Appendix 1. Input Parameters Description

I. Element

Type	Code	Records
Sentinel	SENT	1
Dipole	DIPO	12
ES Deflector	EDIP	8
Multipole	POLE	8
Multipole Corrector	MULT	6
Solenoid	SOLE	4
Velocity Selector	VELS	11
Lens	LENS	2
Shift-Rotate	SHRT	2
Drift	DRIF	2
Collimator	COLL	2

A. Problem Definition (3 records)

Record	Variable		Format
1	NTITLE	- Problem or other identifying description	20A4
2	NR	- Number of rays to be traced per energy.	7I5
	NP	- Number of integration steps per printed line NP=100+N - Print out every Nth step for central energy only. NP>200 - Omit all intermediate printout.	
	NSKIP	- Transfer matrix option (see Table below)	
	JFOCAL	- Output coordinate axes option. JFOCAL=0 - Intersection of Rays 1 and 2, or their projections on the xz plane, is used to determine the origin and orientation of the output coordinate system. z-axis oriented along direction of Ray 1. JFOCAL=1 - Origin of output coordinate system fixed at $z_D = 0$, where D denotes the final fixed coordinate system in the last element. The z-axis is oriented along the direction of Ray 1. The subroutines used for calculating the orbits through optical elements in RAYTRACE in general use either three or four fixed coordinate systems per element. The first and last are referred to as systems A and D. JFOCAL=2 - Output coordinate system is the D-axis system of the final element.	
	JMTRX	- Not used.	
	JNR	- A flag which is used to determine whether the rays to be traced appear as input in the data stream or are generated automatically by the program JNR=0 - Individual input rays appear in the data stream immediately following the SENTINEL terminator. JNR=2 - Input record after SENTINEL defines a pair of paraxial rays. JNR=6 - Input record after SENTINEL defines 6 rays describing the usual midplane point source problem. JNR=14 - Input record after SENTINEL defines 14 rays describing the full solid angle point source problem.	

Record	Variable		Format
		JNR=46 - Input record after SENTINEL defines 46 rays describing the full solid angle general non-point source problem.	
	NPLT	- Plotting option. NPLT=0 - Normal. NPLT≠0 - Generate plot file.	

Transfer Matrix Options

Matrix	NR	NSKIP
Point Source (Midplane)	$6 \leq NR < 14$	0
Point Source (Full Solid Angle)	$14 \leq NR < 46$	0
Standard	≥ 46	0
None	Any	$\neq 0$

Record	Variable		Format
3	Energy	- Particle kinetic energy in MeV for first calculation	5F10.5
	DEN	- Change in particle energy for successive runs	
	XNEN	- Number of complete runs with successive energy changes including first run. Default = 1.	
	PMASS	- Mass of particle (AMU)	
	Q	- Charge state of particle, units of electron charge.	
		- If mass and charge are not specified, i.e. PMASS=0 and Q=0, the program assumes a relativistic particle with Q=1, v=c, and p=E in MeV/c.	

B. Dipole (12 records)

Record	Variable		Format
1	DIPOLE		A4
2	LF1	- Entrance fringing field integration step size (cm)	6F10.5
	LU1	- Uniform field integration step size (cm)	
	LF2	- Exit fringing field integration step size (cm)	
	DG	- Differential step size used in determining off mid-plane components of B using numerical differential methods. Recommended for all four step sizes: 0.3D (D=Gap) although LU1 can be made larger to save computer time. For MTYP=6, DG serves another function. See Sec. V. A.	
	MTYP	- Magnetic dipole option MTYP=0,1 - Uniform field dipole. Fringing field determined by calculation of the distance to the effective field boundary in the z-direction. MTYP=2 - Uniform field dipole. Fringing field determined as described in Sec. V.A. MTYP=3 - Non-uniform field dipole with n-value and second-, third-, and fourth-order corrections. Fringing field determined as for MTYP=2, but including n-value, etc. MTYP=4 - Non-uniform field dipole - cylindrical geometry. Similar to MTYP=3 but better suited for purely conical pole pieces. This option is used to describe magnets with wedge-shaped gaps ("CLAMSHELL") by making R large, PHI small, and by setting BET1=GAMA=DELT=0 but $n \neq 0$, and normally large because R is artificially large. MTYP=5 - Uniform field dipole, circular pole option. MTYP=6 - Pretzel magnet option.	
	IMAP	- Array number for generating and identifying fringing field array maps. If IMAP=0, maps are not generated and the field components are calculated directly for each point, i.e. four times for each integration step. Two dipoles with identical values of IMAP will share a common array. IMAP$\leq$5.	
3	A	- Distance (cm) from origin of system A (initial) to system B (situated at entrance edge EFB of magnetic element)	5F10.5

