EGS4 Particle Trajectory and Geometry Display Program cgview

(Ver 1.2   Windows)

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2004-07-16 Draft for EGS course

Abstract

In a calculation using the EGS4 code, it is important and convenient to check the geometry for the calculation and particle trajectory visually for validating the of calculation conditions. Also, a graphical interface is useful for understanding the interactions. This report describes the program cgview, which displays 3D geometry (ex, CG) and particle trajectory information, and the EGS4 user code to produce the necessary data. This report describes the equivalent contents in both Japanese and English.

This manual is a draft for EGS course.

Cgview can be used with EGS4 and EGS5. Please change " EGS4" in this draft as " EGS".

Also, please change program sample in mortran language as that in fortran language

in Chapter 12.

1. Introduction

The EGS4 Shower Display system (cgview) is used to display three-dimensional particle trajectories of electrons, positrons and photons on a windows PC. The data of particles' trajectories are calculated by using the EGS4 code system.

The first EGS4 particle trajectory display system was developed for a graphic terminal of an IBM main-frame computer. Then, EGS4_Windows_2 was made using the PHIGS package on a unix workstation. The EGS4 particle trajectory display system for MS-DOS PC was developed at KEK, and updated for the windows PC. However, only the cylinder and slab geometry can be displayed on this system..

It is possible to describe a complicated geometry using "Combinatorial Geometry (CG)" in the EGS4 calculation. The EGS4 Shower Display system (cgview) is used to display three-dimensional particle trajectories of electrons, positrons and photons together with the geometry described in CG. It is possible to check if the geometry is properly input or not on a three-dimensional display using cgview. The time to prepare the geometry may be reduced by using cgview.

Sections 2 to section 10 of this report describe the computer environment, installation and operation of cgview. Users can understand the function of cgview by reading this part while running cgview with sample data.

Section 11 describes the structure of the particle trajectory and geometry data. This data is sent from EGS4 to cgview. Section 12 describes the EGS4 user code used to produce this data..

2. Environment

Hardware	: PC/AT-Compatible machine
OS	: Windows98 or later
Video Card	: Should work for OpenGL
	Drivers with an older version may not work for Open GL. Please download a new driver from the video card maker if the system does not run properly.
Display color	: It is recommended to use 32 bit (TRUE COLOR).
	Please use 16 bit if the system does not run.

3. Outline of functions

3.1 Functions for the geometry display

    1) The following 4 kinds of geometry data are displayed:

      - Spheres of co-center.

      - Cylinders of co-center line.

      - 3-dimensional slabs.

      - CG (combinatory geometry)

    2) Method of display (default is plane)

      - Plane display

      - Wire-frame display

    3) Level of display

    The following 3 levels can be specified for displaying the geometry:

      - Body   …Display of each body can be turned ON/OFF with a specified color.

      - Zone   …Display of each zone can be turned ON/OFF with a specified color.

      - Material   …Display of each material can be turned ON/OFF with a specified color.

    4) Hide a part of the geometry

    By specifying a virtual box, it possible to hide a part of the geometry which overlaps with the virtual box. Please specify the minimum and maximum of x-, y- and z-directions of a virtual box. If some of them are left blank, the minimum and maximum values are automatically set from the data being displayed.

    5) Area of the display

    The area of the display is automatically set using input data.

    6) Axis for the display

    The axis for the display can be selected from the following 4 sets. A right-hand system of coordinates is adopted:

      - Z-Y   … Z-axis plus in right direction, Y-axis plus for upper direction (default).

      - Y-Z   … Y-axis plus in right direction, Z-axis plus in upper direction.

      - X-Z   … X-axis plus in right direction, Z-axis plus in upper direction.

      - X-Y   … X-axis plus in right-direction, Y-axis plus in upper direction.

    7) Specification of the background color

    It is possible to select the background color (default color is black).

    8) Specification of the character color

    It is possible to select the character color (default color is white). Characters are used in the axis, title, memo etc.

9) Correction option in specifying zones

Zone may not be properly displayed due to a numerical problem of the computer. This tends to happen when subtraction of the body is performed. To correct this, the size of the subtracting body is made bigger. The amount of correction is calculated from the following items and equation:

- Correction factor … A correction is specified as ratio to the original length (default = 1E-6).
- Correction value … Specify a correction value directly (default=0.005cm).

Corrected length = original length + original length * correction factor + correction value

3.2 Function regarding particle trajectory display

1) The following 3 kinds of particles are displayed:
- Photon (gamma,x)
- Electron (e$^-$)
- Positron (e$^+$)

2) The following items can be specified:
- History region

By inputting the upper and lower boundaries of the history, the area of history to be displayed is specified. If not specified, the minimum and maximum history numbers are automatically used. Also, by specifying the number of the last history, that number of the last part of the history is displayed.

- Line color

Specify for each kind of particle.

Photon   - Yellow(Default)

Electron   - Red

Positron   - Blue

- Line type

Select line type from the following 4 types for each particles: The default value is the solid line for all particles.

[Solid, Chain, Dot-chain, Double dot chain]

- Line width … Possible to select the line width for each particle. The default is 1.
- Turn ON/OFF … Displaying each kind of particle can be turned ON/OFF.
- Energy region

By specifying the energy region for each kind of particle, it is possible to turn off displaying particles whose energies are outside of the specified energy region. If not specified, 0 and 1E+15 are specified as the lower and upper boundary, respectively.

3) Particle weight

It is possible to modify the line width using WEIGHT information of each particle. The width of each particle is set as the line width for each kind of particle * WEIGHT. If the WEGHT value is not written in the input data, 1 is specified for all points.

4) LATCH

It is possible to control the turning ON/OFF display by using a flag for each history. Also, turning ON/OFF latch function can be specified.

3.3 Function using mouse

The following 3 functions are related to mouse operation:

1) Zoom in/out

Move mouse while pushing the right button of the mouse.Zoom in and out by moving the mouse downward and upward, respectively.

2) Parallel movement

Move the mouse while pushing both the right and left buttons or the central button of the mouse.

3) Rotation

Move the mouse while pushing the left button of the mouse.

3.4 Peripheral functions

1) Functions on the displaying axis

   - Turning ON/OFF of axis

   - Unit of scale … Unit of scale for the axis (default is cm).

   - Interval of scale … Interval of the scale line (default value = 1).

   - Scale length … Length of the scale line for the axis (default value = 0.25).

   - Arrow size … Arrow size at the top of the axis (default value = 1)

   - Character size … Character size for a scale label (default value = 1)

   - Character space … Character space for a scale label (default value = 5)

2) Functions on displaying a title box

It is possible to add a title box in a displayed figure. The user inputs the contents of the title box. The position of title box can be changed using the mouse. (Multi-line input is allowed for the title box.)

3) Functions on displaying the memo box

It is possible to add a memo box in a displayed figure. The user inputs the contents of the memo box. The position of a memo box can be changed using the mouse. (Multi-line input is allowed for the memo box.)

4) Functions on displaying a legend

It is possible to add a legend of particles in a displayed figure. The contents of the legend are:

   - Region of history being displayed

   - Line type and color for each particle

5) Functions on the printing figure

It is possible to print a figure displayed on the screen.

6) Functions on saving a figure

It is possible to save a figure displayed on the screen in a bit map file.

7) Open a DOS window

It is possible to open a DOS window from the main window of cgview.

8) Read a file in again

It is possible to read in the current data file. Specification of file name is not necessary. After an EGS4 calculation is finished, the data file can be read in again to see the calculated result. Using this function a semi-interactive use of EGS4 and cgview is possible.

9) Initialization of a specification

It is possible to clear the specifications for the display and use default values.

3.5 Function to create geometry data

CGVIEW can be used to help create geometry data for an EGS4 calculation. Only CG data are supported for this function. Input geometry data of the EGS4 code to CGVIEW, and check them in a 3-dimensional figure on the screen. Also, it is possible to save created data. This data can be used as a CG input file in an EGS4 calculation.

3.6 Function to check geometry data

CGVIEW can be used to help check geometry data for an EGS4 calculation. Input Start Position and Direction for particle. CGVIEW checks a geometry data at middle point of boundaries. if zones overlap, no define zone or outside zone's material number is not 0 then CGVIEW prints an error message.
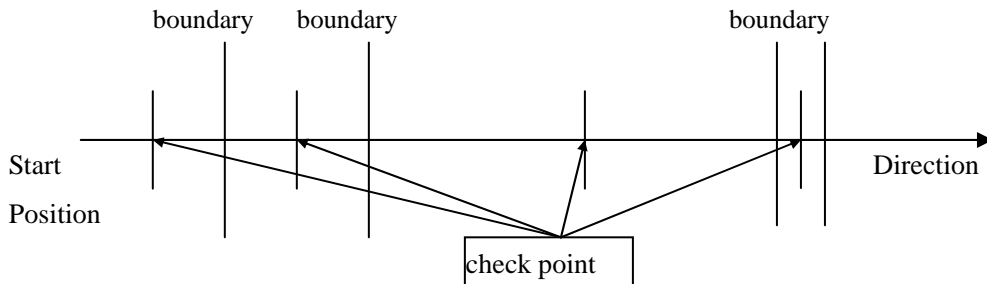
4. Installation

1) Set CD-ROM to PC and open it from "my computer".

2) Double click "setup_eng.exe" in the medium.

3) Specify a folder to install cgview.

The default folder for the installation is c:¥Program Files¥cgview (Read ¥ as back slash.)

