

# AASI ▪ Advanced Alphaspectrometric Simulation

User Manual of AASI 2.0

## Software

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## Manual

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# 1. INTRODUCTION

AASI is an application for simulating the energy spectra of alpha particles. It uses a Monte Carlo method to produce artificial alpha spectra, enabling convenient studying of the phenomena and the different factors that affect the spectrum quality.

It is recommended to start by taking a look at one or more of the examples provided with AASI. Feel free to skip directly to the section 4. [Tasks & examples](#), and go through the [Example 1](#) to get an immediate feel to the use of this program.

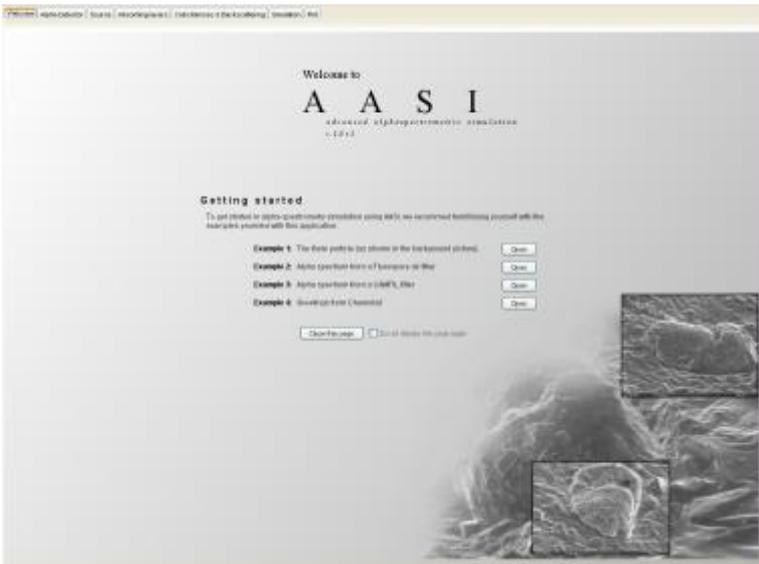
## 2. KEY FEATURES

- AASI offers a broad range of features to simulate alpha spectra in various situations:
- Alpha detector properties. The properties of the alpha detector can be taken into account to simulate measurements made with a specific detector model. See section 3.2.2 [The alpha detector properties](#) for details.
- Radiation source properties. Different type of radiation sources with user-specified nuclide composition can be taken into account. See section 3.3.3 [The radiation source properties](#) for details
- Material between the detector and source. Different layers of absorbing materials may be defined. See section 3.4.1 [Absorbing layers](#) for details
- Coincidence and backscattering studying. Coincidences between the alpha particles and electrons / x-rays can be taken into account for simulating the spectra. See section 3.5.1 [Backscattering](#) and [Coincidences](#) for details
- Type of simulation. Geometric detection efficiency in addition to the energy spectra may be calculated. See section 3.5.2 [Geometric efficiency calculation for details](#).
- Plotting and visualisation. The simulation results, i.e. the alpha particle energy spectra can be instantly plotted and further saved into file or printed. See section 3.7.1 [Displaying alpha spectra in the plot page](#) for details.

## 3. THE INTERFACE

The different aspects concerning alpha radiation are grouped into pages that contain the respective features. When editing the values of the parameters in the numeric fields, remember to press enter to make sure the changes are applied.

### 3.1. The welcome page



The welcome page is the first thing you will see when you start AASI for the first time (and subsequent times, unless you disable it). The welcome page contains version information, as well as controls that allow you to open example simulations included with AASI. You may control the behaviour of the welcome page using the following controls:

#### 'Do not display this page again' checkbox

Do not display this page again

When checked this option prevents the welcome page from being displayed when you start AASI. If you later change your mind, you may open the welcome screen using the *Help* → *Show welcome page* menu item. You may then uncheck the box and the welcome page will be displayed when you start the application.

#### Close welcome page button

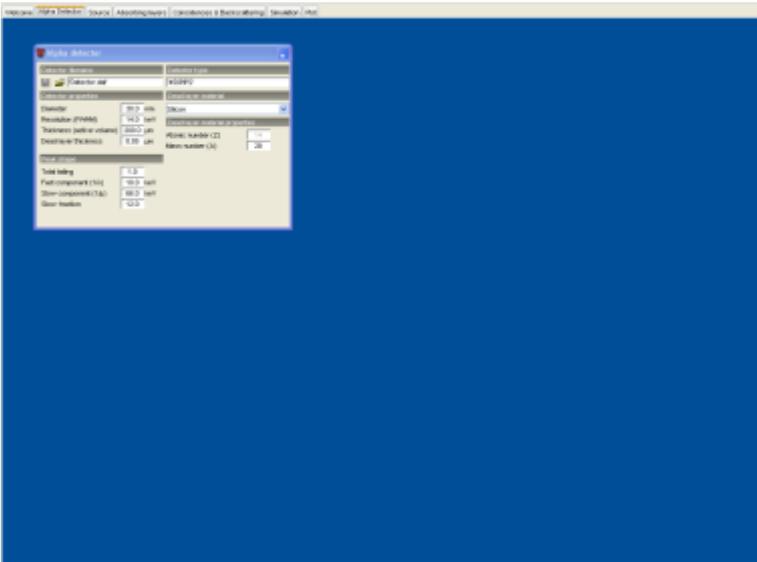
Close this page

Do not display this page again

Closes the welcome page. If closed, you may open the welcome page using the *Help* → *Show welcome page* menu item.

To open an example file, use the buttons next to the example descriptions. For more information about the examples, see section 4. [Tasks & examples](#).

## 3.2. The detector page



Here you can edit the detector properties as well as manage detector files. It is important to note that each simulation is associated with a detector, whose properties can be saved and loaded independently from the rest of the parameters. This page contains only a single window.

### 3.2.1. Loading and saving detector files

The detector properties are described in a separate file and you can save and load them using the user interface. The detector files should be saved using the extension `.det`, to avoid confusion with file types, although this is not strictly necessary.

**Important:** When a simulation is saved, a reference to the detector used with the simulation is also saved. When a saved simulation is opened, AASI will look for the corresponding detector in the same location as the opened simulation and, failing that, in the `detectors` subdirectory of your AASI directory. The final fallback will be the file `Detector.det` in `AASI/bin` directory, it will be used when all else fails.

The detector management is handled by two buttons:

#### Open detector button



Loads detector properties from a file. Pressing the button pops up a file selection dialog from which the desired detector file can be selected.

#### Save detector button



Saves the detector properties into a file. Pressing the button pops up a file selection dialog which can be used to specify the file name.

### 3.2.2. The alpha detector properties

Detector properties have an effect on the alpha particle peak shape. In this window the detector properties are characterised. Once you have determined the properties of your detector, and

saved the to a file, you do not need to modify them later in subsequent simulations. The properties of the detector are divided into groups:

### *General properties*

#### **Diameter**

Detector properties	
Diameter	30.0 mm
Resolution (FWHM)	14.0 keV
Thickness (active volume)	200.0 $\mu\text{m}$
Dead layer thickness	0.05 $\mu\text{m}$

The diameter of the active detector volume. Alpha particles emitted from the source are registered as pulses by the detector when they enter this volume.

#### **Resolution**

Detector properties	
Diameter	30.0 mm
Resolution (FWHM)	14.0 keV
Thickness (active volume)	200.0 $\mu\text{m}$
Dead layer thickness	0.05 $\mu\text{m}$

The detector Full Width at Half Maximum, is defined in here as the width of the gaussian part of the detector response. The total response is a convolution of the gaussian and exponential parts.

#### **Thickness**

Thickness (active volume)	200.0 $\mu\text{m}$
Dead layer thickness	0.05 $\mu\text{m}$

The thickness of the active volume of the detector. The active volume means the volume that is actually able to detect incoming alpha particles.

#### **Dead layer thickness**

Thickness (active volume)	200.0 $\mu\text{m}$
Dead layer thickness	0.05 $\mu\text{m}$

The thickness of the dead layer of the detector. The dead layer is a thin layer of material on the surface of the detector that does not register incoming alpha particles. The dead layer contributes to the energy loss of the alpha particles. (See, however, page 24).

## Peak shape properties

### Total tailing

Total tailing	1.0
Fast component (1/λ)	10.0 keV
Intermediate component (1/μ)	66.0 keV
Slow component (1/η)	1000.0 keV
Fast/Intermediate area ratio	12.0
Slow/Intermediate area ratio	0.25

The total amount of peak tailing to apply (0 = none, 1= full). This parameter allows regulation of how much tailing is desired in the simulation. If full tailing is used, all pulses registered by the detector are distributed according to the exponential and Gaussian parts of the detector response.

### Fast component

Total tailing	1.0
Fast component (1/λ)	10.0 keV
Intermediate component (1/μ)	66.0 keV
Slow component (1/η)	1000.0 keV
Fast/Intermediate area ratio	12.0
Slow/Intermediate area ratio	0.25

Used to specify the so-called “fast” component (the component that decreases rapidly) of the triple exponential tail by giving the mean of the first of the three exponential envelopes.

### Intermediate component

Total tailing	1.0
Fast component (1/λ)	10.0 keV
Intermediate component (1/μ)	66.0 keV
Slow component (1/η)	1000.0 keV
Fast/Intermediate area ratio	12.0
Slow/Intermediate area ratio	0.25

Used to specify the so-called “intermediate” component (the component that decreases with intermediate speed) of the triple exponential tail by giving the mean of the second of the three exponential envelopes.

### Slow component

Total tailing	1.0
Fast component (1/λ)	10.0 keV
Intermediate component (1/μ)	66.0 keV
Slow component (1/η)	1000.0 keV
Fast/Intermediate area ratio	12.0
Slow/Intermediate area ratio	0.25

Used to specify the so-called “slow” component (the component that decreases slowly) of the triple exponential tail by giving the mean of the last of the three exponential envelopes.

### Fast / Intermediate area ratio

Total tailing	1.0
Fast component (1/λ)	10.0 keV
Intermediate component (1/μ)	66.0 keV
Slow component (1/η)	1000.0 keV
Fast/Intermediate area ratio	12.0
Slow/Intermediate area ratio	0.25

This area ratio is used to specify the ratio between the areas of the fast and intermediate exponential components. This property can be used to fine tune the tailing effects together with the slow, intermediate and fast component properties.

### Slow / Intermediate

Total tailing	1.0
Fast component (1/λ)	10.0 keV
Intermediate component (1/μ)	66.0 keV
Slow component (1/η)	1000.0 keV
Fast/Intermediate area ratio	12.0
Slow/Intermediate area ratio	0.25

Area ratio is used to specify the ratio between the areas of the slow and intermediate exponential components. This property can be used to fine tune the tailing effects together with the slow, intermediate and fast component properties.

## Dead layer properties

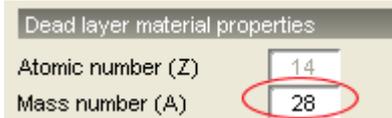
### Dead layer material list



Dead layer material  
Silicon

The dead layer material list allows you to select the material of the dead layer of the detector. The dead layer contributes to the energy-loss of an incoming alpha particle.

### Dead layer material mass number

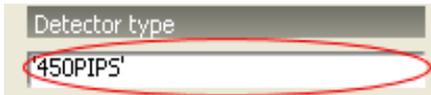


Dead layer material properties  
Atomic number (Z) 14  
Mass number (A) 28

Used to specify an isotope of the material selected in the dead layer material list.

