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**TORCAPP: Time-Dependent Cyclotron Orbit Calculation
and Plotting Package**

Addendum 1

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Work supported by
Holifield Heavy Ion Research Facility, Physics Division

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Date Published - November 1982

UNION CARBIDE CORPORATION, NUCLEAR DIVISION
operating the
Oak Ridge Gaseous Diffusion Plant . Oak Ridge National Laboratory
Oak Ridge Y-12 Plant . Paducah Gaseous Diffusion Plant
under Contract No. W-7405 eng 26
for the
DEPARTMENT OF ENERGY

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ACKNOWLEDGMENTS

Addendum 1

The authors wish to express our appreciation to L. B. Maddox who prepared the original documentation for the TORCAPP program. The clarity with which the original authors wrote both the documentation and the code was invaluable in the current efforts to modify the program.

Two of the authors, L. D. Merriman and L. A. Schnautz, are employed as part of Union Carbide's cooperative program for students. L. D. Merriman, from the University of Tennessee at Knoxville, did the principal work on the development of the extractor option. The three-dimensional version was primarily developed by L. A. Schnautz from the University of Evansville, Indiana.

Special thanks go to B. J. Waddell who patiently typed and retyped this report.

The development and documentation of this program were funded by Holifield Heavy Ion Research Facility, Physics Division, under Contract No. W-7405 eng 26.

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Addendum 1

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ABSTRACT

This addendum describes the modifications and additions to TORCAPP which have been implemented since the original report was issued in November 1979 by L. B. Maddox and G. S. McNeilly. Major changes include input of electric field data for central region studies, provision for extractor elements to allow extraction studies, and three-dimensional tracking of central rays.

1. INTRODUCTION

Addendum 1

The original TORCAPP (time-dependent cyclotron orbit calculation and plotting package) has been extended to allow three major additional areas of cyclotron design to be studied. (1) Explicit input of electric field data now permits central region studies to be accomplished. (2) Extractor elements can now be defined, thus allowing complete extraction beam quality investigations. (3) Three-dimensional magnetic fields may be input to the 3D version of TORCAPP, thus permitting central ray tracking in three dimensions. The central region and extraction codes have been added to the program CALPAT, while the three-dimensional code is in a modified version called CALF3D. Since CALF3D was generated from the original code, it does not include the central region or extraction options.

This addendum indicates the code changes and describes the modifications and additions to the input data which will allow a user of the previous version of TORCAPP to implement the new version. The new version, with test data, is available from the authors.

2. CAPABILITIES AND FUNCTIONS

Addendum 1

Calculations Performed in CALPAT

Changes have been made in the way the time for the integration step is established. The input variables SIZE1, SIZE2, and DTMAX are used to determine an adjustable time increment. Internally these input variables are converted from cm and degrees to meters and radians with default values of 1 cm, 1 meter, and 4 degrees. Subroutine TSCALE determines a new time increment from the local trajectory dynamics by calculating the minimum distance from the components of the velocity after each time step (see Section 3).

The option which allowed input of initial radius, angle, and direction has been removed. Thus, the initial position in x, y, and z coordinates and the components of the velocity is the only input for the particle or particles.

An additional change was made which removed the input parameter for the particle's kinetic energy. The current program calculates the energy from the components of the velocity and the mass of the particle.

CALP3D includes the calculations mentioned in the original documentation, as well as the changes mentioned above. However, the subroutine BRECT and its associated call to BINTRP have been modified to handle a three-dimensional magnetic field configuration.

Printed Output

CALPAT and CALP3D. Printed output from these programs has been divided into two types: a debugging version and a production version.

Standard print unit [IO (unit 6)]:

- a) If PRTOPT>0 and IDEBUG=1, the output is a columnar listing indicating time, position, velocity, field value, radius, and angle for each time step. If the central region is being studied, then the output also includes the initial E-field data, energy, and the RF-phase for each position. For the CALP3D version, the three components of the magnetic field are included.
- b) If PRTOPT>0 and IDEBUG=0, the output indicates time, position, field values, radius, and angle for each time step. When IEFLD=1, the output includes the energy, the initial E-field value at a point, and the RF-phase. In CALP3D, this production version adds the field values also.