Record	Variable		Format
	B	- Distance (cm) from origin of system C (situated at exit edge EFB of magnetic element) to origin of output system D	
	D	- Gap width (cm)	
	R	- Radius of curvature (cm) used in geometrical construction of layout	
	BF	- Nominal value of the field on the central radius R (Tesla)	
4	PHI	- Angular extent between the EFB of system B and that of system C (degrees). Nominally equivalent to the bend angle	3F10.5
	ALPHA	- Angle between the central trajectory and the normal to the effective field boundary (EFB) at entrance (degrees)	
	BETA	- Angle between the central trajectory and the normal to the exit boundary (degrees). Both ALPHA and BETA are positive when the normals are outside the orbit for positive transverse plane focussing.	
5	NDX	- 'n-value', of field index for non-uniform field magnets (first-order term).	4F10.5
	BET1	- 'β-value', of field index for non-uniform field magnets (second-order term).	
	GAMA	- 'γ-value', of field index for non-uniform field magnets (third-order term).	
	DELT	- 'δ-value', of field index for non-uniform field magnets (fourth-order term).	
6	Z11	- Integration limit (cm) defining the start of the entrance fringing field zone in coordinate system B. Normally positive.	4F10.5
	Z12	- Integration limit (cm) defining the termination of the entrance fringing field zone in coordinate system B. Normally negative.	
	Z21	- Integration limit (cm) defining the start of the exit fringing field zone in coordinate system C. Normally negative.	
	Z22	- Integration limit (cm) defining the termination of the exit fringing field zone in coordinate system C. Normally positive.	

Record	Variable		Format
7	C00 C01 C02 C03 C04 C05	- Coefficients used in the expansion of the fringing field fall-off at the entrance of the magnetic element.	6F10.5
8	C10 C11 C12 C13 C14 C15	- Coefficients used in the expansion of the fringing field fall-off at the exit of the magnetic element.	6F10.5
9	BR1	- Correction for presence of constant field in region of entrance fringe field (Tesla).	6F10.5
	BR2	- Correction for presence of constant field in region of exit fringe field (Tesla). In the Split-Pole Spectrometer, BR1 and BR2 describe the asymptotic field in the split.	
	XCR1	- Equivalent to a coordinate system shift (cm) at the entrance (element SHRT) with Δx=−XCR1. Used to correct for displacement of central ray caused by extended fringing field (see Fig. 2). Use XCR1=XCR2=0 unless the actual hardware element will be offset.	
	XCR2	- Equivalent to a coordinate system shift (cm) at the exit with Δx=XCR2. Used to correct for displacement of central ray caused by extended fringing field.	
	DELS1	- A correction to the location of the effective field boundary. The effective field boundary at entrance is moved towards the magnet (for positive Δz) by an amount Δz =DELS1$*D$.	
	DELS2	- A correction to the location of the effective field boundary. The effective field boundary at exit is moved towards the magnet (for positive Δz) by an amount Δz =DELS2$*D$.	

Record	Variable		Format
10	RAP1	- Inverse radius of curvature of entrance boundary (cm^{-1}). Convex surfaces are positive.	2F10.5
	RAP2	- Inverse radius of curvature of exit boundary (cm^{-1}). Convex surfaces are positive. In the program, except for MTYP=5, circles described by RAP1 and RAP2 are approximated with an eighth-order power series.	
	WDE	- Mechanical width of the entrance pole boundary. Used only when IMAP is non-zero.	
	WDX	- Mechanical width of the exit pole boundary. Used only when IMAP is non-zero.	
11	S02 S03 S04 S05 S06 S07 S08	- Coefficients used in description of entrance boundary curvature. Contributions of RAP1 are added to those of S02, S04, S06, and S08.	7F10.5
12	S12 S13 S14 S15 S16 S17 S18	- Coefficients used in description of exit boundary curvature. Contributions of RAP2 are added to those of S12, S14, S16, and S18.	7F10.5

