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ABSTRACT

Two IBM-704 codes have been written which are auxiliary to the Bevatron orbit code BOC. The first, BEFCYF, interpolates among tabulated values of the median-plane magnetic flux density of the Bevatron to produce an equivalent array of values in a form appropriate to BOC. The second, DBDT, produces azimuthal derivatives of the fields produced by BEFCYF. The internal operation of BEFCYF and DBDT is described, and instructions for their execution are given.

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INTRODUCTION

Two IBM-704 codes have been written (in FORTRAN II), the first (designated BEFCYF) accepts as input the experimentally measured values of the magnetic flux density at the median plane of the Bevatron, in a form appropriate to the geometry of its vacuum tank, and produces by interpolation an equivalent set of field values on a polar grid situated at the geometrical center of the machine; the second (DBDT) provides azimuthal derivatives corresponding to the fields produced by BEFCYF. These two codes were designed to make possible beam-extraction studies for the Bevatron by means of the Oak Ridge General Orbit Code No. 1482, as modified by T. A. Welton for such studies. This modification is referred to as BOC.

In addition to the above two codes, an auxiliary code has been written (designated BEXP) which transfers the experimentally measured values of the flux density in the "straight sections" of the Bevatron (see below) from punched cards to tape.

The descriptions contained in this report are of a general nature, and should suffice for making usual production runs. They are not, however, intended as a substitute for the FORTRAN II listings of the codes, which are both explicit and largely self-explanatory.

BEVATRON MEDIAN-PLANE FLUX DENSITY

The input data for BEFCYF are presently derived from a UCRL Engineering Note, job number 4901-01, File number MT-1, which presents in graphical form the experimentally measured values of the magnetic flux density at the median plane in Quadrant 2 and in the entrance half of the west tangent tank (i.e., "straight section") of the Bevatron. The data are presented graphically in the form of profiles of two types:

(1) There are a radial profile (referred to here as $F(\rho)$) and an azimuthal profile (referred to here as $G(\phi)$) based on a polar coordinate system with origin at the center of the circle of which Quadrant 2 is a sector. (See Fig. 1.) $F(\rho)$ was measured along a radius through a typical sector, radial distance being measured from the equilibrium radius; $G(\phi)$ was measured along an arc corresponding to the equilibrium orbit. $G(\phi)$ is presented graphically in the angular interval -12.5 deg $< \phi < \sim -0.5$ deg,[1] with an additional "typical sector" profile covering an additional -2.5 deg and joining smoothly to the segment of the profile ending at -12.5 deg. (It is assumed that the remainder of the profile; for each quadrant, symmetry about 45 deg is also assumed, and the four quadrants are assumed equivalent.)

(2) For the tangent tank, there are profiles based on a rectangular coordinate grid with origin at the intersection of the "gauge line" with the center line (equilibrium orbit; positive X is taken in a direction corresponding to increasing ρ ; positive Y is taken in the direction of beam travel. Profiles for negative values of Y (which overlap the azimuthal profile) mesh smoothly with the azimuthal profile.

Engineering Note MT-1 presents the above set of profiles for each of three average flux densities (the average being taken over a typical sector at the center line). Each set of profiles is normalized (with respect to the appropriate average), to unity at the center line of a typical sector.

[1] In Engineering Note MT-1 under discussion here, ϕ is 0 at the "gauge line" separating Quadrant 2 from the west tangent tank; ϕ os taken as increasing in the sense of beam travel. For BEFCYF ϕ is taken as increasing in the opposite sense (i.e., opposite to the direction of beam travel.)