Change   Click "..." button and go to 4)

No change   Click "Unzip" button and go to 5)
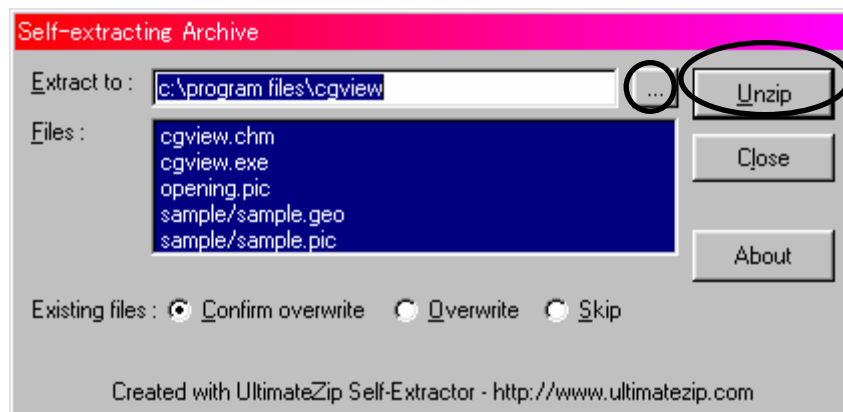
4) Select folder for installation and click "OK"; the program returns to 3).
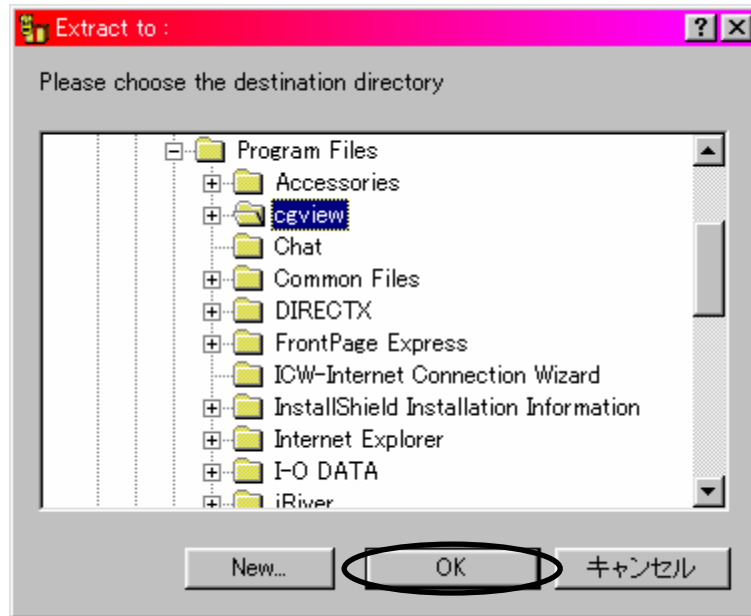
5) Copying files starts. After copying is finished, the following windows appears. Installation terminates by clicking "OK".

5. Start up

The following main window appears on the screen after cgview starts properly.
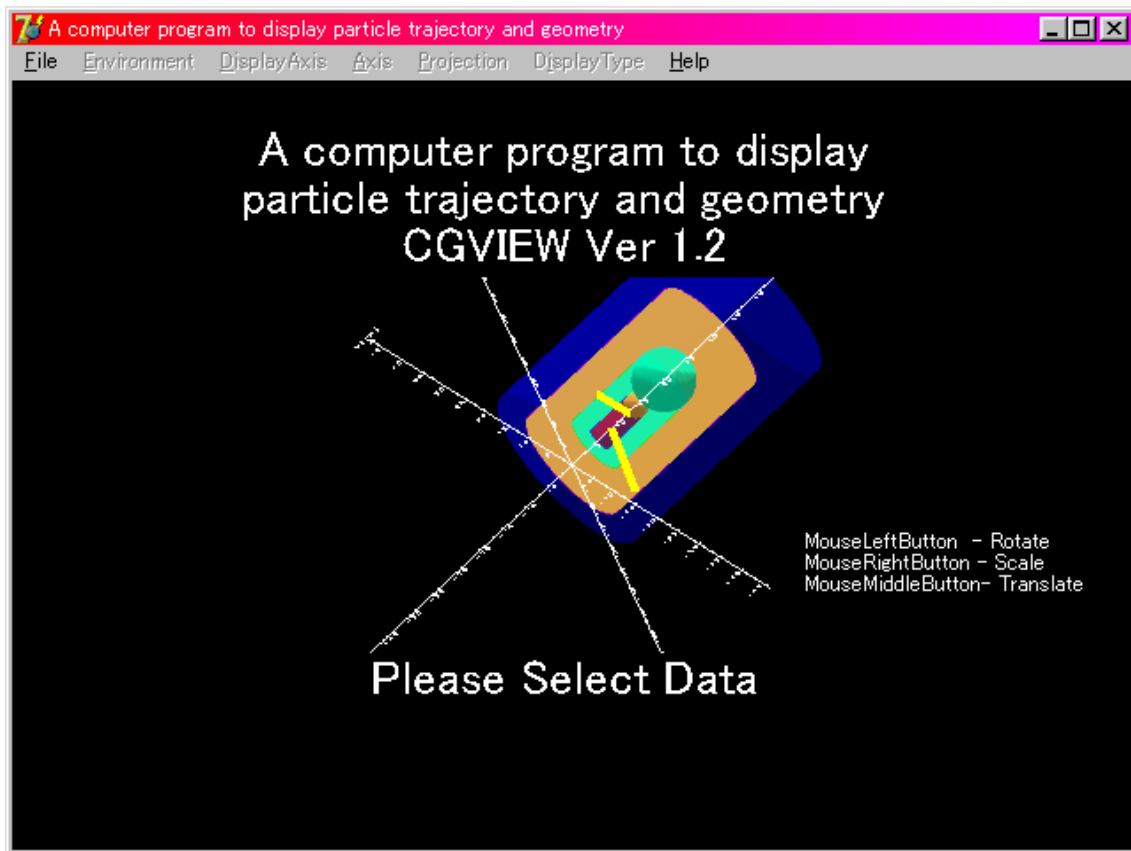
6. Basic operation

6.1 Read in data file

　To read in file, select **[File]-[Read geometry/trajectory data]** in the main menu. Then, file dialog is displayed. Specify the file to be read in.
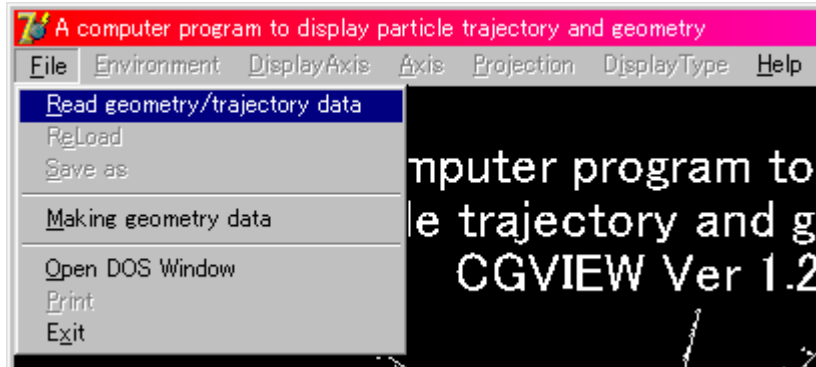
6.2 Read in data file again

　When the current data file is modified by an EGS4 calculation, it is possible to read in the current data again. To read in again, please select **[File]-[Reload].**　By using this function, the semi-interactive use of cgview and EGS4 is possible.
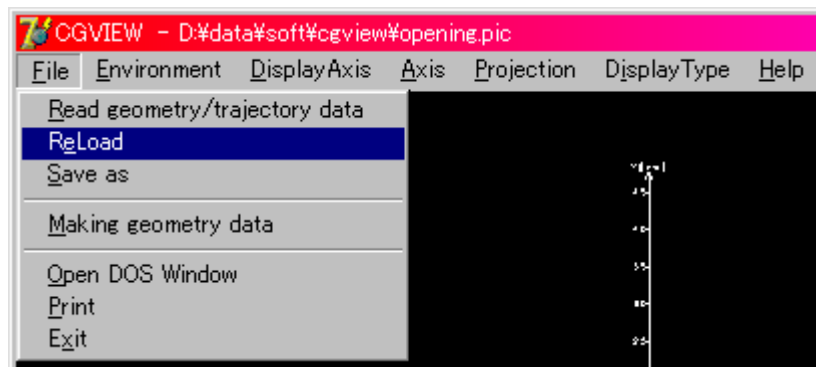
6.3 Save displayed particle trajectory

It is possible to capture a currently displayed particle trajectory picture and save it. The file type for the saving is a bitmap (extension is bmp) or jpeg(extension is jpg). In the main menu, select **[File]-[Save as]**. Then, file dialog appears to input the file name. Input the file and click "Save", and then the displayed picture is saved.
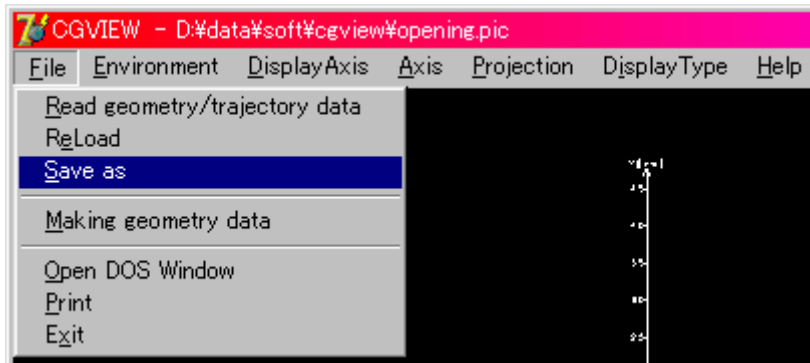
6.4 Open a DOS window

