDEG, SMIN = Declination δ in deg/arc-min [FORMAT (I3, F5.1)];

Brightness

AMK, AMI, AMV = Apparent K-magnitude, I-magnitude and visual magnitude (m_K, m_I, m_v) [FORMAT (3F5.2, 3X)];

Spectral class

- A = O, B, A, F, G, K, M, N, S or C, according to the stellar spectroscopic classification scheme [FORMAT A1],
- B = 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9, according to the spectral subclass [FORMAT A1],
- C = E (for emission spectrum) or P (for peculiar spectrum) or other identifying spectral specification [FORMAT A1];

Distance

- R = r, the distance from Earth in parsec [FOR-MAT F6.1]
- NOTE A gap [FORMAT 8X] has been left prior to the F6.1 format for entry of other stellar information that might be desired in the future (i.e., UV data).

Space on the stellar data file entries has also been left for, e.g., star names as designated by constellation and brightness (for example, Polaris = α UMi) or by catalogue (such as the BD = Bonner Durchmusterung, or HD = Henry Draper, etc.). The respective stellar data input file (file-name = STARDAT, YALSTAR, CONDAT or NEAR-DAT, etc.) is called by the command GET, STAR = file-name. The only other file that has to be called prior to running the programs is VIDEO, used as the repository for output data in the tabulation that is employed for generating a display in video-recording mode. The file VIDEO itself, as called by the command GET, VIDEO prior to running the programs, comprises two blank lines in its original form; as the output data are generated, they are entered into this file, displacing the blank lines. As each new batch of output data from a series of computational runs is created, each batch is stacked behind the other, sequentially expanding the output tabulation.

Thus, the instructions to start the calculations are as follows:

OLD, CELESTE (or STELLA, as the case may be) GET, STAR = file-name (e.g., GET, STAR = CONDAT)

GET, VIDEO

RUN

Then follow the running specifications, as described in section 4.2, input either from the interactive terminal or from IBM punched cards.

To initiate a further run (the output from which would be appended to the end of the file VIDEO), one repeats the command

RUN

and continues with a fresh set of running specifications, etc.

When the sequence of one or more runs has been completed, the tabulated output data are listed by giving the command

EDIT, VIDEO

(In terminal operating mode, the message "BE-GIN TEXT EDITING" signals that the system is ready)

LIST; * (implying "List to the end-of-file")

When the entire table of output is printed, one leaves the Text Editor mode through the command END (and then either LOG-OFF or begin a new cycle of computations).

4.2. Running specifications

The specifications that determine the computer run are input either on IBM cards or as an 8-line data batch from the terminal in the case of the batch program "CELESTE", or in interactive conversational mode from the terminal in the case of the terminal program "STELLA". The running responses are entered in free-field format, numerical data entries being separated by commas. To illustrate this part of the input, the data statements are underlined below; the non-underlined statements in curly brackets $\{\cdots\}$ indicate the conversational prompts from the terminal in the program "STELLA", describing the next line of data to be entered (line numbers refer to "STELLA" input, card numbers to "CELESTE" input):

- Statement 1: (DESCRIPTIVE TITLE (A96))
- Line 1 or Card 1: <u>TITLE HEADER</u> (96 alphanumeric characters, FORMAT 12A8)
 - Statement 2: {WOULD YOU PREFER A FORE OR AFT VIEW?}
- Line 2 or Card 2: Enter either <u>FORE</u> or <u>AFT</u> [FORMAT A4]
 - Statement 3: (PLEASE SPECIFY APEX SEMIANGLE (IN DE-GREES):)
- Line 3 or Card 2: Enter α [FORMAT F5.1]
- Note: If $\alpha \leq 0^{\circ}$ or > 90°, set to $\alpha = 60^{\circ}$. Statement 4: (WHAT IS YOUR DIREC-
- TION OF FLIGHT?) Line 4 or Cârd 3: Enter θ_s, ϕ_s (the flight angles
 - THETAS, PHIS in degrees) Statement 5: (WHAT IS YOUR DIS-TANCE FROM EARTH (IN PARSEC)?)
- Line 5 or Card 3: Enter <u>z</u> (the variable Z in parsec; 1 pc = 3.26 ly = 3.086 $\times 10^{16}$ m)
 - Statement 6: {ENTER CUTOFF MAGNI-TUDE, BETA, VISUAL OP-TION:}
- Line 6 or Card 3: Specify $(m'_v)_{max}$, β , <u>IOPT</u> [FORMAT F5.1, F7.6, I1]
 - Note: (i) The specification of $(m'_v)_{max} =$ CMAG serves as a curb upon the extensiveness of the output data by limiting the number of stars featured in the output plot and tabulation.
 - (ii) The speed ratio $\beta = BETA \equiv v/c$ is dimensionless; v is the speed of the

spacecraft and c is the speed of light $(2.998 \times 10^8 \text{ m/s})$.

(iii) The "visual option" IOPT excludes IR and UV data from the output when it is set to zero, i.e., when IOPT = 0 only stars in the visible region of the spectrum are output; when

IOPT = 1 all stars, e.g., IR, visible and UV are included in the output.

- Statement 7: (WOULD YOU LIKE A STAR PLOT? (ENTER "YES" OR "NO"):)
- Line 7 or Card 4: Specify <u>YES</u> or <u>NO</u> [FOR-MAT A3]
- Note: If "NO" is specified, the input concludes at this point; if "YES", then one more statement and specification follows.
 - Statement 8: {A COLOUR PLOT? (EN-TER "YES" OR "NO"):}
- Line 8 or Card 5: Specify <u>YES</u> or <u>NO</u> [FOR-MAT A3]
- Note: Having specified "YES" to the plot option (APLOT) in line 7 or card 4, one has the choice of representation of stars, either through letters (U, B, G, W, Y, R, I) denoting the star colour if this option (BPLOT) is set to "YES", or through asterisks (*) if this option (BPLOT) is set to "NO". The star plot in either case depicts the FORE or AFT view from the spacecraft headed in the direction (θ_s , ϕ_s) at the speed β ; the view is a cone of semi-angle α .

To summarize, the running data specifications for "CELESTE" are the following:

- (1) DESCRIPTIVE TITLE
- (2) FORE or AFT, α
- (3) $\theta_{\rm s}, \phi_{\rm s}, z, (m'_{\rm v})_{\rm max}, \beta$, IOPT
- (4) YES or NO

(5) YES or NO (only if the preceding specification was YES).

The running data specifications for "STELLA" are the same, except that the data in (2) and (3) are divided up:

- (1) DESCRIPTIVE TITLE
- (2) FORE or AFT

- (3) α
- (4) $\theta_{\rm s}, \phi_{\rm s}$
- (5) z
- (6) $(m'_v)_{max}$, β , IOPT
- (7) YES or NO

(8) YES or NO (only if the preceding specification was YES).

Sample inputs are given in section 5 for various test runs.

4.3. Description of program procedure and subroutines

Both programs operate identically once the stellar data files and running specifications have been established. They both use the same variables and subroutines, as identified in table 1. For clarity in the description below, variables will be designated with capital letters in square brackets, e.g., as [VARIAB].

The programs each commence by preparing VIDEO to act as the repository for output data and use the data block INFR1 (containing data tabulations that have been plotted as fig. 2) to associate a temperature T [= antilog TEMP(J) = BOL(1, J)] with each of the 33 categories [J] of stellar spectral classes [SP1(1, J) = SPCL(J)] and subclasses [SP1(2, J) = SPCN(J)]. Then, for these temperatures T, the programs assign appropriate magnitude differences $[m_1 - m_K = DIFIK(J) = BOL(2, J)]$ and IR bolometric corrections $[m - m_K = DIFBK(J) = BOL(2, J)]$.

The programs then read in the running specifications (interspersing the specifications with interactive printed-out statements in the case of "STELLA") and proceed with calculations as follows:

- (a) The programs compute the Einstein speed factor $\gamma \equiv (1 \beta^2)^{-1/2}$ [= GAMMA] and enter the main program loop in which the various relativistic transformations are carried out.
 - (i) The right ascension α [= IHOUR/MIN/ISEC] and declination δ [= IDEG/SMIN] are converted to ϕ [= PHI] and θ [= THETA], expressed in radians, and
 - (ii) taking account of the flight direction (θ_s ,

Glossary	of principal sy	mbols, varia	bles, subrou	tines and	data blocks		
Symbol	Variable	Sub	Data	(eq.)	First mention	in	Définition
		routine	block	uo.	CELESTE line	STELLA line	
	APEX				37	41	Apex semiangle of viewing cone
				6			Spacecraft acceleration in galactic system
a,				Ξ			Proper acceleration of spacecraft (in own frame)
1	ABMP				142	156	<i>m</i> ', apparent bolometric magnitude
	AMI				59	72	m_1 , IR apparent magnitude at $\lambda = 0.84 \ \mu m$
	AMK				59	72	$m_{\rm K}$, IR apparent magnitude at $\lambda = 2.20 \ \mu m$
	AMV				59	72	$m_{\rm v}$, apparent visual magnitude
	AMVP				143	157	m'_{v} , perceived apparent visual magnitude
	APLOT				50	61	Plot option
ß	BETA			(12)	40	52	Speed ratio $\beta \equiv v/c$ ($v =$ spacecraft speed)
Bmar				(3)			Maximal speed ratio in g-boost flight
B.C.				(23)			Bolometric correction
B.C.\				(23)			Apparent bolometric correction
			BCI		139/429	152/444	Tabulated bolometric correction
			BCOR		176/408	191/423	Visible star data tabulation
			BCORI		408	423	Visible star data tabulation (first part)
			BCOR2		427	442	Visible star data tabulation (second part)
	BCP				139	145	Bolometric correction (B.C. or B.C.)
	BPLOT				51	64	Colour option in plot
		BRSTR			91/278	104/293	Bright visible star assignment subroutine
J				(<u></u>]			Velocity of light
	CMAG				40	52	$(m'_{v})_{max}$, the cutoff apparent visual magnitude
,		CONV			120/257	133/272	Polar to rectangular coordinate conversion routine
ø					30 /401	311/ 02	Decilitation, reau as ADEO, SIMIN TD mominide difference
	DIFBA				104/06	014/00	$m_{\rm c} - m_{\rm c}$ IR magnitude difference
7	NIST			(15)	110	158	Radial distance to star from spacecraft
d Ω	16171			(21)			Solid angle in galactic frame
dΩ'				(21)			Solid angle in spacecraft system
d <i>t</i>)			Time interval in galactic frame
<i>dt'</i>				(8)			Time interval in spacecraft frame
ıp∕ap				e			Acceleration a in galactic frame
٨	GAMMA			6	55	68	Einstein factor, $\gamma \equiv (1 - \beta^2)^{-1/2}$
ĥ	ETA				93/118	106/131	Speed-direction parameter, $\eta \equiv \gamma (1 + \beta \cos \Theta_z)$
	IDEG				59	72	Declination component in degrees
	IHOUR				59	72	Righ ascension component, in h