## Other properties

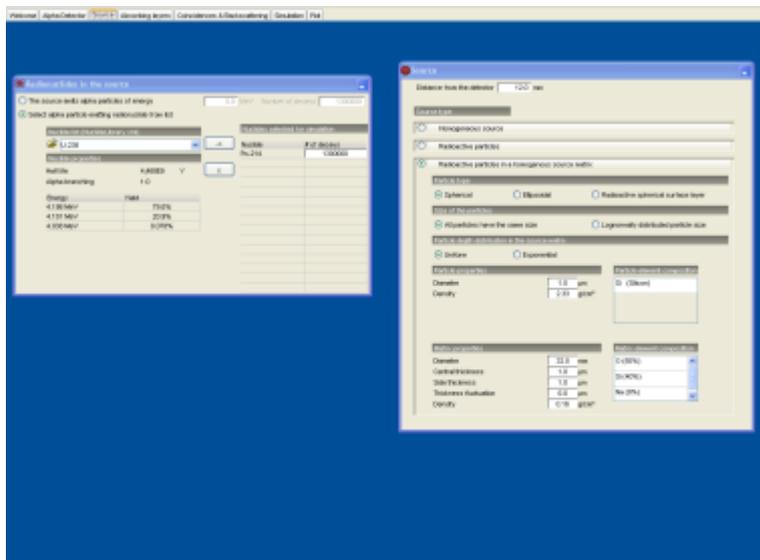
### Detector type



Detector type  
450PIPS

Detector type is a user-specified descriptive text that characterises the detector. E.g. 450 PIPS could mean that PIPS detector is used with an area of 450 mm<sup>2</sup>.

## 3.3. The source page



By source we mean the alpha emitting radionuclides specified by the user and the material in which they are contained. The source is composed of materials (not necessarily the same elements as the radionuclides) in which the alpha particle energy loss occurs. Example: Source material may be UO<sub>2</sub>, but the alpha particle energy deposition is calculated only for the radionuclides selected by the user from the nuclide list, e.g. <sup>239</sup>Pu, meaning that <sup>239</sup>Pu nuclides are present in UO<sub>2</sub> matrix.

Specifying the radiation source consists of defining the alpha particle emitting radionuclides present in the source and how they are distributed in the source matrix. For example, aerosol

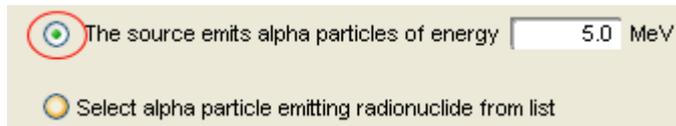
particles containing alpha particle emitting radionuclides on their surface (such as radon progeny) may be distributed in an air filter composed of stable material.

The simulation can be done either by specifying the energy of the alpha particles emitted from the source, or by using library data on radionuclides.

### 3.3.1. Specifying the alpha particle energy

Sometimes it may be useful to assume that the source emits alpha particles of given energy i.e. no specific radionuclides are selected for the simulations. This can be done using the following controls. Note, however, that in this case the coincidence and backscattering features are unavailable.

#### **'The source emits alpha particles of energy' button**



The source emits alpha particles of energy  MeV

Select alpha particle emitting radionuclide from list

Selects an alpha emitter that emits alpha particles of given energy to be simulated.

Selecting the 'The source emits alpha particles of energy' button enables the following controls:

#### 'The emitted energy' field

MeV

Sets the energy in MeV of the alpha particles emitted from the source. Values are required to be  $> 0$ .

#### 'The number of decays' field

Number of decays:

Sets the number of decays, i.e. the number of alpha particles emitted to simulate. Values are required to be  $> 0$ .

### 3.3.2. Specifying the alpha particle emitting nuclide

AASI includes an extensive library of data on alpha particle emitting radionuclides, based on the ENSDF database. To simulate a source with specific nuclides as the alpha emitters, use the following controls:

#### 'Select alpha particle emitting radionuclide from list' button

The source emits alpha particles of energy  MeV  
 Select alpha particle emitting radionuclide from list

Selects a nuclide to be used as the alpha emitter. Selecting this option enables further options allowing you to choose the nuclides and the library to use.

Selecting this option allows you to choose the alpha emitter from a list of radionuclides and enables the following controls:

#### The 'open library' button

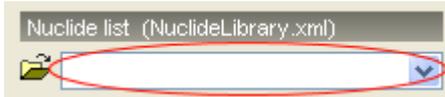
Nuclide list (NuclideLibrary.xml)

The open library button allows you to open a nuclide library from which to select the nuclides for simulation. Pressing this button will open a file chooser dialog from which you may choose the appropriate library. The nuclides in the library will then be displayed in the [nuclide selection list](#).

AASI uses two libraries:

- NuclideLibrary.xml - the basic library with data on the most important alpha-emitting radionuclides. This library is based on the ENSDF radionuclide data.
- PuCoincidences.xml - a special library with additional data needed for the coincidence and backscattering calculations.

### The nuclide selection list



The nuclide selection list allows you to select a nuclide from currently loaded nuclide library (the name of the library is displayed above). Once the nuclide is selected, information about it will be displayed below, and it may be moved to the selection using the [add nuclide to selection](#) button.

### The 'add nuclide to selection' button



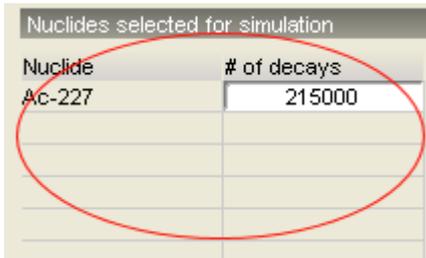
The add nuclide to selection button adds the nuclide selected in the [nuclide selection list](#) into the [nuclides selected for simulation table](#). The nuclide is now set as an alpha emitter in the source for the simulation.

### The 'remove nuclide from selection' button



The remove nuclide from selection button removes the nuclide selected in the [nuclides selected for simulation table](#).

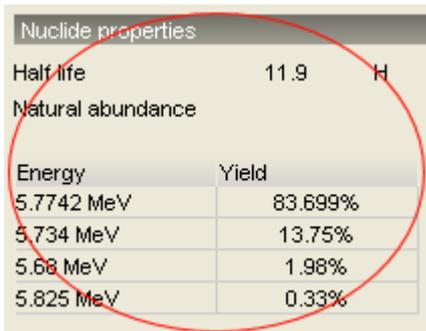
### The 'nuclides selected for simulation' table



Nuclide	# of decays
Ac-227	215000

The nuclides selected for simulation table displays the nuclides that will be used in the simulation. For each nuclide to be used, a name and number of decays is displayed. You can specify the number of decays for each nuclide as desired, values are required to be  $> 0$ . If the nuclide has coincidence data, its name will be displayed in blue color.

### The nuclide info view



Nuclide properties		
Half life	11.9	H
Natural abundance		
Energy		
5.7742 MeV	Yield	
	83.699%	
5.734 MeV	13.75%	
5.68 MeV	1.98%	
5.825 MeV	0.33%	

The nuclide info view displays information about the nuclide selected currently in the [nuclide selection list](#). Half life, natural abundance and alpha lines are shown.

### 3.3.3. The source properties

The distance of the source from the detector and the source type are given here. You can define whether the emitters are in a homogeneous source, in particles of known properties or in particles embedded in a source matrix.

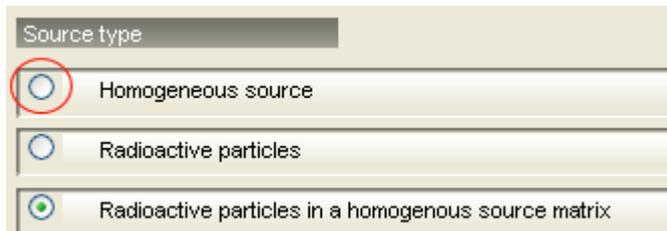
To specify the distance of the source from the detector use the following control:

#### The 'source-detector distance' field

 Distance from the detector 12.0 mm Specifies the distance of the source from the detector. The distance is measured from the top surface of the source (or the highest point in case of convex / concave sources).

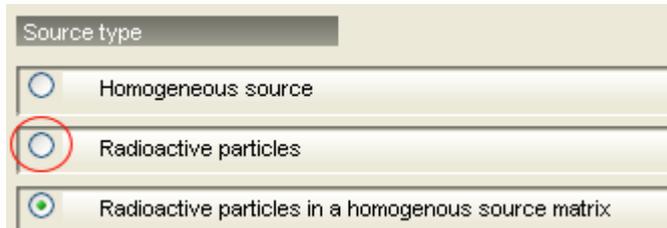
To select how the alpha emitters are distributed in the source use the following controls:

#### The 'homogeneous source type' button

 Source type  
 Homogeneous source  
 Radioactive particles  
 Radioactive particles in a homogenous source matrix

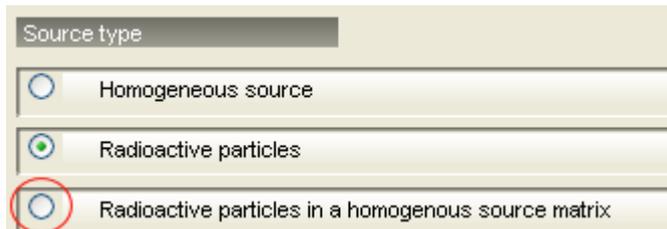
The alpha particle emitters are homogeneously distributed into a source matrix.

#### The 'radioactive particles source type' button

 Source type  
 Homogeneous source  
 Radioactive particles  
 Radioactive particles in a homogenous source matrix

The alpha particle emitting material is in the form of radioactive particles.

#### The 'radioactive particles in homogeneous source matrix type' button

 Source type  
 Homogeneous source  
 Radioactive particles  
 Radioactive particles in a homogenous source matrix

The alpha particle emitting radionuclides are present in particles of known properties. In addition, these particles are embedded in a homogeneous matrix.

### 3.3.3.1. Homogeneous source

In this source type the alpha particle emitters are homogeneously distributed in the source matrix of following properties:

#### The source diameter

Source properties	
Diameter	30.0 mm
Central thickness	0.12 $\mu\text{m}$
Side thickness	0.12 $\mu\text{m}$
Thickness fluctuation	0.0 $\mu\text{m}$
Density	18.95 $\text{g}/\text{cm}^3$

The source is assumed to be cylindrical in shape, and this is the diameter of the cylinder.

#### Central thickness

Source properties	
Diameter	30.0 mm
Central thickness	0.12 $\mu\text{m}$
Side thickness	0.12 $\mu\text{m}$
Thickness fluctuation	0.0 $\mu\text{m}$
Density	18.95 $\text{g}/\text{cm}^3$

The thickness of the source at its center. This can be used together with the side thickness to specify a source that has convex or concave upper surface (the surface facing the detector). When central thickness is modified, side thickness is automatically set to match.

#### Side thickness

Central thickness	0.12 $\mu\text{m}$
Side thickness	0.12 $\mu\text{m}$

The thickness of the source at its side. This can be used together with the central thickness to specify a source that has convex or concave upper surface (the surface facing the detector)

#### Thickness fluctuation

Thickness fluctuation	0.0 $\mu\text{m}$
Density	18.95 $\text{g}/\text{cm}^3$

Standard deviation of normally distributed thickness fluctuation.

#### Density

Thickness fluctuation	0.0 $\mu\text{m}$
Density	18.95 $\text{g}/\text{cm}^3$

The density of the source material.

The source material can be defined using the following controls:

#### 'Source element composition' table

Source element composition
C (Carbon)

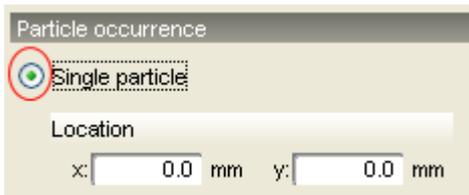
This table displays the elemental composition of the source. By clicking on the white area of table you are able to edit the material. See section 3.7 [editing materials with the material editor](#).

### 3.3.3.2. Radioactive particles

In this type of source the alpha particle emitters are distributed in particles of different properties. You have several options to control the type of particles to be used in the simulations:

*Particle occurrence* defines how particles are located on the sample:

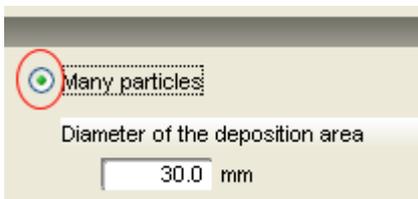
#### 'Single particle' button



The location of the single radioactive particle can be edited with the two fields for x and y - coordinates. The origin of the coordinate system coincides with the symmetry axis of the detector.

*Important:* This option disables the lognormal size distribution.

#### 'Many particles' button



Radioactive particles are randomly distributed into the deposition area whose diameter is given by the user.

*Particle type* defines the shape of the particles and how alpha emitters are distributed within them.

#### 'Spherical particle type' button



Spherical shape is used for the homogeneous particle(s).