3. GENERAL EQUATIONS IMPLEMENTED

Addendum 1

Adjusted Time (defined in subroutine TSCALE)

The time is adjusted for each integration step by choosing the minimum value of Δt_1 or Δt_2 based on the following:

$\vec{V}_1$ = velocity vector from previous step.

$|\vec{V}_1|$ = magnitude of previous velocity vector.

$\vec{V}_2$ = velocity vector determined by current step.

$|\vec{V}_2|$ = magnitude of current velocity vector.

$$\Delta t_1 = \text{SIZE2}/|\vec{V}_m| \quad (1.A1.a)$$

$$\Delta t_2 = \Delta t_0 (\text{DTMAX}/\Delta\theta) \quad (1.A1.b)$$

where

SIZE2 = input variable defining the maximum length between points for each integration step in the limiting case of zero B-field.

$|\vec{V}_m|$ = maximum value of the magnitude of $|\vec{V}_1|$ or $|\vec{V}_2|$.

Δt_0 = the delta time used for the previous integration step, with the initial $\Delta t = \text{SIZE1}/C$ where C = speed of light in meters/second.

DTMAX = Input variable defining the maximum change in particle direction steps.

$$\Delta\theta = \text{Arccos} \frac{\vec{V}_1 \cdot \vec{V}_2}{|\vec{V}_1| |\vec{V}_2|}$$

Additional print units:

- a) I02 (Unit 18) is used only for output from the central region study.
 - 1. If IDEBUG=1, the printout contains the input parameters and the x and y values after internal conversion of the E-field. Additional output includes a columnar listing for the particle position in the cyclotron, the x component of the E-field, time, radius, and angle at every 100th time step.
 - 2. If IDEBUG=0, output is restricted to the input parameters.
 - 3. EDEBUG is a logical variable set internally in BLOCK DATA, which controls the amount of output to this unit during input and initial processing of the E-field. If EDEBUG=.TRUE., the E-array will be printed before it is expanded, after it is expanded, and after it is converted. This variable also controls the out-of-field message from subroutine EXEYEZ.
- b) IOUT22 (Unit 22) contains information from subroutine TSCALE about the size adjustments for the time steps. This information is printed only if IDEBUG=1. Output includes DTIME, the velocity of x and y and the magnitude of velocity from the previous step, current velocity and magnitude, the dot product of the velocity vectors, and angle in degrees.

PATPLT. No change.

4. DESCRIPTION OF SUBROUTINES

Addendum 1

Changes to CALPAT and CALP3D

1) MAIN

Calls READEX if extractor study is being done (CALPAT only).

3) INPUTP

Determines the initial energy based on the input velocity.

4) PACKET

The option of converting R, NTI, and TI into x, y, and z coordinates has been removed.

6) PARTCL

Provides output according to specified options. (See "Printed Output" in Section 2 for more information.)

8) EQUA

Calls EXEYEZ for the central region study (CALPAT only).

9) BRECT

No change for CALPAT.

For CALP3D this subroutine and the associated subroutine BINTRP has been modified so that three-dimensional fields are used.

10) BINTRP

Calls CHECK if an extraction study is being done (CALPAT only).

11) BPRIME

Calculates partial field derivatives using the two-point central differencing. The source for this subroutine was not changed. This description is a correction to the original documentation.

Not included in CALP3D, where 3-D fields replace a Taylor Series B_z .

Additional CALPAT Subroutines**1) READEX**

Reads the coordinates for the extractor elements and the necessary corrections for the BFIELD.

2) TSCALE

Called from PARTCL. Provides DE with adjustable time steps for integration. (In CALPAT and CALP3D both.)