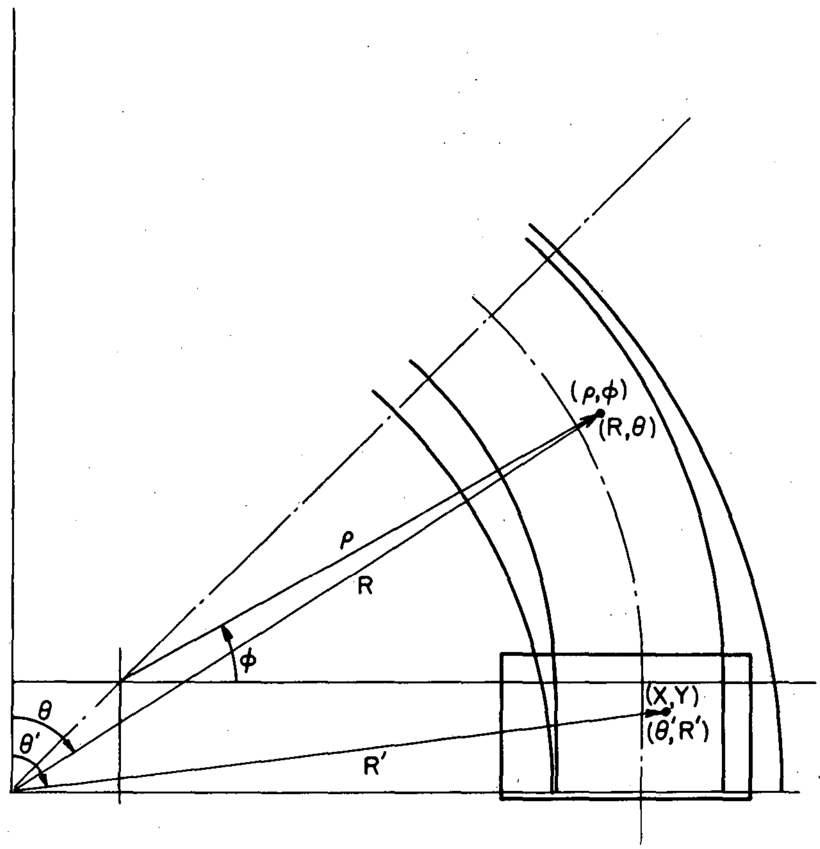

Fig. 1. Coordinate systems for BEFCYF.

BEFCYF AND AUXILIARY CODES

Input Data For BEFCYF

For utilization by BEFCYF the flux-density information must be converted to tabular form. The requirements are as follows:

(1) The radial profile, ranging from ρ = RH0 to RHOMAX, is converted to tabular form NSUBR values being taken at intervals of DLTRHO (usually 3 inches). These values must be punched consecutively (in order of increasing radius) on cards according to the FORTRAN II form 7F10.6.

(2) For the azimuthal profile, there must be NSBTHT tabular values ranging from DLTPHI (usually 0.25 deg) to PHITRN (usually 15 deg), at intervals of DLTPHI, punched consecutively on cards according to the FORTRAN II form 7F10.6.

(3) For the tangent tank, a two-dimensional rectangular grid of values corresponding to limits XMIN, XMAX, YMIN, and YMAX, tabulated at the intervals DELTAX and DELTAY, must be supplied as a BCD input tape (No. 4) to BEFCYF.

BEXP

For convenience in preparing the above tape, a FORTRAN II code called BEXP has been written. It accepts as input a card on which are punched consecutively, according to form 6F10.4, 2I5 the values of XMIN, XMAX, DELTAX, YMIN, YMAX, DELTAY, IMAX, and JMAX (IMAX is the total number of data values from XMIN to XMAX at intervals of DELTAX, i.e., IMAX = ((XMAX - XMIN)/DELTAX) + 1; similarly for JMAX . IMAX and JMAX must be < 100; this card is followed by JMAX sets of cards, consecutive with increasing Y, on which are punched, consecutively with increasing X, IMAX (normalized) flux-density values, 10 values per card, according to form 10F7.4. A Tape 4 must be dialed in order to execute BEXP, and that tape, at the termination of BEXP, is ready for immediate use as Input Tape 4 to BEFCYF. Since it is written in BCD it can be printed directly on the off-line printer for checking purposes. If sense switch 6 is depressed while BEXP is executed, the on-line printer prints directly the contents of Tape 4. Within BEFCYF, the two-dimensional array of values read from Tape 4 is referred to as BEXP (I, J).

BEFCYF

From the input data discussed above, BEFCYF produces primarily a (binary) Tape 1, on which are N + 1 records, where N = ((RMOT - RMIN) / (RSTEP) (DELTAR) + 1. The first record contains NTGER, RMIN, RMOT, and DELTAR. The remaining N records each contain M flux-density values, where

$$M = \frac{90}{(\text{THSTEP})(\text{DELTHT})}.$$

(Usually N = 41 and M = 360.) The contents of Tape 1 have the following significance:

Record 1: NTGER, RMIN, RMOT, DELTAR (loading information),
Record 2: B(RMIN, 90 deg - ($\Delta\theta$)(THSTEP)), B(RMIN, 90° - 2($\Delta\theta$)(THSTEP), etc.,
Record 3: B(RMIN + (ΔR)(RSTEP), 90 deg - ($\Delta\theta$)(THSTEP), B(RMIN + (ΔR)(RSTEP), 90 deg - (2($\Delta\theta$)(THSTEP)), etc.,
Record 4: B(RMIN + 2(ΔR)(RSTEP), 90 deg - ($\Delta\theta$)(THSTEP)), etc.

The basic operation of BEFCYF is illustrated by the skeleton flow chart in Fig. 2.

Input Parameters for BEFCYF

The parameters required by BEFCYF, together with their FORTRAN II format specifications, are listed below. (Figure 3 illustrates the significance of the geometrical parameters among the following.)

Card No. 1 6E12.5	BNORM:	The normalization value of the flux density in a typical sector (in units of oersteds), as discussed above.
	BINNER:	A sentinel number, assigned to B(R, θ) for $\rho < \rho_0$, or for X < XMIN or Y < YMIN or both.
	BOUTER:	A sentinel number assigned to B(R, θ) for $\rho > \rho_0$, or for X > XMIN or Y > YMIN or both.
Card No. 2 7F10.6	UNITL:	Unit of length, in inches.
	RMIN:	Minimum value of R.
	RMOT:	Maximum value of R.
	RHO:	Minimum value of ρ (i.e., first value of ρ for which F(ρ) is tabulated).