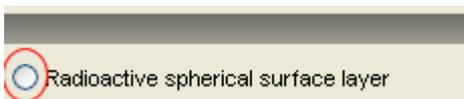
#### 'Ellipsoidal particle type' button



Ellipsoidal shape is used for the homogeneous particle(s) simulated.

*Important:* This option disables the use of a lognormal size distribution. All particles are considered to have the same size instead.

#### 'Spherical surface layer type' button



Radioactive material is distributed on the surface of spherical particles.

*Particle size* defines the size of the particles used in the simulation.

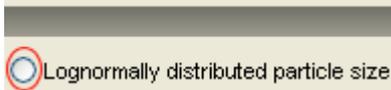
*Important:* This option is not available when the single particle option is used

#### 'All particles have the same size' button



All particles have the same size defined in an item available in the particle properties.

## 'Lognormally distributed particle size' button



Parameters of the lognormal distribution are given in an item available in particle properties.

The lognormal distribution of the particle sizes is characterised by mean diameter and geometric standard deviation. A property for constraining the maximum size of the particles is also used to prevent the improbable and undesirable cases of extremely large particles.

The number of decays for each generated particle is assumed to be proportional to the mass of the particle.

*Important:* This option is not available if single particle or ellipsoidal particle type are selected

*Particle properties* defines the properties of the particles based on the *occurrence*, *type* and *size* options mentioned above. It is important to realize that not all properties are available with all combinations of options. For instance specifying a lognormal size distribution obviously excludes the particle size property but presents the parameters of the distribution for editing instead.

## Particle diameter

Diameter   $\mu\text{m}$

The diameter of the particle(s) to simulate.  
*Only available with spherical particle type.*

## Particle X diameter

X diameter   $\mu\text{m}$

The diameter of the particle(s) along the X - axis.  
*Only available with ellipsoidal particle type.*

## Particle Y diameter

Y diameter   $\mu\text{m}$

The diameter of the particle(s) along the Y - axis.  
*Only available with ellipsoidal particle type.*

## Particle Z diameter

Z diameter   $\mu\text{m}$

The diameter of the particle(s) along the Z - axis. This is the axis that points towards the detector.  
*Only available with ellipsoidal particle type.*

## Mean diameter

Mean diameter   $\mu\text{m}$

The count mean diameter of the particle(s).  
Values must be  $\geq 0.2 \mu\text{m}$   
*Only available with lognormal size distribution*

## Geometric standard deviation

Geometric standard deviation

The geometric standard deviation of the diameter.  
*Only available with lognormal size distribution*

## Diameter ceiling

Diameter ceiling

5.0  $\mu\text{m}$

The maximum diameter of the particle(s).  
*Only available with lognormal size distribution*

## Particle density

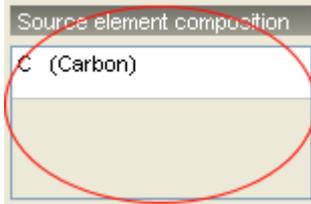
Density

2.11  $\text{g/cm}^3$

Density of the particles.

The particle material can be defined using the following controls:

## 'Particle element composition' table



Source element composition
C (Carbon)

This table displays the elemental composition of the particles. By clicking on the white portion of table you will be able to edit the material. See section 3.7 [editing materials with the material editor](#).

### 3.3.3.3. Radioactive particles in a homogeneous matrix

In this type of source, the alpha particle emitting particles are distributed in a homogeneous source matrix. When this type of source is selected, you must define both the particle and the source matrix properties.

For the particles the procedure is similar to the option of radioactive particles. Except that:

- Single particle simulation is not supported in this scheme
- Since the particles are now embedded in the source matrix, it is possible to define how the particles have penetrated the matrix. Use the following controls:

#### 'Uniform depth distribution' button

 Specifies that uniform distribution is used in distributing the particles into the source matrix.

#### 'Exponential depth distribution' button

 Specifies that exponential distribution is used in distributing the particles into the source matrix. The parameters of the exponential depth distribution can then be edited in the particle properties.  
*Only available with spherical particles, or spherical surface layer.*  
*Disables matrix side thickness, a cylindrical source is assumed with this option.*

- Particle properties for specifying the exponential depth distribution are included. The rest of the particle properties are same as in the radioactive particles source case:

#### Percentage to distribute exponentially

 The percentage of the particles to be distributed exponentially into the source matrix. The rest are on the surface of the matrix.  
*Only available with exponential depth distribution*

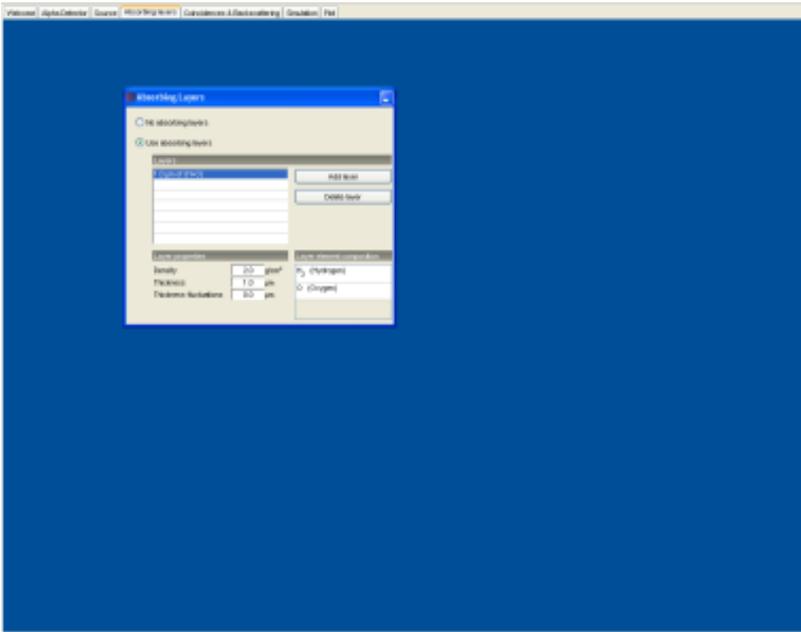
#### Mean penetration depth

 The mean penetration depth of the particles in the source matrix.  
*Only available with exponential depth distribution*

The source matrix housing the particles is defined in the same way as in the option of homogeneous source, except that:

- Only central thickness is used if exponential depth distribution is selected. The source matrix is considered to be cylindrical

### 3.4. The absorbing layers page

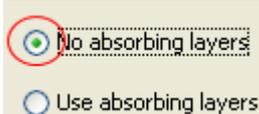


The absorbing layers page allows you to add layers of different materials between the radiation source and the detector. This page contains only one window.

#### 3.4.1. Using absorbing layers

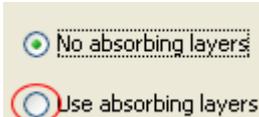
To enable or disable the use of absorbing layers use the following controls:

##### The 'No absorbing layers' button



Disables the use of absorbing layers. This button provides a convenient way to remove the effects of the absorbing material layers in a simulation.

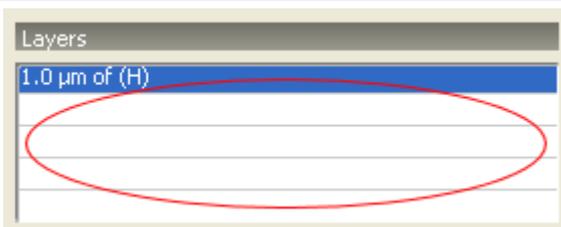
##### The 'Use absorbing layers' button



Enables the use of absorbing layers. The layers can now be added, removed and edited via further controls.

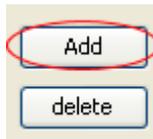
To add, remove and edit the absorbing layers use the following controls:

##### The layers table



Use this table to select the absorbing layer to edit by left clicking the corresponding row. When a layer is selected its properties are then shown in the [layer density](#), [thickness](#) and [thickness fluctuation](#) fields. The layer material is displayed in the [layer element composition table](#) and the layer can be removed with the [delete layer](#) button.

### The 'add layer' button



This button adds an absorbing layer to the layers table. The layer will initially have thickness of 1  $\mu\text{m}$ , density of 1  $\text{g}/\text{cm}^3$  and elemental composition of hydrogen. The layer can now be selected in the [layers table](#) and its properties edited.

### The 'delete layer' button



This button deletes the layer currently selected in the layers table. The selected layer is denoted by highlighted background. The deleted layer is then lost and won't be considered in the simulation.

### The layer density field

Layer properties	
Density	0.0013 $\text{g}/\text{cm}^3$
Thickness	1.0 $\mu\text{m}$
Thickness fluctuations	0.0 $\mu\text{m}$

This field lets you specify the density of the currently selected layer.

### The layer thickness field

Layer properties	
Density	0.0013 $\text{g}/\text{cm}^3$
Thickness	1.0 $\mu\text{m}$
Thickness fluctuations	0.0 $\mu\text{m}$

This field lets you specify the thickness of the currently selected layer.

### The layer thickness fluctuations field

Layer properties	
Density	0.0013 $\text{g}/\text{cm}^3$
Thickness	1.0 $\mu\text{m}$
Thickness fluctuations	0.0 $\mu\text{m}$

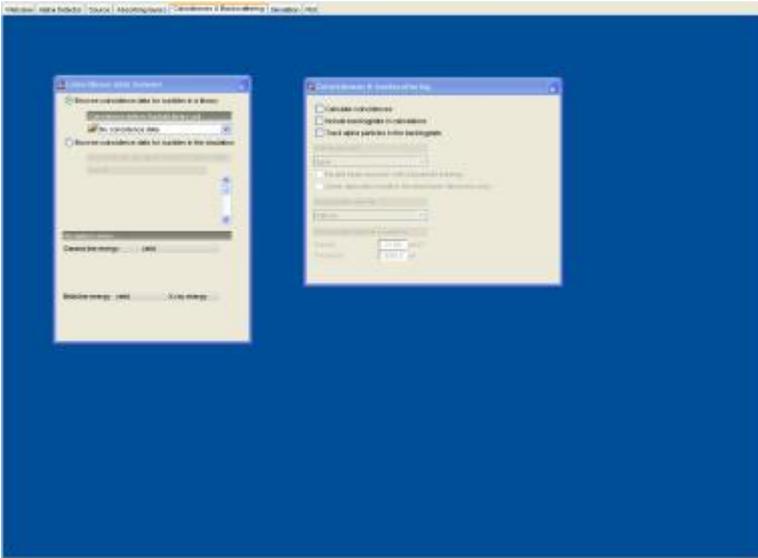
The standard deviation of the normally distributed thickness fluctuations of the currently selected layer.

### 'Layer element composition' table

Layer element composition	
H (Hydrogen)	

This table displays the elemental composition of the currently selected layer. By clicking on the white area of table you will be able to edit the material. See section 3.7 [editing materials with the material editor](#).

### 3.5. The coincidences & backscattering page



Two phenomena that may influence the alpha particle energy spectra are coincidences and backscattering. The former is caused by the coincident detection of the alpha particle and the particles (electrons, x-rays) emitted by daughter nucleus. The latter is caused by the alpha particles rebounding from the backing plate due to elastic scattering,

#### 3.5.1. Enabling coincidences and backscattering

**Important!** To enable coincidence or backscattering calculations, your nuclide library must contain additional data about the nuclides. For this purpose a library called PuCoincidences.xml is supplied with your AASI. Please note that the default library NuclideLibrary.xml does not contain the coincidence information! Use the coincidence data browser to verify that the nuclides you have selected into the simulation have this additional library data. Nuclides with coincidence data will be displayed with blue color in the '**nuclides selected for simulation**' table in the source page.

Note that the coincidence data format has changed, and the libraries from previous versions of AASI are now incompatible with version 2.0.

To include coincidence effects in your simulations use the following controls:

##### The 'Calculate coincidences' checkbox

Calculate coincidences  
 Store coincidence output in a file  
 Include backingplate in calculations  
 Track alpha particles in the backingplate

This checkbox enables or disables the calculation the coincidences between an alpha particle and electrons and x-rays.