When a user needs to open a DOS window to run an EGS4 calculation, select **[File]-[Open DOS window]** in the main menu. Then command prompt window shows up, as indicated in the lower figure.
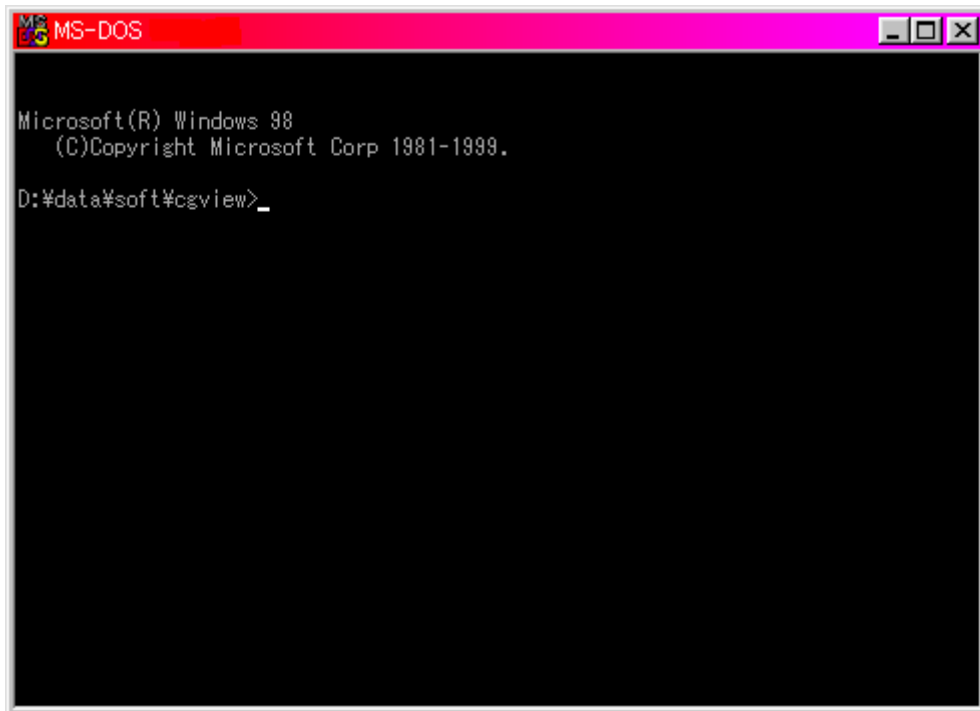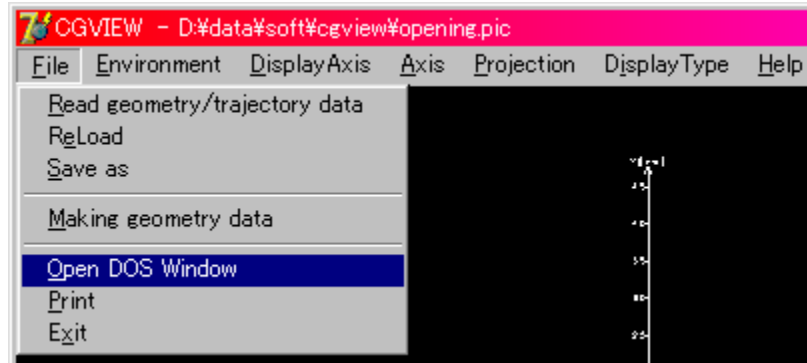
6.5 Print a picture

It is possible to print a currently displayed picture of a particle trajectory and geometry. In the main menu, select **[File]-[Print]**. A dialog appears to select a printer. Select a printer and click OK. Then the picture is printed out.
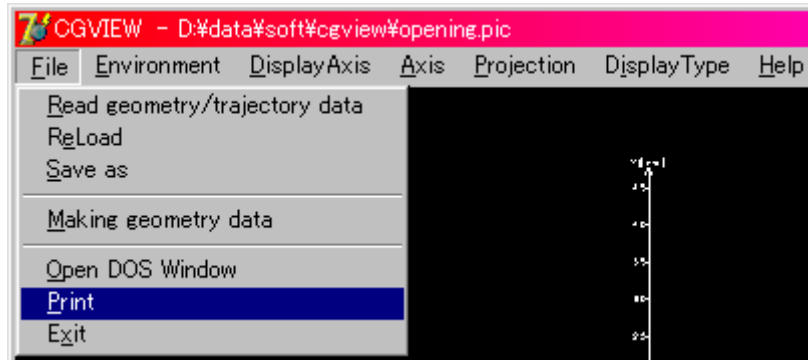
6.6 Indicates help on how to use cgview

When a user needs to indicate help on how to use cgview, select **[Help]-[Usage]** in the main menu. Then table of contents of help shows up. The user may read/print out the necessary items.
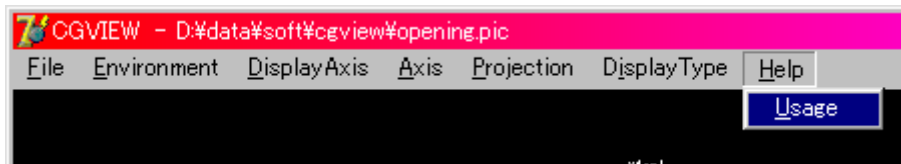
6.7 Termination of an application

Select **[File]-[Exit]** in the main menu.
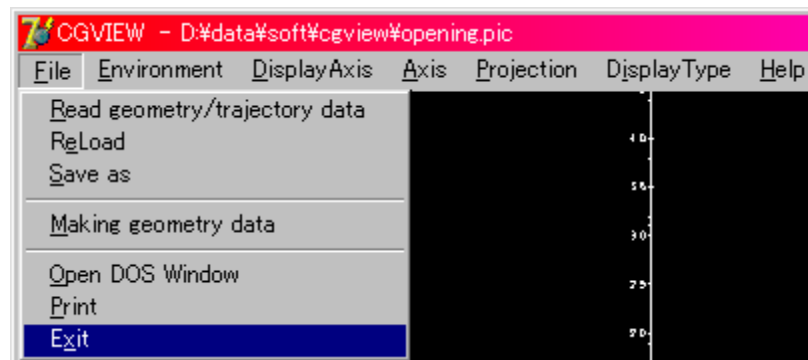
7. Specification and changing of the environment for the display

7.1 Turning ON/OFF the displaying axis

    - Turning on the displaying axis -> Select **[Display Axis]-[ON]** in the main menu.

    - Turning off the displaying axis -> Select **[Display Axis]-[OFF]** in the main menu.
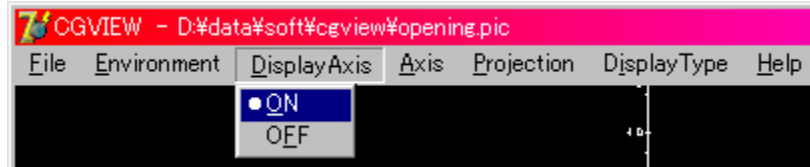
7.2 Changing the displayed axis

    By specifying the axis, the eye point is moved and the direction of the displayed coordinate is changed.

    - Z-axis plus in the right direction, Y-axis plus in the upper direction in the window

       -> Select **[Axis]-[Z-Y]** in the main menu

    - Y-axis plus in the right direction, Z-axis plus in the upper direction in the window

       -> Select **[Axis]-[Y-Z]** in the main menu

    - X-axis plus in the right direction, Z-axis plus in the upper direction in the window

       -> Select **[Axis]-[X-Z]** in the main menu

    - X-axis plus in the right direction, Y-axis plus in the upper direction in the window

       -> Select **[Axis]-[X-Y]** in the main menu
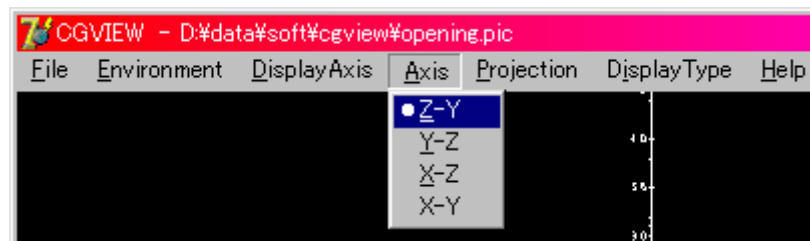
7.3 Changing the projection type

    The following two types of projections can be specified:

  -Ortho

    Projection lines toward the projection plane are parallel. Bodies at far points and near points are indicated using the same size.

    Select **[Projection]-[Ortho]** in the main menu to specify this type.

  -Perspective

    Projection lines from the object converge at the eye point.Just as people see things, a body at a far point is indicated as being smaller and a body at a near point is indicated as being larger. The user can feel the perspective.

    Select **[Projection]-[Perspective]** in the main menu to specify this type.
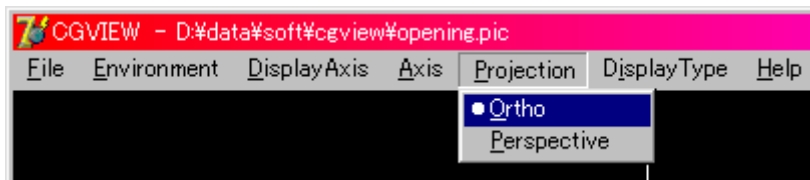
7.4 Changing the geometry display type

    The geometry display type can be changed.

  - Polygon   ... Select **[Display Type]-[Polygon]** in the main menu.

  - Wire frame   ... Select **[Display Type]-[Line]** in the main menu.
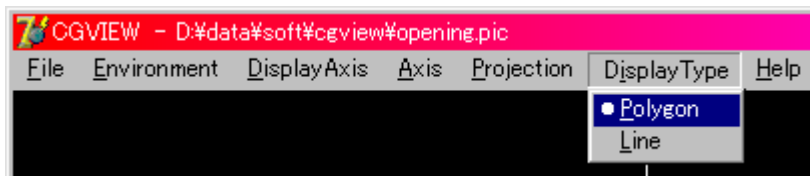
7.5 Changing the level of the geometry display

The level of the geometry display can be selected from the following 3 levels:

- Body … Each body is displayed.

- Zone … Each zone is displayed.

    (The zone is a combination of bodies and is called "region" in EGS4)

- Material … Each medium is displayed.

    (Group of the region with identical material.)

Turning ON/Off and changing the color is possible for each item at each level.