44 ÷ -. . ĥ . . Table 1

		IMAG			221/226	236/241	Subroutine, called by SPEC, to assign temperature and bolometric magni-
							tude for IR stellar sources and/or K, M, S, C class stars
			INFRI		385	400	Tabulated data block for IR stars
	IOPT				40	52	Visual option (provision for star plot)
	ISEC				59	72	Right ascension component, in s
K				(14)			$K = (z/r) \sec \Theta$, parallax formula variable
~				(19)			Star principal wavelength in galactic system
×				(61)			Star principal perceived wavelength, $\lambda' \equiv hc/kT'$
т				(24)			Bolometric magnitude
m	AMI				59	72	IR apparent magnitude at $\lambda = 0.84 \ \mu m$
•	MIN				59	72	Right ascension component, in min
m _K	AMK				59	72	IR apparent magnitude at $\lambda = 2.20 \ \mu m$
m ,	AMV				59	72	Apparent visual magnitude at $\lambda = 0.5556 \ \mu m$
m',	AMVP			(23)	143	157	Perceived apparent visual magnitude
φ	IHd			(01)	70	83	Azimuthal angular coordinate of star (polar)
ф				(11)			Azimuthal angle of star in flight direction
Φ,	PHIP			(13)	83	96	Transformed azimuthal angle of star (perceived)
چ	SIHd			(10)	40	46	Azimuthal angle of flight direction
1	Ы				32	32	$\pi = 3.141592654$
		PLOT			155/336	169/351	Plot subroutine, to provide astroscape
r	R			(14)	60	73	Distance to star from origin of solar system
s				Ð			Distance covered in flight
	SMIN				59	72	Declination component, in min of arc
	SPCL				26/388	26/403	Spectral class designation (O, B, A, F, G, K, M, S, C)
	SPCN				27/391	27/406	Spectral subclass designation (0-9)
		SPEC			90/173	103/188	IR data assignment subroutine
Т	TEMP			(20)	28/394	28/409	Planck temperature of star
T'	TEMPP			(20)	122	135	Apparent Planck temperature of star
т _Е				9			Time duration of flight in Earth frame
٦,				Ξ			Time duration of flight in spacecraft frame
θ	THETA			(10)	74	87	Sagittal polar coordinate of star
0	THETA			(10)	86	66	Transformed polar coordinate of star referred to flight direction as z-axis
Ð,	THETAP			(12)	119	132	Apparent sagittal coordinate of star
θ	THETAS			(01)	4	46	Sagittal polar flight angle
6 ,	THETAZ			(14)	67	110	Polar coordinate of star, corrected for parallax
			TMP1		134/438	147/453	Data listing of temperature in block BCOR2
a				6			Velocity of spacecraft
			١IJ		214/410	229/425	Data listing of m_1 apparent magnitudes
	VIEW				37	39	Astroscape view option ("FORE" or "AFT")
			VKI		302/418	230/433	Data listing of $m_{\rm K}$ apparent magnitudes
		WAVE			123/240	136/255	Subroutine associating colour with temperature
N	Z			(14)	64	48	Distance travelled by spacecraft along z-axis

 ϕ_s) [= THETAS, PHIS] cited in the running specifications, the stellar coordinates are converted to new coordinates (Θ , Φ) [= THETA, PHIP] referred to the flight direction as the z-axis.

(b) Various subroutines are then called in to correlate temperatures and brightnesses (i.e., apparent magnitudes) with the individual stars as the stellar input file is scanned. For bright visible stars, characterized as such by the identifying letter B [as ID1], the subroutine BRSTR is called; for all other spectral sources, such as IR stars (for which the identification ID1 is not "B"), the subroutine SPEC is called instead.

In BRSTR, the following is effected;

- (i) For visible stars in the spectral class O, B, A, F or G the appropriate temperature T [= TEMP], and magnitudes m_1 , m_K and m [= AMI, AMK, AMB] are determined, according to class [= SPCL] and subclass [= SPCN].
- (ii) For stars in the spectral category C or N, the bolometric correction B.C. [= BC] appropriate to high temperature T > antilog 4.1 is calculated according to the formula (25), which corresponds to the Johnson tabulation [20] for main-sequence stars or, if T < antilog 4.1, corrected values of the magnitudes m_1 , m_K and m [= AMI, AMK, ABM] are calculated in accord with Johnson's tabulation as encapsulated within the data listings of VI1, VK1, BC1 and TMP1 in the block data BCOR (subdivided into BCOR1 and BCOR2).

In SPEC, essentially the same treatment is applied to dwarf visible stars and IR stellar sources, namely,

- (i) For stars in the spectral class K, M, S or C the subroutine IMAG is called, which builds the magnitude difference $m_1 m_K$ [= DIFIK], using data table INFR1, and thence obtains the respective temperature [= T = TEMP] and bolometric magnitude m [= ABM].
- (ii) For stars in classes C or N, or for stars in the input file that have no specification of the m_1 -magnitude, corrected apparent

magnitudes $m_{\rm I}$ and m [= AMI, ABM] are determined from the specified $m_{\rm K}$ [= AMK], and thence the temperature T [= TEMP] is established.

- (iii) For IR stars, the $m_{\rm K}$ -specification is used as a means to assign a temperature T[= TEMP] corresponding to the appropriate tabulated value of BOL(1, J) and thence, if $m_{\rm I}$ has not also been specified in the input file, its value [= AMI] is determined. From these, the requisite bolometric magnitude m [= ABM] is obtained.
- (c) Having assigned temperatures and apparent (visual and/or bolometric) magnitudes to each star in the input file, the programs then evaluate the parallax formulae (14) and (15) to obtain Θ_z [= THETAZ] and d [= DIST]. To take due account of aberration, the programs first calculate the speed-direction parameter $\eta \equiv \gamma (1 + \beta \cos \Theta)$ [= ETA] and then perform the relativistic transformation to Θ . Since $\Phi' = \Phi$ [= PHIP], the polar coordinates (Θ' , Φ') are thereby established [as THETAP, PHIP], corrected for parallax and aberration. As a means of specifying the star's location on the (rectangular) display grid in the depiction of an astroscape (plotted as print-out, or displayed on a colour console), it is convenient to convert these polar coordinates to rectangular Cartesian coordinates (x, y) = X, Y, which are stored and may be conveyed directly to a colour display unit. In the output, the apparent polar coordinates are listed under "THETA", "PHI", and the rectangular coordinates under "HORIZ", "VERTICAL".
- (d) The programs then use η [= ETA] to calculate the apparent temperature T' [= TEMPP] via eq. (20), and thence, using the subroutine WAVE, assign the requisite colour (i.e., wavelength) to each star as perceived ("U", "B", "G", "W", "Y", "R", "I" = ultra-violet, blue, green, white, yellow, red, infra-red).
- (e) At this point, the programs establish whether the apparent temperature T' conforms to wavelengths in the visible region of the spectrum and, if the specification option IOPT (="visual option") has been set to zero, re-

tains only the visible stars for further handling (i.e., rejects all entries Doppler-shifted into the UV or IR regions). If IOPT = 1, all stars (UV, visible and IR) are included in the output. For these stars, the apparent bolometric correction B.C.' [= BCP] is determined along similar lines to those used previously for B.C. [= BC], and thence the magnitudes m' and m'_v [= ABMP, AMVP] are calculated, using eq. (23).

(f) Having obtained the entire batch of results for each member of the set of stars contained in the input file (and, at option, having rejected those which underwent a Doppler shift into the UV or IR regions), the programs then, if so directed in the running specifications, provide a printed plot of the astroscape with the aid of the PLOT subroutine, and append the output tabulation to the contents of the file VIDEO (and/or feed them directly to a display unit).

4.4. Output

As each run is completed, a new run with fresh specifications may be initiated through the command

RUN (or CELESTE in batch mode)

wherein the stellar input data will continue to be taken from the file STAR = file-name (file-name = STARDAT, YALSTAR, CONDAT or NEARDAT, etc., as the case may be). If a new star-file is desired, this is called and used via the directive

GET, STAR = new-filename RUN (or CELESTE in batch mode)

The new run specifications again have provision for directing that a star chart in the form of an astroscape is printed out (or suppressed) at will. The numerical results are sequentially appended to the output file VIDEO. At any stage, the contents of this output file may be stored in the user's catalogue for future reference, e.g., either by directing

RENAME, ASTRODAT = VIDEO SAVE, ASTRODAT

thus storing the output in a saved file ASTRO-

DAT or, at the cost of losing the original file VIDEO with its two empty lines as lodged in the catalogue, simply storing the new VIDEO, filled with output data, via the command

REPLACE, VIDEO = VIDEO

Alternatively, if a print-out of the numerical data in VIDEO is desired at any time, this may most simply be accomplished through the employment of the "TEXT EDITOR" mode, which leaves STELLA (or CELESTE) as the primary working file. The commands entered from the terminal, or from cards, would then be as underlined below (with interactive terminal statements illustrated within curly brackets $\langle \cdots \rangle$ as before, in the case of "STELLA"):

Command:	EDIT, VIDEO
Statement:	(BEGIN TEXT EDIT-
	ING.)
Optional command to	
enumerate the num-	
ber of lines in	
VIDEO:	NUMBER
Responsive statement:	$\overline{\langle xxx LINES TO EOF. \rangle}$
-	(EOF = end of file)
	L;* (list to end)
	(Tabulated output data
	follows here}
Statement:	{-END OF FILE-}
Command:	END (to leave the
	"TEXT EDITOR" mode).

From this point, one may start afresh with a new cycle of operations, destroying the filled VIDEO file with its old output data and recalling the original VIDEO file with its two blank lines from the catalogue, ready to receive new data:

GET, VIDEO, STAR = file name

RUN (or CELESTE, in batch mode)

As indicated in the program summary, the only restriction on the extent of the program has been in the feasible length of the stellar input data files and in the omission of a treatment to evaluate the bolometric correction for UV sources. The latter would be needed only in the consideration of Doppler red-shifts that affect stars in the rearward

view, causing UV sources to become shifted into the visible range of wavelengths. As UV star catalogues are still incomplete, this provision has been left to await future refinement. It has not been felt necessary, either, to allow for views in other directions than fore or aft (though the changes needed for the admission of sideways views would be slight). The program deals only with point sources, and is not therefore designed to accommodate extended emitters such as nebulae, etc. Indeed, the ultimate in aberration and Doppler-shift would be experienced at the speed $\beta = 1 - 10^{-8}$, when the entire firmament of 3 K cosmic background radiation would be shifted into the visible range and perceived as an intense $(m'_{\nu} \approx -24.5)$ point of light spanning less than 1 min of arc in diameter, in an otherwise totally black environment.