3) CHECK

Determines which extractor element, if any, contains the current point and recalculates the BFIELD if the particle is inside an element.

4) INSYD2

Function which determines if a particle is inside the extractor.

5) EXEYEZ

Interpolates to find an E-field value for a point.

Calls INPUTE.

6) FIXUP

Reads in the electric field and establishes the electric field array.

7) INPUTE

Reads in the data for calculations with electric fields.

Calls FIXUP.

Changes to PATFLT

Program does all calculations in double precision but uses single precision for the plotting.

3) PLOT1P

Option added for generating plots with fixed scaling, although automatic scaling is the default.

4) PLTPAK

Contains the option of placing tick marks on the axis for a packet plot.

5. DATA INPUT GUIDE

Addendum 1

CALPAT - Unit 4

MAIN

1. No change
2. Calculation and output variables

Format (5I5)

IPAK	IPRNTB	IEXTR	IEFLD	IDEEUG
5	10	15	20	25

INPUTF

- 3.-6. No change

INPUTP

7. No change - read only if IPAK $\neq$ 0
8. Particle and integration variables

Format (4E10.5)

FMASS	Q	TINT	TMAX
10	20	30	40

9. No change
- 9.1 Variables for adjustable time steps

Format (3E10.3)

SIZE1	SIZE2	DTMAX
10	20	30

10. No change
11. Removed - option no longer available
12. No change

CALPAT - Unit 10

No change

CALPAT - Unit 19

Input for extractor study

READEX

1. Number of extractors

NEX
2

Format (I2)

2. Extractor geometry

Format (I2/4D17.10/4D17.10)

KN
XEX(1,1) | XEX(1,2) | ... | XEX(1,KN)
YEX(1,1) | YEX(1,2) | ... | YEX(1,KN)

KN
XEX(NEX,1) | XEX(NEX,2) | ... | XEX(NEX,KN)
YEX(NEX,1) | YEX(NEX,2) | ... | YEX(NEX,KN)

3. B-field corrections

Format (10D8.3)

BCORZ(1) | BCORZ(2) | ... | BCORZ(NEX)

CALPAT - Unit 20

Central Region Studies

INPUTE

1. Electric field coordinates

Format (2I5,4D10.0)

NX | NY | XBEG | YBEG | DX | DY
5 10 20 30 40 50

2. Descriptive variables

Format (4D10.0,F10.0)

XORIGN | YORIGN | FREQ | PHI | DEEV
10 20 30 40 50

FIXUP

3. Field Format

Format (14A4)

Example: (10F5.2)

!FMT(1) ! FMT(2)!...!FMT(14)!

4. Electric field values

Format (FMT)

E(1,1) ! E(2,1)! ...! E(NX,1)!.
.
.!E(1,NY) ! E(2,NY)! ...!E(NX,NY)!PATPLT - Unit 16 [11]

(Documentation references to Unit 11 have been changed to Unit 16.)

No change

PATPLT - Unit 18

1. Change in PLTOPT if MRKPLT.EQ.1 and NP.EQ.1

Format (I5)

!PLTOPT!
5

2. Fixed scaling for plotting when NP = 1

Format (6F10.6,2F5.3)

!XLO ! XHI ! YLO ! YHI ! ZLO ! ZHI ! XSTP ! YSTP!
10 20 30 40 50 60 65 70

3. Packet Plots with tick marks and rounded scaling

Format (I5)

!NTICK!
5

CALP3D

Use the input guide for the new version of CALPAT with the exceptions listed below.