Select **[Environment]-[Environment for Display]** in the main menu. Then, a window (Fig.7.1) shows up. Please select **[geometry display]** from the tabs at the upper part.
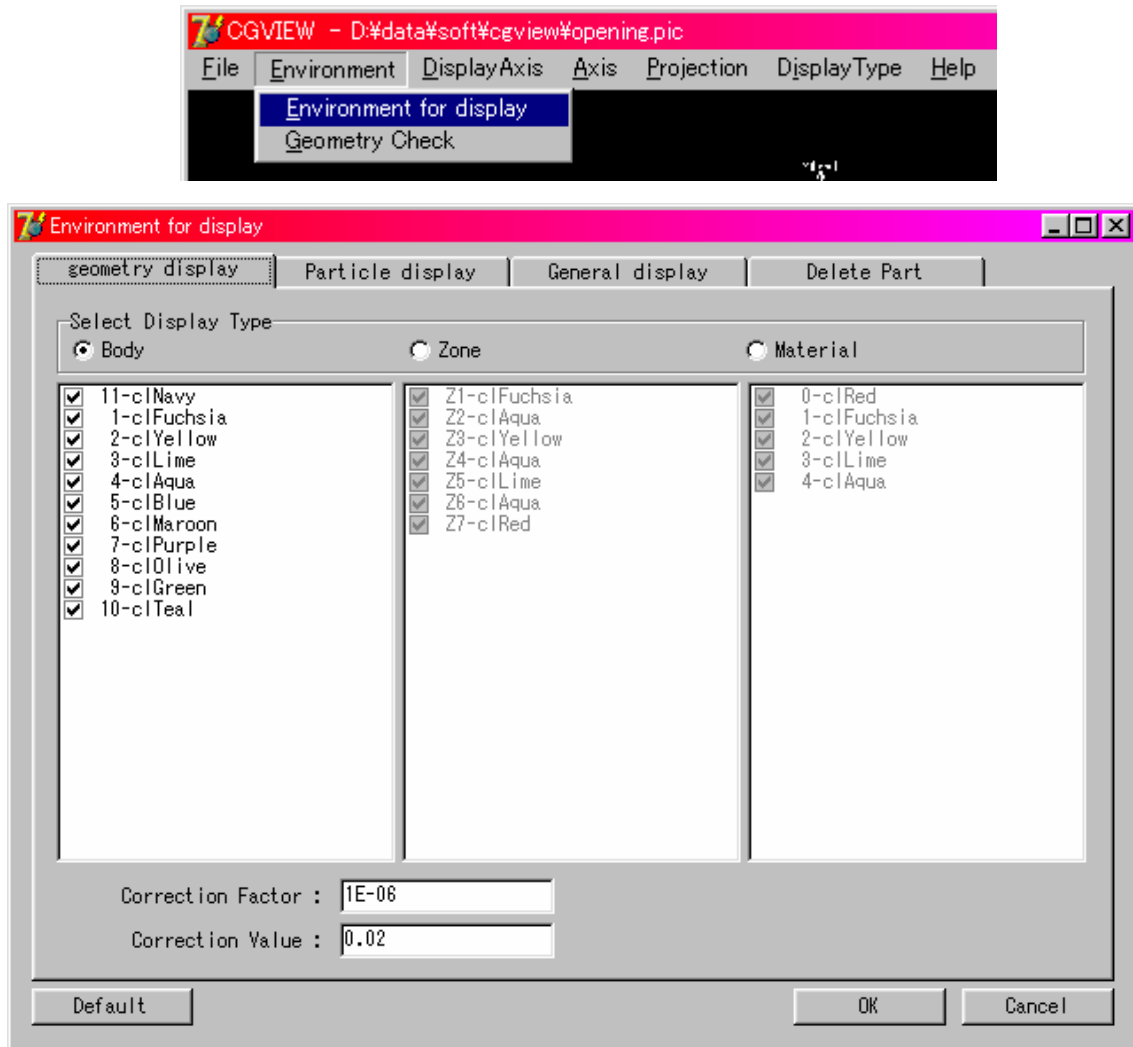
Fig 7.1   Window for specifying the geometry display

7.5.1 Changing the level for the geometry display

Please select the level for the geometry display from the items in **[Select Display Type]**, as shown in Fig.7.1.

7.5.2 Selection of body, zone and material number for the display

A list of data is indicated under each level for the display. These data correspond to the geometry information in the current data file. By putting "check" for each body, zone and material number, the display or no display can be controlled.

Checked … Display

Uncheck … No display

Also, click the right button of the mouse for all display or no display. Here, a popup menu like in Fig.7.2 shows up. Select **[All Check]** for all displays or **[All UnCheck]** for no display in the menu.
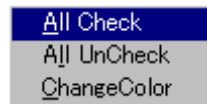
Fig.7.2   Popup menu

7.5.3 Changing the display color

The color for each body, zone and material number can be changed.

Select an item in the list by a left click of the mouse. When an item is selected, the color for the item becomes reverse, as shown in Fig.7.3. Then click the right button of the mouse to indicate the popup menu.

Caution   Here, be careful to select an item by a left click first. Otherwise an illegal operation may be caused.
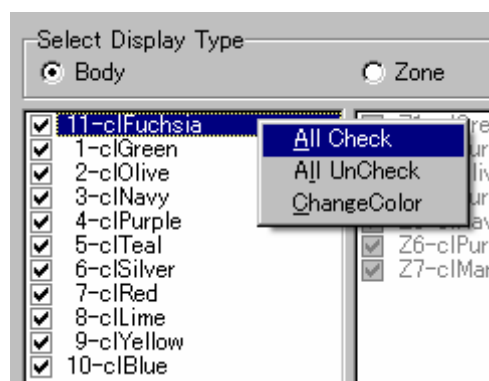
Fig 7.3   Selection of an item in the list

When **[Change Color]** is selected in the pop up menu, a dialog box for color selection shows up. Please select a color for the item. When the color is selected properly, the color ID code in the list is changed to the selected one.

7.5.4 Correction option for displaying zone

The zone may not be properly displayed due to a numerical problem of the computer. This tends to happen when the subtraction of a body is done, as shown in the figure below.
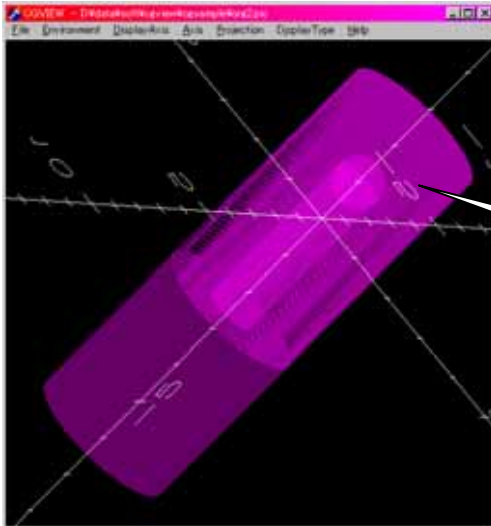
This part should be deleted, but left not deleted. This is due to the overlap of two bodies.

To correct this, the size of subtracting body is made larger. The following two items are specified for this purpose as shown in Fig.7.1.

- Correction factor … A correction is specified as the ratio to the original length (default=1E-6)
- Correction value … Specify a correction value directly (default = 0.005cm)

The size of a subtracting body is calculated by the following equation:

   Corrected length = Original length * (1 + Correction factor) + Correction Value

After a correction, the zone is properly shown, as indicated in the figure below.
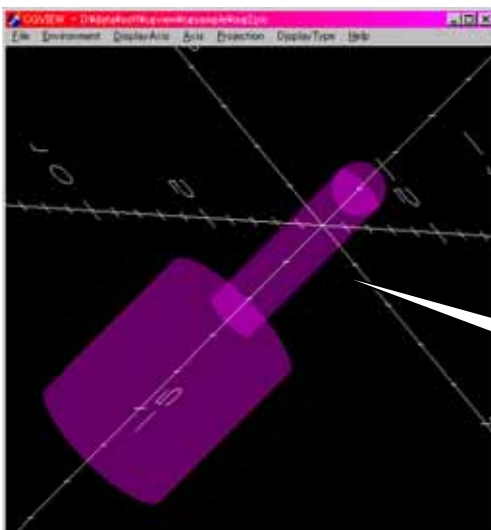
Zone is properly displayed by specifying a correction value of 0.005.

7.6 Changing the specification regarding a particle trajectory display

The following items can be changed regarding the particle trajectory display: history region, line color and line type for each kind of particle, and energy region.

Select **[Environment]-[Environment for Display]** in the main menu to make a change. Then, a window, as shown in Fig 7.6, appears. Select **[Particle display]** among the tabs at the upper part of the window.
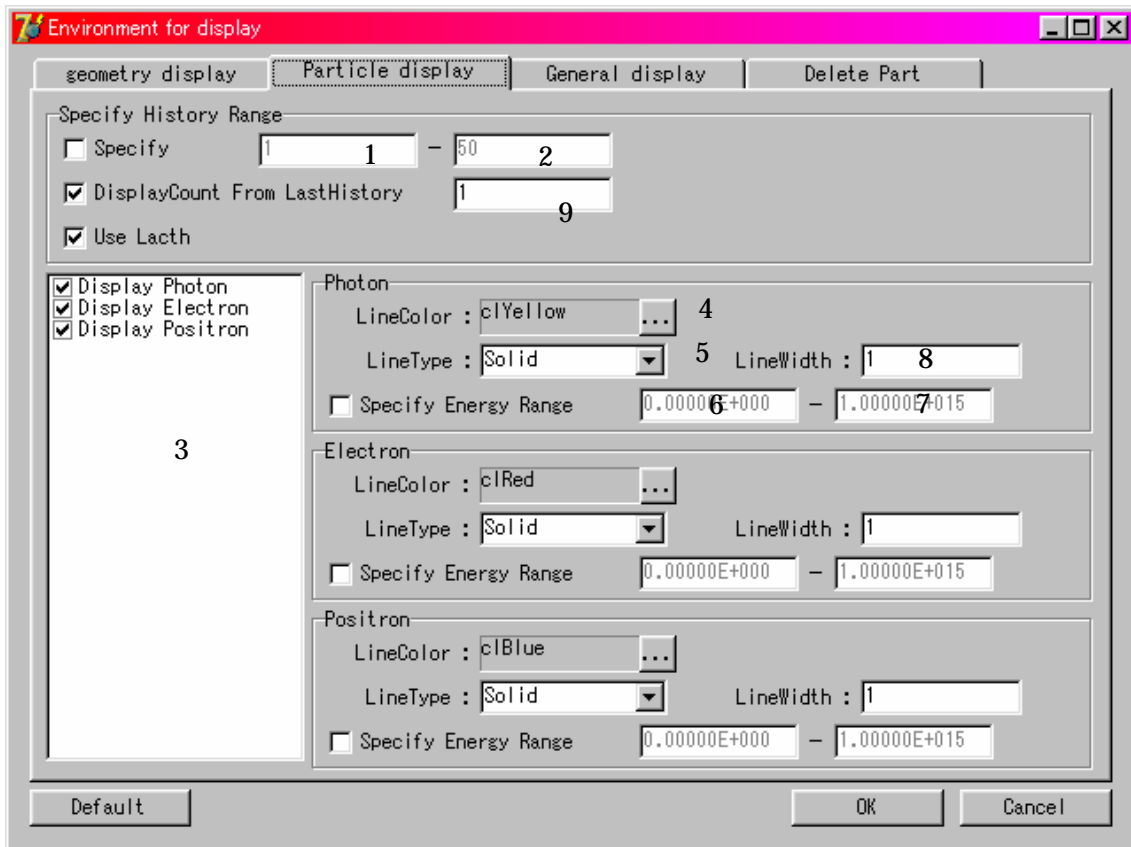
Fig 7.6   Window to specify a particle display

7.6.1 Specification of a history region

If a user specifies a history region, only the particles within this history region are displayed.