5. Description of test runs

For each program, four sample runs have been undertaken, and are presented with specimen input and output. These are as follows:

- (a) The fore view from the midpoint (z = 100 pc) of a flight to Polaris (αUMi) in the direction of the north celestial pole (NCP), with the coordinates (α, δ) = (1^h31^m13^s, 89°15.0') → (θ, φ) = (θ_s, φ_s) = (Θ, Φ) = (0°, 0°) at the extreme relativistic speed β = 0.999 (at which Polaris, identified as star BY011 in the STARDAT, CONDAT and YALSTAR catalogues, is blueshifted into the UV range, with T' = 268 215 K), excluding UV output (IOPT = 0) from the starfile CONDAT;
- (b) The same as (a), but including UV output through setting OPT = 1;
- (c) The fore view from the midpoint (z = 0.92 pc) of a flight to Barnard's Star (identification number BN004 in NEARDAT; not included in the CONDAT stellar data file used in the test runs) at the coordinates (α, δ) = (17^h56^m0^s, 4°36.0'), i.e., (θ,φ) = (θ_s, φ_s) = (85.4°, 269.0°) at the non-relativistic speed β = 0.122 proposed for the Daedalus mission, excluding UV output from the starfile CONDAT;

(d) The same as (c), but with the file NEAR-DAT (containing nearby and bright stars) used for the stellar input data file (this contains Barnard's Star as BN004), excluding UV output.

Only the last few pages of printout are reproduced in this paper.

Acknowledgements

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TEST RUN OUTPUT

READY. GET,STAR=NEARDAT

READY. RUN

82/11/29. 16.47.24. PROGRAM STELLA

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DESCRIPTIVE TITLE (ABO) ? STELLA-NEARDAT FORE MIDWAY (Z=0.92PC) VIEW TO BARNARD'S STAR AT .122C WITH MV'.LE.14 WOULD YOU PREFER A 'FORE' OR 'AFT' VIEW? ? FORE PLEASE SPECIFY APEX SEMIANGLE (IN DEGREES): ? 60.0 WHAT IS YOUR DIRECTION OF FLIGHT? ? BS.4+269.0 WHAT IS YOUR DISTANCE FROM EARTH (IN PARSEC) ? ? 0.92 ENTER CUTOFF MAGNITUDE,BETA,VISUAL OPTION: ? 14.0+0.122.0 WOULD YOU LIKE A STAR PLOT? (ENTER \$YES\$ OR \$NO\$): ? YES A COLOUR PLOT? (ENTER \$YES\$ OR \$NO\$): ? YES

STELLA-NEARDAT FORE MIDWAY (Z=0.92PC) VIEW TO BARNARD'S STAR AT .122C WITH MV'.LE.14 BETA= .1220

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CMAG= 14.00

SRU 11.217 UNTS.