2. Calculation type variables

Format (2I5)

IPAK	IPRNTB
5	10

INPUTF - Unit 4

3. Field size variables

Format (5I5)

NR	NT	NXT	NZ	IFTYPE
5	10	15	20	25

4. Field step sizes and accuracy parameters

Format (6F10.0)

DR	DT	DZ	ZMIN	RELERR	ABSERR
10	20	30	40	50	60

INPUTP - Unit 4

10. Number of particles

Format (I5)

NP
5

INPUTF - Unit 10

1. Field data

Format (FMT)

B(1,1,1,1)	...	B(NR,NT,NZ,3)
------------	-----	---------------

Input Variable Definitions

Abbreviations:

1) Subroutine Names

FX - FIXUP
IE - INPUTE
IF - INPUTF
IP - INPUTP
M - MAIN for CALPAT and CALP3D
PP - PATPLT
RX - READEX

2) Data Units

AMU - atomic mass units
C - control variable
CM - centimeter
DEG - degrees
EU - electron units
G - gauss
KG - kilo gauss
KV - kilo volt
MEV - million electron volts
MHZ - mega hertz
MM - millimeter
MRAD - milliradian
S - second

INPUT VARIABLES

Adendum 1

Remove

E
IOPT
NTI
R
TI

Add

Variable Name	Input Group Number	Subroutine Read In	Data Units	Definitions
BCORZ(1)	3	RX	KV/IN	Electro-static extractor electric field. (Converted to KG internally for element 1.)
BCORZ(2-10)	3	RX	KG	ΔB_z corrections to the main field due to extractor elements 2-10.
DEEV	2	IE	KV	Dee voltage.
DTMAX	9.1	IP	DEG	Maximum change in particle direction Between steps. Will default to 4°.
DX	1	IE	IN	Increment value for x-axis of electric fields.
DY	1	IE	IN	Increment value for y-axis of electric fields.

Variable Name	Input Group Number	Subroutine Read In	Data Units	Definitions
DZ	4	IF	IN	Increment value for z coordinates for 3D version.
E(XMAX,YMAX)	4	FX		Electric fields for central region. The array size for the y-direction should be larger than any calculated trajectory.
FREQ	2	IE	MHZ	RF-Frequency.
IDEBUG	2	M	C	Controls output information. Requires PKTOPT>0. =1;extensive output includes time, position, velocity, field. =0;(default) limits output to time, position, field.
IEFLD	2	M	C	Central region study. =0;no central region. =1;do central region study.
IEXTR	2	M	C	Extractor study. =0;do not do extractor study. =1;do extractor study.
KN	2	RX	C	Number of coordinates per axis per extractor to be input. Usually = 4.
NEX	1	RX	C	Number of extractors.

Variable Name	Input Group Number	Subroutine Read In	Data Units	Definitions
NTICK	3	PP	C	for packet plots: =0;no tick marks,exact minimum and maximum values on axis. =1;tick marks with rounded labels below the axis. =-1;tick marks with rounded labels above the axis.
NX	1	IE	C	Size of E-field array for input in x direction.
NY	1	JE	C	Size of E-field array for input in y direction.
NZ	3	IF	C	Number of z coordinates.
PHI	2	IE	DEG	Angle used to determine phase shift for central region study.
SJZE1	9.1	IP	CM	Minimum length of arc for each time step.
SIZE2	9.1	IP	CM	Maximum length between points for each time step.
XBEG	1	IE	IN	Beginning x coordinate for E-field input.
XEX(10,20)	2	RX	M	X coordinates for each extractor element.
XHI	2	PP	M	X-axis maximum for fixed scaling plot for single particle.

Variable Name	Input Group Number	Subroutine Read In	Data Units	Definitions
XLO	2	PP	M	X-axis minimum for single particle, fixed scaling plot.
XORIGN	2	IE	IN	True x-origin for central region.
XSTP	2	PP	M	Step size on x-axis for single particle, fixed scaling plot.
YBEG	1	IE	IN	Beginning y-coordinate for E-field input.
YEX(10,20)	2	RX	M	Y-coordinates for each extractor element.
YHI	2	PP	M	Y-axis maximum for single particle, fixed scaling plot.
YLO	2	PP	M	Y-axis minimum for single particle, fixed scaling plot.
YORIGN	2	IE	IN	True y-origin for central region..
YSTP	2	PP	M	Step size on y-axis for single particle.
ZHI	2	PP	M	Z-axis maximum.
ZLO	2	PP	M	Z-axis minimum.
ZMIN	4	IF	IN	Minimum value of Z for CALP3D.