The user can select one of the following two possible methods:

- Specify the history region

[Specify] is indicated in the **[Specify History Range]** frame in Fig 7.6.

  Checks this   Specify history range

  Does not check this Not specify history range

If the history range is not specified, all of the particles are displayed.

To specify the range, input the lower limit of the range (Box with 1) and the upper limit of the range (Box with 2) in the textbox at the right-hand side of the [Specify] check box. If either box is left blank, the minimum or maximum history number of the data is assigned as the lower or upper value, respectively.

- Specify the number of displaying histories from the last history

[Display Count from Last History] is indicated in the **[Specify History Range]** frame in Fig.7.6.

  Checks this   Specify the number of displaying histories from the last history.

  Does not check this Number of displaying histories is not specified.

All of the history is displayed when the history range for the display is not specified.

Type in the number of displaying histories in the box with 9 (Default = 1).

7.6.2 Specify the type of particle for display

The following 3 kinds of particles are indicated in cgview:

- Photon (gamma, x)

- Electron (e$^-$)

- Positron (e$^+$)

Displaying each kind of particle is specified by checking each item in the 3 list box in Fig.7.6.

To suppress displaying a kind of particle, delete the check sign for that particle.

7.6.3 Changing the line color for a particle trajectory

The line color for a particle trajectory can be changed. Click button 4 in Fig.7.6 to change the line color. Then, a dialog box to select the color appears. Select a color. The color ID code in the box is changed to the selected one when the color is selected without any trouble. Also, the line color of electrons and positrons can be changed by clicking the button in each box.

7.6.4 Changing the line type for the particle trajectory

The line type for a particle trajectory can be changed. The following 4 types of lines can be used:

- Solid line

- Dashed line

- Single dot chain line

- Double dot chain line

Select the line type in the pull-down menu in Fig 7.6-5.

7.6.5 Specifying the line width

The line width for the standard weight particle is specified. Default=1. Because the default line width is 1 pixel, the line of width N is indicated as N pixel line. Input a positive integer to textbox 8 in Fig. 7.6.

7.6.6 Specifying energy range

By checking **[Specify Energy Range]** in a frame of each particle in Fig.7.6, the energy-range specification is enabled. In this case, a particle is displayed only if its energy is within a specified range. If this button is not checked, the energy range is not specified.

Type in the lower and upper energy in text boxes 6 and 7 in Fig 7.6, respectively, to specify the energy range. If either of these boxes is left blank, 0 and 1e15 are automatically assigned for the lower and upper energy, respectively. Unit is [MeV].

7.6.7 WEIGHT

The width of the particle trajectory line is automatically modified using particle WEIGHT data (which is read in from the input data file). The line width is set as the line width described in section 7.6.5 x WEIGHT.

7.6.8 LATCH function

By checking **[Use Latch]** in **[Specify History Range]** frame in Fig.7.6, the LATCH function is enabled. In this case, a history with a negative value of the latch flag is not displayed. If this button is not checked, the LATCH function is cancelled.

7.7 Changing the window design

The conditions of the display, the background color, title and axis etc, can be changed.

Select **[Environment]-[Environment for display]** in the main menu. Then, a window, as shown in Fig. 7.7, appears. Select **[General display]** among the tabs in the upper position.
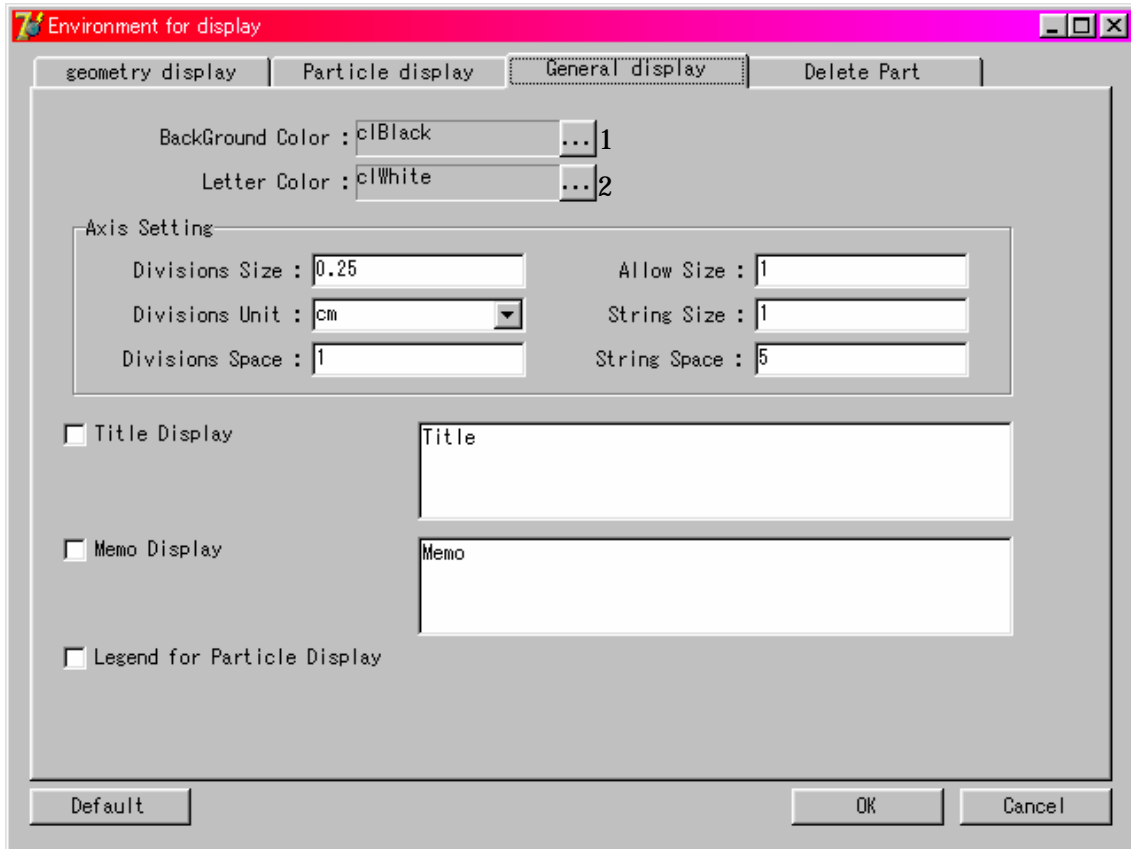
Fig.7.7   Window to change the conditions for the window design

7.7.1 Changing back ground color

It is possible to change the background color. Click 1 button in Fig.7.7. A dialog box appears to select the color. Please select a color. The color ID code in the box is changed to the selected one when the color is selected without any trouble.

7.7.2 Changing the character color

It is possible to change the colors of the axis, title, memo and legend. Click button 2 in Fig.7.7. Then, a dialog box to select the color appears. Select a color. The color ID code in the box is changed to the selected one when the color is selected without any trouble.

7.7.3 Changing the setting of the axis

The following items can be changed. Type in the values to text boxes for each item in the **[Axis Setting]** frame:

- Divisions Size … Length of the division line at the axis
- Division Unit … Division unit at the axis
- Divisions Space … Interval of divisions at the axis
- Allow Size … Size of allow at the top of the axis
- String Size … Size of character for the division label
- String Space … Spacing for the division label character

7.7.4 Displaying a title

A title can be displayed in a window. Please check **[Title Display]** in the General display. Then, a sample title appears in an input box, as shown in the following figure. The title can be typed in here.

Also, a displayed title can be moved inside the main window by a left click.

7.7.5 Displaying memo

Memo can be displayed in the window. Check **[Memo Display]** in the General display. Then, a sample memo appears in an input box, as shown in the following figure. A memo can be typed in here.

Also, a displayed memo can be moved inside the main window by a left click.

7.7.6 Displaying a legend

A legend can be displayed in the window. As shown in the following figure, the contents of the legend include the range of history number, the line color and the line type for each kind of particle.
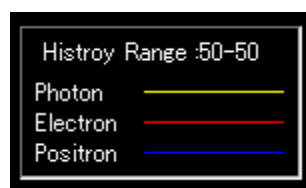
7.8 Hiding a part of the geometry