RUN COMPLETE. EDIT,VIDEO

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2 1 1 1	IEVI EDI	1140.										
STELLA		ORE N	CP UTEN	FROM 7=10				、				
THE CH	TOPE MACA	ATTUDE	CF VIEW	AND DETA	VPL HI BEIH-V	TH FORE AFVILLEN		, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		TOTANOF		
THE CO	IOFF MAGE	TIODE	= 4.0	HND BEIH	= .9990000 WI	TH FURE SEMIAPEX =	60.0 IN 1	DIRECTION	0.0; 0.0) AT L	ISTANCE A	= 100.00	PL.
LINE	10	SC	COLUUR	HURIZ	VERTICAL	THETA' (DEG)	PHI(DEG)	ETA	TEMP'(KELVIN)	AVM'	DISTANCE	(PU)
1	BY023	F5	Y	13,394	10.814	17,2145	51.0833	۰9772	6254.	3.59	76.92	
2	BY057	AO	в	.294	-10.902	10.9064	178.4542	2.3477	23125.	3.12	66,64	
3	BY215	FO	R	21,836	-2.290	21.9556	95.9875	+6087	4279.	3.28	148.10	
4	BY321	B2	в	787	-11.894	11.9205	183,7875	1,9833	35700.	3.49	421.69	
5	BY325	B1	в	-2.237	-19,189	19.3193	186.6500	.7809	16790.	2.91	218.91	
6	BY326	83	Ğ	-2.239	-19,189	19.3193	186.6542	7809	12104.	3.32	218.91	
7	BY 329	NT.	ō	-1.707	-9 450	0 5770	107 7017	7 0199	0007	-7.44	1005 34	
é	DY754	D 4	ő	-17 000	-71430	7.33/7	10/ / / / / /	3+0107	77774	-2.44	1003.24	
8	DIAJA	51	5	-13+080	-21,805	23.4268	210,9583	.45/3	9832.	2.71	157.39	
7	81403	m1	Ţ	-12.769	-5.32/	13,8361	247+3542	1+4910	5413.	•89	132.10	
10	BY 436	F2	G	-13+439	-,729	13.4591	266.8958	1,5723	10534.	3.83	160.70	
STELLA	-CONDAT F	ORE N	CP VIEW	FROM Z=10	OPC AT BETA=0	+999 WITH MV'+LE+4	(INCL: UV))				
THE CU	TOFF MAGN	ITUDE	= 4.0	AND BETA	= .9990000 WI	TH FORE SEMIAPEX =	60.0 IN 1	DIRECTION (0.0, 0.0) AT D	ISTANCE 2	z = 100.00	PC.
LINE	ÍD	SC	COLOUR	HORIZ	VERTICAL	THETA'(DEG)	PHI(DEG)	ETA	TEMP'(KELVIN)	AVM'	DISTANCE	(PC)
1	BY005	KO	11	508	2 844	2 8810	10.1202	10 4075	07047	- 44	41.44	
ŝ	PYO11	ED	ŭ	017	2,070	210710 077E	22 8042	44 2025	72007+	.07	100.02	
2	DYACT	50	ů.			.0335	22:0042	441/023	200215.	+ 33	100102	
د	81023	F5	Ţ	13.394	10.814	17.2145	51.0833	.9//2	6254.	3.57	76.92	
4	BY057	AO	в	,294	-10.902	10.9064	178.4542	2.3477	23125.	3.12	66.64	
5	BY060	AOP	ย	569	-2.368	2.4353	193.5083	23,5041	231515.	1.03	70.08	
6	BY063	B 3	บ	685	-1.352	1,5158	206.8833	33.1294	513506,	1.90	185.97	
7	BY069	A3	U	615	513	.8009	230.1833	40.7346	358465.	2.25	109.52	
8	BY215	FÖ	R	21.836	-2.290	21.9556	95.9875	. 6087	4279.	3.28	148.10	
ē	BY321	82	B	787	-11.894	11.9205	183.7975	1.9977	35700	7.40	471.49	
10	BY 325	B1	ř	-2.237	-10.100	19 7107	104 4500	7909	14780	2 01	710 01	
	BY724	57	ě.	2,237	-17+107	17,3173	100+0300	.7807	10/70.	2+71	210.71	
11	D1320	83	e e	-2+237	-19.189	17.3173	180.0042	./809	12104.	3.32	218.91	
12	81329	n 3	G	-1.293	-9,450	9.5379	187,7917	3.0189	9997.	-2.44	1085.24	
13	BY 337	BO	U	-2.148	-10.166	10.3901	191.9333	2.5724	68168.	1.59	1087.41	
14	BY354	B1	G	-13.080	-21.805	25.4268	210,9583	٠4573	9832.	2.71	157.39	
15	BY 397	BO	U	-4.623	-2,525	5,2672	241.3583	8,5678	227047.	3.43	299.06	
16	BY 405	Mi	Y	-12.769	-5.327	13.8361	247.3542	1.4910	5413.	.89	132.10	
17	RY42A	BT	, ii	-5.451	725	5.4949	242.4917	7.5344	114784	3.22	1043.48	
10	BYA20	P1	ŭ	-5 474	- 450	5 4700	247 4000	7 5004	147171	7 77	1047 77	
10	BY 470	22	ä	-5,034	-+652	5.0107	20314000	7.3674	1031/1.	2:33	1003122	
		P4	- U	-3.702				2.100/1	127207.	2.YA	10031/1	
	D1402		-		1102		20010200			= : : =		
20	BY436	F2	G	-13,439	729	13.4591	266.8958	1.5723	10534.	3.83	160.70	
20 STELLA	BY436 -CONDAT I	F2 FORE M	G IIDWAY (-13.439 Z=.92PC) V	-,729 VIEW TO BARNAR	13.4591 13.571	266.8958 WITH MV'.L	1.5723 E.4	10534.	3.83	160,70	
20 STELLA	BY436 -CONDAT I TOFF MAG	F2 FORE N NITUDE	G IIDWAY (= 4.0	-13.439 Z=.92PC) U	-,729 /IEW TO BARNAF = ,1220000 W3	13.4591 ND'S STAR AT .122C ITH FORE SEMIAPEX =	266.8958 WITH MV'.L 60.0 IN	1.5723 E.4 DIRECTION (10534. 85.4, 269.0) AT	3.83	160.70 Z = .92	2 PC.
20 STELLA THE CU	BY436 -CONDAT I TOFF MAGI	F2 FORE M NITUDE	G IIDWAY (= 4.0	-13.439 Z=.92PC) V AND BETA HORIZ	-,729 JIEW TO BARNAF = ,1220000 W3	13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THFTA:(DEG)	266.8958 WITH MV'.L 60.0 IN PHI(DEG)	1.5723 E.4 DIRECTION (10534. 85.4, 269.0) AT 1	3.83 DISTANCE	160.70 Z = .92 DISTANCE	2 PC.
20 STELLA THE CU LINE	BY436 -CONDAT I TOFF MAGI ID	F2 FORE M NITUDE SC	G IIDWAY (= 4.0 COLOUR	-13.439 Z=.92PC) (AND BETA HORIZ	729 /IEW TO BARNAF = .1220000 WI VERTICAL	13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG)	266.8958 WITH MV'.L 60.0 IN PHI(DEG)	1.5723 E.4 DIRECTION (ETA	10534. 85.4, 269.0) AT TEMP'(KELVIN)	3.83 DISTANCE AVM''	160.70 Z = .92 DISTANCE	2 PC. (PC)
20 STELLA THE CU LINE	BY436 -CONDAT I TOFF MAGI ID	F2 FORE M NITUDE SC	G_ IIDWAY (= 4.0 COLOUR	-13.439 Z=.92PC) V AND BETA HORIZ	-,729 JIEW TO BARNAF = ,1220000 WI VERTICAL	13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 70.4547	266.8958 WITH MV'.L 60.0 IN PHI(DEG)	1.5723 E.4 DIRECTION (ETA	10534. 85.4, 269.0) AT TEMP'(KELVIN)	3.83 DISTANCE AVM/	160.70 Z = .92 DISTANCE	2 PC. (PC)
20 STELLA THE CU LINE	BY436 -CONDAT I TOFF MAGI ID BY397	F2 FORE M NITUDE SC B0	G IIDWAY (= 4.0 COLOUR B	-13.439 Z=.92PC) V AND BETA HORIZ -23.953	-,729 VIEW TO BARNAF = ,1220000 WI VERTICAL 22,196	13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 32.6563 32.6563	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196	1.5723 E.4 DIRECTION (ETA 1.1061	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313.	3.83 DISTANCE AVM/- 2.62	160.70 Z = .92 DISTANCE 249.26	2 PC. (PC)
20 STELLA THE CU LINE 1 2	BY436 -CONDAT I TOFF MAGI ID BY397 BY405	F2 FORE M NITUDE SC B0 M1	G IIDWAY (= 4.0 COLOUR B R	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437	-,729 VIEW TO BARNAF = ,1220000 WI VERTICAL 22,196 28,494	13.4591 13.4591 RD'S STAR AT +122C (TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009.	3.83 DISTANCE AVM 2.62 .27	160.70 Z = .92 DISTANCE 249.26 51.87	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412	F2 FORE M NITUDE SC B0 M1 K2	G IIDWAY (= 4.0 COLOUR B R Y	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683	-,729 VIEW TO BARNAF = .1220000 WI VERTICAL 22.196 28.494 36.554	13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 32.4563 33.9389 39.0314	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898.	3.83 DISTANCE AVM/ 2.62 .27 1.69	160,70 Z = .92 DISTANCE 249.26 51,87 19,72	2 PC+ (PC)
20 STELLA THE CU LINE 1 2 3 4	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415	F2 FORE M NITUDE SC B0 M1 K2 K5	G_ IIDWAY (= 4.0 COLOUR 8 R 7 R R	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586	-,729 JIEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142	13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0868	10334. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898. 4132.	3.83 DISTANCE AVM/ 2.62 .27 1.69 3.09	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY419	F2 FORE M NITUDE SC B0 M1 K2 K5 F0	G IIDWAY (= 4.0 COLOUR 8 R Y Y W	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494	729 JIEW TO BARNAF = .1220000 WJ VERTICAL 22.196 28.494 36.554 43.142 45.374	13.4591 RD'S STAR AT .122C TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0868 1.0841	10534. 85.4; 269.0) AT TEMP' (KELUIN) 29313. 4009. 4898. 4132. 7622.	3.83 DISTANCE AVM - 2.62 .27 1.69 3.09 3.06	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY419 BY426	F2 FORE M NITUDE SC B0 M1 K2 K5 F0 B3	G IIDWAY (= 4.0 COLOUR 8 R Y Y R R B	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912	-,729 JIEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506	13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX - THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.8265	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0868 1.0841 1.0984	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898. 4132. 7622.	3.83 DISTANCE AVM/ 2.62 .27 1.69 3.09 3.06 2.69	160.70 Z = .92 DISTANCE 249.24 51.87 19.72 47.00 15.31 999.22	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7	BY436 -CONDAT I TOFF MAGI BY397 BY405 BY412 BY415 BY415 BY419 BY428	F2 FORE M NITUDE SC B0 M1 K2 K5 F0 B3 B1	G IIDWAY (:= 4.0 COLOUR B R Y R W B B B	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368	-,729 JIEW TO BARNAW VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313	13.4591 13.4591 RD'S STAR AT .122C TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9369 33.9369 33.9314 44.6708 46.1618 37.8265 37.8265	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 353.3238	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0868 1.0841 1.0984	10534. 85.4: 269.0) AT : TEMP' (KELVIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624.	3.83 DISTANCE AVM'' 2.62 .27 1.69 3.09 3.06 2.69 1.80	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31 999.22 999.22	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY415 BY419 BY426 BY428 BY428 BY428	F2 FORE M NITUDE SC B0 M1 K2 K5 F0 B3 B1 P2	G IIDWAY (= 4.0 COLOUR B R R Y R W B B B B	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591	729 /IEW TO BARNAF = .1220000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 19.009	13.4591 13.4591 13.4591 13.4591 14.502 14.503 14.508 14	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 352.5393 353.3238	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0840 1.0984 1.0984 1.0984 1.0984	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898. 4132. 7622. 23624. 19733.	3.83 DISTANCE AVM' 2.62 .27 1.69 3.09 3.04 2.69 1.80 2.45	160.70 Z = .92 DISTANCE 249.24 51.87 19.72 47.00 15.31 999.22 999.24	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY415 BY415 BY416 BY426 BY428 BY428 BY428 BY432	F2 FORE M NITUDE SC B0 M1 K2 K5 F0 B3 B1 B2 S2	G IIDWAY (= 4.0 COLOUR B R Y R R B B B B	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -8.491 -4.368 -2.591	-,729 JIEW TO BARNAF = .1220000 WJ VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.8265 37.5674 39.1349 40.4715	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 352.53973 353.3238 356.2032	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0968 1.0848 1.0984 1.0988 1.0984	10534. 