C. Electrostatic Deflector (8 records)

Record	Variable		Format
1	EDIP		A4
2	LF1	- Entrance fringing field integration step size (cm).	5F10.5
	LU1	- Uniform field integration step size (cm).	
	LF2	- Exit fringing field integration step size (cm). Recommended for these three step sizes: 0.3D (D=Gap) although LU1 can be larger to save on computer time.	
	DG	- Differential step size used in determining off mid-plane components of B using numerical differential methods. Recommendation: DG=0.2D or smaller.	
3	A	- Distance (cm) from origin of system A (initial) to system B (situated at entrance edge EFB of electrostatic element).	5F10.5
	B	- Distance (cm) from origin of system C (situated at exit edge EFB of electrostatic element) to origin of output system D.	
	D	- Gap width (cm)	
	R	- Radius of curvature (cm) used in geometrical construction of layout	
	EF	- Electric field on the central orbit (kV/cm)	
4	PHI	- Angular extent between the EFB of system B and that of system C (degrees). Nominally equivalent to the bend angle.	5F10.5
5	EC2 EC4	- Coefficients describing second and fourth order curvature of the iso-field lines on the median plane in the fringing field regions — due to finite width of the plates.	5F10.5
	WE	- Plate width (cm).	
	WC	- Not presently used.	
6	Z11	- Integration limit (cm) defining the start of the entrance fringing field zone in coordinate system B. Normally positive.	4F10.5
	Z12	- Integration limit (cm) defining the termination of the entrance fringing field zone in coordinate system B. Normally negative.	
	Z21	- Integration limit (cm) defining the start of the exit fringing field zone in coordinate system C. Normally negative.	

C. Electrostatic Deflector (8 records)

Record	Variable		Format
	Z22	- Integration limit (cm) defining the termination of the exit fringing field zone in coordinate system C. Normally positive.	
7	C00 C01 C02 C03 C04 C05	- Coefficients used in the expansion of the fringing field fall-off at the entrance of the electrostatic deflector.	6F10.5
8	C10 C11 C12 C13 C14 C15	- Coefficients used in the expansion of the fringing field fall-off at the exit of the electrostatic deflector.	6F10.5

D. Multipole (8 records)

Record	Variable		Format
1	POLES		A4
2	LF1	- Entrance fringing field integration step size (cm).	3F10.5
	LU1	- Uniform field integration step size (cm).	
	LF2	- Exit fringing field integration step size (cm). Recommended for all three step sizes: 0.3R	
3	A	- Distance (cm) from origin of system A (initial) to system B (situated at EFB of entrance edge of magnetic element).	4F10.5
	B	- Distance (cm) from origin of system C (situated at EFB of exit edge of magnetic element) to origin of output system D.	
	L	- Effective length (cm) of magnetic element.	
	R	- Aperture radius (cm).	
4	BQ	- Quadrupole component at r=R (Tesla).	5F10.5
	BH	- Hexapole component at r=R (Tesla).	
	BO	- Octapole component at r=R (Tesla).	
	BD	- Decapole component at r=R (Tesla).	
	BDD	- Dodecapole component at r=R (Tesla).	
5	Z11	- Integration limit (cm) defining the start of the entrance fringing field zone in coordinate system B. Normally positive.	4F10.5
	Z12	- Integration limit (cm) defining the termination of the entrance fringing field zone in coordinate system B. Normally negative.	
	Z21	- Integration limit (cm) defining the start of the exit fringing field zone in coordinate system C. Normally negative.	
	Z22	- Integration limit (cm) defining the termination of the exit fringing field zone in coordinate system C. Normally positive.	
6	C00 C01 C02 C03 C04 C05	- Coefficients used in the expansion of the fringing field fall-off at the entrance of the magnetic element.	6F10.5

D. Multipole (8 records) - Continued

Record	Variable		Format
7	C10 C11 C12 C13 C14 C15	- Coefficients used in the expansion of the fringing field fall-off at the exit of the magnetic element.	6F10.5
8	FRH FRO FRD FRDD	- Fractional radius of multipoles, in terms of quadrupole radius, used in calculating fringing field fall-off, *e.g.* FRH=0.9 makes the hexapole fall-off 0.9^{-1} times faster with distance from the EFB than the quadrupole field.	8F10.5
	DSH DSO DSD DSDD	- A correction for the effective length of individual multipole elements relative to the quadrupole. A positive DS represents a displacement inward of the EFB at the entrance and exit in units of R.	