6. PLOTTING PROCEDURE

Addendum 1

No changes except some local modifications.

7. EXAMPLE JCL^{*}

Addendum 1

There have been many changes in the local Job Control Language since the original report was issued. However, listed below are only those areas where changes in the code have generated the need for additional input/output units. The unit numbers mentioned are assigned to integer variables and defined internally in BLOCK DATA.

All the TORCAPP programs (CALPAT, CALP3D, and PATPLT), without exception, have changed the previous disk output units 11 and 12 to 16 and 17, respectively. This change was necessary because of a local machine-dependent modification and has no effect on the execution of the program. Also, an output unit, 22, has been added to both the CALPAT and CALP3D programs. See Section 2 for a detailed explanation of the printer output to units 22 and 18 which are mentioned below.

CALPAT

Central Region Option. This option added three I/O units to the JCL. Two of these units, 18 and 22, are for printed output. The additional unit, 20, is for the input data set which contains the information relating to the E-field.

Extractor Option. Two units were added for this option: unit 22 and unit 19. The input data set which defines the extractor geometry is read from unit 19.

CALP3D

The Job Control Language for this program module is as shown in the original documentation with the exception of unit 22 and the numerical change mentioned above.

PATPLT

The plotting program contains very few changes from the original. Unit 18 (previously identified as unit 13) added input parameters for the options of fixed scaling for a single particle and for tick marks and rounded axes on the nine particle-packet plots. See Section 5 for a complete list of these input variables.

^{*}The authors will provide sample JCL listings upon request.

8. EXAMPLE CALCULATIONS

Addendum 1

The first two examples are from an extraction study for uranium. The ion was initially positioned at the entrance to the first extraction element. The input data set shown in Fig. 8.A1.1 defines the geometry of the elements and the field correction factors.

Example 1:

The input data to calculate a single particle path through the extractor elements is shown in Fig. 8.A1.2. Fig. 8.A1.3 is an example of the trajectory with the extractors schematically represented by boxes, which were superimposed on the plot generated by the PATPLT program.

Example 2:

Fig. 8.A1.4 is the input data set for a uranium nine-particle packet. The plots in Fig. 8.A1.5 show the packet position at sixteen different times during the extraction study. These figures demonstrate the change in PATPLT that places tick marks on the axis and uses rounded scaling for the end points.

Example 3:

The central region study uses input data sets containing the ion information (Fig. 8.A1.6) and the initial E-field values (Fig. 8.A1.7). The examples are for a neon particle with zero initial RF-phase, using third-harmonic acceleration. Fig. 8.A1.8 is the plot generated from the input data. The dee gap center line for the Oak Ridge Isochronous Cyclotron is located at $X = -0.254$ cm. The case selected (failure to accelerate) demonstrates the adaptation of the algorithm to complicated trajectories. The time step is adjusted according to the rate of change of velocity.

Example 4:

Fig. 8.A1.9 is the input data set for the three-dimensional version, CALP3D, and Fig. 8.A1.10 is the plot. The particle illustrated is oxygen and the B-field used was a uniform field.