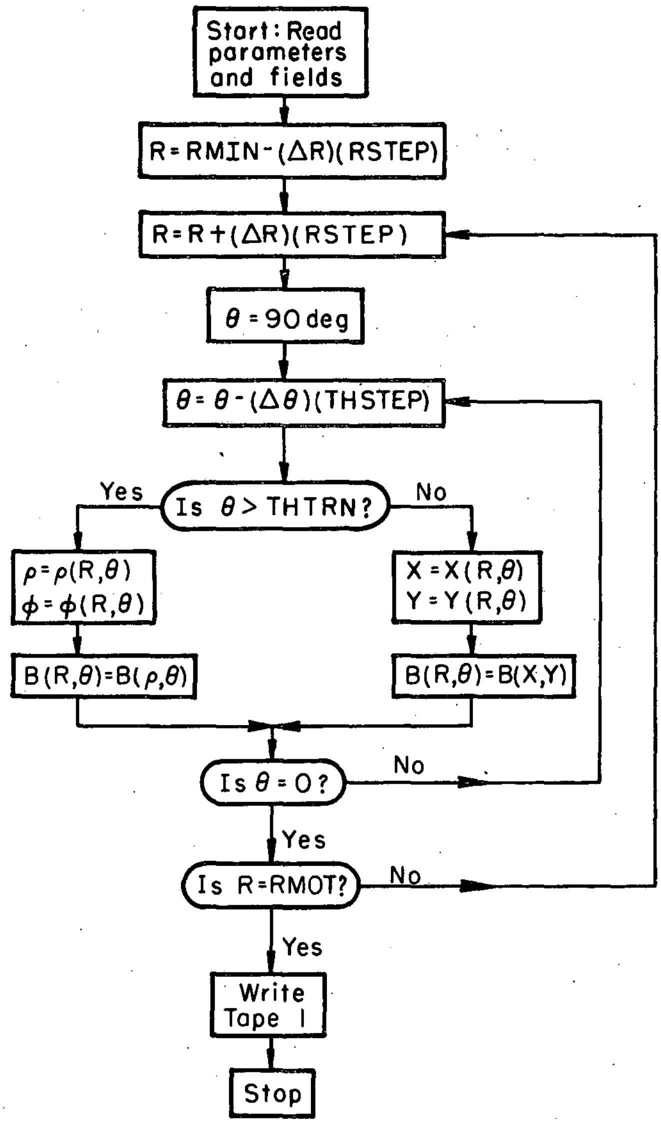

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Fig. 2. Skeleton flow chart for BEFCYF.

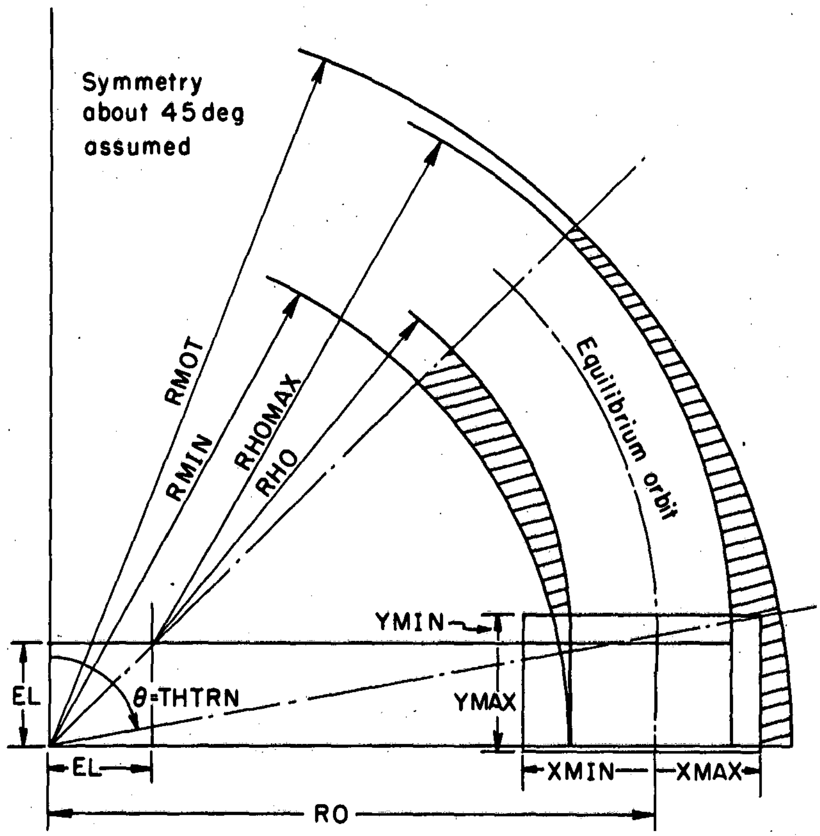

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Fig. 3. Geometrical parameters for BEFCYF.

