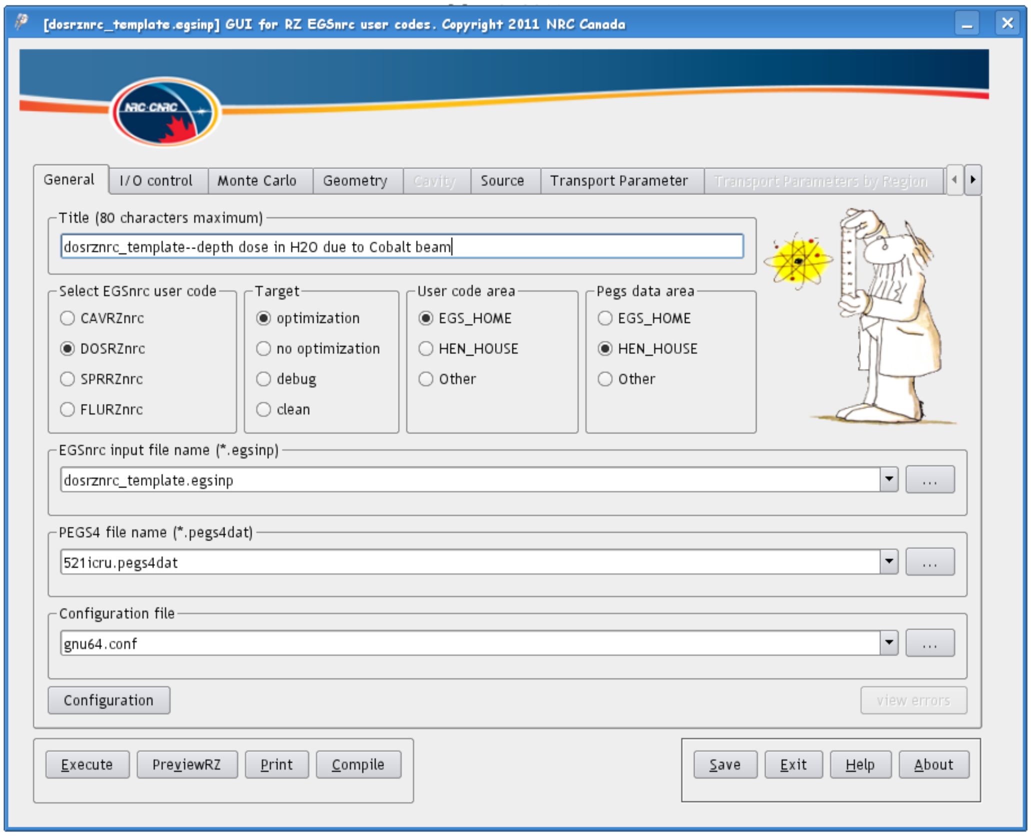
User Manual for egs_inprz, a GUI for the NRC RZ user-codes

Ernesto Mainegra-Hing
Ionizing Radiation Standards
National Research Council of Canada
Ottawa, K1A OR6
mainegra@irs.phy.nrc.ca

June 15, 2015

NRCC Report PIRS-801(RevB)



[dosrznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada

Title (80 characters maximum): dosrznrc_template--depth dose in H2O due to Cobalt beam

Select EGSnrc user code: ○ CAVRZnrc ● DOSRZnrc ○ SPRRZnrc ○ FLURZnrc

Target: ● optimization ○ no optimization ○ debug ○ clean

User code area: ● EGS_HOME ○ HEN_HOUSE ○ Other

Pegs data area: ○ EGS_HOME ● HEN_HOUSE ○ Other

EGSnrc input file name (*.egsinp): dosrznrc_template.egsinp

PEGS4 file name (*.pegs4dat): 521icru.pegs4dat

Configuration file: gnu64.conf

Front page of the egs_inprz GUI for the RZ EGSnrc User Codes.

Abstract

This is the reference user manual for egs_inprz, a graphical user interface for the EGSnrc RZ user-codes suite. It briefly introduces the GUI and describes how to install it and work with it. Descriptions and snapshots of each of the input blocks are provided.

Contents

1 Introduction

One of the major improvements in the RZ user-codes was moving from an input format based on a long series of numbers to a text based input which is easier to use. This text based system for input files was then used to create a single routine (`get_inputs`) to read inputs entries for all the user codes so that now one can cut and paste entire input blocks from one user code to another. This routine is now part of the EGSnrc system and can be used in any user-code to parse through `key=value` pairs in an input file. As a consecuence, input files look very similar and, more importantly, they are much easier to read and know exactly what the simulation is about without having the description of the inputs open on the desk. The idea behind using a GUI for working with EGSnrc input files is to further extend the above mentioned improvements. Although the input files are currently very readable, one must still remember what the keys used in an input file mean. By using this GUI, a user can immediately get a description about any input parameter by means of tool-tips.

`egs_inprz` is a Graphical User Interface (GUI), originally created for manipulating (reading, creating, modifying, printing and visualizing) input files for the RZ suite of EGSnrc user-codes : DOSRZnrc ,CAVRZnrc ,SPRRZnrc and FLURZnrc (see NRCC report PIRS-702[1]). Furthermore it can be also used for compiling and executing these user-codes. `egs_inprz` is user friendly, offering more flexibility, on-line help and therefore, increases the efficiency in getting hands-on experience with the EGSnrc user codes.

This GUI was developed using Qt, a multi-platform, C++ Graphical User Interfaces toolkit that enables building efficient, portable and maintainable GUI applications quickly and easily. Qt is a fully object-oriented, easily extensible C++ application framework that enables rapid building of state-of-the-art GUI applications. For more information please see http://qt.nokia.com/.

2 Installation

This GUI is part of the multi-platform version[2] of the EGSnrc Monte Carlo simulation system[3]. For its development we used the Qt library (version 3.1 or higher) and therefore, users wanting to build it, will have to install this library. Most Linux distributions include the Qt library these days, since the popular Desktop Environment KDE is based on this library. However, if the Qt library is not available in the user's system, one can download the latest Qt3 distribution from their archives at `ftp://ftp.qt.nokia.com/qt/source/`.

Only Linux/Unix users need to built this GUI since it is distributed as a binary executable on Windows. We might start distributing binary executables for Linux/Unix as well in the near future. The only requirement for this to happen is that most Linux distributions and Unixes are binary compatible and the GUI is linked statically to the Qt library.

If during the building process you encounter problems with the system Qt library, then it is recommended to install the Qt library directly from Trolltech instead of using the one on your system. Most of the time, conflicts are caused by an uncomplete or a buggy Qt library.

2.1 Installing Qt3 under Linux/Unix.

The Qt library changed considerably from version 3 to 4, without maintaining backwards compatibility. For this reason it would take a considerable effort to adapt `egs_inprz` to using Qt4. For now we are still relying on the latest release of the Qt3 library, version 3.3.8b. Since the installation notes on Trolltech's website now refers to Qt4, we are copying here their installation instructions for Qt/X11 Version 3.3.8 verbatim.

```
  INSTALLING Qt/X11 Version 3.3.8


You may need to be logged in as root, depending on the permissions of
the directories where you choose to install Qt.


1.  Unpack the archive if you have not done so already:

cd /usr/local
gunzip qt-x11-free-3.3.8.tar.gz # uncompress the archive
tar xvf qt-x11-free-3.3.8.tar # unpack it

    This creates the directory /usr/local/qt-x11-free-3.3.8 containing the
    files from the main archive.

    Rename qt-x11-free-3.3.8 to qt (or make a symlink):
```

```
mv qt-x11-free-3.3.8 qt

    The rest of this file assumes that Qt is installed in /usr/local/qt.


2.  Set some environment variables in the file .profile (or .login,
    depending on your shell) in your home directory. Create the
    file if it is not there already.

QTDIR    - the directory in which you're building Qt
PATH    - to locate the moc program and other Qt tools
MANPATH     - to access the Qt man pages
LD_LIBRARY_PATH    - for the shared Qt library

    Note that under IRIX the additional LD_LIBRARYN32_PATH and
    LD_LIBRARY64_PATH variables are used for specifying library
    search paths. Set the variable that matches your configuration, or
    see the rld(5) man page for more information.
    On AIX set LIBPATH and on HP-UX set SHLIB_PATH instead of LD_LIBRARY_PATH.

    This is done like this:

    In .profile (if your shell is bash, ksh, zsh or sh), add the
    following lines:

QTDIR=/usr/local/qt
PATH=$QTDIR/bin:$PATH
MANPATH=$QTDIR/doc/man:$MANPATH
LD_LIBRARY_PATH=$QTDIR/lib:$LD_LIBRARY_PATH

export QTDIR PATH MANPATH LD_LIBRARY_PATH

    In .login (in case your shell is csh or tcsh), add the following lines:

setenv QTDIR /usr/local/qt
setenv PATH $QTDIR/bin:$PATH
setenv MANPATH $QTDIR/doc/man:$MANPATH
setenv LD_LIBRARY_PATH $QTDIR/lib:$LD_LIBRARY_PATH

    After you have done this, you will need to login again, or
    re-source the profile before continuing, so that at least $QTDIR
    and $PATH are set. Without these the installation will halt with an error
    message.

    Note that the SGI MIPSpro o32 and Sun WorkShop 5.0 targets are no
```

longer supported as of Qt 3.3.

3. Install your license file as $HOME/.qt-license.
   For the free edition and evaluation version, you do not need a license file.

4. Building.

   This step compiles the Qt library, and builds the example programs, the tutorial, and the tools (e.g. Qt Designer).

   Type:

```
./configure
```

   This will configure the Qt library for your machine. Note that GIF support is turned off by default. Run ./configure -help to get a list of configuration options. Read PLATFORMS for a list of supported platforms.

   To create the library and compile all the examples and the tutorial, type:

```
make
```

   If your platform or compiler is not supported, please contact us at qt-bugs@trolltech.com so that we can assist you. If it is supported but you have problems, see http://www.trolltech.com/platforms/ for information on known issues.

   At this point you have binaries created in $QTDIR (eg. $QTDIR/lib/ contains libqt.so). If, however, you would like to have your Qt installed in a non-local installation you can run configure with options splitting Qt into different areas for example:

```
  ./configure -libdir /usr/local/lib -bindir /usr/local/bin -headerdir /usr/local/includ
```

   If you supplied a custom install directory using the -prefix parameter in step 2, you can:

```
make install
```

   This will install Qt onto your machine using the paths you've set.

```
    (See ./configure -help for more information). If you choose to
    install Qt like this, remember that you must set your
    LD_LIBRARY_PATH to match your -libdir and your QTDIR to your
    -headerdir (as described in (2) above).


5.  In very few cases you may need to run /sbin/ldconfig or something
    similar at this point if you are using shared libraries.

    If you have problems running the example programs, e.g. messages like

 can't load library 'libqt.so.3'

    you probably need to put a reference to the qt library in a
    configuration file and run /sbin/ldconfig as root on your system.
    And don't forget to set LD_LIBRARY_PATH as explained in (2) above.


6.  The online HTML documentation is installed in /usr/local/qt/doc/html/
    The main page is /usr/local/qt/doc/html/index.html
    The man pages are installed in /usr/local/qt/doc/man/



That's all.  Qt is now installed.
```

2.2 Building egs_inprz

The user can have this and the other GUI's built during installation of the EGSnrc system, provided `QTDIR` is properly set. At any time the user can go to `$HEN_HOUSE/gui/egs_inprz` and type

```
./make [EGS_CONFIG=desired_config]
```

A C++ compiler will have to be installed on your computer in order to build the GUIs. On Windows one **must** have installed either MS C++ 6.0 or Borland C++.