##### The 'Store coincidence output in a file' checkbox

Calculate coincidences  
 Store coincidence output in a file  
 Include backingplate in calculations  
 Track alpha particles in the backingplate

This checkbox enables or disables the storing of the simulated coincidence data into a file. Use the coincidence output file field and coincidence output file selector to specify the filename.

### The 'Include backingplate in calculations' checkbox

Calculate coincidences  
 Store coincidence output in a file  
 Include backingplate in calculations  
 Track alpha particles in the backingplate

This checkbox enables or disables the use of backingplate in calculations.

### The 'Track alpha particles' checkbox

Calculate coincidences  
 Store coincidence output in a file  
 Include backingplate in calculations  
 Track alpha particles in the backingplate

Track alpha particles in the source backing plate.

*Important: thin source is assumed! Energy loss in the source matrix is assumed to be negligible!*

*This feature is only available with 'Include backing plate' option.*

### The 'Coincidence output selector' button

Coincidence output file  
 'measSetupId\_nuclideId.ccf'

Use this button to open up a file browser to choose the coincidence output file.

### The 'Coincidence output file' field

Coincidence output file

Give the path to the coincidence output file using this field.

### The backingplate material list

Backingplate material

The material of the backingplate has an impact on the backscattering effect. Use this list to choose the element the backingplate is composed of.

### The backingplate density

Backingplate material properties	
Density	7.874 g/cm <sup>3</sup>
Thickness	2000.0 μm
Atomic number (Z)	26
Mass number (A)	56

Use this field to specify the density of the backingplate material. Values in this field are required to be in the range (0, 23)

### The backingplate thickness

Backingplate material properties	
Density	7.874 g/cm <sup>3</sup>
Thickness	2000.0 μm
Atomic number (Z)	26
Mass number (A)	56

Use this field to specify the thickness of the backingplate in micrometers. The values are required to be > 0.

### The backingplate atomic number

Backingplate material properties	
Density	7.874 g/cm <sup>3</sup>
Thickness	2000.0 μm
Atomic number (Z)	26
Mass number (A)	56

This field displays the backingplate materials atomic number.

### The backingplate mass number

Backingplate material properties	
Density	7.874 g/cm <sup>3</sup>
Thickness	2000.0 μm
Atomic number (Z)	26
Mass number (A)	56

Use this field to specify an isotope of the backingplate material.

### The shielding model list

Shielding model	
Nigam	▼

Allows you to choose the shielding model for screened Rutherford scattering of electrons.

### The 'parallel beam emission' checkbox

Parallel beam emission with full particle tracking  
 Linear deposition model in the dead layer (electrons only)

Electrons are emitted parallel to the detectors symmetry axis, i.e. electrons impinge the the detector at 90 degree angle. This option is useful for backscattering studies.

### The 'Linear deposition model in the dead layer' checkbox

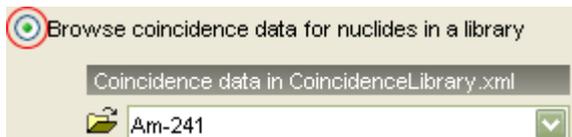
Parallel beam emission with full particle tracking  
 Linear deposition model in the dead layer (electrons only)

Electrons deposit part of their energy in the detected signal. Deposited energy in the forming of the pulse increases linearly with the depth.

### 3.5.2. Viewing coincidence data on nuclides

Use the coincidence data browser to view coincidence data for nuclides in a library or in the current simulation. You may open a library and select the nuclide whose data you want to view by using the following controls:

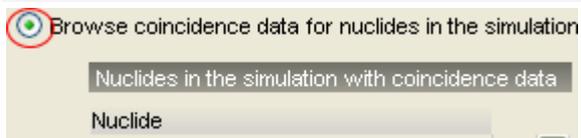
#### The 'Browse data for library' button



This button enables you to browse coincidence data for nuclides in a library. The nuclide library can be opened using the open library button below. Choose the nuclide whose data you want to view using the list right next to the open library button. The coincidence data for the selected nuclide will then be displayed in the bottom of the coincidence info browser. If the library you have opened has no nuclides with coincidence data, then the list will simply display 'no coincidence data' item.

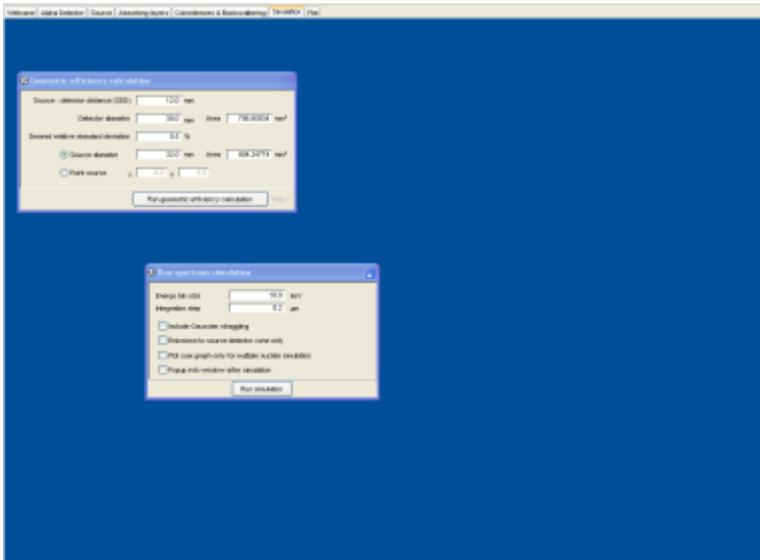
You can view the data for nuclides currently selected for the simulation by using the following controls:

#### The 'Browse data for simulation' button



This button enables you to browse coincidence data for nuclides currently selected for simulation. The table below displays all the nuclides in the current simulation with coincidence data. You may choose the nuclide whose data you want to view by selecting it in the table. The coincidence data for the selected nuclide will then be displayed in the bottom of the coincidence info browser. If the simulation currently has no nuclides with coincidence data, the table will be empty.

### 3.6. The simulation page



This page is used to run the geometric efficiency and spectrum simulation calculations. The windows on this page can also be used to set some properties of the calculations. This page contains two windows, one for geometric efficiency calculation, and another for the spectrum simulation.

#### 3.6.1. Simulation options and running

There are a variety of ways to launch the simulation calculation when a desired set of properties has been entered in the detector page and the source page. Using the calculation page provides the method with the most control over the simulation, such as a specific binning size and control over plotting and information to display about the simulation.

##### 3.6.1.1. Running the simulation using the simulation window

The simulation window allows you to set the binning size for energies of the spectra, apply Gaussian straggling and control the info window popup and multiple nuclide plotting behavior using the following controls:

###### The energy bin size

Energy bin size

Sets the output energy bin size for the simulation.

###### The 'include gaussian straggling' checkbox

Include Gaussian straggling

Uses Gaussian straggling in the energy loss calculations.

###### The 'Emissions in the source detector cone only' checkbox

Emissions to source detector cone only

Alpha particles will be emitted towards the detector only instead of all directions. This will reduce simulation time.

###### The integration step field

Integration step

In this field you may specify the length of the step used when calculating alpha particle energy loss.

### The 'plot sum graph only' checkbox

Plot sum graph only for multiple nuclide simulation

Controls the behaviour of plotting when multiple nuclides are selected for simulation. When this option is selected only the sum of the nuclides energies is plotted. When deselected the independent spectra of the nuclides will be plotted in addition to the sum.

### The 'popup info window' checkbox

Popup info window after simulation

When selected the simulation info browser is popped up. When deselected no info window is shown.

## 3.6.1.2. Running the simulation using the run menu

The run menu allows you to run the simulation quickly, without turning to the calculation page. All the options selected in the Simulation window are in use when you use the run menu. To launch the simulation use the *Run->Run simulation* menu item or the ctrl+r keyboard shortcut.

## 3.6.2. Geometric efficiency calculation

The geometric efficiency calculation window allows for calculating the geometric detection efficiency for a certain measurement setup. Like the simulation, the geometric efficiency calculation can be started in variety of ways.

### 3.6.2.1. Using the geometric efficiency calculation window

In the geometric efficiency calculation window the measurement setup can be specified using the following controls:

#### The source detector distance

Source - detector distance (SDD)

The distance of the source surface from the detector. Note that the source and the detector geometries are coplanar and this is the distance between the planes that contain them.

#### The detector diameter

Detector diameter

The diameter of the detector window for geometric efficiency calculation. The detector window geometry is a disc with this diameter, coplanar with the xy-plane.

### The desired standard deviation

Desired relative standard deviation

The desired relative standard deviation to achieve by the calculation. Smaller values will yield more accurate results at the cost of longer running time. At short source-detector distances smaller values may be used, but at long distances larger values may be needed.

### The 'source diameter' button

Source diameter

Specify the diameter of the source disc.

### The 'area' field

Area   
Offset

Specify the area of the source disc.

### The 'offset' field

Area   
 Offset

Specify the offset (lateral distance between the detector and source disc centers).

### The 'point source' button

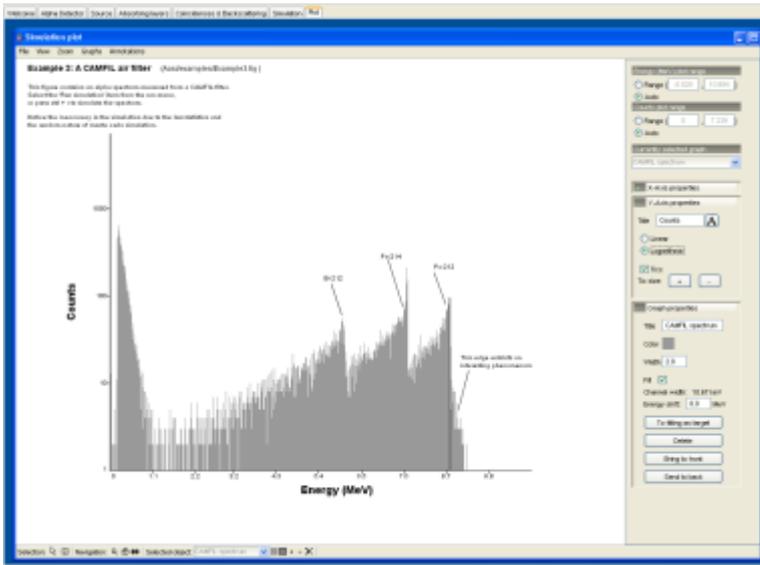
Point source x  y

With this option the source is a point in the xy plane. Note that the source-detector distance is the distance between the planes that contain the source and the detector.

## 3.6.2.2. Calculating geometric efficiency using the run menu

Using the run menu is a quick way to run the geometric efficiency calculation without turning to the calculation page. Selecting the *run geometric efficiency calculation* item or by invoking its keyboard shortcut ctrl+g in the run menu will cause the geometric efficiency calculation window to pop up. This can then be used exactly like the one in the calculation page.

### 3.7. The plot page



The plot page displays the spectrum simulation results. The plot page contains a single window that allows you to load previous results or measurements and display them together with your current session simulations. Saving the figures in different formats and printing are also supported.

#### 3.7.1. Displaying alpha spectra in the plot page

The plot page is automatically brought to the front by the program when a simulation is completed. This enables the user to quickly see the results, which are displayed as graphs of counts against energy. The plot page also contains tools for zooming and translating the graph display, as well as creating figures by editing axis titles, adding annotations and so on.

##### 3.7.1.1. The graph display properties

Some basic properties of the graph display can be set using the display properties pane on the right of the view. Use the following controls:

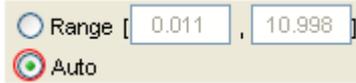
##### The 'Energy plot range' & 'Counts plot range' buttons



These buttons let you specify the range on the desired axis to be displayed in the graph display. These buttons enable the range fields to their right that can be used to specify the minimum and maximum value to be displayed. Press enter to apply the new range after typing in the desired value.

*Hint: pressing this button when it is selected will redraw the graph display with the values of the range fields, this can be useful when using the zoom or pan tools.*

### The 'Energy auto' & 'Counts auto' buttons



These buttons select automatic determination of plot range. When these buttons are selected and a new graph is introduced into the graph display, the display range will be set to be the minimum and maximum of the graphs in the graph display. Effectively ensuring that all data contained in the graphs is shown.