Card No. 2 7F10.6	RHOMAX:	Maximum value of ρ (i.e., last value of ρ for which $F(\rho)$ is tabulated).
	PH1:	Value of ϕ, beyond which $g(\phi)$ is represented by typical sector profile.
	PHITRN:	PH1 plus period of typical sector profile.
Card No. 3 7F10.6	THTRAN:	Value of θ such that for $\theta \leqslant$ THTRN, $B(R, \theta) = B(\rho, \phi)$, and for $\theta >$ THTRAN $B(R, \theta) = B(X, Y)$; this is the transition angle which is used as a criterion to decide whether to obtain $B(R, \theta)$ from the polar (r, ϕ) profiles, or from the rectangular (X, Y) grid.
	EL:	Half the length of the tangent tank.
	RO:	RHO + EL; this is the length from the geometrical center of the machine (the origin of the R, θ polar grid) to the equilibrium orbit, measured along the tangent line.
Card No. 4 7F10.6	RSTEP:	The R-interval multiplier, converted internally to a fixed-point number, and used to control the R loop by means of a FORTRAN II DO statement of the form DO ________ I= 1, 41, RSTEP.
	DELTAR:	The value of the interval between consecutive values of R.
Card No. 5 7F10.6	THSTEP:	The θ-interval multiplier, converted internally to a fixed-point number, and used to control the θ loop by means of a FORTRAN II DO statement of the form DO ______ J =1, 360, THSTEP.
	DELTHT:	The value of the interval between consecutive values of θ.
Card No. 6 7F10.6	PHISTP:	The ϕ-interval multiplier; a vestige of an early form of BEFCYF, not actually used by the code in its present form.
	DLTPHI:	The value of the azimuthal interval between consecutive points on the tabulated azimuthal profile, $G(\phi)$.

Card No. 7 7F10.6	RHSTEP:	The ρ-interval multiplier; a vestige of an early form of BEFCYF, not actually used by the code in its present form.
	DLTRHO:	The value of the radial interval between consecutive points of the tabulated radial profile $F(\rho)$.
Card No. 8 6I12	A:	The atomic mass number of the nucleus whose trajectory is to be studied.
	Z:	The atomic charge number of the nucleus whose trajectory is to be studied.
	NTGER:	An arbitrary integer, 12 or fewer digits.
	NSUBR:	The number of values on the tabulated radial profile.
	NSBTHT:	The number of values on the tabulated azimuthal profile.

Following card No. 8 the $F(\rho)$ table is read in, followed by the $G(\phi)$ table. In addition, one must, of course, have available Input Tape 4 as prepared by BEXP (see above).

Sense-Switch Options

For BEFCYF the IBM-704 console sense switches have the following significance:

Sense switch 1: Not significant

Sense switch 2: Not significant

Sense switch 3: Not significant

Sense switch 4: This sense switch must be ON (depressed) in order for Tape 1 to be written.

Sense switch 5: If this sense switch is ON (depressed), a Tape 3 must be dialed, and a BCD listing of the input parameters and $B(R, \theta)$ will be written on that tape. As $B(R, \theta)$ is recorded one word per record, this tape is very long and requires an unreasonable length of off-line printer time to be printed in full. Hence it should be written only for debugging purposes, and then only partially, as a rule.

Sense switch 6: If this switch is ON (depressed), the on-line printer produces exactly the same listing as is written on Tape 3 by the sense switch 5 option above. Sense switch 6 should be ON only for debugging purposes. It may, however, be turned ON at the beginning of the operation, so that the on-line printer is allowed to print out the input parameters, and then turned off. Thus a permanent listing of the parameters associated with a particular Tape 1 can be obtained in a convenient format.

Units

It is assumed in BEFCYF that all input fields are normalized in the sense discussed above. The code then writes its output $B(R, \theta)$ in units such that

$$\text{BUNIT} = \frac{(\text{A})(0.123208 \times 10^{7})}{(\text{Z})(\text{UNITL})(\text{BNORM})}$$

This choice of units was dictated by the requirements of BOC.

Summary of Operating Instructions for Usual Production Run of BEFCYF:

1. Dial (blank) Tape 1.
2. Mount and dial as Tape 4 the appropriate BEXP tape (file-protected).
3. Depress sense switch 4.
4. If an on-line listing of input parameters is desired, depress sense switch 6.
5. Clear computer and load consecutively
   (a) BEFCYF binary deck,
   (b) input parameters,
   (c) $F(\rho)$ table,
   (d) $G(\phi)$ table.
6. If sense switch 6 was depressed, turn it OFF after printout of input parameters.
7. Normal STOP is indicated by a program stop with 77777_8 in address field of storage register.
8. Dismount, label, and file-protect Tape 1.
9. Dismount Tape 4.

10. If an on-line printout of input parameters was obtained, remove it from the printer, label, and file it. (This may, of course, be done while the program is being executed.)

The usual runtime for a 41 x 360 B-value Tape 1 is approximately 13 minutes.

SUBROUTINES AND SUBFUNCTIONS OF BEFCYF

Function RPTRIK (R, THETA)

For values of R and θ that fall in the angular aperture for which B is given in terms of $F(\rho)$ and $G(\phi)$, this subfunction is entered. It computes ρ and ϕ from the arguments R and θ, checks for RHO $< \rho <$ RHOMAX (if this relation is not satisfied, the sentinel value BINNER is assigned to $B(R, \theta)$ for $\rho <$ RHO, BOUTER is assigned to $B(R, \theta)$ for $\rho >$ RHOMAX); if this relation is satisfied, subfunctions FNTRPL(RHO) and GNTRPL(PHI) are entered, and $f(\rho)$ and $G(\phi)$ are computed, whereafter the product $(F(\rho))$ $(G(\phi))$ is returned as the value of $B(R, \theta)$, after appropriate adjustment of units.