Note: You only need to pass `EGS_CONFIG` to `make` if it is not set or you want/need to build the GUI for a different configuration as the current one. In principle, all Makefiles provided in the new EGSnrcMP environment are for `GNU make`. Although they might also work with other Unix `make` versions.

It is important that the environment variable `QTDIR` points to the location where Qt3.x was installed. This can be checked by issuing the command:

`echo $QTDIR` on Unix/Linux or

`echo %QTDIR%` on a Windows console.

One can change this environment variable by issuing the command

`setenv QTDIR Qt3_location` for the C shell, or

`export QTDIR = Qt3_location` for Bash, or

`set QTDIR=Qt3_location` on a Windows console.

On Unix/Linux this variable can be set on a system wide basis by including the corresponding statement above in the `.cshrc` resource file for the C-shell or the `.basrc` resource file for Bash.

On Windows the user can also set the QTDIR environment variable system wide by right clicking on the `My Computer` icon, selecting `Properties` and clicking on the `Environment Variables` button in the `Advanced` tab.

3 Using egs_inprz

3.1 Running egs_inprz

After installing EGSnrc, egs_inprz is located on HEN_HOUSE/bin/my_machine/. my_machine stands for the name of the configuration used to build the GUI. For more information about configurations the user is referred to the PIRS-877 report on the new multi-platform environment[2].

On Windows the user can invoke directly the binary executable from a DOS console, since its location will be on the user's PATH environment variable. If requested by the user, there will be also shortcuts to the GUI's distributed with the EGSnrc system on the Desktop and Start Menu.

On Unix/Linux the user can also invoke directly the binary executable from a shell console, since its location is added to the user's PATH environment variable when the corresponding egsnrc_[cshrc|bashrc]_additions is sourced, which **must** have been done after installing the EGSnrc system. The alias egsinprz is also available, which points to HEN_HOUSE/bin/my_machine/egs_inprz and starts the GUI in the background. If requested by the user, shortcuts for the KDE desktop environment are also created by the installation GUI.

Once all the necessary information is entered, the user can perform different operations from within the GUI provided the input file has been saved to the disk since all other operations use the disk version of the input file.

3.2 Reading EGSnrc RZ input files

Existing input files can be read directly from the command line by passing the file name as argument, i.e., by invoking

egs_inprz *filename[.egsinp]*

where the file name can be with or without extension. If the file does not exist, a warning message is shown and the file name new_file.egsinp is used instead. Note, that in this case no input file will exist. To have an actual input file and be able to run a calculation, the user **must** have saved it. Saving new_file.egsinp without modifying any entry will leave a default input file for use with the RZ user code dosrznrc.mortran.

Once an existing input file is loaded, it is searched to identify the user-code it belongs to. If no user-code is identified, DOSRZnrc is used by default. Once the user-code to be used is known, its location becomes the place where the GUI will look for input files.

Regarding location, the EGSnrc system relies on having the input file on the EGSnrc user area, *i.e.*, EGS_HOME/user-code. This is so because for execution, temporary directories and output files are created, moved and deleted and all these operations are relative to the EGS_HOME/user-code location.

For this reason, this GUI will only store input files in the user's EGSnrc area, i.e., EGS_HOME/user-code. If the EGSnrc user area does not exist, the GUI creates it and issues a warning.

Input files can be also read in from the GUI's General tab. Once the GUI is loaded, a list of available **.egsinp* input files in the current directory is offered to the user through the EGSnrc input file name combo box. By default the input file template *dosrznrc_template.egsinp*, distributed with the EGSnrc system, is loaded. Alternatively, the user can click on the button to the right of the combo box to invoke an open file dialog to open any **.egsinp* file located anywhere.

The GUI verifies that all media used in the input file are available in the selected PEGS4 data set. By default this file is set to be 521icru.pegs4dat, a standard data file, that comes with the EGSnrc distribution. If any medium is not found in the current PEGS4 data file, an error message pops up recommending that the user corrects the media names and/or find the appropriate data file.

The user-code area is the location where egs_inprz will look for input files. Initially, egs_inprz assumes that the user-code area is EGS_HOME/user-code, where user-code is by default *dosrznrc*. If the GUI is started from any user-code location, user-code is changed to the corresponding user-code. If a valid input file name is passed as argument to egs_inprz, then after identifying the user-code, user-code is updated properly. The user-code area can be later changed by the user in the general input tab (see figure 5 in section 5.1).

Similarly, the PEGS4 data area is the location where egs_inprz will look for PEGS4 data sets. Since there are some data sets in the EGSnrc distribution, we chose to set this area to be in HEN_HOUSE/pegs4/data by default. Later on, when users have created their own data sets, they can switch to EGS_HOME/pegs4/data or any other location of their preference.

3.3 Creating EGSnrc RZ input files

As mentioned above, when starting the RZ GUI, the template dosrznrc_template.egsinp is read in, which contains defaults for all possible entries. Saving this template under any other name is a possible way for getting started. In similar fashion, one can switch to another RZ user-code (see section 5.1) and select the corresponding input template file.

3.4 Porting input files between NRC RZ user-codes

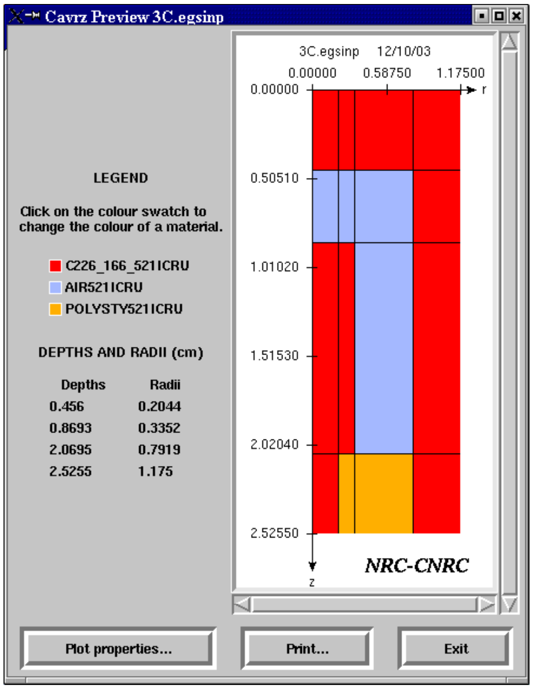
Sometimes different user-codes share common input blocks like transport parameters, geometry, variance reduction parameters, and so on. For instance, the user might want to run a CAVRZnrc calculation to obtain the dose inside the air cavity of an ion chamber and also run a FLURZnrc calculation to obtain the spectrum inside the cavity for the same chamber. This is easily acomplished with egs_inprz by loading the input file for the CAVRZnrc calculation, switching to the other user code input by clicking on the corresponding radio button in the user-code group box (see figure 5 in section 5.1). One will have to modify the default entries for the selected user-code to suit the user's problem if needed. Once the proper entries are made, the input file can be saved by clicking on the *Save* or *Save&Exit* button in the user's EGSnrc user-code area (if it doesn't exist, it is created automatically, and a warning is issued to the user).

3.5 Viewing the geometry with previewRZ

Once an existing input file has been loaded or created from scratch and saved on the hard drive, the user can invoke `previewRZ`, a tool supplied with the EGSnrc distribution, which allows one to visualize the geometry and material data (see figure 1). The `PreviewRZ` button, placed in the left bottom corner of the GUI (see any GUI snapshot in section 5), becomes enabled if Tcl/Tk is installed on your computer, the input file exists and there were no errors reading the geometry. Pressing this button is equivalent to typing on the command line of a console (Windows or Unix/Linux)

```
HEN_HOUSE/previewRZ/previewRZ name[.egsinp]
```

where the input filename can be entered with or without extension.



LEGEND

Click on the colour swatch to change the colour of a material.

🟥 C226_166_521ICRU
🟦 AIR521ICRU
🟧 POLYSTY521ICRU

DEPTHS AND RADII (cm)

Depths	Radii
0.456	0.2044
0.8693	0.3352
2.0695	0.7919
2.5255	1.175

Figure 1: View of a 3C cylindrical ionization chamber using `previewRZ`.

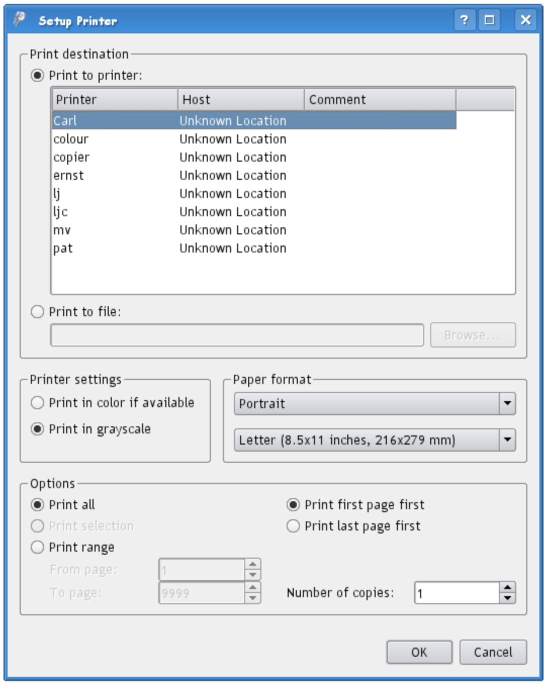
`previewRZ` is a Tcl/Tk script which had been previously used at NRC only on Unix/Linux.

We have now successfully used `previewRZ` on Windows 2000/XP after downloading and installing a Tcl/Tk self-extracting distribution. To find out whether Tcl/Tk is available on the user's system, `egs_inprz` tries to find the binary executable `wish.exe` on Windows or `wish` on Unix/Linux in any of the locations defined on the user's PATH environment variable. The Tcl/Tk package is **FREELY** distributed for HP-UX, Linux, Solaris, and Windows by ActiveState Corp. To obtain Tcl/Tk go to http://www.activestate.com/Products/ActiveTcl/ and click on the `Download` link of the page. For more information and useful links on Tcl/Tk please visit http://www.tcl.tk/software/tcltk/

Future versions of the `egs_inprz` GUI will use its own previewing tool, but for now, users wishing to have the feature of looking at the geometry they are defining, will have to install the Tcl/Tk package.