E. Multipole Corrector (6 records)

Record	Variable		Format
1	MULT		A4
2	LF	- Integration step size (cm)	3F10.5
	DG	- Differential step size (cm) used in determining off-midplane components of B using a numerical differential technique. Recommended for both step sizes: 0.3D	
3	A	- Distance (cm) from origin of system A (initial) to coordinate system situated at centre of multipole element.	6F10.5
	B	- Distance (cm) from coordinate system situated at centre of multipole element to origin of output system D.	
	L	- Length of the Multipole Corrector (cm).	
	W	- Width (cm) of multipole element.	
	D	- Gap (cm) of multipole element.	
	BF	- Nominal value of field at $x = W/2$ and $z = 0$, i.e. the value the field at $x = W/2$ will attain if one of the coefficients C0–C5 is equal to unity and the others zero.	
4	Z1	- Starting point of integration measured from coordinate system at centre of multipole element (cm). Normally negative.	2F10.5
	Z2	- Termination point of integration measured from coordinate system at centre of multipole element (cm). Normally positive.	
5	C0	- Coefficients describing dipole, quadrupole, etc. content of the field. Normal range −1. to +1.	6F10.5
	C1		
	C2		
	C3		
	C4		
	C5		
6	C6	- Not used.	
	C7	- Coefficients used to define how the field varies with z/L, basically describing a bell-shaped curve. Typical values are C7=0.4, and C8=0.1	3F10.5
	C8		

F. Solenoid (4 records)

Record	Variable		Format
1	SOLE		A4
2	LF	- Integration step size (cm) for all regions. Recommended: LF=0.2D	F10.5
3	A	- Distance (cm) from origin of system A (initial) to the entrance edge of the solenoid element (i.e., edge of the hardware, not the EFB).	5F10.5
	B	- Distance (cm) from exit edge of the solenoid element to origin of output system D	
	L	- Length (cm) of solenoid.	
	D	- Diameter (cm) of solenoid.	
	BF	- Asymptotic magnetic field of solenoid (Tesla), *i.e.* BF= $0.4\pi IN/L$	
4	Z11	- Starting point of integration measured from input egde of solenoid. Normally positive.	2F10.5
	Z22	- Termination point of integration measured from exit edge of solenoid. Normally positive.	

G. Velocity Selector (11 records)

Record	Variable		Format
1	VELS		A4
2	LF1	- Integration step size (cm) of the entrance fringing field region.	4F10.5
	LU1	- Uniform field integration step size (cm).	
	LF2	- Exit fringing field integration step size (cm).	
	DG	- Differential step size (cm) used in determining off mid-plane components of E and B using a numerical differential technique. Recommended: LF1=LF2=0.3DE; LU1 can be larger; DG=0.2DE or smaller.	
3	A	- Distance (cm) from origin of system A (initial) to system B (situated at EFB of entrance fringing field)	5F10.5
	B	- Distance (cm) from origin of system C (situated at exit edge EFB of velocity selector) to origin of output system D.	
	L	- Effective length (cm) of velocity selector.	
	BF	- Magnetic field of velocity selector (Tesla)=B_y.	
	EF	- Electric field of velocity selector (kV/cm)=E_x.	
4	RB	- Equivalent radius required if NDX$\neq$0.	2F10.5
	NDX	- First order magnetic field index	
5	DB	- Separation distance of magnetic poles (cm).	4F10.5
	DE	- Separation distance of electrodes (cm).	
	WB	- Width of magnetic poles (cm).	
	WE	- Width of electrodes (cm).	
6	Z11	- Integration limit (cm) defining the start of the entrance fringing field zone in coordinate system B. Normally positive.	4F10.5
	Z12	- Integration limit (cm) defining the termination of the entrance fringing field zone in coordinate system B. Normally negative.	
	Z21	- Integration limit (cm) defining the start of the exit fringing field zone in coordinate system C. Normally negative.	
	Z22	- Integration limit (cm) defining the termination of the exit fringing field zone in coordinate system C. Normally positive.	