Function FNTRPL(RHO) and Function GNTRPL(PHI)

These subfunctions accept as arguments values of ρ and ϕ respectively, compute the values of $F(\rho)$ and $G(\phi)$ by four-point Lagrange interpolation among the tabulated values of these respective functions, and return these values to the calling program (RPTRIK).

Function XYTRIK(R, THETA)

This subfunction is entered when the point (R, θ) falls in a region where $B(R, \theta)$ is given in terms of the two-dimensional rectangular array of values (BEXP). The subfunction computes X and Y from the arguments R and θ, and submits these to Function NTGRZN, which returns an integer that is used as the index of a many-way fork. Depending upon the value of this index, either a sentinel value (BINNER or BOUTER) is assigned to $B(R, \theta)$, or the arguments (X, Y) plus a control integer are submitted to one of the subfunctions ENTRPL, QNTRPL, or CNTRPL.

Function NTGRZN(X, Y)

This subfunction inspects the arguments to determine their location with respect to the two-dimensional grid of values BEXP and on the basis of this inspection returns an integer from 1 to 12. Figure 4 illustrates the significance of these integers.

Function CNTRPL (X, Y)

If the arguments X and Y are found by NTGRZN to lie in Zone 5 (see Fig. 4), XYTRIK submits X and Y to CNTRPL, which picks up the 4 x 4 array of values from BEXP that "surround" the point X, Y and submits this array, together with the coordinates of X, Y relative to this array, to FORM 1, which returns the value of B(X, Y) that is subsequently assigned by XYTRIK to B(R, θ).

Function ENTRPL(X, Y, K), K = 1, 2, 3, 4

If the point X, Y is found by NTGRZN to lie in one of the four edge zones (see Fig. 4), then X, Y, and a value of K depending upon the edge in which X, Y lies are submitted to this function, which--operating analogously to CNTRPL (except that it uses FORM 2)--returns a value of B(X, Y), which is subsequently assigned to B(R, θ) by XYTRIK.

Function QNTRPL (X, Y, K), K = 1, 2, 3, 4

If the point X, Y is found to lie in one of the four corners of BEXP, this subfunction is entered; its operation (using FORM 3) is analogous to that of ENTRPL.

Function FORM 1 (T1, T2, BK), Function FORM 2 (T1, T2, BK,) and Function FORM 3 (T1, T2, BK)

These subfunctions are used by CNTRPL, ENTRPL, and QNTRPL, respectively, to obtain values of B(X, Y) from the 4 x 4 two-dimensional array BK (which these last three subfunctions construct from BEXP). FORM 1 is operative if the point in question is "surrounded" by the 16 points of BK; it produces a value of B(X, Y) by double four-point Lagrange interpolation among the 16 values of BK(I, J). FORM 2 is operative if the point in question lies on the edge of the array BK(I, J); it produces a value of B(X, Y) by first performing sequentially four "one-sided" Lagrange interpolations, then performing a usual four-point (central) Lagrange interpolation among the four values so obtained. FORM 3 is operative if the point in question lies in the corner of the array BK; it produces a value of B(X, Y) by double "one-sided" Lagrange interpolation.

The usual (central) Lagrange interpolation performed by FORM 1, FORM 2, and FORM 3 uses (essentially) the relation