3.6 Printing *.egsinp input files

To produce a hard copy of the input file, users have the option to print the file by pressing the `Print` button located in the button group on the lower left corner of the GUI (see any GUI snapshot in section 5). A Print Dialog pops up with a list of available printers and a printer and paper format setup among other options (see figure 2).



Setup Printer

Print destination

● Print to printer:

Printer	Host	Comment
Carl	Unknown Location	
colour	Unknown Location	
copier	Unknown Location	
ernst	Unknown Location	
lj	Unknown Location	
ljc	Unknown Location	
mv	Unknown Location	
pat	Unknown Location	

○ Print to file:

Printer settings

○ Print in color if available

● Print in grayscale

Paper format: Portrait

Letter (8.5x11 inches, 216x279 mm)

Options

● Print all

○ Print selection

○ Print range

From page: 1

To page: 9999

● Print first page first

○ Print last page first

Number of copies: 1

Figure 2: Printer Setup Dialog on SuSE Linux 10.3 KDE 3.5.9

3.7 Compiling the RZ user codes

When one modifies the user-codes, these need to be re-compiled. The user can perform this operation from within the GUI by pressing the *Compile* button on the lower left corner of the GUI (see for instance figure 5 in section 5.1). On the `General Information` tab there is a `Target` radio button group box where one can choose the type of compilation desired. By default it is set to `optimization` which uses the optimization option defined in the active config file generated during the EGSnrc installation process or the configuration utility available in all the EGSnrcMP GUI's. The other available options are `no optimization, debug and clean`. Optimization is recommended for production runs after the user-code and the input file have been thoroughly tested.

3.8 Executing the RZ user codes

After all necessary information has been entered and stored, one can execute the EGSnrc RZ user-code from within the GUI by pressing the *Execute* button on the lower left corner of the GUI (see figure 5 in section 5.1). A dialog appears where one can define the different execution parameters (see figure 3). There are two modes for running an EGSnrc RZ user-code, *interactive* or *batch*, *i.e.*, using a batch queuing system. The execution mode defaults to *interactive.* The *batch* execution mode is only available on Unix/Linux since it has not been implemented on Windows yet. At NRC the *PBS batch system* is currently used to send jobs to a queue where they are remotely executed, returning the results after completion to the user EGSnrc area.

On Unix/Linux if the batch execution mode is selected, a pane becomes enabled where queue input parameters can be entered such as the queueing system, type of queue and number of jobs to submit (see figure 4). The GUI recognizes which queueing systems are available by looking up on `$HEN_HOUSE/scripts` for batch definition files in the form `batch_options.queueing_system`, where `queueing_system` stands for either `at`, `nqs` or `pbs`. The user can add any other batch submission system by creating a batch definition file in a similar fashion to the ones in the EGSnrcMP distribution.

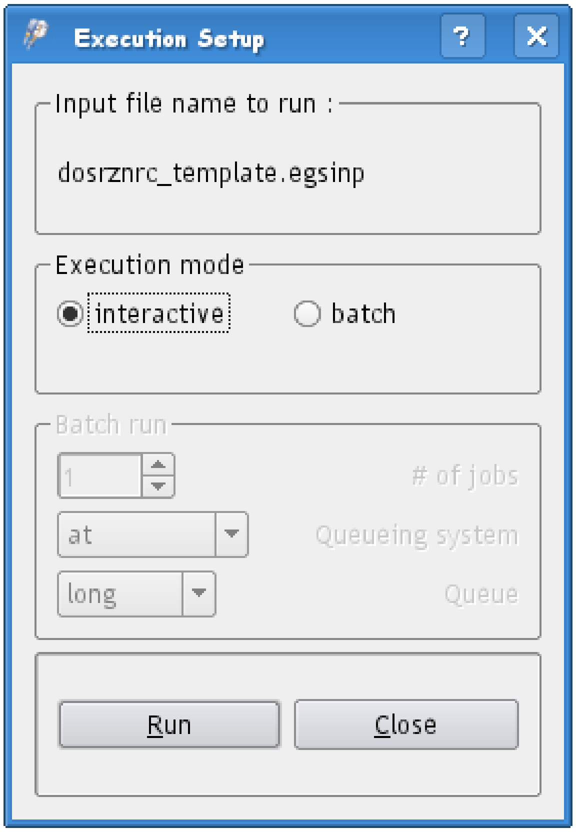
The default batch submission system assumed in the GUI is the standard Unix job submission tool `at`. The batch definition files provided in the directory `$HEN_HOUSE/scripts` contain specific definitions for the `at`, `NQS` and `PBS` batch submission systems. If the user wants to make NQS, PBS or any other system the default job submission system, he/she can define the environment variable `EGS_BATCH_SYSTEM` to be nqs, pbs or the name of the other queueing system.

These are the batch definition files distributed with the EGSnrc system:

```
batch_options.at

batch_options.nqs

batch_options.pbs
```



Execution Setup

Input file name to run : dosrznrc_template.egsinp

Execution mode ● interactive ○ batch

Batch run

1 # of jobs

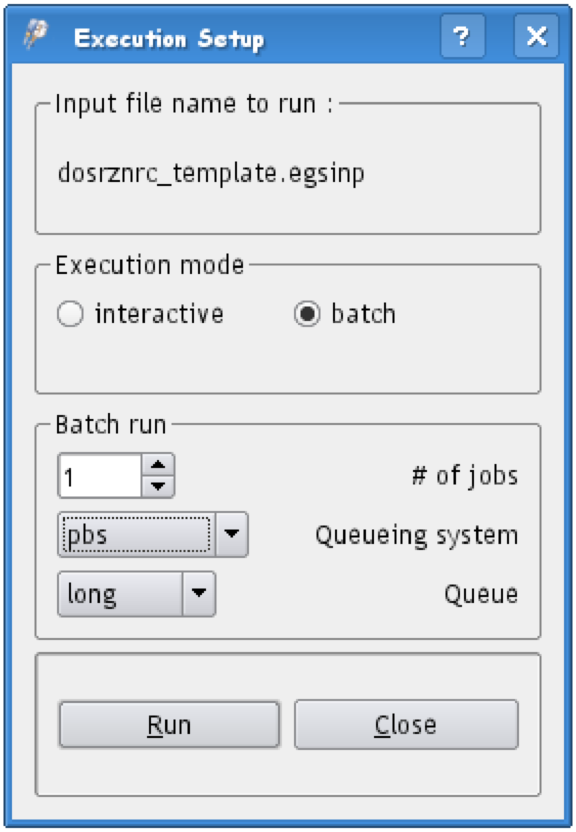
at Queueing system

long Queue

Figure 3: Execution Setup Dialog.

Queue names are installation especific and at NRC the names *short*, *medium* and *long* have been adopted for PBS and NQS. To change these, edit the names in the proper batch definition file.

For more information on the implementation of parallel runs in the new EGSnrc system, the reader is refered to the NRCC report PIRS-877.



Execution Setup

Input file name to run :

dosrznrc_template.egsinp

Execution mode

○ interactive ● batch

Batch run

1 # of jobs

pbs Queueing system

long Queue

Figure 4: Execution Setup Dialog in batch mode.

4 Getting help

One of the advantages of a graphical user interface is the possibility of providing information in an interactive way. `egs_inprz` uses this feature extensively by activating so called *tool tips* when the user positions the mouse over a given area in the GUI. A dialog pops up *temporarily* with information, if available, about the corresponding input quantity.

There is also the possibility of activating these *tool tips permanently* (until another action is performed: mouse click or key press). For this, the user must set the focus on the relevant location and press `Shift+F1`. The help text appears immediately; it goes away as soon as the user does something else.

More general information is provided in html format through the *Help* button located in the lower right corner of the GUI (*html* version of this document). `egs_inprz` attemps to run *Internet Explorer* on Windows and *Konqueror* or *Netscape* on Unix/Linux to show the document. If none of these are available an error message is displayed. In that case the user can go to `$HEN_HOUSE/gui/egs_inprz/html` and load the index page *index.html* with an html browser of his/her choice.

5 Input blocks description and screenshots

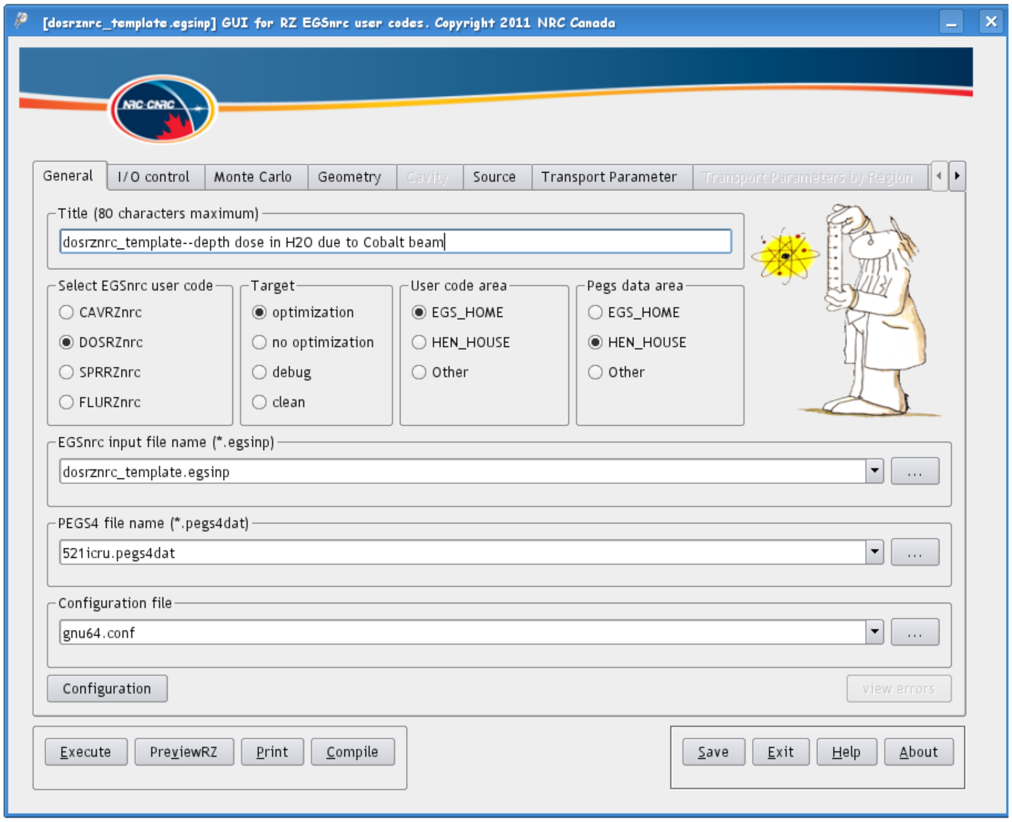
In this section we describe briefly the different input blocks that are used in the NRC RZ user codes. We have also included screenshots of the different input tabs of the GUI. In each of these tabs, there are input options, common to all the RZ user codes. But some of them are specific to one user code and remain disabled when one selects a different user code. The active file name is always displayed on the GUI's caption. This can be useful to recognize whether the current file name in the input box is the same as the active one.