*Hint: pressing this button when it is selected will determine the range and redraw the graph display, this can be useful when using the zoom or pan tools.*

### The graph selection list



This list is used to select a graph to be set as currently selected. Once a graph is selected, its properties can then be edited in the Spectrum properties compartment. It is noteworthy that the graph displayed at this list is also used in some other places, most notably when saving graphs. See section 3.6.2 [Loading, saving and printing alpha spectra](#) for details.

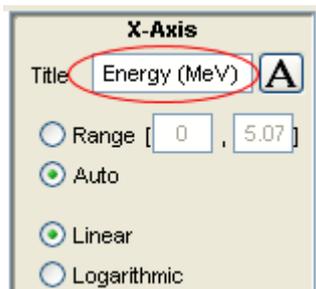
Alternatively, you may use the selection tool to select a graph. The selected graph is displayed in transparent red when the selection tool is activated.

The x- and y-axis specific properties can be edited in the x-axis and y-axis compartments. The compartments can be expanded by pressing the '+' symbol.



They will reveal the following controls:

### The 'X-Axis title' & 'Y-Axis title' fields



In this field you can set the title for the x- or y-axis. The font of the title can be changed using the button to the right of this field. Note that you need to press enter after you have typed the new title for the changes to be reflected in the graph display. Press enter to apply the new title.

### The 'Linear X-Axis' & 'Linear Y-Axis' buttons



This button selects linear scale to be used in the graph display for the x- or y-axis.

### The 'Logarithmic X-Axis' and 'Logarithmic Y-Axis' buttons



This button selects logarithmic scale to be used in the graph display for the x- or y-axis.

The currently selected spectrum properties can be edited by expanding the Spectrum properties compartment.



It will reveal the following controls:

### The graph title field

A control panel for graph title. It includes a text input field containing "Line energy (5.0 M)", a color selection field with a black square, a width input field with "1", and a fill checkbox which is unchecked. The text input field is circled in red.

This field is used to give edit the name of the graph. The name is used only as the display name in the graph selection list, but the user may change the name. Press enter to apply the new name.

### The graph color field

A control panel for graph color. It includes a color selection field with a black square, a width input field with "1", and a fill checkbox which is unchecked. The color selection field is circled in red.

This field is used to edit the color of the graph in the graph display. Clicking on this field will popup a color selector from which the desired color can be picked. This and the following option are useful when comparing graphs from different simulations.

### The graph width

A control panel for graph width. It includes a color selection field with a black square, a width input field with "1", and a fill checkbox which is unchecked. The width input field is circled in red.

This field is used to edit the width of the graph in the graph display. Note that widths smaller than 1 are allowed. Press enter to apply the new stroke width.

### The fill graph checkbox

A control panel for fill graph. It includes a color selection field with a black square, a width input field with "1", and a fill checkbox which is unchecked. The fill checkbox is circled in red.

Checking this box will make the space between the graph and the X-Axis (energy) appear filled by the graph color. This option can be useful when comparing many graphs to a specific graph.

### The 'To front' and 'To back' buttons

Two buttons: "To front" and "To back". Both buttons are circled in red.

These buttons affect the order in which the graphs are rendered onto the graph display. To front moves the current graph in front of all other graphs while To back button does the converse.

### The Energy shift field

A control panel for energy shift. It includes a text input field for "Channel width" with the value "10.667 keV" and another text input field for "Energy shift" with a red circle around it, followed by the unit "MeV".

This field is only available for graphs loaded from a .phd file. The graph may be shifted by the amount specified in the field. Pressing enter will apply the energy shift.

### 3.7.1.2. Navigating the graph display

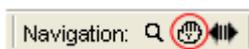
Sometimes it is desirable to view an area of interest in the graph without displaying the whole range of the energy spectrum. In such case, you may use the following controls:

#### The 'zoom tool' toggle button



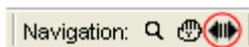
This button toggles the zoom tool on. Left-clicking on the graph display will then increase zoom in the view, displaying more detail near the clicked point. Right-clicking decreases zoom, displaying less detail but larger range. Dragging the mouse zooms to a specific region, specified by the drag rectangle. Dragging the mouse outside the axis will constrain the zoom to the nearest axis.

#### The 'pan tool' toggle button



This button toggles the pan tool on. Dragging on the graph display will move the display to the direction of the drag. Dragging the mouse outside the axis will constrain movement to the nearest axis.

#### The 'reset view' button



This button resets the view so that the whole spectrum range will be visible.

The graph display can also be navigated using the range fields on the display properties pane.

### 3.7.1.3. Annotating a figure

The figure that is shown on the graph display can be annotated by adding text and lines. There are two types of each object to add, plain objects and tag objects, e.g. for text there are text objects and text tag objects. The difference between the two is that plain objects are not affected by navigation such as zoom and pan, whereas the tag objects are. The plain objects are therefore suitable for adding a figure title or explanation of what the figure is about. The tag objects could be used for instance to add an explanation for a peak in the figure, in this case when the peak is panned out of view, the annotation would also.

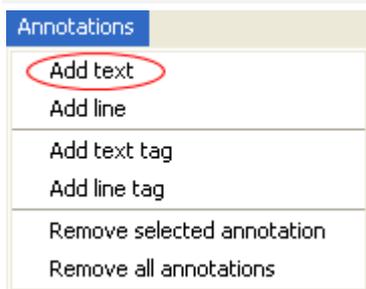
To select, add or edit an annotation use the following controls:

#### The 'selection' tool



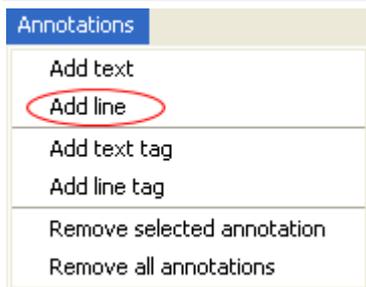
This button toggles the selection tool on. When this tool is selected, the handles of the annotations are displayed and you can use them to select annotations and edit them. You can select an annotation by left clicking its handle. Left clicking again on the handle of the selected annotation starts editing of the selected annotation.

### The *Annotations*→*Add text* menu item



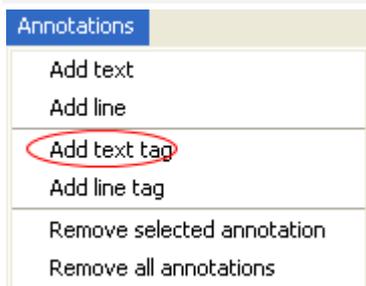
This item toggles the text annotation tool on. When this item is selected, left-clicking on the graph display will add a text annotation to the position of the click. You may then type in the text and use the button to the left of the textfield to change the font. To edit a previous text annotation use the select tool, select the lower left corner of the text annotation and left-click twice.

### The *Annotations*→*Add line* menu item



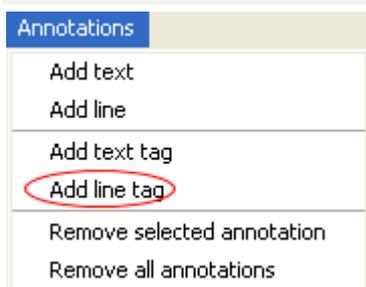
This item toggles the line annotation tool on. When this tool is selected, dragging the mouse in the graph display will result in a line annotation being added between the starting and ending point of the drag. To edit a previous line annotation use the select tool, select the beginning or ending point of the line and drag it to a new location.

### The *Annotations*→*Add text tag* menu item



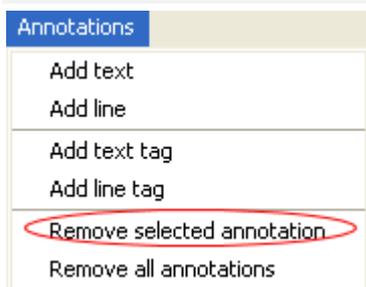
This button item the text tag tool on. When this tool is selected, left-clicking on the graph display will add a text tag to the position of the click. Note that you must add the tag into the visible space between the axii..

### The *Annotations*→*Add line tag* menu item



This item toggles the line tag tool on. When this tool is selected, dragging the mouse in the graph display will result in a line annotation being added between the starting and ending point of the drag. Note that you must add the line tag into the visible space between the axii.

### The *Annotations*→*Remove selected annotation* menu item

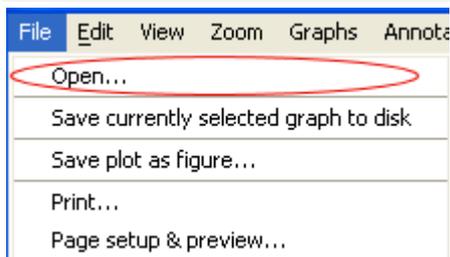


When selected, this item erases the currently selected annotation.

### 3.7.2. Loading, saving and printing alpha spectra

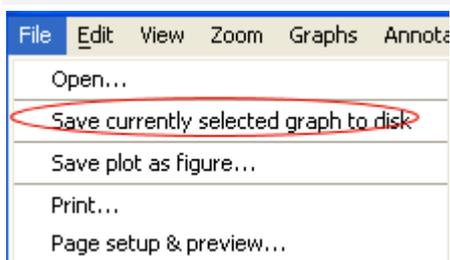
The plot page can also be used to load and save alpha spectra in various different formats. When saving spectra it should be noted that when the graph display is displaying several spectra, the one that will be saved is the currently selected spectrum. Use the following controls:

#### The *File*→*Open...* menu item



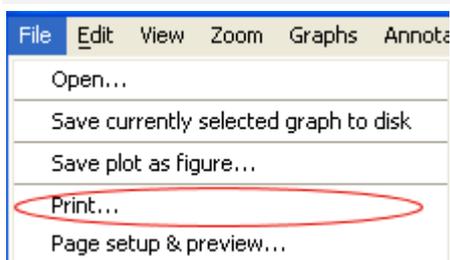
Adds a graph from a file into the graph display. Note that when loading .fig files, all graphs already in the graph display will be removed prior to loading. Loading a bitmap format will add it as an image annotation.

#### The *File*→*Save currently selected graph to disk* menu item



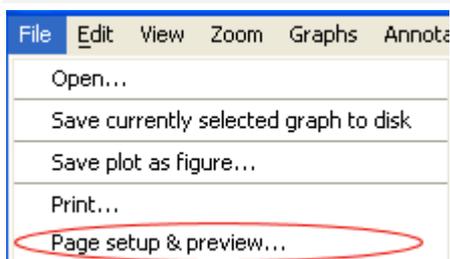
Saves the currently selected spectrum to file. Pressing the button pops up a filechooser dialog that lets you select the desired output filename and format. Only .phd, .graph and .fig files can then be subsequently read back to AASI.

#### The *File*→*Print...* menu item



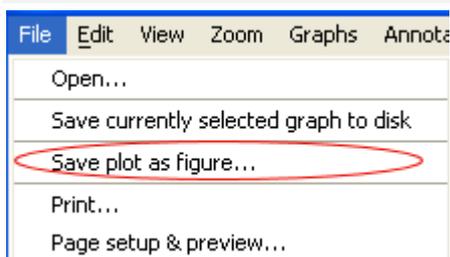
Prints the figure in the graph display. A print dialog is shown, allowing you to select the printer and paper options.

#### The *File*→*Page setup & preview...* menu item



Allows you to setup the page for printing. A dialog is shown that displays you a preview of the print and tools that allow you to reposition or enlarge the figure as it will appear on the printed page. Clicking ok will apply the settings, and they will be in effect from that point on. Cancel will discard the changes into the page setup.

#### The *File*→*Save plot as figure...* menu item



Saves the current plot as a figure, complete with all the graphs, annotations, axii and tics. The figure format may be chosen to be either a bitmap, scalable vector graphics or AASI figure. Only AASI figure (.fig) is editable with AASI after saving.