ORNL-DWG 82-18219

9					NEX
4					KN
	-0.1000000D-02	-0.2000000D+00	-0.6000000D+00	-0.4000000D+00	XEX
	0.5039000D+00	0.9954000D+00	0.8858000D+00	0.3958000D+00	YEX
4					KN
	-0.4000000D+00	-0.7000000D+00	-0.8000000D+00	-0.5000000D+00	XEX
	0.4413000D+00	0.7233000D+00	0.4789000D+00	0.1369000D+00	YEX
4					KN
	-0.5000000D+00	-0.9000000D+00	-0.1000000D+01	-0.7000000D+00	XEX
	0.2371000D+00	0.4091000D+00	0.1760000D+00	0.4700000D-01	YEX
4					KN
	-0.6000000D+00	-0.1000000D+01	-0.1000000D+01	-0.6000000D+00	XEX
	-0.4910000D-01	-0.1411000D+00	-0.4032000D+00	-0.3112000D+00	YEX
4					KN
	-0.5000000D+00	-0.8000000D+00	-0.4000000D+00	-0.1000000D+00	XEX
	-0.3543000D+00	-0.6393000D+00	-0.1140700D+01	-0.8557000D+00	YEX
4					KN
	-0.5000000D-01	-0.3000000D+00	0.5000000D-01	0.3000000D+00	XEX
	-0.8880000D+00	-0.1125500D+01	-0.1470700D+01	-0.1233200D+01	YEX
4					KN
	0.1072740D+01	0.3528000D+00	0.9338300D+00	0.1603700D+01	XEX
	-0.5000000D+00	-0.5000000D+01	-0.3000000D+01	-0.5000000D+00	YEX
4					KN
	0.1759700D+01	0.1430600D+01	0.1839700D+01	0.2168400D+01	XEX
	-0.5000000D+00	-0.3000000D+01	-0.3000000D+01	-0.5000000D+00	YEX
	-120.000	-4.000	-4.000	0.000	BCORZ
				-22.300	
				0.000	
				8.670	
				13.180	

Fig. 8.A1.1. Input Data Set for Extractor Geometry

Fig. 8.A1.2. Input Data for Single Particle Through Extractors

ORNL-DWG 82-18221

PARTICLE * 1

MASS - 238.0

CHARGE - 44.0

TIME 0.00000- 1.20591×10^{-7}

ENERGY (MEV) - 2441.0

Fig. 8.A1.3. Particle Path Through Extractors

Fig. 8.A1.4. Input Data for Nine-Particle Packet

ORNL-DWG 82-18223

I- 7.517 $\times 10^{-3}$
2X(1) = 0.0
Y(1) = 751.4I- 0.006
1X(1) = -319.2
Y(1) = 668.3 I- 2.352 $\times 10^{-3}$
4X(1) = -612.6
Y(1) = 470.4I- 1.558 $\times 10^{-3}$
3X(1) = -808.9
Y(1) = 179.8

Fig. 8.A1.5. Packet Plots

Fig. 8.A1.5. Packet Plots (cont.)

Fig. 8.A1.5. Packet Plots (cont.)

Fig. 8.A1.5. Packet Plots (cont.)

[illegible]