Note that the bottom row of buttons are available with all tabs.

5.1 The General Information Tab

As its name suggests, this section of the tabbed dialog is intended to collect general information not contemplated inside the input file itself like the input and pegs4 data file names, the areas to search for those files, compilation mode, execution mode and its parameters, the user code name, etc. The title constitutes an exception, since it is part of the input file, but does not fit in any of the different input blocks.

A very useful feature in this GUI is the ability to set the location of the input and pegs4 files automatically to be in the HEN_HOUSE or EGS_HOME area. This saves time by not having to browse all the way to the location of different files, acting like a shortcut. If the files are loaded from a location different than the above mentioned, the Other radio button is checked. Note that upon loading an input file from a location other than the HEN_HOUSE or EGS_HOME user code area, it will be only saved on the EGS_HOME user code area.



[dosrznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada

Title (80 characters maximum): dosrznrc_template--depth dose in H2O due to Cobalt beam

Select EGSnrc user code: ○ CAVRZnrc ● DOSRZnrc ○ SPRRZnrc ○ FLURZnrc

Target: ● optimization ○ no optimization ○ debug ○ clean

User code area: ● EGS_HOME ○ HEN_HOUSE ○ Other

Pegs data area: ○ EGS_HOME ● HEN_HOUSE ○ Other

EGSnrc input file name (*.egsinp): dosrznrc_template.egsinp

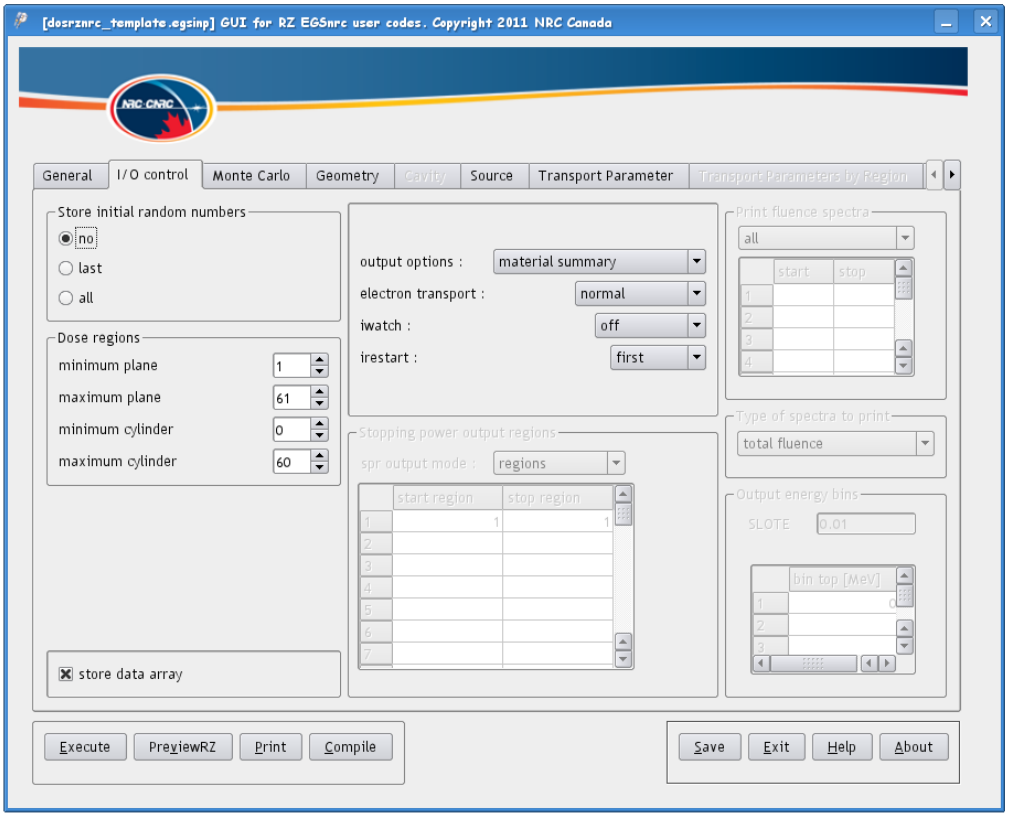
PEGS4 file name (*.pegs4dat): 521icru.pegs4dat

Configuration file: gnu64.conf

Figure 5: General Input for the RZ EGSnrc User Codes.

5.2 The I/O Control Tab

This block contains information relevant to the I/O controls of the NRC user codes. Many of the inputs are common to all codes, but there are some which are specific to only some of them.



Store initial random numbers
● no
○ last
○ all

Dose regions
minimum plane 1
maximum plane 61
minimum cylinder 0
maximum cylinder 60

☒ store data array

output options : material summary
electron transport : normal
iwatch : off
irestart : first

Stopping power output regions
spr output mode : regions

	start region	stop region
1	1	1
2		
3		
4		
5		
6		
7		

Print fluence spectra
all

	start	stop
1		
2		
3		
4		

Type of spectra to print
total fluence

Output energy bins
SLOTE 0.01

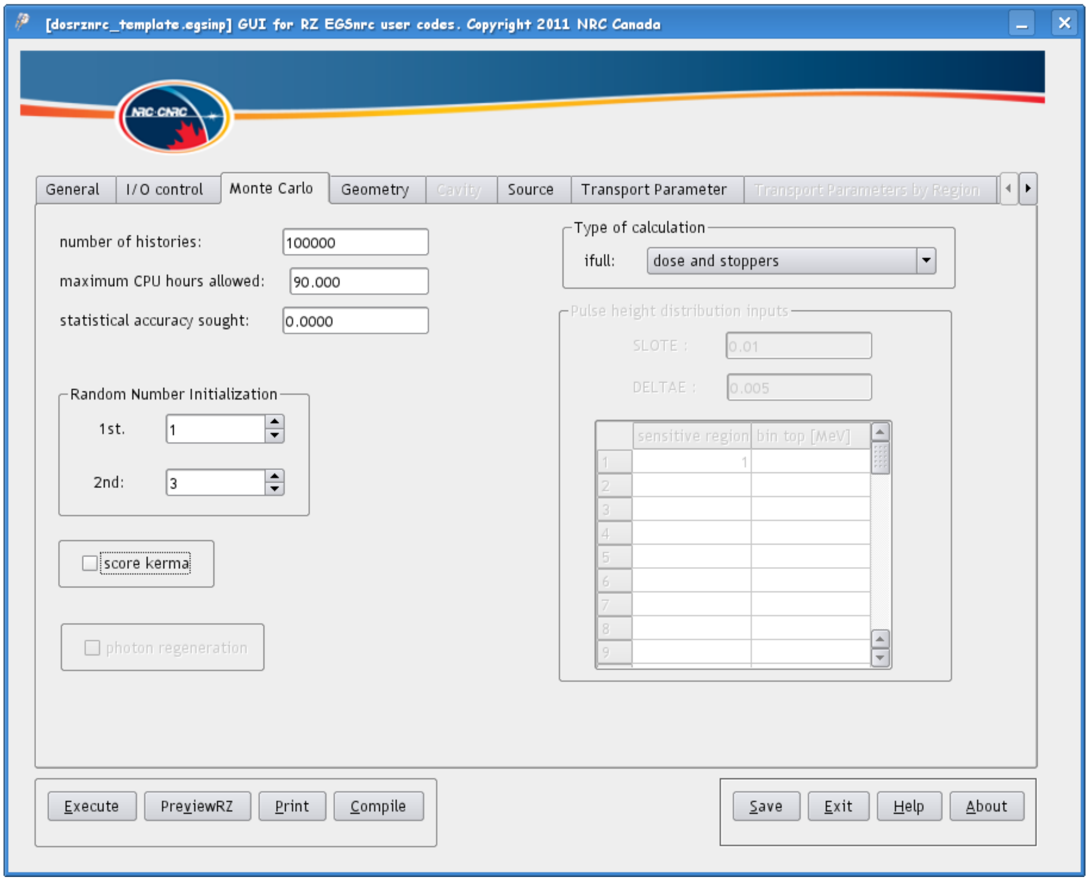
	bin top [MeV]
1	0
2	
3	

Figure 6: I/O control for the RZ EGSnrc User Codes.

5.3 The Monte Carlo Parameter Tab

This input tab collects the typical information required in a Monte Carlo simulation like the number of histories to run, the initial random number seeds, desired statistical accuracy, and the maximum CPU time for the calculation. There are also more user code specific entries that are enabled or disabled depending on the user code selected.

An input block required only by the user code DOSRZnrc when the calculation type is *pulse height distribution* is also included in this tab. For other calculation types and user codes, this box remains disabled.



[dosrznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada

number of histories: 100000

maximum CPU hours allowed: 90.000

statistical accuracy sought: 0.0000

Random Number Initialization

1st. 1

2nd: 3

□ score kerma

□ photon regeneration

Type of calculation

ifull: dose and stoppers

Pulse height distribution inputs

SLOTE : 0.01

DELTAE : 0.005

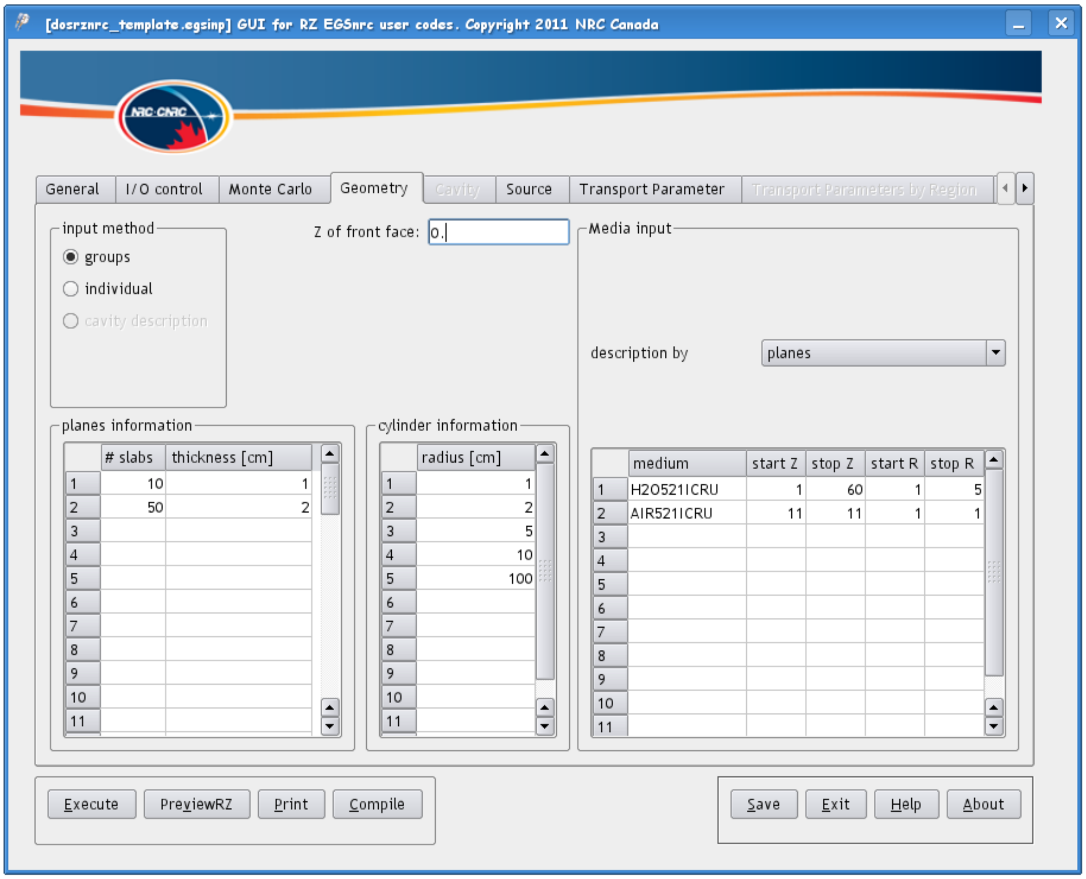
	sensitive region	bin top [MeV]
1	1	
2		
3		
4		
5		
6		
7		
8		
9		

Figure 7: Monte Carlo parameters for the RZ EGSnrc User Codes.