### 3.7.2.1. File formats for figures and graphs

AASI can open files in .phd, .graph and .fig formats, and save graphs in .phd, .graph, .fig, .eps, .ps, and .phd formats. Out of these formats .phd and .graph are best suited for further processing or analysis of data, and the rest are more suited for presentations and the like. Here is a summary of the file formats:

Format	Filename extension	can read	can write	description
Graph	.graph	yes	yes	The AASI graph format. ASCII, one graph. Format: x, c, y per row. Interpretation: x is the left edge of bin in MeV, c is the center of the bin in MeV, y is number of counts in that bin.
Figure	.fig	yes	yes	The AASI figure format. Binary, multiple graphs with annotations.
IMS2.0	.phd	yes	yes	IAEA message format, ASCII, an energy calibration under #gEnergy tag, consisting of channel - energy pairs. The reference point for the channel is the centroid. Channel contents are found under #gChannels tag. The channels are enumerated from 1...n in groups of 5
IEC	.iec	yes	no	Canberra exchange format, ASCII, much like the IMS2.0, except does not have human-readable tag names.
Adobe pdf	.pdf	no	yes	Portable document format, binary, scalable vector graphics.
PostScript	.ps	no	yes	Printer command language format, scalable vector graphics.
Encapsulated PostScript	.eps	no	yes	Printer command language format, scalable vector graphics.
Portable network graphics	.png	yes	yes	Bitmap format.
Compuserve graphics interchange	.gif	no	yes	Bitmap format.

### 3.8.Editing materials with the material editor

The material editor is used to edit the materials of various components in the simulation setup. A material in AASI is an element, a compound or a mixture. The material editor allows you to edit these types of materials, or to choose a material from a list of presets.

To choose a material from the presets use the following controls:

#### The presets list



Selects the material from a list of presets.

To choose between the type of material to edit, use the following controls:

#### 'Compound material' button



Selects the material type to be compound. This is also the recommended material type for single element materials.

#### 'Mixture material' button



Selects the type of material to be mixture.

To inspect the properties of the current material you may plot its stopping power:

#### Plot stopping power button



This button plots the stopping power of the material currently in the material editor. A plot window is popped up that displays the graph of the stopping power. The plot can be navigated in the same way as the plot page.

### 3.8.1. Editing compound materials

When a compound material type has been selected, the chemical composition of the compound can then be specified by giving its molecular or empirical formula using the following control:

#### 'Molecular formula' field



Use this field to give the empirical or molecular formula of the compound. Use chemical symbols to specify the constituent elements and subscripted number to denote the number of atoms of that element. Use superscripted number in front of element symbol to denote an isotope. You can change a number from subscript to superscript by up and down arrows. The elements in the compound are enumerated to the right of the field.

You may also give the formula using the periodic table window and clicking the desired elements. See 3.7.4 [using the periodic table window](#).

### 3.8.2. Editing mixture materials

When a mixture material type has been selected further controls for mixture editing will be enabled. The mixture is specified by selecting the elements in the mixture

#### Element list



Use this list to select an element for the mixture. The element can then be moved to the mixture elements table using the add element to mixture button. When an element is selected in the list, information about it will be displayed below.

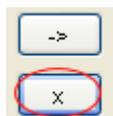
The element list also includes two molecules:  $\text{UO}_2$  and  $\text{ThO}_2$  with specific stopping power parameterisations available from literature.

#### Add element to mixture button



Use this button to add an element into the mixture elements table. The element in the mixture can then be edited.

#### Remove element from mixture button



Use this button to remove an element from the mixture elements table.

### Mixture elements table

Elements selected for simulation					
Element	Z	A	Mass percentage	Atoms in molecule	
Silicon	14	28	41.7%	1	1
Carbon	6	12	58.3%	1	1

Use this table to define the mixture when the constituent elements have been selected. Use the *mass percentage column* by either dragging the histograms or clicking mouse button and entering a value to specify the relative mass percentage of the element in the mixture.

The *A column* may be used to specify an isotope element.

You may also give the elements in the mixture by using the periodic table window and clicking the desired elements.

### 3.8.3. Using material presets

Material presets allow loading and saving of materials defined using the material editor. You can save common or often needed materials as presets when the desired compound or mixture has been defined.

To save the material currently in the material editor as a preset use the following controls:

#### Save preset button



Clicking this button allows you to save the material currently under editing as a preset. You will be prompted for the name and density of the material. After you have saved the material it will become available in the preset list for quick recall.

To remove the currently selected preset from the list of preset materials use the following controls:

#### Save preset button



Clicking this button will remove the preset material currently displayed in the preset list view.

### 3.8.4. Using the periodic table window

The periodic table window can be used to specify the elements used in the material.

For compound materials:

- Click the desired element with mouse. The element you clicked will be added to the compound formula field. Subsequent clicks on the same element will increment the number of atoms for that element e.g. clicking O twice would add O<sub>2</sub> into the compound formula field.

For mixture materials:

- Click the desired element with mouse. The element you clicked will be added into the mixture elements table as a new row.

### 3.9. The simulation info browser

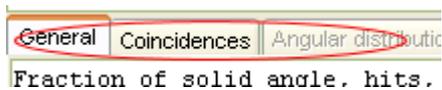
The simulation info browser can be used to view additional information about the last simulation run. It may optionally be automatically opened after simulation in the same fashion as the plot page, or it may be opened using the *view->Simulation info browser* menu item. To view the information, use the following controls:

#### The nuclide info list



Selects the nuclide for which additional simulation information is displayed. The list contains all the nuclides that were used in the last simulation run. When you select a nuclide in the list, the pages below will be filled with the information pertaining to that nuclide.

#### The simulation info pages



Chooses the information to view on the simulation of the nuclide selected in the nuclide info list. The 'general' information will always be available, the availability of the rest of the information depends on the simulation options used in the last run.

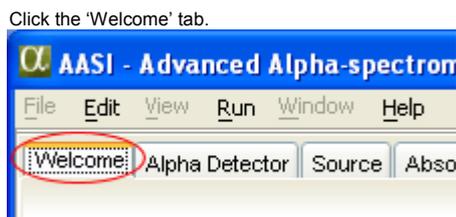
## 4. TASKS & EXAMPLES

In this section you will find some tasks and examples that walk you through certain type of simulations. You may use the Welcome page to open the examples by clicking the button next to the example description. Doing so will cause the plot page to be opened with an informative figure. By going through these examples, you will familiarise yourself with the use of AASI program for alpha spectrometric simulations.

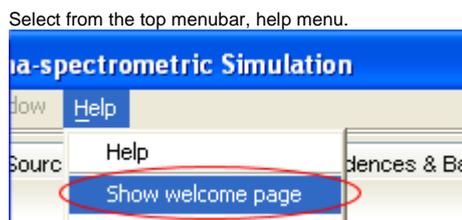
### 4.1. Example 1

The first example file is a simulation of an alpha spectrum from the so-called “thule particle” (it is in fact this particle that is depicted in the SEM images in the cover of this book and on the welcome page of AASI). The properties of the “thule particle” are well known, and in this example we will compare the simulated spectrum to the measured one. Try the following steps:

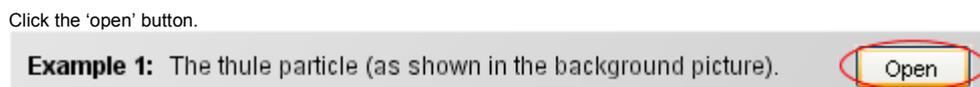
1. Turn to the welcome page.



If the tab is not visible, use *Help* → *Show welcome page* menu item.

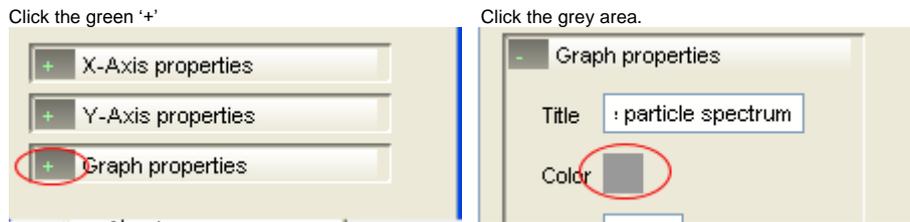


Open the first example by clicking the 'open' button next to Example 1 on the welcome page.

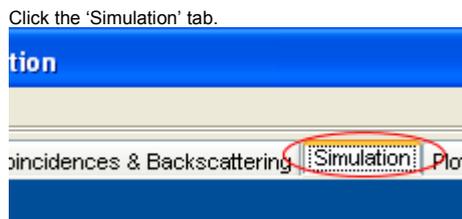


The plot page opens and displays information about this example and an actual alpha spectrum measured from the “thule particle”.

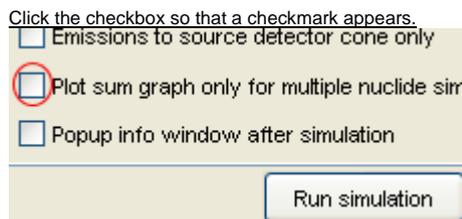
2. Open the graph properties pane and set the color of the graph to light blue.



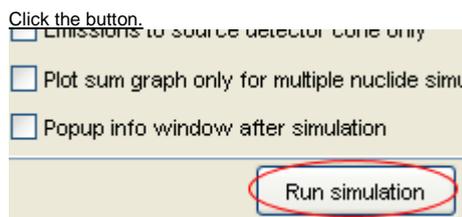
3. Turn to the simulation page.



Make sure the 'plot sum graph only' option is checked in the spectrum simulation window.

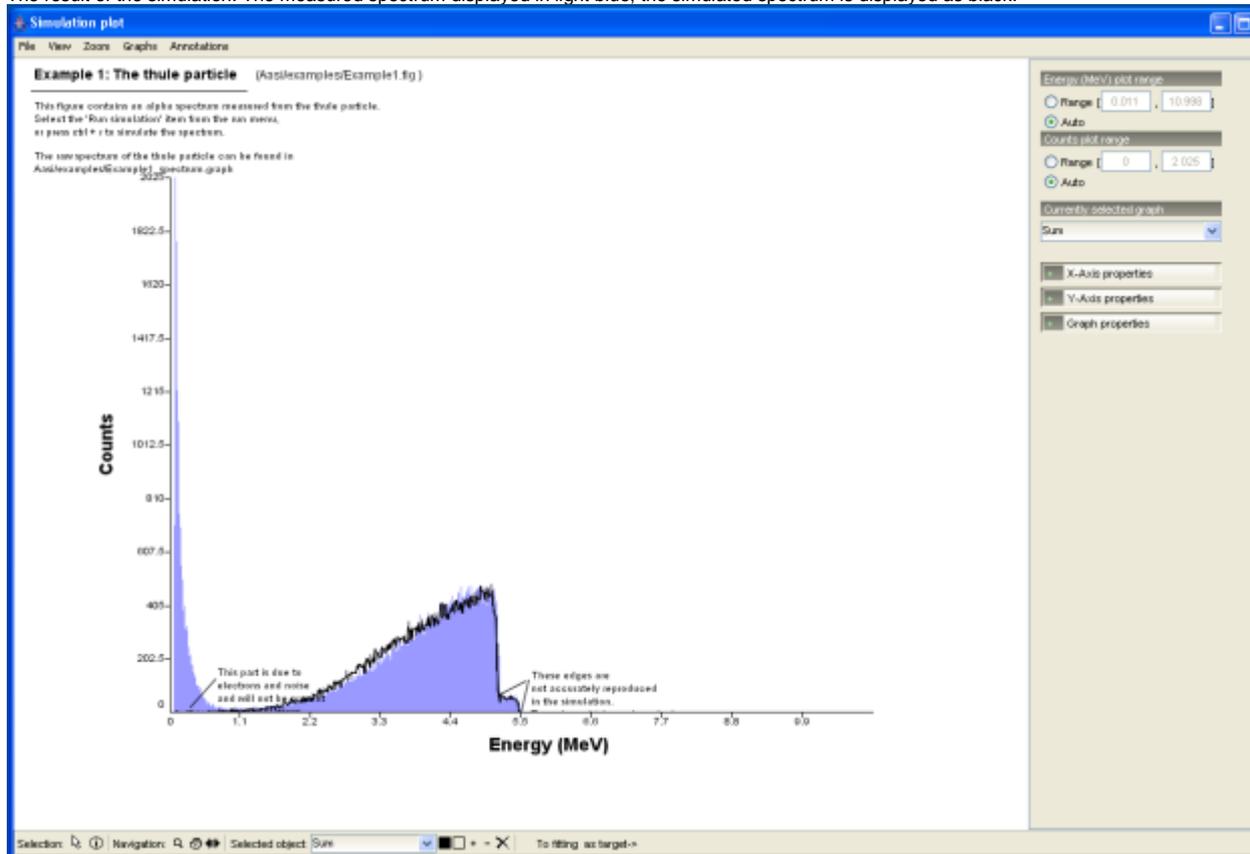


4. Press the 'Run simulation' button to begin the simulation.



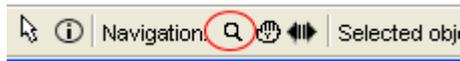
When the simulation is done AASI will turn to the plot page automatically. The resulting spectrum is displayed as a black graph on top of the measured light blue spectrum.