Fig. 8.A1.6. Input Data for Central Region Study

ORNL-DWG 82-18225

10	33	-2.5D0	8.0D0	0.5D0	0.5D0	NX,NY,XBEG,YBEG,DX,DY
0.1D0	-0.75D0	18.42	0.0D0	69.	XORIGN,YORIGN,FREQ,PHI,DEEV	NEON-THIRD HARMONIC
(10F5.2)						
0.00	0.00	0.00	0.30	0.43	0.42	0.40 0.35 0.00 0.00
0.00	0.00	0.00	0.30	0.41	0.37	0.34 0.30 0.00 0.00
0.00	0.03	0.06	0.09	0.12	0.40	0.60 0.36 0.05 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.00
0.00	0.03	0.06	0.09	0.12	0.42	1.00 0.36 0.11 0.01
0.00	0.03	0.06	0.09	0.12	0.42	1.03 0.36 0.11 0.04
0.00	0.03	0.06	0.09	0.12	0.42	1.03 0.36 0.11 0.04
0.00	0.00	0.00	0.00	0.03	0.42	1.03 0.40 0.11 0.04
0.00	0.00	0.00	0.00	0.00	0.50	1.30 0.90 0.10 0.02
0.00	0.00	0.00	0.00	0.00	2.00	2.00 0.00 0.00 0.00
0.00	0.00	0.00	0.00	0.00	0.90	1.07 0.90 0.10 0.00
0.00	0.00	0.00	0.00	0.03	0.90	1.07 0.90 0.10 0.00
0.00	0.03	0.06	0.09	0.12	0.90	1.07 0.90 0.10 0.00
0.00	0.07	0.11	0.16	0.21	0.77	0.87 0.68 0.08 0.00
0.00	0.10	0.14	0.20	0.26	0.40	0.50 0.30 0.06 0.00
0.02	0.11	0.15	0.20	0.28	0.23	0.15 0.10 0.04 0.00
0.03	0.11	0.15	0.20	0.28	0.23	0.15 0.10 0.03 0.00
0.03	0.11	0.15	0.20	0.28	0.23	0.15 0.10 0.03 0.00
0.03	0.11	0.15	0.20	0.28	0.23	0.15 0.10 0.03 0.00
0.02	0.11	0.15	0.20	0.28	0.23	0.15 0.10 0.03 0.00
0.00	0.10	0.14	0.21	0.30	0.26	0.18 0.13 0.02 0.00
0.00	0.05	0.13	0.23	0.32	0.30	0.21 0.16 0.01 0.00
0.00	0.00	0.10	0.26	0.34	0.34	0.24 0.20 0.00 0.00
0.00	0.00	0.04	0.28	0.36	0.38	0.29 0.23 0.00 0.00
0.00	0.00	0.00	0.30	0.41	0.40	0.35 0.28 0.00 0.00
0.00	0.00	0.00	0.30	0.43	0.40	0.40 0.30 0.00 0.00

Fig. 8.A1.7. Input Data for Electric Field

ORNL-DWG 82-18226

PARTICLE # 1

MASS - 22.0

CHARGE - 5.0

TIME 0.00000 3.14661 $\times 10^{-9}$

ENERGY (MEV) - 0.0

Fig. 8.A1.8. Central Region Acceleration

ORNL-DWG 82-18227

1	1	3	1	0	0	PLTOPT,PRTOPT,IDIM,NPRPLT,IBEOPT,MRKPLT
0	0	0				IPAK,IPRNTB,IDEBUG
20	180	5	7	0		NR,NT,NXT,NZ,IFTYPE
	1.		2.		2.	-5. 1.D-06 1.D-06 DR,DT,DZ,ZMIN
(9F8.1)						FMT
1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000 1.0000000
1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000 1.0000000
1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000 1.0000000
.159901E+2		8..000000000	.310000D-5			FMASS,Q,TINT,TMAX
0.0D0	0.0D0	0.0D0				SIZE1,SIZE2,DTMAX
1			NP			
-0.30313027000E+02		0.31860276000E+01		0.00000000000E+00		X,Y,Z
0.57670930000E+07		0.82473272000E+08		0.16491209000E+08		VX,VY,VZ

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Fig. 8.A1.9. Input Data for Three-Dimensional Case

ORNL-DWG 82-18228

PARTICLE # 1

MASS - 16.0

CHARGE - 8.0

TIME 0.00000 - 9.23225×10^{-7}

ENERGY(MEV) - 0.0

Fig. 8.A1.10. Three-Dimensional Version

9. UNITS INFORMATION

Addendum 1

The following unit information is for the input variables which have been added to the program.

Input Variable	Input Units	Internal Units
E-Field	$\frac{\text{kV/in}}{\text{kV}}$	V/m
DEEV	kV	V
PHI	degrees	radians
XBEG	inches	meters
YBEG	inches	meters
DX	inches	meters
DY	inches	meters
DZ	inches	meters
FREQ	MHz	radians/sec.
XORIGN	inches	meters
YORIGN	inches	meters
BCORZ(1)	kV/in	tesla
BCORZ(2-10)	kgauss	tesla
DTMAX	degrees	radians
SIZE1	cm	meters
SIZE2	cm	meters
ZMIN	inches	meters