To display a cut view of the geometry, or to show the inside geometry, it is possible to hide a part of the geometry. Select **[Environment]-[Environment for display]** in the main menu. Then, a window appears, as shown in Fig.7.8. Select **[Delete part]** among the tabs at the upper part of the window.
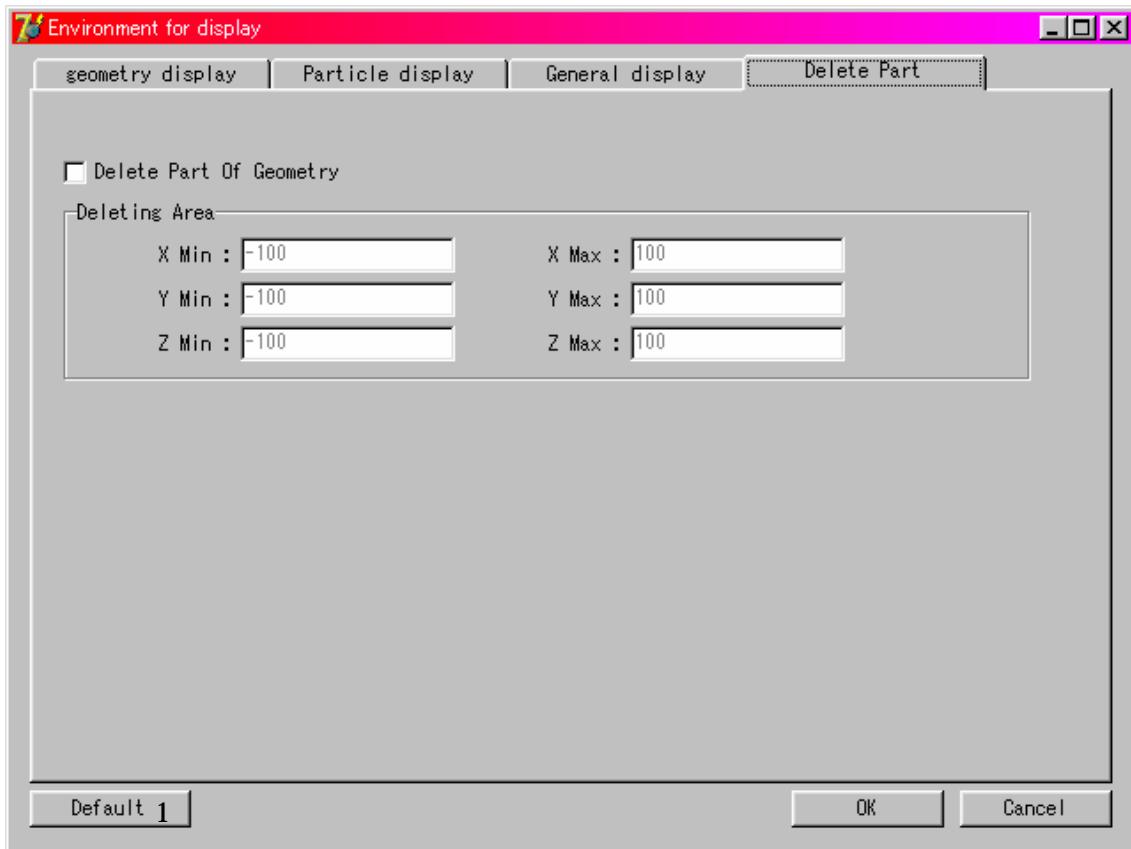
Fig.7.8   Window to set a deleting part

Please check **[Delete Part of Geometry]**.   The range for the deleting part is specified in a frame of **[Deleting Area]**. Type in the values to specify a virtual box. The geometry inside the virtual box is not displayed. The meanings of the input items are as follows (Unit is in [cm]).

  - X Min … Minimum value for X (If left blank, automatically set from data.)

  - X Max … Maximum value for X (If left blank, automatically set from data.)

  - Y Min … Minimum value for Y (If left blank, automatically set from data.)

  - Y Max … Maximum value for Y (If left blank, automatically set from data.)

  - Z Min … Minimum value for Z (If left blank, automatically set from data.)

  - Z Max … Maximum value for Z (If left blank, automatically set from data.)

7.9 Returns to the initial setting

The environment returns to the initial setting by pushing the [Default] button in Fig.7.8-1.

8. Function using the Mouse

The response of the application may become slow if much geometry data is displayed. Turn off displaying insignificant geometry data before operating the mouse in this case. After the eye point is set, turn on displaying all geometry data.

8.1   Rotation

Move the mouse while clicking the **left button** to **rotate** the displayed objects.

8.2   Parallel movement

Move the mouse while clicking both the **left and right buttons** to **move** the displayed object. **The central button** of a 3-button mouse can also be used for movement.

8.3   Zoom-in objects

Move the mouse downward while clicking **the right button** to **zoom in**.

8.4   Zoom-out objects

Move the mouse upward while clicking **the right button** to **zoom-out**.

9. Creating geometry data

The cgview can be used to help create geometry data for an EGS4 calculation. In cgview, CG geometry data of the EGS4 code can be created, and these data are immediately displayed in 3-D figures on the screen for checking. Also, it is possible to save created data. This data can be used as a CG input file in an EGS4 calculation.

9.1 Opening a window to create geometry data

Select **[File]-[Making geometry data]** in the main menu to open a window to create geometry data. Then, a window as shown in Fig.9.1 appears.
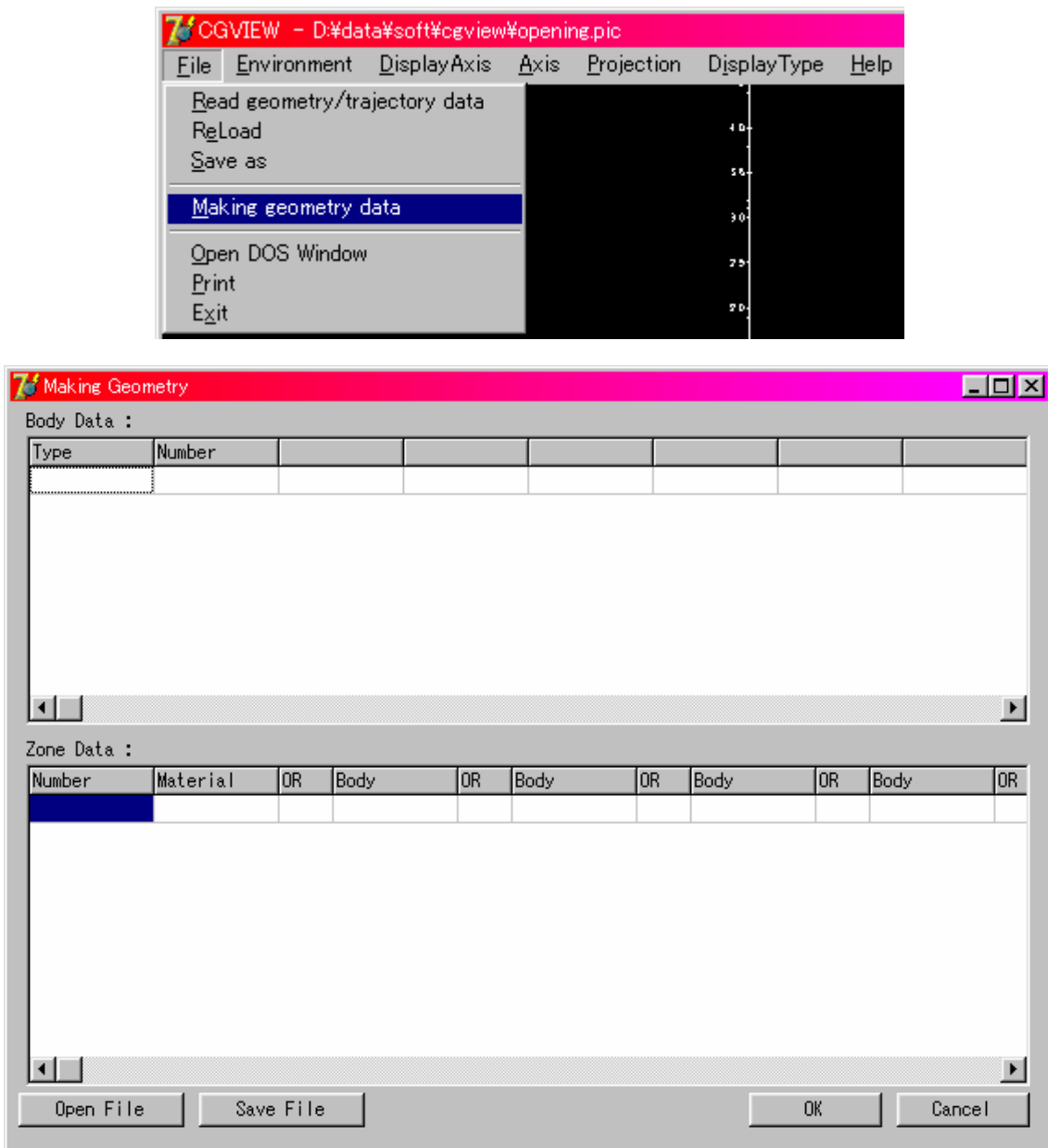
Fig.9.1 Window to create geometry data

9.2 Input geometry data

Only CG data are supported for this function

- Body data … Input Body data

	Type	param 1	param 2	param 3	param 4	param 5	param 6	param 7	param 8
Cube	RPP	XMIn	XMax	YMIn	YMax	ZMIn	ZMax		
Cylinder	RCC	Vx	Vy	Vz	Hx	Hy	Hz	R	
Cone	TRC	Vx	Vy	Vz	Hx	Hy	Hz	R1	R2
Shpere	SPH	Vx	Vy	Vz	R				
Torus	TOR	Vx	Vy	Vz	R1	R2	th1 (deg)	th2 (deg)	Axis X/Y/Z= 1/2/3
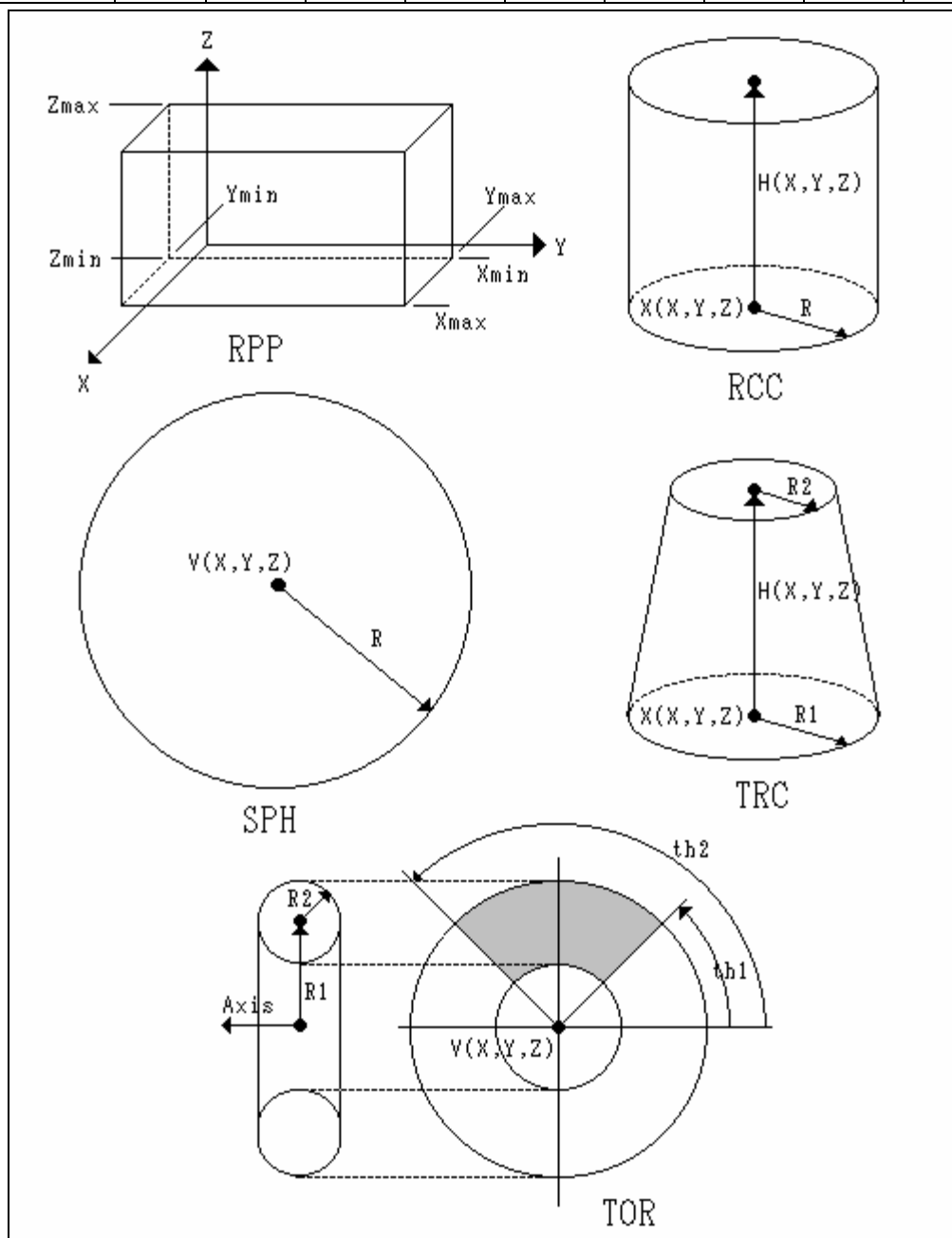
Example of input)