The result of the simulation. The measured spectrum displayed in light blue, the simulated spectrum is displayed as black.



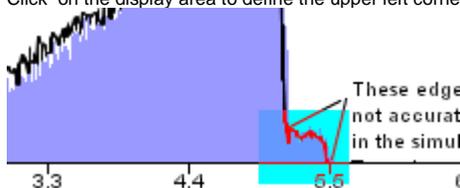
5. Select the 'zoom' tool.

Click the icon to activate the zoom tool



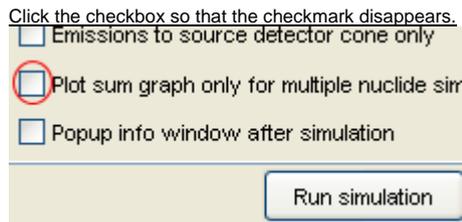
Zoom in by dragging the mouse near the text. The zoom rectangle denotes the new view bounds.

Click on the display area to define the upper left corner of the zoom rectangle. Keep the button down and drag to define the extents.

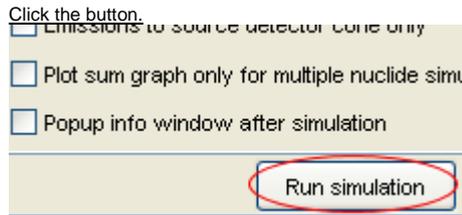


Note that zooming is constrained when you start the drag outside the axis. Try using the 'pan' tool: drag the mouse on the graph display area to drag the view bounds to new location. Use the 'pan' and the 'zoom' tool to take a look at the different parts of the spectra closer up. If you get lost, you may return the original view bounds by pressing the 'reset view' button.





3. Press the 'Run simulation' button to begin the simulation.

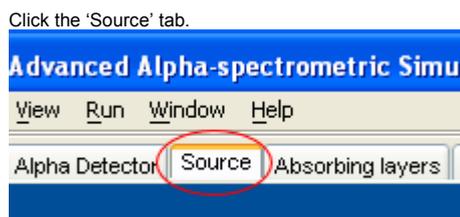


When the simulation is done AASI will turn to the plot page automatically. The spectral components resulting from the different radionuclides in the source will be displayed along with the sum spectrum. Notice that the energy calibration of the measured spectrum doesn't quite match the simulation.

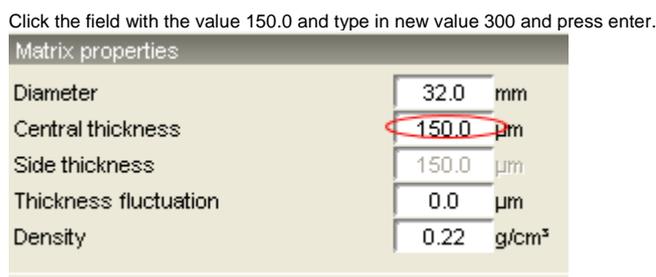
Set the fluoropore spectrum to be the currently selected graph using the graph selection list, then use the graph properties to shift it by -0.05 MeV



4. Turn to the source page



5. Make the filter thicker by changing the thickness of the source matrix in the source window, write in value of 300  $\mu\text{m}$



Run the simulation again (do steps 2 & 3), notice that the thickness of the source matrix did not have a big impact on the resulting spectrum. The reason for this is that the particles are distributed close to the surface, with mean penetration depth only 15  $\mu\text{m}$ .

6. Turn to the source page again (step 4), change the mean penetration depth of the particles to 50  $\mu\text{m}$ .

Click the field with the value 15.0 and type in new value 50 and press enter.

Particle properties	
Mean diameter	0.5 $\mu\text{m}$
Geometric standard deviation	1.5
Diameter ceiling	5.0 $\mu\text{m}$
Density	2.33 $\text{g}/\text{cm}^3$
Percentage to distribute exponentially	5.0 %
Mean penetration depth	15.0 $\mu\text{m}$

Run the simulation again (do steps 2 & 3). There are still no large changes. The reason is that only 5 % of the particles are distributed into the source matrix, the rest are on the surface.

7. Go back to the source page and change the percentage to distribute exponentially to 50 %

Click the field with the value 5.0 and type in new value 50 and press enter.

Particle properties	
Mean diameter	0.5 $\mu\text{m}$
Geometric standard deviation	1.5
Diameter ceiling	5.0 $\mu\text{m}$
Density	2.33 $\text{g}/\text{cm}^3$
Percentage to distribute exponentially	5.0 %
Mean penetration depth	15.0 $\mu\text{m}$

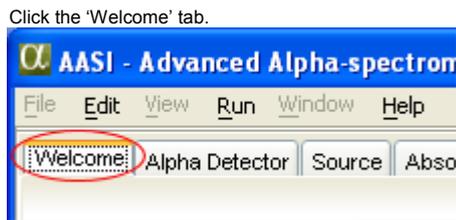
Run the simulation again, this time the peaks exhibit much wider tails.

8. Turn back to the source page, try to change the way the particles are distributed into the source matrix, use uniform distribution instead of exponential. Also try different parameter values.

### 4.3. Example 3

This example simulates a typical alpha spectrum from a CAMFIL air-filter. In this example we will take a look at how the various properties of the radioactive particles embedded in the source matrix affect the resulting spectrum. We start off similar to Examples 1 & 2. Try the following steps:

1. Turn to the welcome page.



If the tab is not visible, use *Help* → *Show welcome page* menu item.

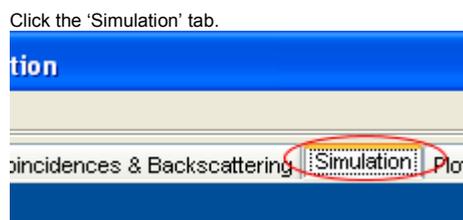


Open the first example by clicking the 'open' button next to Example 3 on the welcome page.

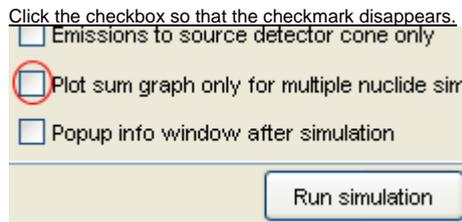


The plot page opens and displays information about this example and an actual alpha spectrum measured from a fluoropore filter.

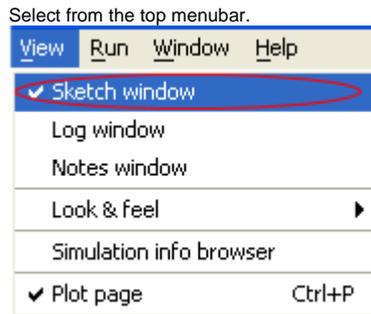
2. Turn to the simulation page.



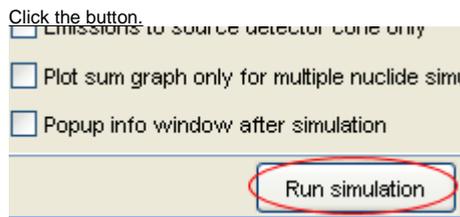
Make sure the 'display sum graph only' option is not checked in the spectrum simulation window.



At this point, open the sketch window by selecting *View*→*Sketch window* menu item.



3. Press the 'Run simulation' button to begin the simulation.



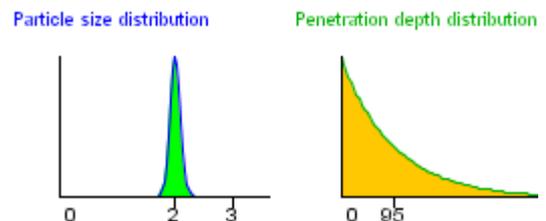
When the simulation is done AASI will turn to the plot page automatically. The spectral components resulting from the different radionuclides in the source will be displayed along with the sum spectrum.

4. Turn back to the source page, and edit the particle size distribution, you will see a visual representation of the distribution in the sketch window. Use the following values, mean diameter = 2.0, Geometric standard deviation = 1.1, Diameter ceiling = 3.

Click the property, type in new value, press enter.

Particle properties	
Mean diameter	0.4 $\mu\text{m}$
Geometric standard deviation	1.2
Diameter ceiling	2.0 $\mu\text{m}$
Density	2.33 $\text{g/cm}^3$
Percentage to distribute exponentially	95.0 %
Mean penetration depth	95.0 $\mu\text{m}$

The sketch window shows the particle size concentrated around 2.



5. Run the simulation again. Notice that the peaks have now a much rounder shape, due to the larger mean size of the particles. Delete all graphs and annotations by using the *Graphs*→*Remove all graphs* and *Annotations*→*Remove all annotations* menu items in the simulation plot window.

- Turn back to the source page. Change the particle type to ellipsoidal, and edit the following particle properties: X diameter = 7, Y diameter = 12, Z diameter = 5

Click the button.

Radioactive particles in a homogenous source material

Particle type

Spherical  Ellipsoidal

Size of the particles

Click the property, type in new value and press enter.

Particle properties

X diameter	7.0 $\mu\text{m}$
Y diameter	12.0 $\mu\text{m}$
Z diameter	5.0 $\mu\text{m}$
Density	2.33 $\text{g/cm}^3$

- Run the simulation. Notice that the tailing is very extreme. This is due to the fact that the exponential distribution, and hence the mean penetration depth, are not used with ellipsoidal particles. Ellipsoidal particles are always distributed into the source matrix with uniform distribution.
- Remove all the graphs. Go to the source page and edit the thickness of the source matrix. Give the value of 10  $\mu\text{m}$ .

Click the property, type in new value and press enter.

Matrix properties

Diameter	32.0 mm
Central thickness	500.0 $\mu\text{m}$
Side thickness	500.0 $\mu\text{m}$

Run the simulation again.

- Now the peaks exhibit a round shape. To get sharper peaks, go to the source page and decrease Z diameter in particle properties (say, to 1  $\mu\text{m}$ ). This will work because the Z axis is the axis pointing towards the detector.
- Experiment with the effects of different properties.

#### 4.4. Task 1 - Basic operation

It is a good idea to go through the example files included in the AASI distribution, see previous sections for details. After you are done with them, you might try the following:

- Open the file Example1.inp.
- Make modifications to the detector on the 'detector page'. And save the detector using the save detector button. Don't overwrite the existing detector file.
- Open Example2.inp by using the button in the welcome page. Notice that the detector resets to the one saved with this particular example file.
- Again modify the detector, save it and this time overwrite the detector file.
- Open any of the example files, notice that the values for the detector in all of them are now the ones you specified in the previous steps.
- Change the source material, and save it as a new preset material.
- Assign the material you saved in the previous step to the particles by editing the particle material and using the material presets list.

## 4.5. Task 2 - Creating a new example file

First edit the simulation properties found on the different pages until a desired set of properties is obtained. Edit the notes in the notes window. Now save the file as Example 5.inp under the directory Aasi/examples/. Now open the text file examples.prs in the same directory. Add the following entry

```
example_5_desc = My own example file!
```

Now when you start AASI again, you will see the fifth example you just added in the welcome page. This feature can be used to add often needed combinations of parameters into the welcome page for quick recall.

## 4.6. Task 3 - Running a simulation from the command line

Open a command line interface (in windows start->run, type cmd and hit enter). Go to your Aasi/bin directory and invoke Aasi by writing `alpha4_1.exe < Input.inp`. This will cause Aasi to run simulation with parameter values defined in Input.inp file. The outputs from the simulations will be written to files results.dat and result.phd.