85.4; 269.0) AT TENP'(KELVIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7370	3.83 DISTANCE AVH 2.62 .27 1.69 3.09 3.04 2.69 1.80 2.45 2.45 2.45	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31 999.22 999.22 999.22	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY415 BY419 BY426 BY428 BY432 BY432	F2 FORE NITUDE SC B0 M1 K2 K5 F0 B3 B1 B2 F2	G IIDWAY (= 4.0 COLOUR 8 R Y R W B B B B W	-13.439 Z=.92PC) U AND BETA HORIZ -23.953 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614	729 /IEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 45.374 37.506 37.313 39.049 40.439	13.4591 13.4591 13.4591 13.4591 14.5708 14.6708 44.6708 46.1618 37.8265 37.5674 39.1349 40.4715 14.6708 40.4715 14.6708 14.	266.8958 WITH NV',L 60.0 IN PHI(DEG) 312.8196 327.0949 339,4777 344.9671 349.3971 352.5393 353.3238 356.2032	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0841 1.0984 1.0984 1.0984	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4998. 4132. 7622. 23624. 19733. 7330.	3.83 DISTANCE AVH' 2.62 .27 1.69 3.09 3.06 2.69 1.80 2.45 2.75	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31 999.22 999.24 76.25	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY415 BY419 BY426 BY428 BY432 BY436 -NEARDAT	F2 FORE NITUDE SC B0 M1 K2 F0 B3 B1 B2 F2 F0RE	G IIDWAY (= 4,0 COLOUR B R Y Y R W B B B B B B B M IDWAY	-13.439 Z=,92PC) (AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0,92PC)	729 JIEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.513 39.049 40.439 VIEW TO BARH	13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.8265 37.5674 39.1349 40.4715 NARD'S STAR AT .122	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 353.3238 353.3238 355.2032 357.714 852.2032	1.5723 E.4 DIRECTION (ETA 1.1043 1.0944 1.0868 1.09841 1.0988 1.0983 1.0943 1.0944	10534. 85.4; 269.0) AT TENP'(KELVIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330.	3.83 DISTANCE AVN'' 2.62 2.7 1.69 3.09 3.04 2.69 1.80 2.45 2.75	160.70 Z = .92 DISTANCE 249.26 51.97 19.72 47.00 15.33 999.22 999.22 999.24 76.25	2 PC+ (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA THE CU	BY436 -CONDAT TOFF MAGI BY397 BY405 BY412 BY415 BY415 BY419 BY426 BY428 BY428 BY432 BY432 BY432 BY432 BY432 HY432 BY432 BY432 BY432 BY432 BY432 BY432	F2 FORE N NITUDE SC B0 M1 K2 F0 B3 B1 B2 F2 F0RE NITUDE	G IIDWAY (= 4.0 COLOUR 8 R 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 9 10 4.0 9 10 10 10 10 10 10 10 10 10 10 10 10 10	-13.439 Z=.92PC) V AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA		13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX - THETA'(DEG) 32.6563 33.9389 33.	266.8958 WITH NV'.L 60.0 IN PHI(DEG) 332.8196 337.4777 344.9671 349.3971 352.5393 353.3238 356.2032 357.7146 C WITH NV'.	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0964 1.0964 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT	3.83 DISTANCE AVM' 2.62 .27 1.69 3.04 2.69 1.80 0.45 2.75 DISTANCE	160.70 Z = .92 DISTANCE 249.24 51.87 19.72 47.00 15.31 999.22 999.22 999.22 997.22 997.22 29.42 Z = .92	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 5 6 7 8 9 STELLA 7 8 9 5 5 4 7 8 9 7 8 9 7 8 9 7 8 9 7 1 1 1 2 1 2 3 4 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BY436 -CONDAT I TOFF MAGI ID BY397 BY405 BY412 BY415 BY415 BY415 BY419 BY426 BY426 BY426 BY426 BY426 BY426 ID ID ID ID ID ID ID ID ID ID	F2 FORE F NITUDE B0 M1 K2 K5 F0 B3 B1 B2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0	G IIDWAY (= 4.0 COLOUR 8 R 8 W 8 B 8 B 8 W 10 W 10 W 10 COLOUR COLOUR	-13.437 Z=,92PC) (AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4,912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ	72- JIEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049 0.01EW TO BARF = .1220000 VERTICAL	13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 33.9389 33.9314 44.6708 46.1618 37.5674 37.5674 39.1349 40.4715 NARD'S STAR AT .122 (TH FORE SEMIAPEX = THETA'(DEG)	266.8958 WITH MV'.L • 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 344.9671 344.9671 352.539 353.3238 355.2328 355.714 357.714 60.0 IN PHI(DEG)	1.5723 E.4 DIRECTION (ETA 1.1061 1.0984 1.0984 1.0988 1.0988 1.0988 1.0983 1.0941 LE.14 DIRECTION (ETA	10534. 85.4, 269.0) AT TENP'(KELUIN) 29313. 4099. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN)	3.83 DISTANCE AVM/' 2.62 .27 1.69 3.09 2.69 1.80 2.49 2.75 DISTANCE AVM/	160.70 Z = .92 DISTANCE 249.24 51.87 19.72 47.00 15.31 999.22 999.24 76.25 Z = .92 DISTANCE	2 PC. (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 6 7 8 9 STELLA THE CU LINE	BY436 -CONDAT TOFF MAG ID BY397 BY405 BY412 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY428 BY428 BY428 BY428 BY428 BY428 BY428 DY428 ID	F2 FORE F NITUDE SC B0 M1 K2 F0 B1 B2 F0 F0 F0 SC	G IIDWAY (= 4.0 COLOUR B R W B B B B B B B B B B B B B B B S C I I O C U D W C C L O U R C C C U D W S C C C U U W S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S C C C U U R S S C C C U U R S S C S C C C U U R S C S C C C U U R S C C C C U R S S C C C C C C C C C C C C C C C C C	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ		13.4591 13.4591 RD'S STAR AT .122C (TH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 33.	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 332.8196 337.4777 344.9671 352.5393 353.3238 356.2032 355.2032 357.7146 CC WITH MV' 60.0 IN PHI(DEG)	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0954 1.0984 1.0984 1.0984 1.0984 1.0963 1.0941 .LE.14 DIRECTION (ETA	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN)	3.83 DISTANCE AVN' 2.62 .27 1.69 3.04 2.69 1.80 2.45 2.75 DISTANCE AVN'	160.70 Z = .92 DISTANCE 249.24 51.07 19.72 47.00 15.33 999.22 999.22 999.24 76.25 Z = .92 DISTANCE	2 PC. (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA 1 2 3 4 5 6 7 8 9 STELLA 1 1 2 1 1 2 1 1 2 3 4 5 1 1 1 2 1 2 3 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BY436 -CONDAT I TOFF MAGI BY397 BY405 BY412 BY415 BY415 BY415 BY416 BY428 BY428 BY432 BY436 -NEARDAT TOFF MAGI ID BN004	F2 FORE F FORE F NITUDE B0 M1 K2 F0 B3 B1 B2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0	G IIDWAY (= 4,0 COLOUR B Y R B B B B B B B B B B S IIDWAY COLOUR R	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000	729 /IEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049 0.439 0.VIEW TO BARF = .1220000 Wi VERTICAL	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 33.9384 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 NARD'S STAR AT .122 ITH FORE SEMIAPEX = THETA'(DEG) .0000	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 352.5393 353.3238 355.25393 355.7146 CWITH MV. 60.0 IN PHI(DEG) 0.0000	1.5723 E.4 DIRECTION (ETA 1.1061 1.0954 1.0954 1.0984 1.0988 1.0988 1.0983 1.0984 1.10984 1.10984 1.0098 1.00984 1.0098	10534. 85.4, 269.0) AT TENP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336.	3.83 DISTANCE AVN' 2.62 .27 1.69 3.09 3.06 2.69 1.80 2.45 2.75 DISTANCE AVM' 6.75	160.70 Z = .92 DISTANCE 249.24 51.87 19.72 47.00 15.31 999.22 999.22 999.24 76.25 Z = .92 DISTANCE	2 PC. (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA THE CU LINE 1 2	BY332 BY332 -CONDAT TOFF MAGI ID BY397 BY405 BY419 BY412 BY419 BY426 BY419 BY424 BY424 BY432 BY433 -MEARDAT TOFF MAGI ID BN004 BN004	F2 FORE F NITUDE SC B0 M1 K5 F0 B3 B1 B2 F0 F0 SC SC SC SC SC SC SC SC SC SC SC SC SC	G IIDWAY (2 = 4,0 COLOUR 8 R Y 8 W B 8 B 8 W 1DWAY 2 = 14,0 COLOUR 8	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930		13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 33.9389 33.9389 33.9389 33.9389 33.9389 33.9389 33.9389 44.6708 44.6708 44.6708 44.6708 45.1618 37.8265 37.5674 37.1349 40.4715 9407 40.4715 1349 1349 40.4715 1349 134	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 332.8196 337.4777 344.9671 352.5393 353.3238 355.2032 355.2032 355.2032 355.7146 C WITH MV' 60.0 IN PHI(DEG) 0.0000 023.8521	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0954 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0975 8	10534. 85.4, 269.0) AT TENP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234.	3.83 DISTANCE AVM' 2.62 .27 1.69 3.09 3.06 2.69 1.80 0.45 2.75 DISTANCE AVM' 6.75 9.11	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.22 299.22 299.22 DISTANCE 2.15 2.15	2 PC. (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA LINE 1 2 7	BY332 BY332 -CONDAT I TOFF MAGI ID BY397 BY405 BY419 BY419 BY419 BY419 BY428 BY428 BY424 BY424 BY432 BY432 BY432 ID BY004 BN004 BN005	F2 FORE F0 FORE F0 B0 M1 K25 F0 B3 B1 B2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0	G IIDWAY (= 4,0 COLOUR 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 9 4 1040 20LOUR 20LOUR 20LOUR 20 20LOUR 20 20 20 20 20 20 20 20 20 20 20 20 20	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930	725 725 JIEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049 40.439 0 VIEW TO BARH = .1220000 Wi VERTICAL .000 36.030 18.420	13.4591 13.4591 13.4591 13.6561 13.6563 32.6563 33.9369 33.9369 33.9369 33.9369 33.9364 46.1618 37.5674 37.5674 39.1349 40.4715 NARD'S STAR AT .122 (TH FURE SEMIAPEX = THETA' (DEG) .0000 39.3942 31.1342	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 344.9671 352.5393 353.3238 355.25393 355.7146 C WITH MV 6.00 IN PHI(DEG) 0.0000 23.8521	1.5723 E.4 DIRECTION (ETA 1.1061 1.0433 1.0964 1.0984 1.0988 1.0988 1.0988 1.0983 1.0941 .LE.14 DIRECTION (ETA	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELVIN) 3336. 3234. 3271.	3,83 DISTANCE AVH' 2,62 .27 1,69 3.09 2,69 1,80 2,45 2.75 0ISTANCE AVH' 6,75 9,11 8,33	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31 999.22 999.24 999.24 76.25 Z = .92 DISTANCE .91 2.515 3.77	2 PC. (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 9 STELLA THE CU LINE 1 2 3 3	BY332 BY332 TOFF MAGI ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY428 BY432 -NEARDAT ID F MAGI DFF MAGI BN006 BN0025 BN025	F2 FORE F FORE F FORE F FORE F F F F F F F F F F F F F F F F F F F	G IIDWAY (COLOUR 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	-13.437 Z=.92PC) U AND BETA HORIZ -23.953 -13.683 -13.683 -13.683 -13.683 -1.586 -8.497 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930 -24.177 -925	-,729 /IEW TD BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0,049 40,439 0,049 0,047 0,057 0,047	13.4591 13.4591 13.4591 13.6591 14.5708 14.6708 46.1618 37.8265 37.5674 39.1349 40.4715 37.5674 37.1349 40.4715 37.878 AT .122 (TH FURE SEMIAPEX = THETA'(DEG) .0000 39.3942 31.1367 55.6400	266.8958 WITH MV'.L 60.0 IN PHI(DEG) 332.8196 337.4777 334.9671 352.5393 353.3238 355.2032 355.2032 355.2032 355.2032 355.2032 355.2032 355.2032 356.001N PHI(DEG) 0.0000 03.8521 309.0602 757 9201	1.5723 E.4 DIRECTION (ETA 1.1061 1.1043 1.0954 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0984 1.0978 1.1304 1.0958 1.1085 1.0858	10534. 