Type	Number						
RPP	1	-2	2	-2	2	-2	2
RCC	2	0	0	0	0	0	10
SPH	3	0	0	11	2		
TOR	4	0	0	0	12	1.5	-90
TRC	5	12	0	2	0	0	8
RCC	6	0	0	0	0	0	3

Body Data :

- Zone data … Input zone data and material number. "Region" in EGS4 is called "zone" in CG.

    first char always 'Z' in Number.

Example of input)

Zone Data :

Number	Material	OR	Body	OR	Body	OR	Body	OR	Body
Z1	1		1		-2				
Z2	2		2		-3				
Z3	3		3		-2				
Z4	5		4		-3				
Z5	4		3		-4				
Z6	2		5		-4				
Z7	1		4		-5				
Z8	10		2		-6				

Click **[OK]** button to display the geometry for the input data.

9.3 Saving created data

Click the **[Save File]** button. Then, a file dialog to save a file appears. Input the file name. The default file extension is (*.geo).

9.4 Opening created data

Click the **[Open File]** button.   Then, a file dialog to open a file appears. Select a file to open. The default file extension is (*.geo).

9.5 Structure of output data

The structure of an output file of geometry data is described.

Body data (See Table 9.1) (Multi lines are allowed.)

END

Zone data (See Table 9.2) (Multi lines are allowed.)

END

Material number for each zone (5 columns × 15)(Multi lines are allowed.)

Table 9.1   Output format of body data

Position of Column	Contents
1 2	Blank
3 5	Body type specifier in CG (RCC, SPH etc)
6 7	Blank
8 10	Body number (Integer)
11	Blank
12 23	Body data (Real), Unit in [cm]
24 and later	Repeat 4 times likewise 12-23 Use second line with blank in 1-11 columns for more than the 5 body data items.

Table 9.2   Output format of zone data

Position of Column	Contents
1 2	Blank
3 5	Zone number (Integer)
6 7	Blank
8 9	OR character (Character)
10	Blank
11 14	Body number (Integer)
15	Blank
16 and later	Repeat 7 times likewise 8-15 Put blank for columns 1-7 for multi-line input

10. Check geometry data

Select **[Environment]-[Geometry Check]** in the main menu to open a window to check geometry data. Then, a window as shown in Fig.10.1 appears.
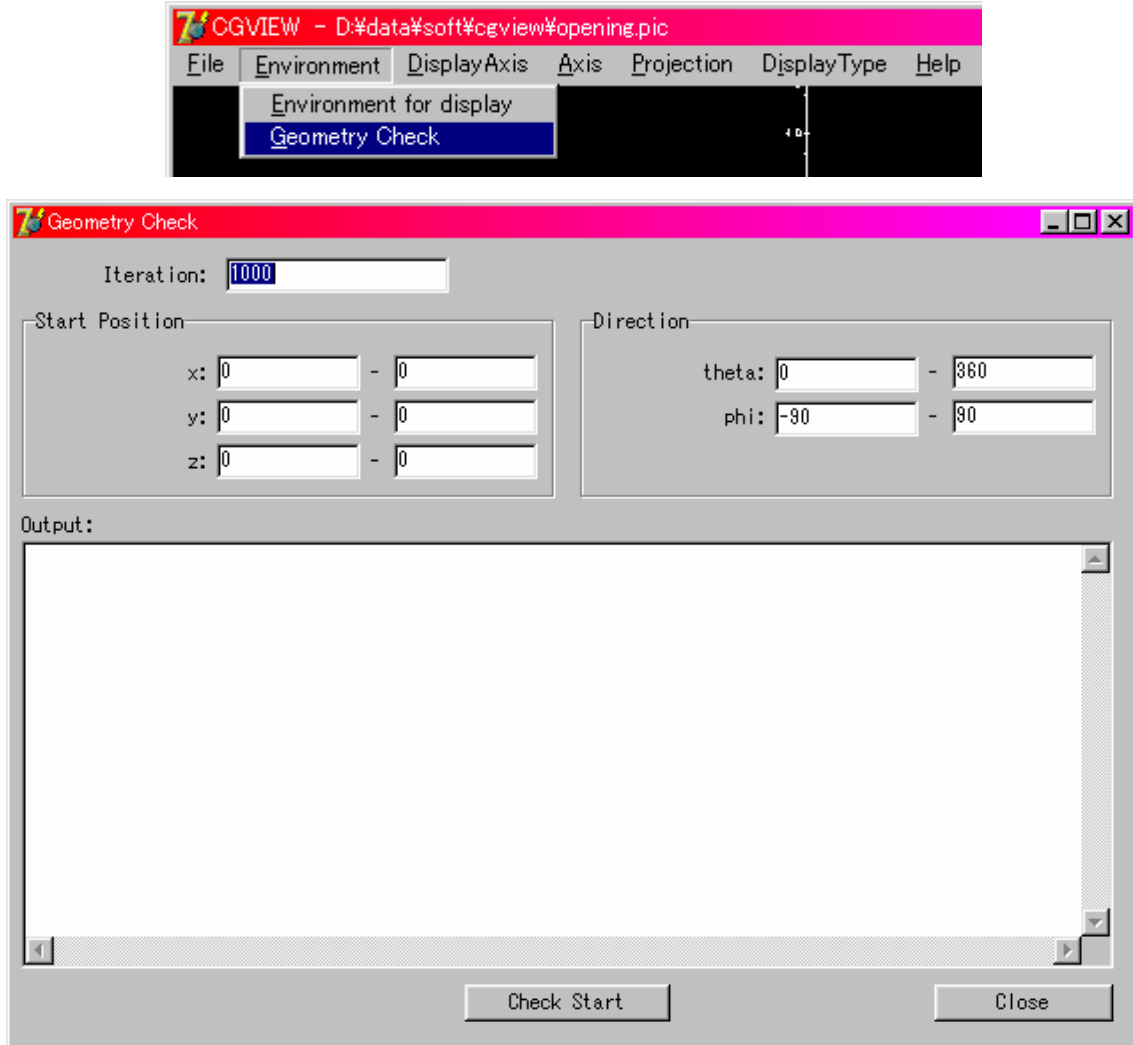

Fig10.1 Window for geometry check

Click **[Check Start]** button to start check geometry data.

StartPosition : Specifying Start Popsition. (default value x= 0 - 0 y= 0 - 0 z= 0 - 0)

the range specification is enabled. In this case, a position is randamly selected

in specified range.

Direction : Specifying Direction [degree]. (default value theta= 0 - 360 phi= -90 - 90)

the range specification is enabled. In this case, a direction is randamly selected

in specified range.
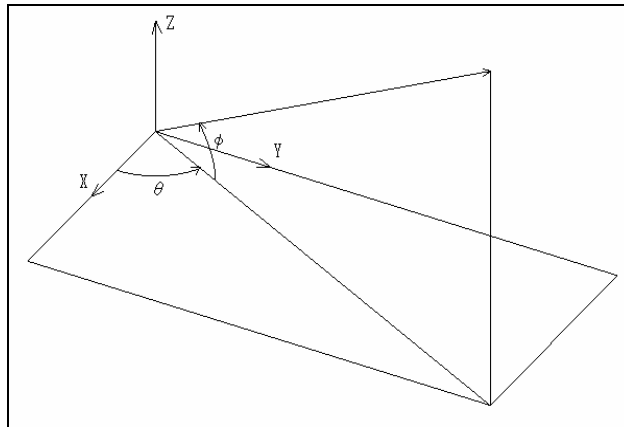
Iteration : Specifying number of particle (default=1000)

a message is printed in output when test finished.