Record	Variable		Format
7	**BC2** **BC4** **EC2** **EC4**	**- Coefficients describing second and fourth order iso-field lines on the median plane in the fringing field region due to finite width of magnetic poles and electrodes.**	**4F10.5**
8	**CB0** **CB1** **CB2** **CB3** **CB4** **CB5**	**- Coefficients used in the expansion of the magnetic fringing field fall-off at the entrance of the velocity selector.**	**6F10.5**
9	**CE0** **CE1** **CE2** **CE3** **CE4** **CE5**	**- Same as CB coefficients, but for the electric fringing field.**	**6F10.5**
10	**CB10** **CB11** **CB12** **CB13** **CB14** **CB15**	**- Same as CB coefficients, but for the magnetic fringing field at the exit.**	**6F10.5**
11	**CE10** **CE11** **CE12** **CE13** **CE14** **CE15**	**- Same as CE coefficients, but for the electric fringing field at the exit.**	**6F10.5**

H. Lens (3 records)

Record	Variable		Format
1	LENS		A4
2	X/X X/T T/X T/T Y/Y Y/P P/Y P/P	- Matrix elements for the spatial coefficients of the transformation matrix of an arbitrary element. Units for lengths and angles are cm and mr, respectively. Particularly useful for an electrostatic Einzel lens, for instance, in an otherwise magnetic optical system. Note: the time variable *t* used in RAYTRACE is not updated through LENS even if the coefficients X/T and Y/P are used to describe a finite thickness.	8F10.5
3	CS E0 N	- Correction term for spherical aberration. - Reference energy for chromatic correction to focal length. - Index for chromatic focal length correction.	3F10.5

I. Shift-Rotate (2 records)

Record	Variable		Format
1	SHRT		A4
2	X0	- All following coordinate systems are displaced in the x-direction by an amount X0 (cm) as measured in the preceding system.	6F10.5
	Y0	- All following coordinate systems are displaced in the y-direction by an amount Y0 (cm) as measured in the preceding system.	
	Z0	- All following coordinate systems are displaced in the z-direction by an amount Z0 (cm) as measured in the preceding system.	
	$\psi_{\hat{x}}$	- The rest of the optical system as a unit is rotated ψ_x (degrees) about the x-axis of the preceding system.	
	$\psi_{\hat{y}}$	- The rest of the optical system as a unit is rotated ψ_y (degrees) about the y-axis of the preceding system.	
	$\psi_{\hat{z}}$	- The rest of the optical system as a unit is rotated ψ_z (degrees) about the z-axis of the preceding system.	

J. Drift (2 records)

Record	Variable		Format
1	DRIF		A4
2	DZ	- Field free drift length (cm)	F10.5

K. Collimator (2 records)

Record	Variable		Format
1	COLL		A4
2	J	- Shape index. J=0, rectangular collimator J=1, elliptical collimator	5F10.5
	X0	- x-coordinate of collimator center	
	Y0	- y-coordinate of collimator center	
	XMAX	- Half-axis in the x-direction	
	YMAX	- Half-axis in the y-direction	

L. System End (1 record)

Record	Variable		Format
1	SENT	- Record separating input data defining the magnetic elements of the system from the data specifying the input coordinates of the different rays to be traced through the system.	A4

M. Input Rays

A. Individual Rays (JNR=0, NR records)

Record	Variable		Format
1→NR	XI	- Particle x-coordinate (cm) at origin of system A for the first element.	7F10.5
	VXI	- Angle (mr) of particle trajectory projected on xz-plane.	
	YI	- Particle y-coordinate (cm) at origin of system A for the first element.	
	VYI	- Angle (mr) of particle trajectory projected on yz-plane.	
	ZI	- Particle z-coordinate (cm) at origin of system A for the first element.	
	VZI	- Not used	
	DELE	- Kinetic energy deviation (%) of particle from central energy	

B. Program-generated rays (JNR≠0. One or more records)

Record	Variable		Format
1	TMIN	- Paraxial midplane angle (mr) for Ray 2.	7F10.5
	PMIN	- Paraxial transverse plane angle (mr) for Ray 2.	
	XMAX	- For JNR≠46, common x-axis displacement for all rays. For JNR=46, maximum non-point source midplane deviation.	
	TMAX	- Maximum angle (mr) defining midplane solid angle	
	YMAX	- For JNR≠46, common y-axis displacement for all rays. For JNR=46, maximum non-point source transverse plane deviation.	
	PMAX	- Maximum angle (mr) defining transverse plane angle.	
	DMAX	- For JNR≠46, common energy deviation (%) for all rays. For JNR=46, maximum energy deviation (%) defining longitudinal phase space acceptance.	
2→(NR–JNR)		Any number of input records defining individual rays can be added to the single line for program-generated rays. NR must be set equal to the total number to be traced.	