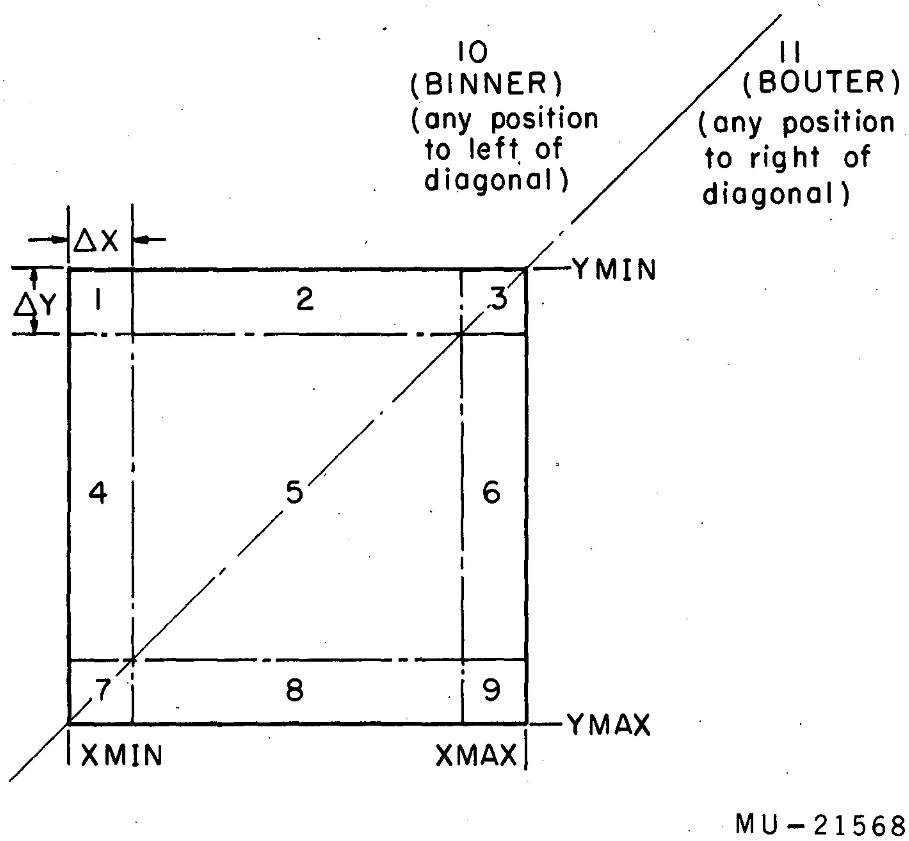

Fig. 4. Significance of the integers assigned by NTGRZN.

$$BX(I) = \sum_{J=1}^{4} C(J)\ BK(I, J),$$

where

$$C(1) = (-1/6)(T1)(1 - T)\ (2 - T),$$
$$C(2) = (1/2)(1 + t)\ (1 - T)\ (2 - T),$$
$$C(3) = (1/2)(T)\ (1 + T\_\ (2 - T),$$
$$C(4) = (-1/6)(T1)(1 + T)(1 - T),$$

with

$$0 \leqslant T \leqslant 1.$$

The "one-sided" Lagrange interpolation performed by FORM 2 and FORM 3 uses (essentially) the relations

$$BX(I) = \sum_{J=1}^{4} C(J)\ BK\ (I, J),$$

where the C(J)'s are obtained from those listed above by the substitution $T \longrightarrow T - 1$.

SUBROUTINE DBDT(B) - MOCK. As presently compiled, BEFCYF requires a subroutine DBDT(B). It was originally planned that this be DBDT, as described in the following section. Since BEFCYF and DBDT are presently incompatible (see the discussion under DBDT), a mock subroutine was written. If it should become desirable to do so, this mock subroutine could be recompiled so as to cause, perhaps under sense-switch option, a BCD tape containing $B(R, \theta)$ to be written.

DBDT

As a companion code to BEFCYF, DBDT was written; its function is to produce a (binary) Tape 2 bearing the azimuthal derivatives of the field on a correspond ng Tape 1 written by BEFCYF.

Internal Operation

Figure 5 is a skeleton flow chart for DBDT. Having read its input parameters and Tape 1 (from BEFCYF), DBDT begins with B(RMIN, O), computes $db/d\theta$ (called DBDTHT), usually by a five-point formula, proceeds to $B\left[\text{RMIN}, (\Delta\theta)(\text{THSTEP})\right]$, $B\left[\text{RMIN}, (\Delta\theta)(2\text{THSTEP})\right]$, etc., then begins again with $B\left[\text{RMJN} + (\Delta R)(\text{RSTEP}), O\right]$ azimuthally to $B\left[\text{RMIN} + (\Delta R)(\text{RSTEP}), (\Delta\theta)(\text{THSTEP})\right]$, etc. The computed values of $dB/d\theta$ are written on Tape 2 in the same order as computed radially, but in

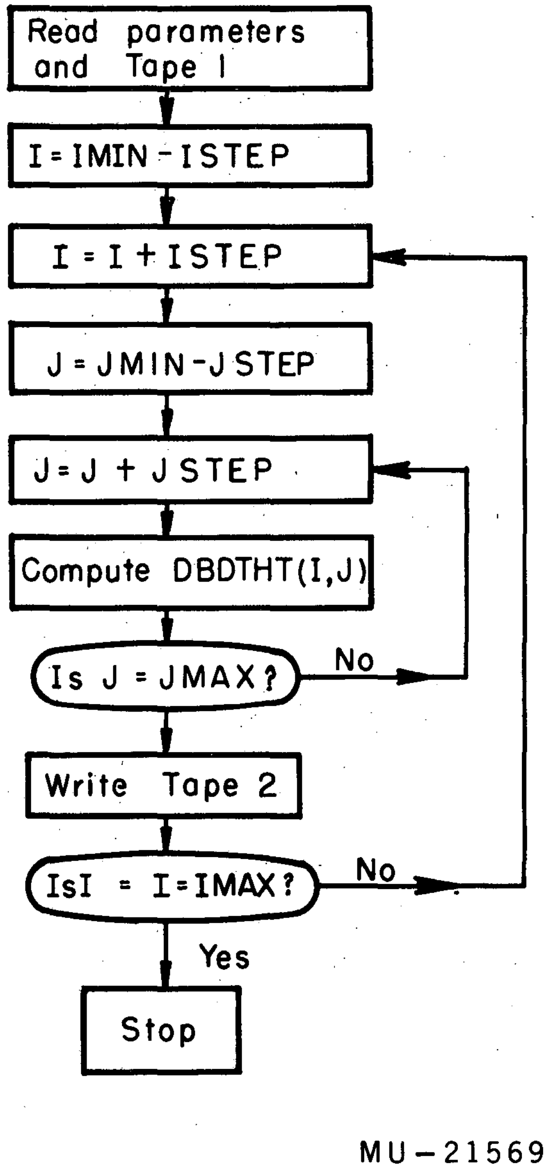

Fig. 5. Skeleton flow chart for DBDT.

the inverse order as computed azimuthally, to conform to the requirements for BOC. In its final form, Tape 2 contains exactly as many records as Tape 1; these records have the following significance:

Record 1: NTGER (the same integer as is written in Record 1 of Tape 1),

Record 2: DBDTHT (RMIN, O), DBDTHT[RMIN, $(\Delta\theta)$(THSTEP)], etc.,

Record 3: DBDTHT [RMIN + (ΔR)(RSTEP), O], etc.,

and: so on for the total number of records.