5.4 The Geometry Tab

This input block contains all the necessary inputs for defining a RZ geometry (cylindrical symmetry) and the media present in the different regions. It is important to notice that for the user code CAVRZnrc an option is available to define the geometry in a simpler way. If the input method selected (upper left corner of the tab) is *cavity description*, then the rest of the input fields in this tab are disabled and the whole geometry input occurs through the next tab, `the cavity tab`.

Only media present in the current PEGS4 data set can be set in the media table. This is assured by activating a combo box in the first column of the media table as soon as the user tries to type or double click on it.



input method
● groups
○ individual
○ cavity description

Z of front face: 0.

Media input

description by planes

planes information

	# slabs	thickness [cm]
1	10	1
2	50	2
3		
4		
5		
6		
7		
8		
9		
10		
11		

cylinder information

	radius [cm]
1	1
2	2
3	5
4	10
5	100
6	
7	
8	
9	
10	
11	

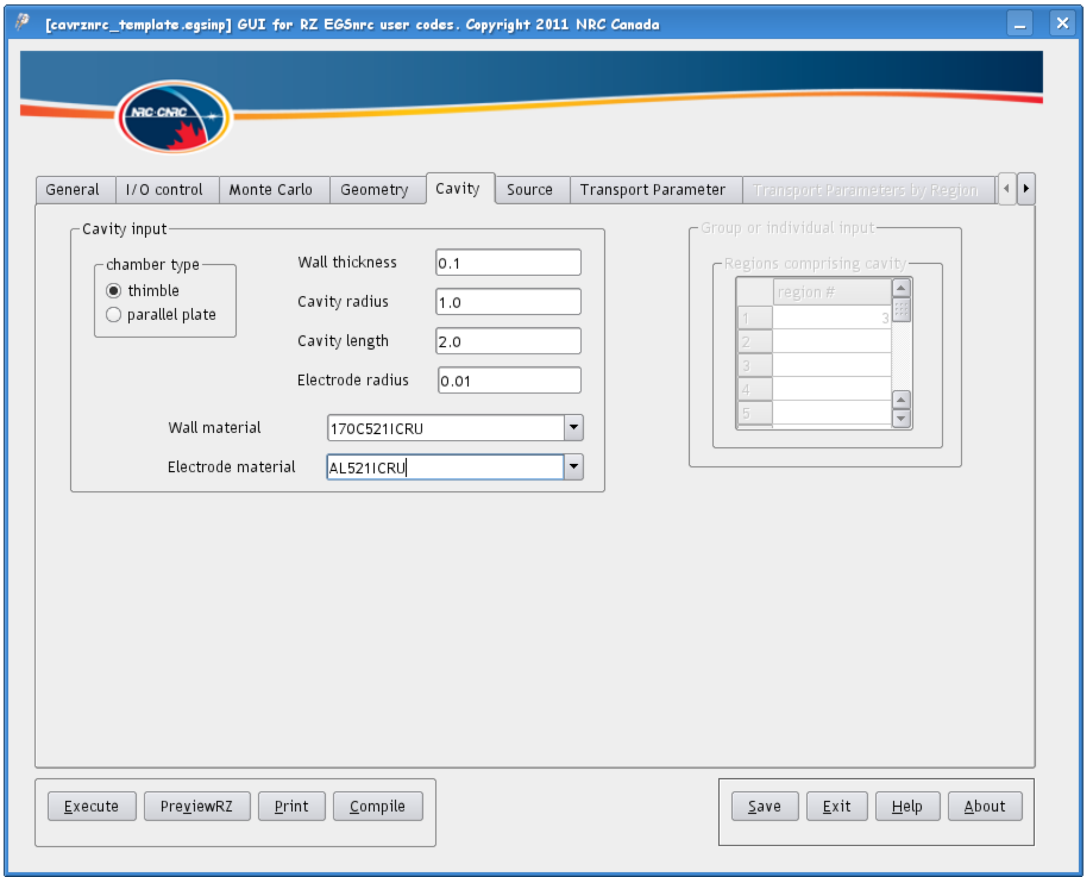
	medium	start Z	stop Z	start R	stop R
1	H2O521ICRU	1	60	1	5
2	AIR521ICRU	11	11	1	1
3					
4					
5					
6					
7					
8					
9					
10					
11					

Figure 8: Geometry Input for the RZ EGSnrc User Codes.

5.5 The Cavity Tab

This tab is only enabled for the user code CAVRZnrc. If the input method selected in the `geometry tab` (upper left corner) is *groups* or *individual*, the user can define the regions comprising the cavity there. If on the other hand, the input method selected is *cavity description*, then the rest of the input fields in the `the geometry tab` are disabled and the the whole geometry input occurs here. The materials for the chamber wall and the electrode can be selected from available media in the current PEGS4 data file. This option was useful for early calculations but is not adequate for chambers in which one wants to include much detail.

Beware: If the input method is cavity description, the material name inside the cavity is assumed to be **AIR** by the user-code CAVRZnrc, *i.e.*, CAVRZnrc will search for this medium in the pegs4 data file.


[cavrznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada
NRC·CNRC
General
I/O control
Monte Carlo
Geometry
Cavity
Source
Transport Parameter
Transport Parameters by Region
Group or individual input
Regions comprising cavity
region #
1
2
3
4
5
Execute
PreviewRZ
Print
Compile
Save
Exit
Help
About

Cavity input

chamber type
● thimble
○ parallel plate

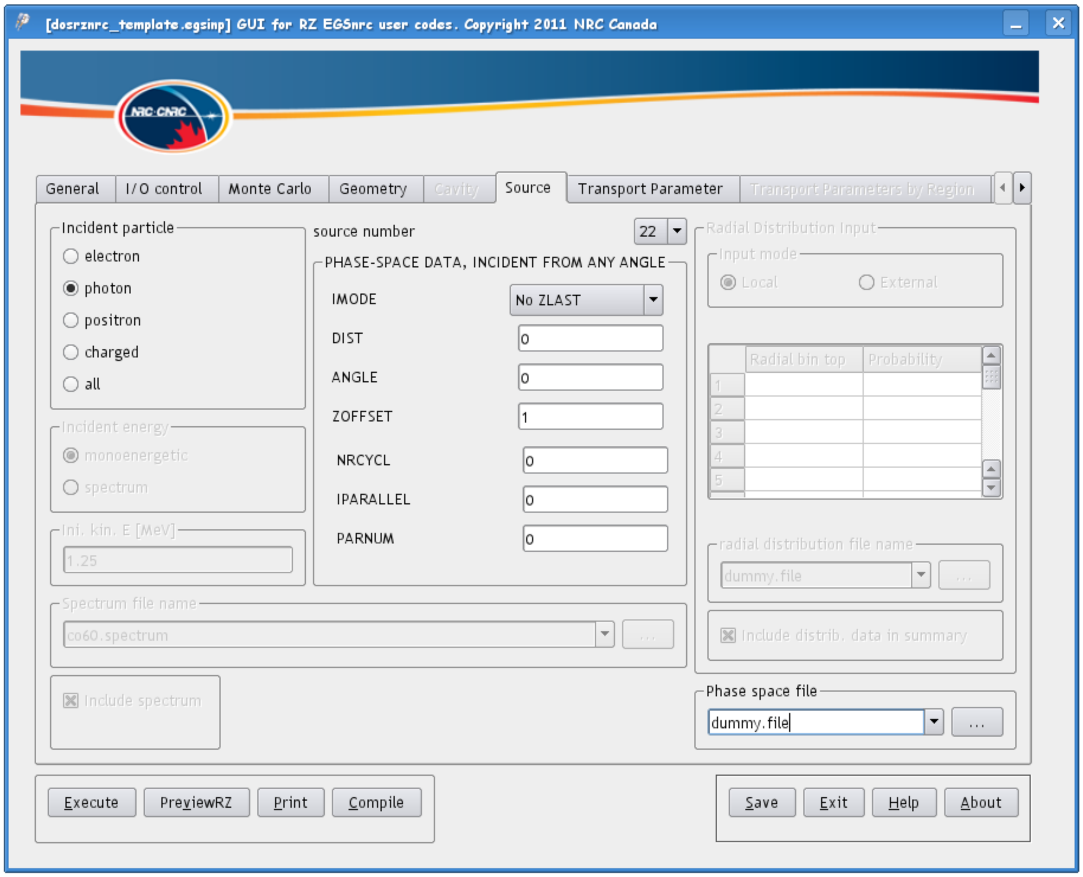
Wall thickness 0.1
Cavity radius 1.0
Cavity length 2.0
Electrode radius 0.01
Wall material 170C521ICRU
Electrode material AL521ICRU

region # 3

Figure 9: Cavity Input for the RZ EGSnrc User Code CAVRZnrc.

5.6 The Source Tab

Any input related to the initial characteristics of the beam or phase space file are entered here. There are 15 different types of source geometries that can be entered. A detailed description of each source can be found in the NRC User Codes Manual (NRCC report PIRS-702[1]) and directly through the `Tool Tips` help feature offered by this GUI.