85.4, 269.0) AT TENP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 7622. 17025. 23624. 17733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234. 3221. 7020.	3,83 DISTANCE AVH/ 2,62 .27 1,69 3,09 3,06 2,69 1,80 2,49 1,80 2,45 2,75 DISTANCE AVH/ 6,75 9,11 8,33 8,33	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.22 25.99	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA 1 2 3 4 5 5 6 7 7 8 9 9 STELLA 1 2 3 4 5 7 8 9 9 8 9 1 8 1 1 1 2 3 4 5 7 8 9 1 8 1 1 1 1 1 2 3 4 5 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BY332 BY332 -CONDAT I TOFF MAGI ID BY397 BY426 BY415 BY415 BY415 BY415 BY415 BY428 BY488 B	F2 FORE F0 FORE SC F0 M SC F0 M SC F0 M SC F0 M SC F0 M SC M SC M SC M SC M SC M SC M SC M SC	G IIDWAY (COLOUR 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925	729 729 JIEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049 40.439 0 VIEW TO BARH = .1220000 Wi VERTICAL .000 36.030 19.620 55.626	13.4591 13.4591 13.4591 13.6561 13.6563 32.6563 33.9369 33.9369 33.9369 33.9369 33.9369 33.9364 46.1618 37.5674 39.1349 40.4715 NARD'S STAR AT .122 (TH FURE SEMIAPEX = THETA' (DEG) .0000 39.3942 31.1367 55.9409	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 344.9671 352.5393 353.3238 355.25393 355.7146 KC WITH MV 6.00 IN PHI(DEG) PHI(DEG) 9 CO000 23.8521 309.0602 353.9201	1.5723 1.5723 E.4 DIRECTION (ETA 1.1061 1.0954 1.0954 1.0964 1.0968 1.0963 1.09741 .LE.14 DIRECTION (ETA 1.1304 1.0958 1.1083 1.0954 1.0958 1.0958 1.0954 1.0958 1.0058 1.09588 1.09588 1.09588 1.09588 1.09588 1.0958	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELVIN) 3336. 3234. 3271. 3292.	3,83 DISTANCE AVH: 2,62 1,69 3,09 3,04 2,89 2,89 2,45 2,75 DISTANCE AVH: 6,75 9,11 8,33 8,38	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31 999.22 999.22 999.24 76.25 Z = .92 DISTANCE .91 2.515 3.22 4.12	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 9 STELLA THE CU LINE 1 2 3 4 5 5	BY32 BY32 -CONDAT I TOFF MAGI ID BY397 BY412 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY428 BY436 FM004 BY004 BN004 BN025 BN030 BN030	F2 FORE F FORE F NITUDE B01 K5 F03 B12 F07 B1 B22 F07 F07 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC M5 SC SC M5 SC SC M5 SC SC SC SC SC SC SC SC SC SC SC SC SC	G IIDWAY (COLOUR B R Y R B B W B B B W IIDWAY COLOUR R R R R R R R R	-13.437 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0.000 15.930 -24.177 -5.925 -4.152	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36.554 43,142 45,374 37,506 37,506 37,513 39,049 40,439 0 VIEW TO BARR = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.938P 39.0314 44.6708 46.1619 37.5674 37.5674 37.1349 40.4715 40.4715 40.4715 1.2574 39.1349 40.4715 1.2574 39.1349 40.4715 1.2574 39.1349 40.4715 37.5674 37.5674 37.5674 37.5674 37.5674 37.5674 37.574 37.574 37.574 37.574 37.574 37.5757 37.5757 37.5757 37.5757 37.5757 37.5757 37.5757 37.5757 37.5757 37.5757 37.57577 37.57577 37.57577 37.57577 37.575777777777777777777777777777777777	246.9758 WITH MV.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393 353.3238 356.2032 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.4716 357.4716 357.474 357.474 353.4926	1.5723 1.5723 E.4 DIRECTION (ETA 1.1043 1.0944 1.0988 1.0984 1.0989 1.0983 1.0984 1.0989 1.0983 1.0984 1.0989 1.0983 1.0984 1.0988 1.0984 1.0988 1.0988 1.0984 1.0988 1.0988 1.0984 1.0988 1.0988 1.0984 1.0988 1.0984 1.0988 1.0988 1.0984 1.0984 1.0984 1.0988 1.0984 1.0868 1.0868 1.0868 1.0868 1.0868 1.0868 1.0853 1.0958 1.0853 1.0951 1.0958 1.0853 1.0951 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0958 1.0053 1.00555 1.0055 1.0055 1.0055 1.0055	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3224. 3224. 3271. 3292. 3162.	3,63 DISTANCE AVH / . 2,62 2,67 1,69 3,06 2,69 1,80 2,45 2,45 2,45 2,45 2,45 2,45 2,45 2,45	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.22 Z = .92 DISTANCE .91 3.12 4.13 4.13	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 5 STELLA 7 8 9 STELLA 7 8 9 STELLA 1 2 3 4 5 6	BY332 BY332 -CONDAT I TOFF MAGI ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY426 BY428 BY48 BY48 BY48 BY48 BY48 BY48 BY48 BY4	F2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F	G IIDWAY (COLOUR B R R W B B B B B B B B B B B B B B B	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 -4.152 1.885	725 725 JIEW TO BARNAF = .122000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049 40.439 0 VIEW TO BARH = .1220000 Wi VERTICAL .000 36.030 19.620 55.626 52.751 2.244	13.4591 13.4591 13.4591 13.6561 13.6563 32.6563 33.9369 33.9369 33.9369 33.9369 33.9369 33.9364 46.1618 37.5674 37.5674 39.1349 40.4715 NARD'S STAR AT .122 (TH FURE SEMIAPEX = THETA' (DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 344.9671 352.5393 353.3238 355.25393 355.25393 355.7146 C WITH MV 6.00 IN PHI(DEG) PHI(DEG) 9 CO000 23.8521 0.0000 2353.9201 355.4996 40.0339	1.5723 1.5723 E.4 DIRECTION (ETA 1.1061 1.0954 1.0954 1.0964 1.0968 1.0963 1.09741 .LE.14 DIRECTION (ETA 1.1304 1.0958 1.1083 1.0653 1.0713 1.1302	10534. 85.4, 269.0) AT TEMP'(KELVIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELVIN) 3336. 3234. 3271. 3292. 3162. 5166.	3,83 DISTANCE AVH' 2,62 1,67 3,09 3,06 2,45 2,75 DISTANCE AVH' 6,75 9,11 8,33 8,38 10,13 3,24	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.31 999.22 999.22 999.24 999.22 999.22 299.24 299.22 299.24 299.24 299.24 16.3 3.22 2015TANCE .91 2.515 3.22 4.13 4.12 4.21	2 PC. (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA THE CU LINE 1 2 3 4 5 6 7 7 8 9 9 5 7 1 2 3 4 5 6 7 7 8 9 7 8 9 9 5 7 1 1 2 3 4 7 7 8 9 9 5 7 1 1 1 2 3 4 5 6 7 7 8 9 1 1 2 3 5 7 7 8 9 1 1 1 2 3 5 7 7 8 9 1 1 1 2 3 5 7 7 8 9 7 7 8 9 7 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 7 8 9 9 9 9	BY332 BY332 -CONDAT I TOFF MAGI ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY415 BY426 BY426 BY432 -NEARDAT ID BN004 BN008 BN032 BN032 BN041 BN041 BN041 BN041	F2 FORE DE FORE DE FORE DE B M125 B M125 B M125 B M25 B M51 S M51 M51 K6	G IIDWAY (COLOUR B R B B B W IIDWAY COLOUR R R R R R R R R R R R R R R R R R R	-13.437 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0.000 15.930 -24.177 -5.925 -4.152 1.885 1.885	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36.554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARR = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1619 37.5674 37.5674 37.1349 40.4715 40.4715 40.4715 40.4715 1.22 ITH FORE SEMIAPEX = THETA'(DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302	246.9758 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393 353.3238 356.2032 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.4714 357.4714 357.474 357.474 357.494 40.0339	1.5723 1.5723 E.4 DIRECTION (ETA 1.1043 1.0944 1.0984 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0084 1.0085 1.0085 1.0085 1.00713 1.1302 1.1302	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234. 3224. 324. 3271. 3292. 3162. 5166. 4199.	3,63 DISTANCE AVH / . 2,62 2,67 1,69 3,06 2,69 1,80 2,45 2,75 0 DISTANCE AVH / 6,75 9,11 8,33 8,38 10,13 3,24 4,95	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.22 2999.22 2999.22 2999.22 2999.22 2999.22 2999.22 2999.22 2999.22 2999.22 399.22 2999.22 399.22 2999.22 399.22 40.13 200.20 15.33 40.21 4	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 7 8 9 9 9 9 9 5 7 8 5 5 6 7 8 5 5 6 7 8 5 7 8 5 7 8 5 7 8 7 8 7 8 7 8 7 8 7	BY332 BY332 ID BY397 BY405 BY415 BY415 BY415 BY415 BY426 BY428 BY4	F2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F	G IIDWAY COLOUR B R V R W B B B W B B B W COLOUR R COLOUR R R R R R R R R R R R R R	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 -4.152 1.885 1.885 10.936	725 /IEW TO BARNAF = .1220000 Wi VERTICAL 22.196 28.494 36.554 43.142 45.374 37.506 37.313 39.049 40.439 0 VIEW TO BARF = .1220000 Wi VERTICAL .000 36.030 19.620 55.626 52.751 2.244 33.038	13.4591 13.4591 13.4591 13.6561 13.6563 32.6563 33.9389 33.9389 33.9389 33.9384 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 NARD'S STAR AT .122 CTH FORE SEMIAPEX = THETA'(DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302 2.9302 2.9302 34.8011	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393 353.3238 355.25393 355.25393 355.25393 355.7146 CWITH MV. 60.0 IN PHI(DEG) 0.0000 23.8521 00.0602 353.9201 355.4996 40.0339 40.0339	1.5723 1.5723 E.4 DIRECTION (ETA 1.1061 1.0984 1.0984 1.0988 1.0988 1.0983 1.0984 1.0988 1.1084 1.1084 1.0853 1.0302 1.1302	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199.	3,83 DISTANCE AVH' 2,62 3,07 3,06 2,45 2,89 1,80 2,45 2,75 DISTANCE AVH' 6,75 9,11 8,33 8,38 10,13 3,24 4,43	160.70 Z = .92 DISTANCE 249.24 19.72 47.00 15.31 999.22 999.22 76.25 Z = .92 DISTANCE .91 2.15 3.23 4.13 4.12 4.21 4.21 4.21 4.21	2 PC. (PC)
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA LINE 1 2 3 4 5 6 7 8 9 STELLA 1 2 3 4 5 6 7 8 9 9	BY332 BY332 -CONDAT I TOFF MAGI ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY415 BY426 BY428 BY432 -NEARDAT ID BN004 BN008 BN025 BN032 BN041 BN041 BN042 BN047 BN047 BN047 BN047	F2 F0 F0REJE F0REJE B0125 B015 B015 B015 B015 B015 B015 B015 B01	G IIDWAY (= 4.0 COLOUR B R R W W B B W W W S COLOUR R R R R R R R R R R R R R	-13.437 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0.000 15.930 -24.177 -5.925 -4.152 1.885 -0.936 -0.000 -0.936 -0.000 -0.000 -0.936 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0	-,72- //IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36.554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARN = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 33,038 44,064	13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.5674 37.5674 39.1349 40.4715 40.	246.9758 WITH MV.L 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 353.3238 354.2371 353.3238 355.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.4714 357.4714 357.4714 357.4971 0.0000 23.8521 309.0602 333.9201 355.4996 40.0339 341.6844 34.3243	1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0968 1.0984 1.0988 1.0988 1.0984 1.0988 1.0983 1.0984 1.0988 1.0988 1.0983 1.0984 1.0988 1.0983 1.0984 1.0988 1.0983 1.0984 1.0988 1.0983 1.0984 1.0988 1.0983 1.0984 1.0988 1.0983 1.0984 1.0988 1.0984 1.0988 1.0984 1.0988 1.0984 1.0988 1.0984 1.0988 1.0984 1.0988 1.0988 1.0988 1.0988 1.0984 1.0988 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0088 1.0085 1.0085 1.0085 1.0083 1.0053 1.0053 1.0053 1.00713 1.1302	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4098. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELVIN) 3336. 3224. 3291. 3292. 3162. 5166. 4199. 5159. 4462.	3,83 DISTANCE AVH / . 2,62 2,67 1,69 3,06 2,69 1,80 2,45 2,45 2,45 2,45 2,45 2,45 2,45 2,45	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.22 SP9.22 299.22 20.76 20.77 20.76 20.76 20.76 20.76 20.76 20.76 20.76 20.	2 PC. 5 (PC) 2 2 2 2 5 2 5 2 5 5 5 5 5 5 5 5