Input Parameters

DBDT requires as input the following:

Tapes: Tape 1 produced by BEFCYF.

Cards:

(1) Exactly the same data cards used by BEFCYF in writing Tape 1, with the following alteration: entry No. 2 of card No. 5 (i.e., DELTHT) must be converted from degrees to radians.

(2) In FORTRAN II form 7I10, one card containing consecutively the following six integers:

IMIN, IMAX, ISTEP: These control the progress of the program as it proceeds from record to record (R value to R value) of Tape 1, via a DO statement of the form DO____ I = IMIN, IMAX, ISTEP. Usually IMIN = 1, IMAX= (number of records of Tape 1) - 1, and I step = 1.

JMIN, JMAX, JSTEP: These control the progress of the program as it proceeds from θ value to Z value within a fixed record (R value), via a DO statement of the form DO____ J = JMIN, JMAX, JSTEP. Usually JMIN = 1, JMAX = 360, JSTEP = 1.

The above six integers make it possible to produce a Tape 2 which corresponds to a subarray of the whole array on Tape 1.

(3) In FORTRAN II form 4E15.5, one card containing consecutively three floating-point numbers:

SNTNL 1

SNTNL 2

SNTNL 3

Sentinel values assigned to $dB/d\theta$ when $B(R, \theta)$ is a sentinel value; or when there are fewer than three azimuthally consecutive values of B that are not sentinels (i.e., when it is not possible to compute the derivative by either a central or a "one-sided" formula using at least three points). If all three of these values are distinct, it is possible to infer (from the value of the sentinel assigned to $dB/d\theta$) for what cause a legitimate value was not computed. If $B(R, \theta)$ is itself found to be invalid (i.e., a sentinel value, either BINNER or BOUTER), then the number SNTNL3 is assigned to $dB(R, \theta)/d\theta$. If $B(R, \theta)$ is itself valid, but both the preceding and following B values are invalid, the value SNTNL1 is assigned to $dB(R, \theta)/d\theta$. If $B(R, \theta)$ and only one of the two B values on either side of it are found valid, the number SNTNL2 is assigned to $B(R, \theta)$. If from three to five azimuthally consecutive valid B values are found, one of which is the value $B(R, \theta)$ in question, a valid value of $dB(R, \theta)/d\theta$ is computed by using as many points as are available (up to five), regardless of the position of $B(R, \theta)$ with respect to them.

Operating Instructions for Usual Production Run of DBDT

1. Mount the appropriate Tape 1 from BEFCYF.
2. Dial a blank Tape 2.
3. If a BCD listing of the contents of Tape 2 is desired, dial a blank Tape 3.
4. Depress sense switch 4 to produce Tape 2; if a BCD listing on Tape 3 is desired, also depress sense switch 5.

5. Clear computer, load DBDT and appropriate data cards.
6. Normal stop is a program step with 77777_8 displayed in the address portion of the storage register.
7. Dismount and file-protect Tape 2 and (if written Tape 3; dismount Tape 1.)

The usually running time for 41 x 360 values of $db/d\theta$, if Tape 3 is written is approximately 8 minutes.

Sense Switch 6

Depressing this sense switch (not used for production runs) results in an on-line printout of intermediate results plus the contents of Tape 3 (see above). Its primary use is for debugging.

Subfunctions

In this section the operation of the FORTRAN II subfunctions used by DBDT is briefly described.

Function BEGIN (INDEX, JTEMP) is entered to compute DBDTHT(R, O) (i.e., the first entry of a record). B(R, $(\Delta\theta)$(THSTEP)), and B(R,$(\Delta\theta)$ (THSTEP)2) are examined for validity (i.e., not being sentinels), and on the basis of this examination either a sentinel value is assigned to DRDTHT(R, 0), or a valid value is computed, the formula used depending upon the number of available consecutive valid values of B.

Function TWO (INDEX, JTEMP) is operative when the second value of $dB/d\theta$ is computed (i.e., DBDTHT(R_1, $(\Delta\theta)$(THSTEP)). Its operation is similar to that of BEGIN.

Function AONWAY (INDEX, INDEX, ITEMP) is operative where it is possible for at least two valid B values to precede the point in question, and for two valid B values to follow it. Hence, in the usual case, a five-point derivative formula can be used. AONWAY examines the relevant points, decides whether a five-point, four-point, or three-point derivative formula must be used (and whether of the central or "one-sided" type), and uses the appropriate arithmetic subfunctions to compute the value of $dB/d\theta$. If it proves impossible to compute the derivative, or if the value of B at the point in question is itself a sentinel value, a sentinel value is assigned to $dB/d\theta$ at this point.