Incident particle
○ electron
● photon
○ positron
○ charged
○ all

Incident energy
● monoenergetic
○ spectrum

Ini. kin. E [MeV]: 1.25

Spectrum file name: co60.spectrum

☒ Include spectrum

source number: 22

PHASE-SPACE DATA, INCIDENT FROM ANY ANGLE

IMODE	No ZLAST
DIST	0
ANGLE	0
ZOFFSET	1
NRCYCL	0
IPARALLEL	0
PARNUM	0

Radial Distribution Input

Input mode: ● Local ○ External

	Radial bin top	Probability
1		
2		
3		
4		
5		

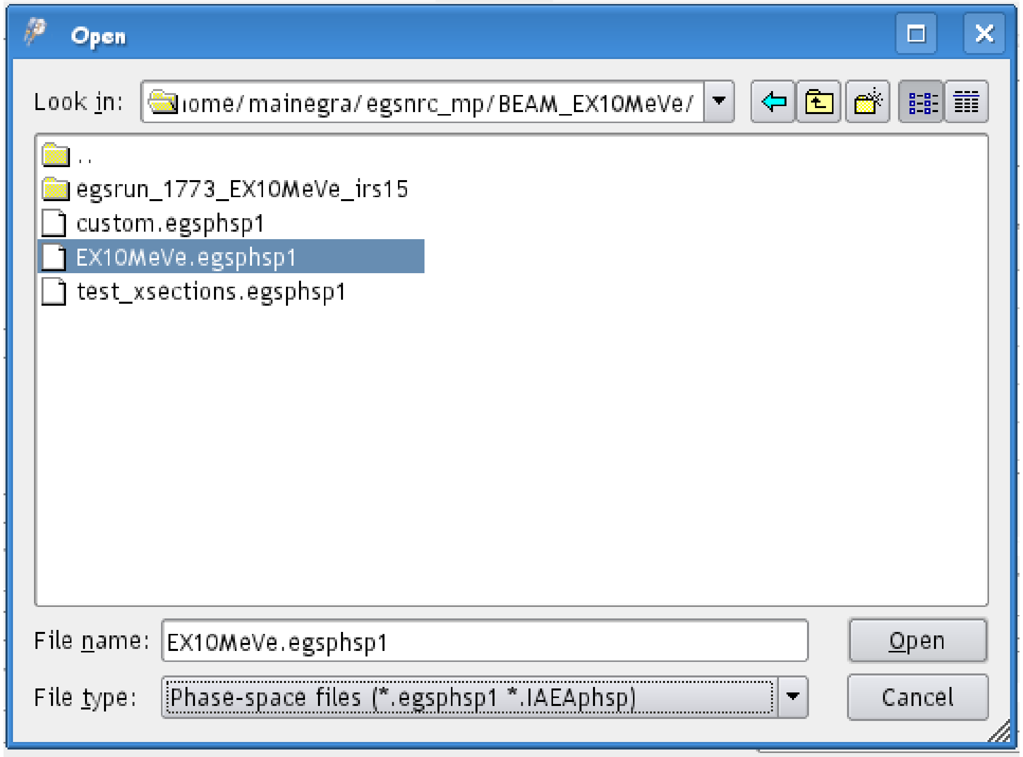
radial distribution file name: dummy.file

☒ Include distrib. data in summary

Phase space file: dummy.file

Figure 10: Source Input for the RZ EGSnrc User Codes.

If the user selects source 21 or 22, the Phase-space file edit line becomes enabled and one can either type the name of a phase-space file or one can use the Open File Dialog to navigate throught the directories to get the desired file. In the latter case, the path is stripped from the file name, but it is still rembered and properly added to the file name when saving the input file. Although EGSnrc accepts phase-space files with arbitrary extensions, it is customary to use the *.egsphsp1 extension for regular phase-space files and *.IAEAphsp for phase-space files using the IAEA format (in this latter case, the extension is improtant). Although the default filter for searching for files uses these extensions (see figure 11), the All files (*) filter is still available.



Look in: ıome/mainegra/egsnrc_mp/BEAM_EX10MeVe/

..
egsrun_1773_EX10MeVe_irs15
custom.egsphsp1
EX10MeVe.egsphsp1
test_xsections.egsphsp1

File name: EX10MeVe.egsphsp1

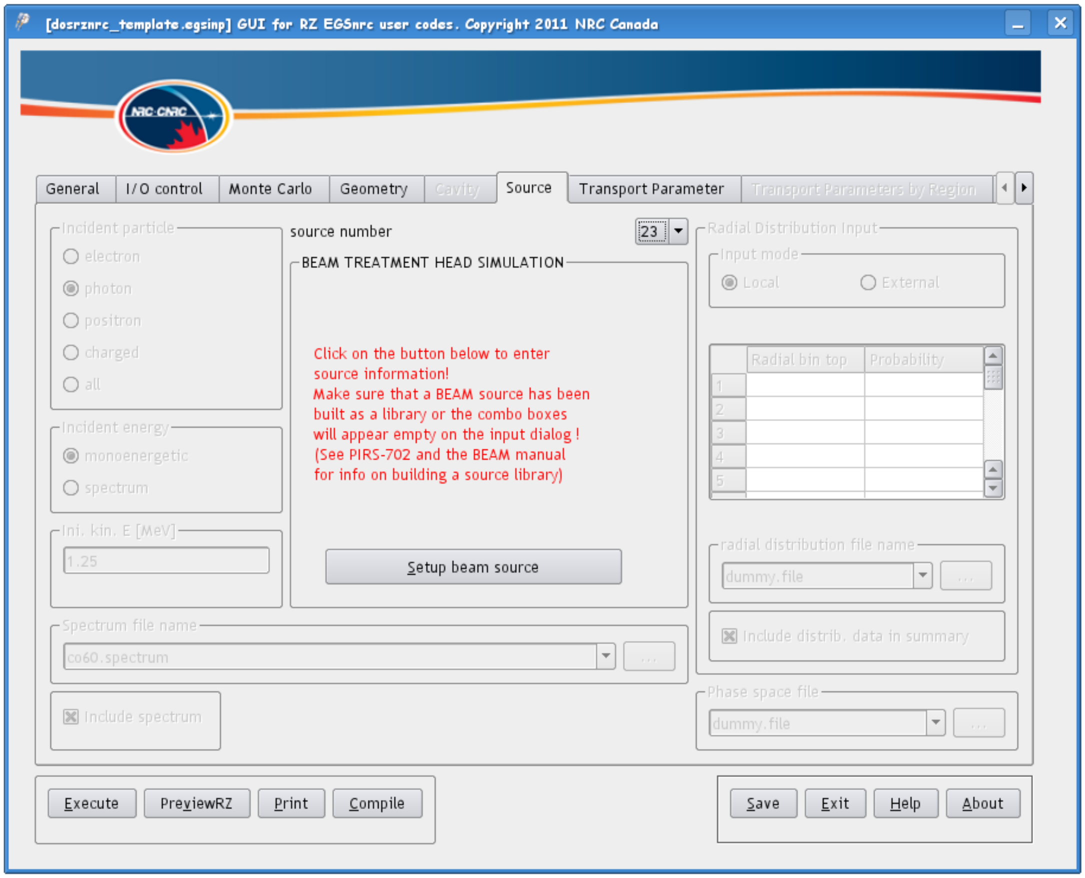
File type: Phase-space files (*.egsphsp1 *.IAEAphsp)

Figure 11: Phase-space open file dialog.

5.6.1 Setting up a BEAM Source

Alternatively to phase-space files, EGSnrc can now use a BEAMnrc simulation as a particle source (figure 12). This source (source 23) needs to be set up in a separate dialog. When the user selects this source, a button appears with a red text, prompting the user to enter the source parameters and warning that unless there are BEAM user-codes compiled as a library on the system, no BEAM user-code will be available.

Clicking on the above mentioned button brings a new dialog (figure 13), where the user can enter the name of the BEAM user-code, the BEAM input file and the required PEGS4 data file based on the current PEGS4 directory. The user can also define a weight window for the particles and the positioning and orientation of the source.



[dosrznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada

Incident particle
○ electron
● photon
○ positron
○ charged
○ all

Incident energy
● monoenergetic
○ spectrum

Ini. kin. E [MeV]: 1.25

source number: 23

BEAM TREATMENT HEAD SIMULATION

Click on the button below to enter source information!
Make sure that a BEAM source has been built as a library or the combo boxes will appear empty on the input dialog !
(See PIRS-702 and the BEAM manual for info on building a source library)

Spectrum file name: co60.spectrum

☒ Include spectrum

Radial Distribution Input

Input mode
● Local ○ External

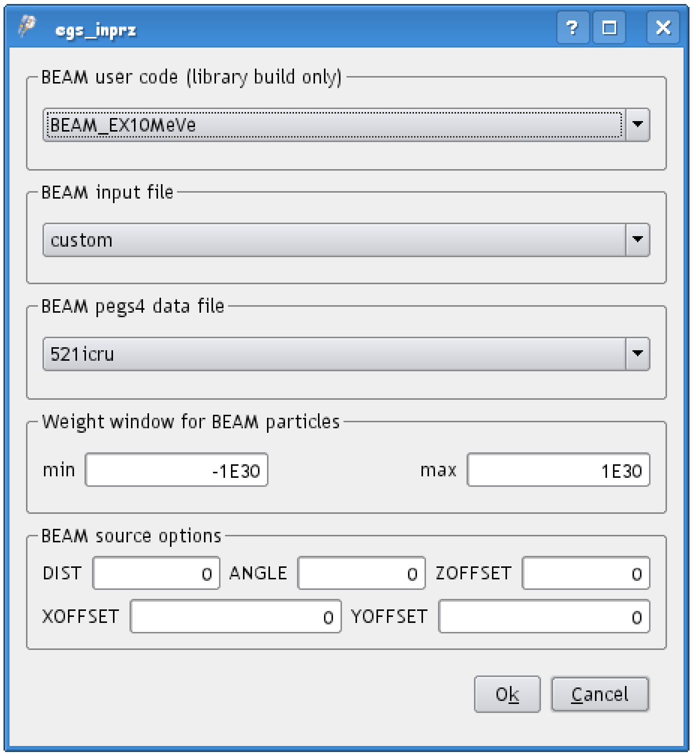
	Radial bin top	Probability
1		
2		
3		
4		
5		

radial distribution file name: dummy.file

☒ Include distrib. data in summary

Phase space file: dummy.file

Figure 12: Selecting BEAMnrc as a source.