Appendix 2. Samples of Input Data Files

A. Magnetic Dipole, MTYP=2.

```
FILE: DIPOLE.DAT HAE 4/16/86
03, 500, 0, 2, 0, 00, 01
300., 10., 1.
DIPOLE D1
3., 10., 3., 1., 2.
200., 200., 10., 100., 1.000
90., 27., 27.
0.
40., -20., -20., 40.
.2401, 1.8369, -.5572, .3904
.2401, 1.8369, -.5572, .3904
0.
0.
1., -2., 0., 0., 0., 0.
1., 2., 0., 0., 0., 0.
SENTINEL
0.
0., 20.
0., -20.
2., 1., 0., 25., 0., 20.
```

B. Electrostatic Deflector

```
FILE: EDIPL.DAT - ELECTROSTATIC DEFLECTOR - HAE 2/26/86
1, 100, 0, 2, 0, 00, 00,
5., 1., 1., 200., 1.0,
SHRT
-.1
EDIPOLE
.5 ,.5 ,.5 ,.5
25., 25., 4., 100., 100.
10.,
.3, .1, 10., 0.,
8., -5., -5., 8.,
.3813, 1.6370, -.64083, .36664, 0., 0.,
.3813, 1.6370, -.64083, .36664, 0., 0.,
SHRT
.1
SENTINEL
0.
```

C. Pretzel Magnet

```
FILE: PRETZEL.DAT HAE 3/16/85
3, 500, 0, 2, 0, 00, 01
5., 5., 3., 100., 10.
DIPOLE D2
2., 2., 2., -.2, 6.
75., 75., 10., 0., 1.
270., 45., 45.
.806
0.
0.
0.
0.
0.
0.
0.
SENTINEL
0.
1.
0., 0., 1.
COMMENTS:
1.  FREE-FLOATING FORMAT WITH COMMAS APPROPRIATE FOR VAX COMPUTER
2.  THE DIGIT 2 IN RECORD 2 PRODUCES OUTPUT IN THE D-AXIS SYSTEM
3.  LAST DIGIT 1 IN RECORD 2 CREATES A PLOT FILE
4.  DG=-.2 (RECORD 5) IS APPROPRIATE FOR PRETZEL MAGNETS ONLY. SEE TEXT.
5.  R=0 (RECORD 6) IS APPROPRIATE FOR PRETZEL MAGNETS ONLY
```

D. Clamshell Spectrometer

```
QCLAM - U of I P=400 MeV/c (alpha=beta=-7) 10/20/84.
03, 500, 0, 0, 0, 00, 01
360., 40., 3.
POLES
4., 4., 4.
50., 37., 50., 12.0
-.474, .142, .081, .028, .015
30., -18., -18., 30.
.1122, 6.2671, -1.4982, 3.5882, -2.1209, 1.723
.1122, 6.2671, -1.4982, 3.5882, -2.1209, 1.723
0.9, 0.8, 0.7, 0.6, .025, .050, .075, .10,
SHRT
0., 0., 0., 0., -60.
DIPOLE
4., 8., 4., 1., 4.
0., 0., 15.00, 133333., 1.6062
.0371, -67., 0.
804.
60., -40., 0., 0.
.2401, 1.8639, -.5572, .3904
-10., 0., 0., 0.,
0.
0.
530., -3.12E6, 5.9E9, -4.0E12,
0.
DIPOLE
4., 8., 4., 1., 4.
0., 0., 15.00, 133333., 1.6062
.0371, 0., -67.
804.
0., 0., -40., 60.
-10., 0., 0., 0.,
.2401, 1.8639, -.5572, .3904
0.
0.
0.
-483., 1.0E5, -1.0E8, -2.0E11, 1.E14
SHRT
0., 0., 0., 0., -60.
DRIFT
120.
SENTINEL
0.,
0., 100.
0., -100.
10., 1., 0., 100., 0., 100.
.5, 0., 0., 0., 0., 0., .086
```

```
.5, 100., 0., 0., 0., 0., .086
.5, -100., 0., 0., 0., 0., .086
```