Function TRIPT(T, DELTA, I, J, K, L) performs the following arithmetic:

$$\text{TRIPT} = \left(\frac{1}{\Delta}\right)\left(\left[G_1(T)\right] B(I,J) + \left[G_2(T)\right] B(I,K) + \left[G_3(T)\right] B(I,L)\right),$$

where

$$G_1(T) = (T - 1.5),$$
$$G_2(T) = 2(1 - T),$$
$$G_3(T) = (T - 0.5),$$

with

$$0 \leqslant T \leqslant 2.$$

This is equivalent to fitting three points with a second-degree polynomial, and then differentiating that polynomial to obtain the derivative on or between the three points.

Function FOURPT ( ) and FUNCTION FIVEPT ( ) operate similarly to TRIPT except that they use, respectively, four and five consecutive points.

Subroutine RECORD ( ) performs the actual operation of writing tapes or printing on-line.

Compatibility of BEFCYF and DBDT

It was originally planned that DBDT should operate as a subroutine to BEFCYF, making it possible to produce Tapes 1 and 2 in one "shot" at the computer. For historical reasons this compatibility does not obtain with the codes in their present form. However, if it should become desirable to have the two codes operate as one, this could be accomplished with a small amount of recompiling with particular attention being paid to the COMMON storage region. The necessary changes may be understood by reference to Fig. 6. Such changes, of course, should not be made without reference to the FORTRAN II listings of the codes, nor without careful testing and (possibly) debugging.

This work was done under the auspices of the U.S. Atomic Energy Commission.

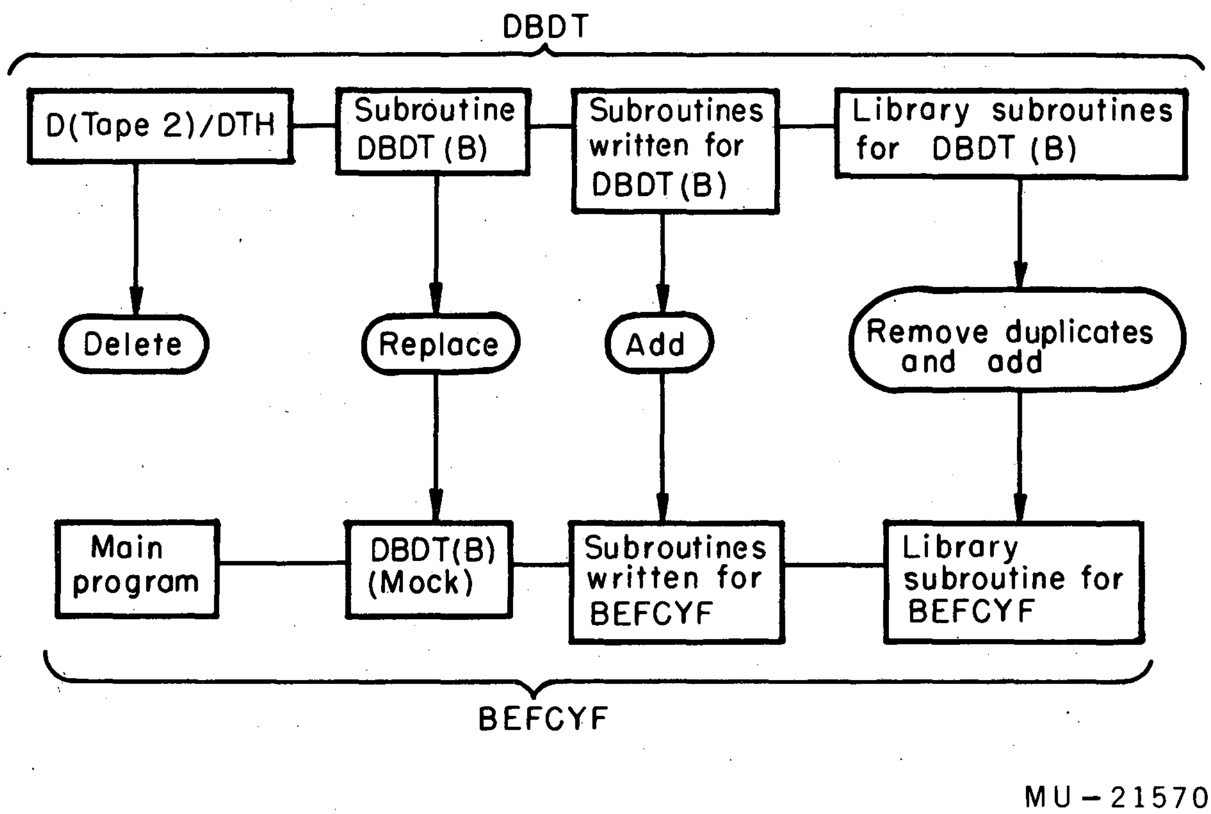

Fig. 6. Schematic of changes required to make DBDT and BEFCYF compatible (see text).