BEAM user code (library build only): BEAM_EX10MeVe

BEAM input file: custom

BEAM pegs4 data file: 521icru

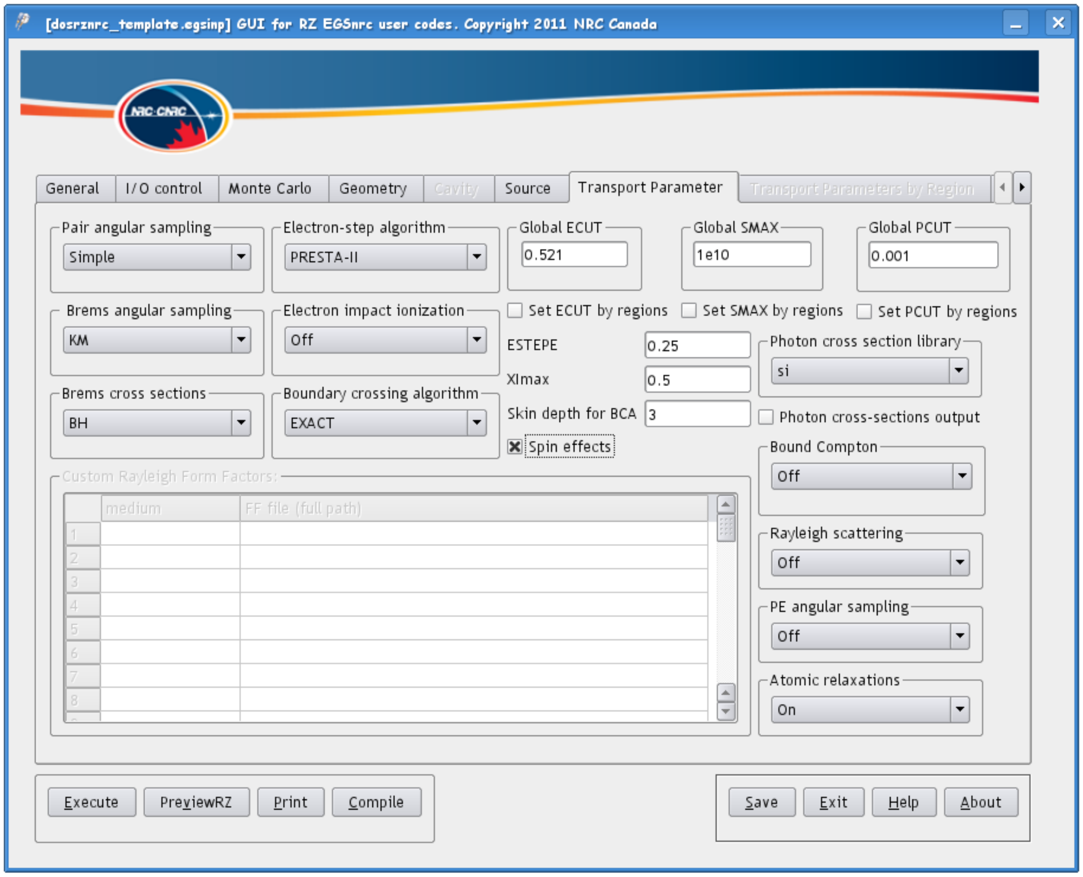
Weight window for BEAM particles: min -1E30 max 1E30

BEAM source options: DIST 0 ANGLE 0 ZOFFSET 0 XOFFSET 0 YOFFSET 0

Figure 13: BEAMnrc source definition dialog.

5.7 The Transport Parameters Tab

This input section gathers information inherent to the physics of the transport of electromagnetic radiation through matter. Threshold energies for photons and electrons, electron transport algorithm to be used, as well as the cross section data and angular distributions to be used are entries that are defined here. By default, EGSnrc uses threshold energies given by AP and AE in each region for photons and electrons respectively. The electron transport is originally set to the EGSnrc default algorithm, which is independent of electron step size. The user can also choose to turn *on* and *off* other effects in the simulation, like Compton binding effects, spin effects, Rayleigh scattering, atomic relaxations and angular sampling of the photo-electrons. For a detailed reading on the physics of the transport of photons and electrons the user is refered to the EGSnrc system manual (NRCC Report PIRS-701[3]).



Pair angular sampling: Simple
Electron-step algorithm: PRESTA-II
Global ECUT: 0.521
Global SMAX: 1e10
Global PCUT: 0.001
Brems angular sampling: KM
Electron impact ionization: Off
□ Set ECUT by regions
□ Set SMAX by regions
□ Set PCUT by regions
ESTEPE: 0.25
XImax: 0.5
Skin depth for BCA: 3
Photon cross section library: si
Brems cross sections: BH
Boundary crossing algorithm: EXACT
□ Photon cross-sections output
☒ Spin effects
Bound Compton: Off
Rayleigh scattering: Off
PE angular sampling: Off
Atomic relaxations: On

Custom Rayleigh Form Factors:

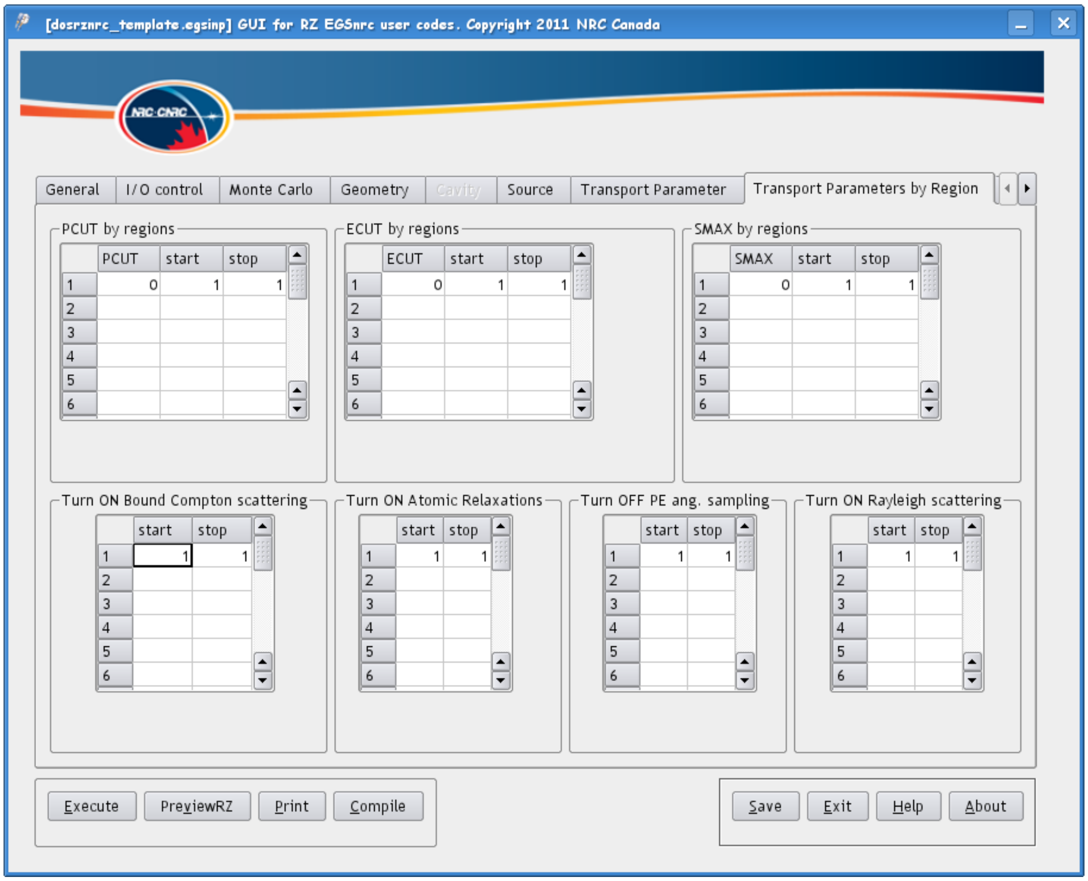
	medium	FF file (full path)
1		
2		
3		
4		
5		
6		
7		
8		

Figure 14: Monte Carlo Transport Parameter Input for the RZ EGSnrc User Codes.

This tab has been updated to most of the latest additions to the `MC trasport parameters` input block. Notably, one can now enter the medium and file names for using custom coherent scattering form factors. Currently the option for defining an arbitrary file with Compton cross sections is not available in the GUI. This wizard tab is already overloaded and will be split in individual tabs for photon and electron/positron inputs in future releases.

5.8 The Transport Parameters by Regions Tab

For some applications it might be desirable to have some of the quantities defined on a region by region basis. This can be done by checking the corresponding check box or radio button of the quantity chosen in the *Transport Parameter* tab. As soon as the user selects a quantity to be set by region this tab is enabled. Here are tables for each of the quantities than can be set up on a region by region basis. Tables will *only* be enabled for those quantities selected in the previous tab.



PCUT by regions

	PCUT	start	stop
1	0	1	1
2			
3			
4			
5			
6			

ECUT by regions

	ECUT	start	stop
1	0	1	1
2			
3			
4			
5			
6			

SMAX by regions

	SMAX	start	stop
1	0	1	1
2			
3			
4			
5			
6			

Turn ON Bound Compton scattering

	start	stop
1	1	1
2		
3		
4		
5		
6		

Turn ON Atomic Relaxations

	start	stop
1	1	1
2		
3		
4		
5		
6		

Turn OFF PE ang. sampling

	start	stop
1	1	1
2		
3		
4		
5		
6		

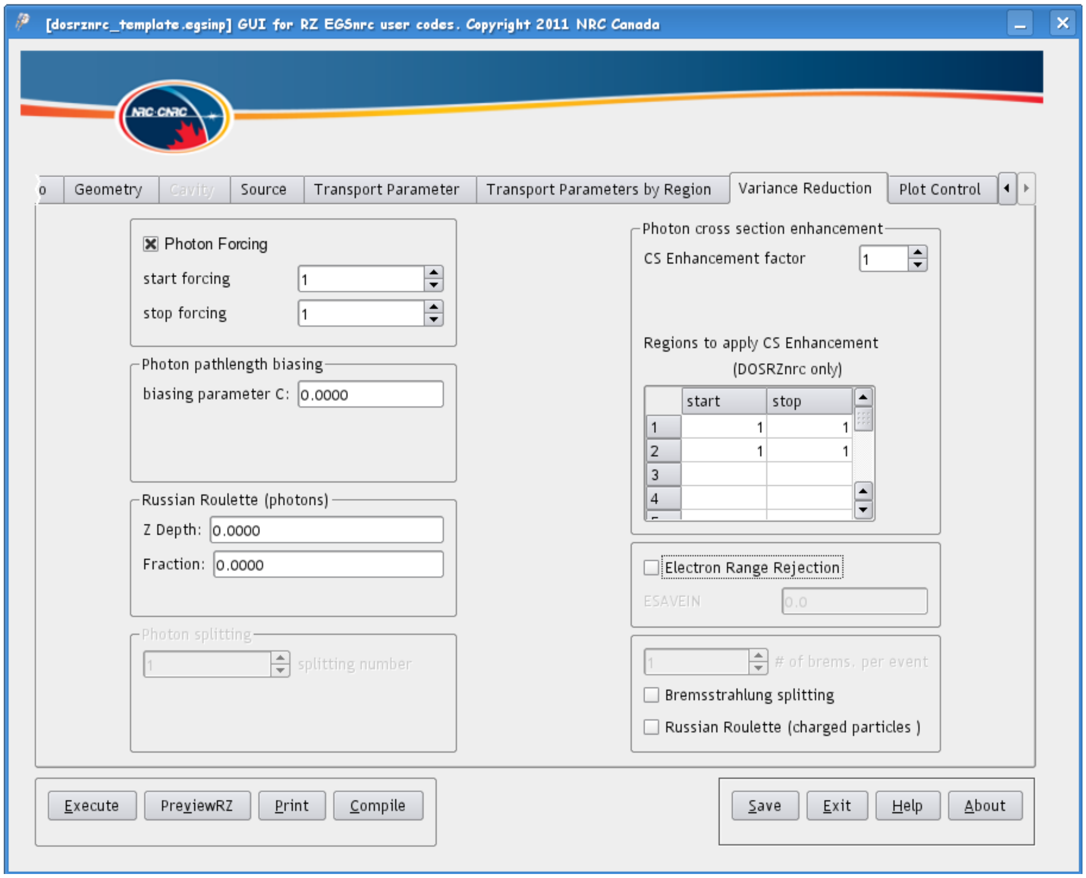
Turn ON Rayleigh scattering

	start	stop
1	1	1
2		
3		
4		
5		
6		

Figure 15: Transport Parameter per Regions Input for the RZ EGSnrc User Codes.