31
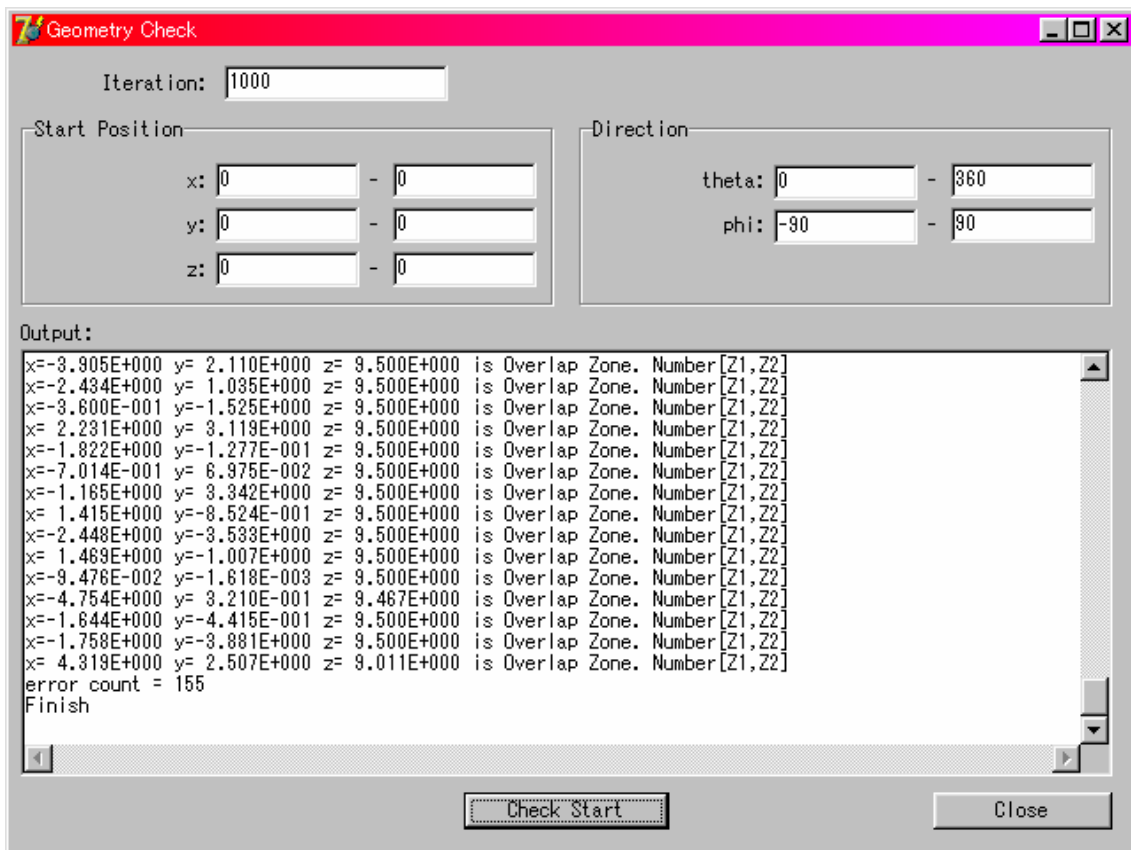
11. Input data structure

Geometry and particle trajectory data are created in an EGS4 calculation and read in by cgview.
The structure of the geometry, particle trajectory data is described.

11.1 Body and Zone data

1) CG System

Body and zone data are input between CSTA and CEND.

Input END at the end of the body data and the zone data.

　　　CSTA

　　　Body data (See Table 11.1. Multi lines are allowed.)

　　　END

　　　Zone data (See Table 11.2. Multi lines are allowed.)

　　　END

　　　CEND

Table 11.1　Input format of body data

| Position of Column	Contents
1-3	Blank
4-6	Body type specifier (RCC, SPH etc)
7-11	Body number (Integer)
12-23	Body data (Real), Unit is cm
24 and later	Repeat 7 times likewise 12-23

Table 11.2　Input format of zone data

Position of Column	Contents
1-3	Blank
4-6	Zone number (Integer)
7-12	Blank
13-14	OR character (Character)
15-19	Zone number (Integer)
20	Blank
21	Repeat 9 times likewise 13-20 Put blank for 1-12 column for multi line input

2) Spheres of co-center

Body and zone data are input between GSTA and GEND.

　　　GSTA

　　　SPHR

　　　Body data 1 (Input number of spheres in 1-6 column)

　　　Body data 2 (Input sphere radius in 15 columns x 4. Unit is cm. Multi lines are allowed.)

GEND

3) Cylinders of the co-center line

Body and zone data are input between GSTA and GEND.

GSTA

CYLS

Body data 1 (Input number of cylinders and planes in 6 columns x 2.)

Body data 2 (Input cylinder radii in 15 columns x 4. Unit is cm. Multi-line input is allowed.)

Body data 3(Input Z coordinate of the plane in 15column x 4. Unit is cm. Multi-line input is allowed.)

GEND

4) Three-dimensional slab

Body and zone data are input between GSTA and GEND.

GSTA

SLAB

Body data 1 (Input number of planes in x-, y- and z-direction in 6 columns x 3.)

Body data 2 (Input X coordinates of the plane in 15 columns x 4. Unit is cm. Multi-line input is allowed.)

Body data 3 (Input Y coordinates of the plane in 15 columns x 4. Unit is cm. Multi line input is allowed.)

Body data 4 (Input Z coordinates of the plane in 15 columns x 4. Unit is cm. Multi line input is allowed.)

GEND

11.2 Material data

Material data are input between MSTA and MEND.

MSTA

Number of zones (1-4 columns)

Material number for each zone (4 columns x 15)

MEND

11.3 Particle trajectory data

Particle trajectory data are written after MEND.

Following input lines are repeated by a number of histories.

History number (See Table 11.3)

Interaction point data lines (See Table 11.4.)

-1

One set

(More than 1 set is

allowed.)

End line of history input (See Table 11.5)

Table 11.3   Input format for history number

Position of Column	Contents
1	Input 0
2-6	History number

Table 11.4   Input format for interaction point data

Position of Column	Contents
1	Particle ID (4=Photon, 5=Electron, 6=Positron)
2-14	X coordinate of interaction point
15-27	Y coordinate of interaction point
28-40	Z coordinate of interaction point
41-50	Particle energy
51-54	Region number of the interaction point
55-64	WEIGHT (If left blank, 1.0 is automatically set.)

Table 11.5   Input format for end line of history input

Position of Column	Content
1	Input 9
2-6	LATCH identifier Input -1 to suppress displaying this particle. Leave blank to display this particle.

12. EGS4 users code

For drawing the trajectories of the particles, it is necessary to obtain a series of data, which include the type of particle as well as its position and energy. If only one particle of the same kind is calculated, the particle trajectory can be obtained by joining the points. In the EGS4 calculation, one or two particles is emitted in an interaction, and a particle having a smaller kinetic energy is followed first after the interaction. When the type of particle followed is different from that of the incident particle, or a new particle is emitted, the group of data must be written on the output file. SUBROUTINE PLOTXYZ is utilized for this purpose.

When SUBROUTINE GEOMGT is used to read in CG information, echo back of the information is output. This echo back is output to the geometry and trajectory data file. The material number of each region is also output to the geometry and trajectory data file. Information about the cylinder, slab geometry is output to the geometry and trajectory data file by utilizing SUBROUTINE GEOMOUT, which was developed for EGS4PICT.

The lines to output the geometry, trajectory information in EGS4 users code are described.

12.1 Main Program

A statement necessary for the shower display is indicated by a comment of "PICT". The following lines are necessary in the main program:

COMMON/NFAC/FNORM,XMIN,XMAX,YMIN,YMAX,ZMIN,ZMAX,NPRECI;

The format of a line of particle information and geometry information are controlled by the value of NRECI, as shown in Fig.12.1. XMIN-ZMAX is used to specify the minimum and maximum values of each coordinate in non-CG geometry (ex. cylinder-slab geometry). XMIN-ZMAX is not used in CG. FNORM is always not used.

NPRECI=2;

NPRECI=2; is specified for cgview.

Table 12.1 Control of Format by NPRECI

NPRECI	Cylinder-Slab	CG	Medium	Format of particle information	Program
0		×	×	I5	EGS4WIN32
1		×	×	I8	EGS4WIN32
2				1PE13.6	CGVIEW

OPEN(9,file='mortjob.pic',status='unknown');

Define the file name to which the data for the shower display are written.

The following lines are added before and after a line of "CALL GEOMGT;" to obtain CG information.

IF(NPRECI.EQ.2) [WRITE(9,:FMT900:);   :FMT900:FORMAT('CSTA');IFTO=9;]

IF(NPRECI.EQ.2) [WRITE(9,:FMT901:);   :FMT901:FORMAT('CEND');]

"IFTO=9;"specifies that echo-back of CG information is output to a file assigned for unit 9. Be careful that an error of CG is output not to a file of unit 6 or screen, but to a file of unit 9.

IF(NPRECI.EQ.2) [

WRITE(9,:FMT20:);   :FMT20:FORMAT('MSTA');

WRITE(9,:FMT21:)NREG;   :FMT21:FORMAT(I4);

WRITE(9,:FMT22:)(MED(I),I=1,NREG);   :FMT22:FORMAT(15I4);

WRITE(9,:FMT23:);   :FMT23:FORMAT('MEND');

]

The material number assigned for each region is output.

WRITE(9,:FMT91:) NOFBAT;   :FMT91:FORMAT('0',I5);

This line is used to indicate a start of history. Output "0", which indicates the start of the history and history number.

WRITE(9,:FMT92:);   :FMT92:FORMAT('9');

This line is used to indicate the end of history. Output "9", which indicates the end of the history. -1 is output after 9 when displaying of this particle is suppressed using the LATCH function.

CALL PLOTXYZ(99,0,0,0.,0.,0.,0.D0,0,0.);

Tell to the SUBROUTINE PLOTXYZ that all of the histories are finished. If the first argument is 99, all of the data that are not written on the output file are output.

CLOSE(UNIT=9, status='keep');

Close the file to which the data for shower display are written.

12.2 SUBROUTINE AUSGAB

Each time when the SUBROUTINE AUSGAB is called, IARG, the stack number (NP), the type of particle (NP), the type of particle (IQ), the position of the particle (X, Y, Z), the energy of particle (E), current region (IR), weight (WT) are transferred to the SUBROUTINE PLOTXYZ by the following statement:

CALL PLOTXYZ (IARG,NP,IQ(NP),X(NP),Y(NP),Z(NP),E(NP),IR(NP),WT(NP));

12.3 SUBROUTINE PLOTXYZ

SUBROUTNE PLOTXYZ was written based on SUBROUTINE PLOTXYZ developed at SLAC for the 2-dimensional display of a shower picture. In a version of PLOTXYZ for egs4pict, particle information was output in integer form to reduce the file size. SUBROUTINE PLOTXYZ was modified to output particle information in real numbers. The output format is controlled by a variable NPRECI, as shown in Table 12.1.