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 1 8 7 8 9 1 1 8 7 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 8 9 1 1 1 1 1 1 1 1 1 1 1 1 1	BY332 BY332 ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY426 BY428 BY48 BY48 BY48 BY48 BY48 BY48 BY48 BY4	F2 F0 F0REUDE BM125 BM122 F0RUDE BM125 BM122 F0RUDE F0RUDE F0RUDE MM5 MM5 K034	G IIDWAY COLOUR B R R B B B B B B B B B B B B B B COLOUR R C COLOUR R R R R R R R R R R R R R R R R R R	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 1.885 1.885 1.0.936 30.100 -31.611	-,729 /IEW TO BARNAF = ,122000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARF = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 2,244 33,038 44,084 49,334	13.4591 13.4591 13.4591 13.6561 13.6561 13.6563 33.9369 33.9369 33.9369 33.9369 33.9369 33.9364 44.6708 44.	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 352.5393 353.3238 355.25393 355.25393 355.7146 CWITH MV. 60.0 IN PHI(DEG) 0.0000 23.8521 00.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 353.9201 354.9201 355.9201 355.95010	1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0954 1.0984 1.0988 1.0963 1.0981 1.0988 1.0983 1.0984 1.0988 1.0083 1.0083 1.0302 1.1302 1.1302 1.1302 1.1302 1.1302 1.1308 1.0308	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199. 5159. 4422. 325.	3,83 DISTANCE AVH / . 2,62 1,69 3,09 3,06 2,45 2,45 2,75 DISTANCE AVH / 6,75 9,11 8,33 8,38 10,13 3,24 4,43 5,84 9,17	160.70 Z = .92 DISTANCE 249.24 719.72 47.00 15.31 999.22 999.22 999.22 76.25 Z = .92 DISTANCE .91 2.15 3.23 4.12 4.12 4.21 4.21 4.21 5.42	2 PC. 2 (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 STELLA 1 2 3 4 5 6 7 8 9 STELLA 1 2 3 4 5 6 7 8 9 5 1 2 3 4 5 5 6 7 8 9 5 1 1 2 3 4 5 5 6 7 8 9 5 1 1 2 3 4 5 5 6 7 8 9 5 1 1 2 3 4 5 5 6 7 8 9 5 1 1 2 3 4 5 5 6 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 7 8 9 5 8 9 7 8 9 1 8 9 7 8 9 1 8 9 1 8 9 1 8 9 1 9 10 10 10 10 10 10 10 10 10 10	BY332 BY332 -CONDAT I TOFF MAGI ID BY307 BY402 BY412 BY412 BY415 BY414 BY426 BY426 BY426 BY426 BY427 BY424 BY424 BY426 BY426 BY427 BY426 BY426 BY426 BY427 BY426 BY427 BY426 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY66 B	F2 FDF F0FUDC F0FUDC F0FUDC F0FUDC FN FN FN FN FN FN FN FN FN FN FN FN FN	G IIDWAY (COLOUR B R Y R B B W Y B B B W Y R COLOUR R R R R Y R Y R Y R S COLOUR R R R R Y R Y R S S S S S S S S S S S	-13.437 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0.000 -24.177 -5.925 1.885 -4.152 1.885 -0.936 -3.1611 0.936 -3.1611 -3.451 -3.451 -3.451 -3.451 -3.455 -	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARN = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 33,038 44,084 49,336 - 910	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX = THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.5674 37.1349 40.4715 40.	246.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 353.3238 354.2032 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.714 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.4000 357.40000 357.40000 357.4000000000000000000000000000000000000	1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0964 1.0988 1.0984 1.0988 1.0988 1.0983 1.0984 1.0988 1.0083 1.0085 1.0075 1.1302 1.1302 1.1302 1.1302 1.1308 1.0599 1.1298 1.02988 1.02988 1.02988 1.02988 1.039888 1.039888 1.039888 1.039888 1.039888 1.039888 1.0398888 1.03988888 1.0398888 1.039888 1.03988 1.0398888 1.	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4098. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3271. 3292. 3162. 5166. 4199. 5159. 4462. 3275. 34.6	3,63 DISTANCE AVM / . 2,62 2,7 1,69 3,06 2,69 1,60 2,45 2,45 2,45 2,45 2,45 2,45 2,45 2,45	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.22 S99.22 209.22 209.22	2 PC. 2 (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA LINE 1 2 3 4 5 5 6 7 8 9 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 9 5 7 8 9 9 9 9 9 9 9 9 9 9 10 11 10 10 10 10 10 10 10 10 10 10 10	BY332 BY332 ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY426 BY428 BY48 BY48 BY48 BY48 BY48 BY48 BY48 BY4	F2 F0 F0RE B0 SC M1 K2 F0 B1 B2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0	G IIDWAY COLOUR B R R B B B W B B B B B B B B B B COLOUR R R R R R R R R R R R R R R R R R R	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0,92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 1.885 1.885 1.0.936 30.100 -31.611 20.243	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARF = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 2,244 2,244 3,3038 44,084 49,336 -,810 2,196 2,296 2,2	13.4591 13.4591 13.4591 RD'S STAR AT .122C THFTAY (DEG) 32.6563 33.9369 33.9369 33.9369 33.937 33.9384 46.1618 37.5674 37.5674 37.5674 37.5674 37.1349 40.4715 NARD'S STAR AT .122 (TH FORE SEMIAPEX = THETA' (DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302 2.9302 2.9302 2.9302 2.9302 33.3800 58.5944 20.2590 50.2594 20.2590 50.270	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 344.9671 352.5393 353.3238 355.25393 355.25393 355.25393 355.7146 WITH MV. 60.0 IN PHI(DEG) 0.0000 23.8521 00.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 353.92000000000000000000000000000000000000	1.5723 1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0954 1.0984 1.0988 1.0963 1.0981 1.0988 1.0983 1.0988 1.00833 1.00833 1.0302 1.1302 1.1302 1.1302 1.1302 1.1308 1.0359 1.03555 1.0355 1.03555 1.03555 1.03555 1	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199. 5159. 4462. 3275. 3464. 7870.	3,63 DISTANCE AVH / · 2,62 1,69 3,09 3,06 2,45 2,75 DISTANCE AVH / 6,75 9,11 8,33 8,38 10,13 3,24 4,55 4,55 8,35 10,13 3,24 4,75 10,13 10,12 10,13 10,12 10,13 10,12 10,13 10,1	160.70 Z = .92 DISTANCE 249.24 19.72 47.00 15.31 999.22 999.22 999.22 299.22 299.22 299.22 299.22 299.22 19.51ANCE .91 2.15 3.23 4.12 4.12 4.21 4.21 5.47 5.14 5.47 5.14 5.47 5.14 5.47 5.14 5.47 5.14 5.47 5.14 5.47 5.14 5.14 5.47 5.14 5.	2 PC. 2 (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA ITHE CULLINE 1 2 3 4 5 5 6 7 8 9 9 STELLA LINE 1 2 3 4 5 5 6 7 8 9 9 9 1 1 1 2 3 4 5 7 8 9 9 9 10 11 10 2 3 4 5 7 8 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10	BY336 -CONDAT I TOFF MAGI ID BY397 BY402 BY412 BY412 BY415 BY414 BY426 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY46 BY66	F2 F0 F0RE b6 NI 105 B0 M1 K5 F0 B1 B2 F0RE b6 S0 F0 S0 F0 S0 S0 S0 S0 S0 S0 S0 S0 S0 S0 S0 S0 S0	G IIDWAY (COLOUR B R Y R B B W Y B B B W Y R R R R R R R R R R R R R R R R R R	-13.437 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0,000 -24.177 -5.925 1.885 -0.930 -24.177 -5.925 1.885 -0.936 -2.10.936 -3.1.611 20.243 20.243 20.243 -2.335	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARN = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 33,038 44,084 49,336 -,810 53,229	13.4591 13.4591 RD'S STAR AT .122C TH FORE SEMIAPEX - THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 40.4	246.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 353.3238 355.25393 355.714 355.714 357.714 357.714 357.714 60.0 IN PHI(DEG) 0.0000 2.38521 309.0602 335.9201 355.4996 40.0339 341.6844 34.3243 327.3508 92.2922 27.1851	1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0964 1.0988 1.0984 1.0988 1.0989 1.0983 1.0984 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0989 1.0989 1.0989 1.0980 1.0080	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4098. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199. 5159. 4462. 3275. 3464. 3339.	3,63 DISTANCE AVM/* 2,62 ,7 1,69 3,06 2,69 3,06 2,45 2,45 2,45 2,45 2,45 2,45 2,45 2,45	160.70 Z = .92 DISTANCE 249.26 51.87 19.72 47.00 15.33 999.22 999.22 999.24 76.22 Z = .92 DISTANCE .91 3.23 4.13 4.15 3.23 4.14 5.12 5.44 5.14 5.14	2 PC. 2 (PC) 2 2 3 5 5 5 5 5 5 5 5 5 5 5 5 5
20 STELLA LINE 1 2 3 4 5 6 7 8 9 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 9 10 11 12 13	BY332 BY332 ID BY397 BY405 BY415 BY415 BY415 BY415 BY415 BY426 BY428 BY4	F2 F0E F0 F0RE F0 B0 M1 SC B0 M1 K2 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0	G IIDWAY COLOUR B R R B B B B W IIDWAY COLOUR B B B B B B B B C COLOUR R R R R R R R R R R R R R R R R R R	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0,92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 1.885 1.885 1.0.936 30.100 -31.611 20.243 27.336 -50.726	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARF = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 2,244 2,244 2,244 3,3038 44,084 -,810 53,229 -18,700	13.4591 13.4591 13.4591 RD'S STAR AT .122C THFTA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 NARD'S STAR AT .122 (TH FORE SEMIAPEX = THETA'(DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302 2.9302 2.9302 34.8011 53.3800 58.5944 20.2590 59.8378 54.0633	266.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393 353.3238 355.25393 355.25393 355.25393 355.7146 CWITH MV. 60.0 IN PHI(DEC) 0.0000 23.8521 00.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 353.9201 350.9201 327.9508 327.9508 327.9538	1.5723 1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0954 1.0984 1.0988 1.0963 1.0988 1.0963 1.0981 1.0988 1.0083 1.0083 1.0302 1.1302 1.1302 1.1302 1.0309 1.0359 1.0357 1.0573 1.0575	10534. 85.4, 269.0) AT TEMP' (KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP' (KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199. 