5.9 The Variance Reduction Tab

In this tab the user can define the parameters for the different variance reduction techniques incorporated in the specific user-codes. Techniques like electron range rejection, bremsstrahlung splitting and Russian Roulette are now implemented in EGSnrc. Pathlength biasing and photon forcing are implemented in all user-codes except FLURZnrc, which only includes photon forcing. Additionally photon cross section enhancement is available in DOSRZnrc and CAVRZnrc and a photon splitting technique is also available in CAVRZnrc. See the NRC User Codes Manual for information on these techniques (NRCC report PIRS-702[1]).



[dosrznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada

☒ Photon Forcing

start forcing: 1

stop forcing: 1

Photon pathlength biasing

biasing parameter C: 0.0000

Russian Roulette (photons)

Z Depth: 0.0000

Fraction: 0.0000

Photon splitting

1 splitting number

Photon cross section enhancement

CS Enhancement factor: 1

Regions to apply CS Enhancement (DOSRZnrc only)

	start	stop
1	1	1
2	1	1
3		
4		

☐ Electron Range Rejection

ESAVEIN: 0.0

1 # of brems. per event

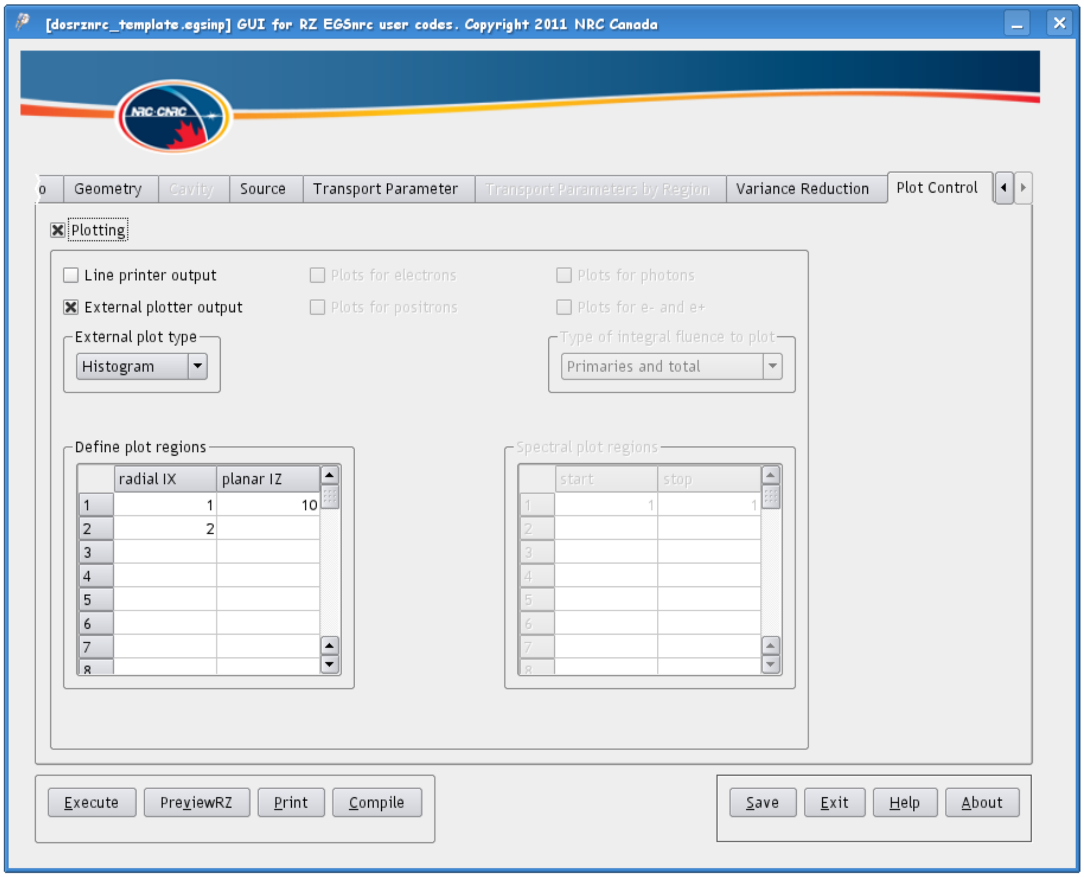
☐ Bremsstrahlung splitting

☐ Russian Roulette (charged particles)

Figure 16: Variance Reduction Parameters for the RZ EGSnrc User Codes.

5.10 The Plot Control Tab

This input block is only relevant for two of the user codes, DOSRZnrc and FLURZnrc. DOSRZnrc has a section of inputs to control plotting of dose *vs* depth/radius results (see figure 17).



☒ Plotting

☐ Line printer output ☐ Plots for electrons ☐ Plots for photons

☒ External plotter output ☐ Plots for positrons ☐ Plots for e- and e+

External plot type: Histogram

Type of integral fluence to plot: Primaries and total

Define plot regions

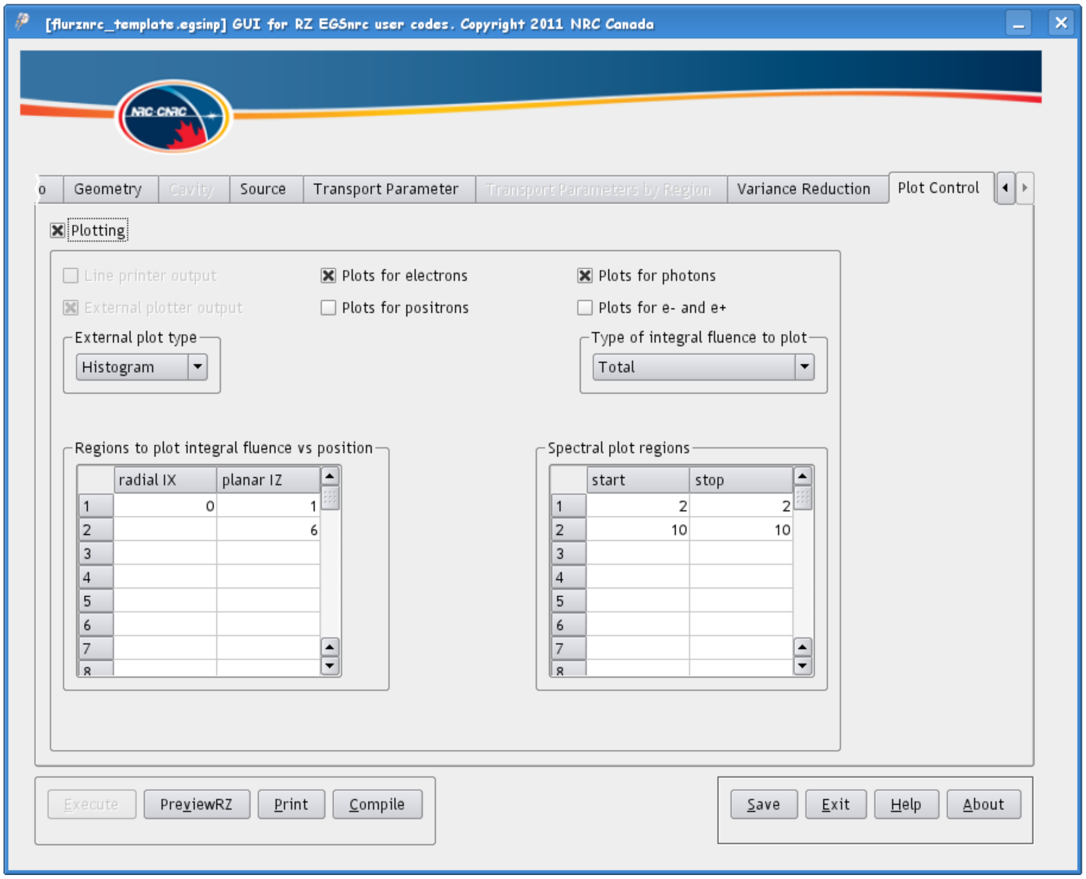
	radial IX	planar IZ
1	1	10
2	2	
3		
4		
5		
6		
7		
8		

Spectral plot regions

	start	stop
1	1	1
2		
3		
4		
5		
6		
7		
8		

Figure 17: Plot Inputs for the RZ EGSnrc User Code DOSRZnrc.

FLURZnrc has two distinct types of plotting outputs. One class of plots gives integral fluence *vs* position plots in various ways (*vs* depth, *vs* radius). The code also ouputs fluence spectra in specified regions (see figure 18).



[flurznrc_template.egsinp] GUI for RZ EGSnrc user codes. Copyright 2011 NRC Canada

☒ Plotting

☐ Line printer output
☒ Plots for electrons
☒ Plots for photons
☒ External plotter output
☐ Plots for positrons
☐ Plots for e- and e+

External plot type: Histogram

Type of integral fluence to plot: Total

Regions to plot integral fluence vs position

	radial IX	planar IZ
1	0	1
2		6
3		
4		
5		
6		
7		
8		

Spectral plot regions

	start	stop
1	2	2
2	10	10
3		
4		
5		
6		
7		
8		

Figure 18: Plot Inputs for the RZ EGSnrc User Code FLURZnrc.

[1] D. W. O. Rogers, I. Kawrakow, J. P. Seuntjens, B. R. B. Walters, and E. Mainegra-Hing, NRC User Codes for EGSnrc, Technical Report PIRS–702(RevC), National Research Council of Canada, Ottawa, Canada, 2010.

[2] I. Kawrakow, E. Mainegra-Hing, and D. W. O. Rogers, EGSnrcMP: the multi-platform environment for EGSnrc, Technical Report PIRS–877, National Research Council of Canada, Ottawa, Canada, 2003.

[3] I. Kawrakow, E. Mainegra-Hing, D. W. O. Rogers, F. Tessier, and B. R. B. Walters, The EGSnrc Code System: Monte Carlo simulation of electron and photon transport, Technical Report PIRS–701 (5th printing), National Research Council of Canada, Ottawa, Canada, 2009.

Index