5159. 4462. 3275. 3464. 3839. 4725.	3,63 DISTANCE AVH / . 2,62 1,69 3,09 3,06 2,45 2,75 DISTANCE AVH / 6,75 9,11 8,33 8,38 10,13 3,24 4,55 4,35 5,84 9,17 7,78 8,-28 -51	160.70 Z = .92 DISTANCE 249.24 19.72 47.00 15.31 999.22 999.22 76.25 Z = .92 DISTANCE .91 2.15 3.23 4.11 4.15 4.21 4.21 5.47 5.14 5.47 10.51	2 PC. 2 (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA ITHE CULLINE 1 2 3 4 5 5 6 7 8 9 9 STELLA 1 2 3 4 5 5 6 7 8 9 9 10 11 2 12 13 14	BY336 BY336 -CONDAT I TOFF MAGI ID BY307 BY402 BY412 BY415 BY412 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY424 BY425 BY424 BY425 BY424 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY427 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY426 BY427 BY426 BY46 BY46 BY66 BY	F0RE B0 F0RE B0 B0 M1 SC B0 M1 K2 K5 B1 B2 F2 F0 SC M5 E M5 K1 M5 K0 K0 K0 K0 K0 M4 M5 K6 K0 V M4 M6 K6 K0 K0 K6 K0 K0 K0 K0 K0 K0 K0 K0 K0 K0 K0 K0 K0	G IIDWAY COLOUR B R Y R B B B W Y R B B B B C COLOUR R R R R COLOUR R R R R Y R R R R R R R R R R Y R R R R R Y G G	-13.437 Z=.92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0.000 15.930 -24.177 -5.925 1.885 -0.936 -24.177 -5.925 1.885 -0.936 -3.1611 20.336 -5.726 8.286	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARN = ,1220000 Wi VERTICAL .000 36,030 19,620 55,626 52,751 2,244 33,038 44,084 49,336 -,810 53,229 -18,700 -34,260	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX - THETA'(DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 40.4715 40.4715 40.4715 40.4715 1.4787 5.9409 52.9139 2.9302 2.9302 3.4.8011 53.3800 58.5944 20.2590 59.6378 54.0633 35.2483	246.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 353.3238 355.25393 355.2138 355.2138 355.214 60.0 IN PHI(DEG) 0.0000 23.8521 309.0602 335.9201 355.4996 40.0339 341.6844 34.3243 327.3508 92.2922 27.1831 249.7634 166.4033	1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0964 1.0986 1.0986 1.0988 1.0984 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0989 1.1083 1.00573 1.2088 1.0573 1.0571 1.0571	10534. 85.4, 269.0) AT TEMP'(KELUIN) 29313. 4009. 4098. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP'(KELUIN) 3336. 3271. 3292. 3162. 5166. 4199. 5159. 4452. 3275. 344. 3275. 344. 3275. 344. 3275. 344. 3275. 344. 3275. 344. 3275. 344. 3275. 346. 4775. 10858.	3,63 DISTANCE AVM / . 2,62 ,7 1,69 3,06 2,69 1,69 3,06 2,45 2,45 2,45 2,45 2,45 2,45 2,45 2,45 4,53 8,33 8,38 8,38 8,38 8,38 8,31 8,32 4,43 5,44 9,17 7,788 7,788 7,798 7,788 7,798 7,798 7,788 7,798 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,788 7,798 7,798 7,788 7,788 7,788 7,788 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,798 7,799 7,798 7,799 7,798 7,799 7,799 7,798 7,799 7,799 7,797	160.70 Z = .92 DISTANCE 249.26 51.07 19.72 47.00 15.33 999.22 999.22 999.22 76.22 Z = .92 DISTANCE 2.155 3.23 4.13 4.21 4.21 4.21 5.42 5.42 5.67 10.51 7.37	2 PC. 5 (PC) 5 2 PC. 5 2 PC. 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
20 STELLA LINE 1 2 3 4 5 6 7 8 9 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 9 10 11 12 13 14 15	BY332 BY332 ITOFF MAGI ID BY397 BY405 BY419 BY415 BY415 BY415 BY415 BY415 BY415 BY426 BY428 BY48	F2 F0RE F0 F0RE F0 B0 M1 SC B0 M1 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0 F0	G IIDWAY COLOUR B R R B B B B B B B B B B B B B B B COLOUR R R R R R R R R R R R R R R R R R R	-13.439 Z=,92PC) U AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.912 -4.368 -2.591 -1.614 (Z=0,92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 1.885 1.885 1.0.936 30.100 -31.611 20.243 27.336 -50.726 8.286 30.169	-,729 JIEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36.554 43,142 45.374 37,506 37,313 39,049 40,439 0 VIEW TO BARF = ,1220000 Wi VERTICAL .000 36,030 19,620 55.626 52,751 2,244 2,244 2,244 2,244 3,3038 44,084 -,810 53,229 -18,700 -34,260 -5,325	13.4591 13.4591 13.4591 RD'S STAR AT .122C THFTAY (DEG) 32.6563 33.9369 39.0314 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 NARD'S STAR AT .122 (TH FORE SEMIAPEX = THETA' (DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302 2.9302 2.9302 2.9302 2.9302 33.3800 58.5944 20.2590 59.6378 54.0633 35.2483 30.6354	246.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393 353.3238 355.25393 355.25393 355.25393 355.25393 355.25393 355.25393 355.25393 355.25393 355.25393 355.25393 355.25393 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 0.0000 23.8521 353.9201 355.4596 40.0339 40.0339 40.0339 341.6844 34.3243 327.3508 92.2922 22.71831 249.7634 166.4033 100.0108	1.5723 1.5723 E.4 DIRECTION (ETA 1.1061 1.0954 1.0964 1.0968 1.0963 1.0978 1.0978 1.0978 1.0978 1.0978 1.0978 1.0978 1.0978 1.1083 1.0653 1.0713 1.1302 1.1302 1.1302 1.1302 1.1302 1.0373 1.0579 1.1208 1.0573 1.06591 1.1084 1.0573 1.06591 1.1084 1.0573 1.06591 1.1087 1.10	10534. 85.4, 269.0) AT TEMP' (KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP' (KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199. 5159. 4462. 3275. 3464. 3839. 4775. 10858. 8738.	3,63 DISTANCE AVH / . 2,62 1,69 3,09 3,06 2,45 2,75 DISTANCE AVH / 6,75 9,11 8,33 8,38 10,13 3,24 4,53 5,84 9,17 7,78 7,29 7,28 7,48 7,48 7,48 7,48 7,48 7,48 7,48 7,48 7,48	160.70 Z = .92 DISTANCE 249.24 719.72 47.00 15.31 999.22 999.22 76.25 Z = .92 DISTANCE .91 2.15 3.23 4.13 4.15 4.21 5.47 5.14 5.47 10.51 7.33 4.31	2 PC. 2 (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2
20 STELLA INE 1 2 3 4 5 6 7 8 9 STELLA LINE 1 2 3 4 5 6 7 8 9 9 10 11 12 13 4 5 6 9 10 11 12 13 14 15 16 10 10 12 13 14 12 12 12 12 12 12 12 12 12 12 12 12 12	BY336 BY337 IDFF MAGI BY397 BY407 BY412 BY412 BY414 BY426 BY428 BY424 BY426 BY466 BY667 BY77 BY7	F0RE B0 F0RE B0 B0 M1 SC B0 M1 K2 K5 B1 B2 F2 F0 SC M5 E M5 K1 M5 K0 V M4 M5 K6 V M4 M6 K2 K5 V M4 M6 K2 K5 M4 M1 K5 M4 M1 K5 M4 M1 K5 K5 K5 K5 K5 K5 K5 K5 K5 K5 K5 K5 K5	G IIDWAY COLOUR B R V B B B V COLOUR B B B B V COLOUR R R R R COLOUR R R R R R R R R R R R R R R R R R R	-13.437 Z=,92PC) 4 AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) 0.000 15.930 -24.177 -5.925 1.885 -0.930 -24.177 -5.925 1.885 -10.936 30.100 -31.611 20.243 3.615 -10.936 -5.726 8.286 30.169 -18.495	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36,554 43,142 45,374 37,506 37,313 39,049 40,439 0 VIEW TO BARN = ,1220000 Wi VERTICAL .000 36,033 19,620 55,626 52,751 2,244 33,038 44,084 49,336 -,810 53,229 -18,700 -34,260 -5,325 28,144	13.4591 13.4591 RD'S STAR AT .122C ITH FORE SEMIAPEX - THETA'(DEG) 32.6563 33.9387 33.9387 33.9387 39.0314 44.6708 46.1618 37.5674 37.5674 37.1349 40.4715 40.4715 40.4715 40.4715 40.4715 1.22 ITH FORE SEMIAPEX - THETA'(DEG) .0000 39.3942 2.9302 2.9302 34.8011 53.3800 58.5946 20.2590 59.8378 54.0633 35.2483 30.6354 33.6254 33.6274	246.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 349.3971 353.3238 355.25393 355.25393 355.218 355.218 60.0 IN PHI(DEG) 0.0000 23.8521 309.0602 3353.9201 305.4996 40.0339 341.6844 34.3243 327.3508 92.2922 27.1831 249.7634 166.4033 100.0108	1.5723 1.5723 E.4 DIRECTION (ETA 1.1063 1.0964 1.0986 1.0986 1.0986 1.0986 1.0986 1.0986 1.0986 1.0986 1.0986 1.0986 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0988 1.0989 1.1083 1.00575 1.00575 1	10534. 85.4, 269.0) AT TEMP' (KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP' (KELUIN) 3336. 3234. 3271. 3292. 3162. 5166. 4199. 5159. 4462. 3275. 3464. 3275. 3465. 4775. 3466. 4775. 34775	3,63 DISTANCE AVM / . 2,62 ,7 1,69 3,06 2,69 1,69 3,06 2,45 2,45 2,45 2,45 2,45 2,45 2,45 1,69 3,06 2,45 2,45 1,69 3,06 2,45 2,45 1,69 3,06 2,45 2,45 1,69 3,06 2,45 2	160.70 Z = .92 DISTANCE 249.26 51.07 19.72 47.00 15.31 999.22 999.22 999.22 76.22 Z = .92 DISTANCE 2.15 3.22 4.11 4.21 4.21 5.42 5.42 5.42 5.42 5.43 5.43 5.43 5.43 5.44 5	2 PC. 5 (PC) 5 2 PC. 5 2 PC. 5 3 5 5 3 5 5 4 PC. 5 5 5 5 5 7 5 7 5 7 5 7 5 7 5 7
20 STELLA LINE 1 2 3 4 5 6 7 8 9 STELLA THE CU LINE 1 2 3 4 5 6 7 8 9 9 10 11 12 13 14 15 16 17	BY336 BY337 ID BY397 BY405 BY415 BY415 BY415 BY415 BY424 BY426 BY466 BY466 BY466 BY667 BY667 BY667 BY667 BY777 BY7777 BY7777 BY777 BY777 BY777 BY777 BY777 BY7	F2 F0	G IIDWAY COLOUR B R R B B B B B B B B B B B B B B B B	-13.439 Z=,92PC) W AND BETA HORIZ -23.953 -18.437 -13.683 -11.586 -8.494 -4.368 -2.591 -1.614 (Z=0.92PC) AND BETA HORIZ 0.000 15.930 -24.177 -5.925 1.885 1.885 1.885 1.0.936 30.100 -31.611 20.243 30.169 -32.699 -16.495 27.8999	-,729 /IEW TO BARNAF = ,1220000 Wi VERTICAL 22,196 28,494 36.554 43,142 45.374 37,506 37,313 39,049 40,439 0 VIEW TO BARF = ,1220000 Wi VERTICAL .000 36,030 19,620 55,624 52,751 2,244 2,247 3,325 2,247 2,279 2,325 2,287 2,477 2,325 2,287 2,477 2,325 2,287 2,477 2,577 2,577 2,577 2,577 2,577 2,577 2,577 2,5777 2,5777 2,57777 2,5777777777777777777777777777777777777	13.4591 13.4591 13.4591 RD'S STAR AT .122C THFTAY (DEG) 32.6563 33.9389 39.0314 44.6708 46.1618 37.5674 37.5674 37.5674 37.5674 37.1349 40.4715 NARD'S STAR AT .122 CTH FORE SEMIAPEX = THETAY (DEG) .0000 39.3942 31.1367 55.9409 52.9139 2.9302 2.9302 2.9302 2.9302 2.9302 2.9302 3.3.8800 58.5944 20.2590 59.6378 54.0633 35.2483 33.6374 48.7506	246.8958 WITH MV.6 60.0 IN PHI(DEG) 312.8196 327.0949 339.4777 344.9671 352.5393 353.3238 355.7146 CWITH MV. 60.0 IN PHI(DEG) 0.0000 23.8521 00.0602 353.9201 355.4996 40.0339 40.0339 40.0339 241.6844 327.3508 92.2922 27.1831 249.7634 166.4033 3100.0108 322.6897	1.5723 1.5723 1.5723 E.4 DIRECTION (ETA 1.1061 1.0984 1.0984 1.0988 1.0963 1.0988 1.0083 1.0302 1.0307 1.0307 1.0087	10534. 85.4, 269.0) AT TEMP' (KELUIN) 29313. 4009. 4898. 4132. 7622. 17025. 23624. 19733. 7330. 85.4, 269.0) AT TEMP' (KELUIN) 3336. 3234. 3271. 3292. 3166. 4199. 5166. 4199. 5159. 4462. 3275. 3464. 3839. 4775. 10858. B738. 4011. 9844.	3,83 DISTANCE AVH / . 2,62 ,27 1,69 3,09 3,06 2,45 2,75 DISTANCE AVH / 6,75 9,11 8,33 8,38 10,13 4,43 3,3,24 4,95 4,33 5,84 9,17 7,78 7,29 7,28 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,28 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,29 7,28 7,29	160.70 Z = .92 DISTANCE 249.24 719.72 47.00 15.31 979.22 797.22 797.22 797.22 797.22 797.22 2.15 3.22 DISTANCE .91 2.15 3.22 4.13 4.21 4.21 5.47 5.14 5.47	2 PC. 2 (PC) 2 2 2 2 2 2 2 2 2 2 2 2 2
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