## 4.7. Task 4 - Creating a figure

Open the file Example 3.inp and run the simulation by pressing `ctr+r`. The plot page will automatically be displayed. Now zoom closer to the peak show in the plot by clicking the zoom button and dragging the mouse below the Energy axis from around  $x$  MeV to  $y$  MeV. Now add a line tag into the plot by clicking the add line tag button and dragging the mouse from the tip of the peak onto the white space to its left. Now add a text tag into the plot by clicking the add text tag button and clicking on the white space besides the left end point of the line. Write peak into the text addition box. Now you should be in the following situation. Now add a title by clicking add text button and adding the text to the white space above the figure. Write Simulation of xxx. Change the font by clicking the change font button. Select size 28 pt and style Bold. End text adding by clicking the mouse outside the text addition box. Now save your figure by clicking save. Select type as .fig and type in the name figure.fig and press ok. Now try zooming the plot to see how the tag objects behave under the changes of view.

## 5. AASI DIRECTORY STRUCTURE AND FILES

We will now describe the files installed, required and used by the AASI application.

### 5.1. What gets installed

When you install AASI a multitude of files, most essential to correct operation of the software, will be placed on your hard-drive. First and foremost, a directory (on some systems called a folder) named AASI will be created. Everything needed to operate the software will be placed under that directory, often referred to as AASI directory. We will now describe each file that should be present after the installation. All the files are required to be present to successfully starting AASI, unless explicitly stated to be optional:

<b>AASI</b>	- A directory, contains everything necessary to operate the AASI software			
└	Aasi.exe	- Windows only, the AASI application launcher. Optional if you know how to execute java jar files.		
	Aasi.sh	- Linux / Unix only, AASI application launch script. Optional if you know how to execute java jar files.		
	UsersManual.pdf	- This file. Optional.		
	<b>detectors</b>	- A directory. This directory is part of the detector search path, so place often used detectors here. Optional.		
	<b>examples</b>	- A directory. Contains the example files. Optional.		
	└	examples.prs	- The example settings. Optional.	
		Example 1.inp	- The first example input file. Optional.	
		Example 2.inp	- The second example input file. Optional.	
		Example 3.inp	- The third example input file. Optional.	
		Example 4.inp	- The fourth example input file. Optional.	
	<b>bin</b>	- A directory. Contains mostly the binaries, and the data needed by them.		
	└	alpha4_1.exe	- The simulator back-end executable binary.	
		AASI_Frontend.jar	- The front end application executable java jar file.	
		LibraryManager.jar	- The nuclide library management program. Executable java jar file. (Experimental, optional)	
		NuclideLibrary.xml	- Library data on radionuclides, based on the ENSDF databases.	
		PuCoincidences.xml	- Library data on radionuclides with specific additions of coincidence data.	
		stopping.dat	- Stopping power coefficient data.	
		photoelAttData.dat	- photoelectric attenuation data.	
		Input.inp	- The default input, loaded at startup of the application. This is required to be present and acceptable!	
		ErrorCodes.txt	-A summary of runtime error codes from the simulator back-end.	
		Detector.det	- The default detector, loaded at startup of the application. This is required to be present and acceptable! This is also the detector which is used if the detector specified in an input file cannot be found.	
		<b>lib</b>	- a directory containing mostly libraries and data required by the binaries.	
		└	wins.prs	- Window settings between sessions. Optional.
			plot.prs	- Plot settings between sessions. Optional.
			mixtures.prs	- Material presets. Optional.

			ParameterSets.xml	- Parameter descriptions for the front end.
			InputTemplate.dat	- Input file file-format description for i/o.
			DetectorTemplate.dat	- Detector file-format description for i/o.
			GeometricEfficiencyTemplate.dat	- Geom. eff. file-format description.
			Elements.dat	- data on elements
			Widgets.jar	- Java library
			Objectify.jar	- Java library
			epsgraphics.jar	- Java library
			JFontChooser.jar	- Java library
			AbsoluteLayout.jar	- Java library
			jh.jar	- Java library
			freehep-graphicsio-svg.jar	- Java library
			freehep-graphicsio-pdf.jar	- Java library
			freehep-graphicsio-ps.jar	- Java library
			freehep-graphicsio-gif.jar	- Java library
			freehep-graphicsio-emf.jar	- Java library
			freehep-graphicsio.jar	- Java library
			freehep-graphics2d.jar	- Java library
			freehep-base.jar	- Java library
			crimson.jar	- Java library
	<b>jre</b>	- A directory. Contains the java runtime environment. Optional if you already have working java installed. Otherwise required. In that case this directory contains multiple subdirectories, all of which are required!		

On Microsoft Windows systems in addition to these files, a desktop shortcut, a start menu entry and an uninstaller are part of the installation, they are all optional.

## 5.2. The simulator and the front-end files

To avoid confusion we have so far mostly talked about AASI application. By this we mean the front-end with the graphical user interface and the simulator back-end together. The simulator back-end however is oblivious to the existence of the front-end and may be used completely independently. The simulator and the libraries it requires can be found in the directory structure:

<b>AASI</b>	- The AASI directory		
	<b>bin</b>	- The binary directory.	
	└	alpha4_1.exe	- The simulator back-end executable binary. Can be executed with an input by issuing command alpha4_1.exe < Input.inp
		NuclideLibrary.xml	- Nuclide library
		CoincidenceLibrary.xml	- Nuclide library with coincidence data
		stopping.dat	- Stopping power coefficient data.
		photoelAttData.dat	- photoelectric attenuation data

Rest of the files described in the previous section are used by the front-end.

## 5.3. File formats

As stated before, the simulator can be run without the graphical user interface. For some users this may be preferable, the formats of acceptable inputs are described in the following sections. An input consists of an ‘input file’ which contains the simulation parameters, and a ‘detector file’ which contains the detector parameters. The detector file is referenced by the input file, so both files must be present. A detector or input file that conforms to the corresponding file format is called *acceptable*.

### 5.3.1. The input file format

We have mentioned input files before, but only in the context of loading and saving them using the graphical user interface. The input files are, however, nothing but simple text files with the following structure:

Line	Description	Values	Example
1	A letter specifying whether the calculation should be for geometric efficiency only or a full simulation. The following lines only apply for full simulation, geometric efficiency is treated in section 5.3.3.	<b>y</b> = geometric efficiency only <b>n</b> = full simulation	n
2	Proceed to spectrum simulation.	<b>y</b> = proceed <b>n</b> = stop	y
3	A float specifying the source-detector distance (SDD) in millimeters	> <b>0</b>	10.0
4	A string specifying the name of the nuclide library to be used.	A string enclosed in ‘ ’	‘NuclideLibrary.xml’
5	The name of the nuclide to use in the simulation , or dummy to specify use of single line with given energy. The name is used to identify the source nuclide data in the nuclide library.	A string enclosed in ‘ ’ ‘dummy’ to use single line with given energy	‘U-238’
6	A letter specifying whether the particle shape should be ball or ellipsoid	<b>b</b> = ball <b>e</b> = ellipsoid	b
7	Depending on the value of line 6 either a float specifying the diameter of the particles (for ball) or 3 comma delimited floats specifying the X,Y and Z semiaxii.	> <b>0</b>	3.0, 2.0, 1.0
8	A letter specifying if spherical shell geometry should be used instead of the shape specified on line 7.	<b>y</b> = use spherical shell <b>n</b> = use shape on line 7	n
9	An integer specifying the number of constituent elements in the particle material	<b>0,1,2,3...</b>	1
10	Three floats. First specifies the density of the particle material, the next two are unused.	> <b>0</b>	9.0, 1.0, 1.0
Next <i>i</i> rows	Next <i>i</i> rows, where <i>i</i> is the value on line 9, will contain the element description. On each row there are two integers and a float, element Z, element A and atomic fraction.	> <b>0</b> , > <b>0</b> , > <b>0</b>	6,12, 1.0
11	A float specifying the size of the energy bin in keV.	> <b>0</b>	16.7
12	An integer specifying the number of constituent elements in the source matrix material.	> <b>0</b>	1
13	Three floats. Density of the source material, thickness of the source material and thickness fluctuations in the source material.	> <b>0</b>	9.0, 1.0, 1.0
Next <i>i</i> rows	Next <i>i</i> rows, where <i>i</i> is the value on line 12, will contain the element description. On each row are two integers and a float: element Z, element A and atomic fraction.	> <b>0</b> , > <b>0</b> , > <b>0</b>	6,12, 1.0
14	A letter indicating whether convex source geometry should be used.	<b>y</b> = use convex source <b>n</b> = cylindrical source	n

15	Two floats specifying the thickness of the source at its center and at its side. These are used only if the value of line 14 is y	>0, >0	10.0, 4.0
16	A letter specifying if an exponential depth distribution should be used for particle deposition	y = use exponential depth n = use uniform depth	y
17	Two floats, the fraction to distribute exponentially, and the half-depth of the distribution in micrometers.	>0, >0	0.8, 14
18	An integer specifying the number of attenuating layers	>0	2
for each layer	An integer specifying the number of constituent elements in the layer material.	>0	1
for each layer	Three floats. Density of the source material, thickness of the source material and thickness fluctuations in the layer material.	> 0	9.0, 1.0, 1.0
for each layer next i rows	Next i rows, where i is the number of elements for this layer material, will contain the element description. On each row are two integers and a float, element Z, element A and atomic fraction.	>0, > 0, > 0	6,12, 1.0
19	a letter indicating whether many random particles should be created	y = many particles randomly n = single particle only	
20	A float specifying the deposition area radius. Only used if value on line 19 is y	>0	10.0
21	A letter specifying whether a lognormal distribution should be used for particle sizes. Not used for single particle.	y = use lognormal distribution n = use size specified on line 19	y
22	Two floats, specifying the mean diameter and geometric standard deviation of the lognormal size particles. Only used if value on line 21 is y	>1, >0	1.0, 2.0
23	A float specifying the maximum diameter for lognormal size particles	>0	5.0
24	Two floats specifying the x and y coordinates of particle location when the value on line 19 is y		-3.0 ,0.1
25	An integer specifying the number of decays to simulate	>0	1500000
26	A letter specifying should only emissions into the source - detector cone be generated	y = generate emissions into the source - detector cone only n = generate emissions to all random directions	n
27	A float indicating the amount of gaussian straggling to include	>0 <= 0 = don't include	1.0
28	A float indicating the size of the integration step.	>0	0.2
29	A letter indicating whether coincidences should be calculated	y = include coincidences n = disable coincidences	n
30	An integer specifying should line output be printed.	1 = enable line output 0 = disable line output	1
31	A letter indicating whether the source backingplate should be taken into account in the simulation.	y = include backingplate n = forget backingplate	n
32	An integer specifying the number of constituent elements in the backingplate material	0,1,2,3...	1
33	Three floats. Density of the source material, thickness of the source material and thickness fluctuations in the layer material.	> 0, >0, >0	9.0, 1.0, 1.0

Next <i>i</i> rows	Next <i>i</i> rows, where <i>i</i> is the value on line 32, will contain the element description. On each row there are two integers and a float, element Z, element A and atomic fraction.	> <b>0</b> , > <b>0</b> , > <b>0</b>	6,12, 1.0
34	Two integers indicating whether to use parallel beam only, and whether to write particle tracking to a file	<b>1</b> = use parallel beam, or particle tracking <b>0</b> = don't use parallel beam, or particle tracking	1, 0
35	An integer indicating whether to use linear deposition model for electrons in the dead layer	<b>1</b> = use linear deposition model <b>0</b> = don't use linear deposition model	1
36	An integer indicating whether to print angular distributions	<b>1</b> = print <b>0</b> = don't print	0
37	An integer indicating which shielding model to use	<b>1</b> = Nigam <b>2</b> = Chaoi <b>3</b> = Moliere	2
38	An integer indicating whether alpha particles should be tracked in the backing plate. Backing plate must be enabled on line 31.	<b>1</b> = track <b>0</b> = don't track	0
39	An integer indicating whether the measurement setup should be drawn into a .ps file	<b>1</b> = draw <b>0</b> = don't draw	0
40	A string indicating the detector file to use.	A string enclosed in ‘	‘Detector.det’
41	A string indicating the coincidence output file to use.	A string enclosed in ‘	‘coincidences.ccf’
42	A letter indicating whether spectrum printing to screen should be done	<b>y</b> = print <b>n</b> = don't print	n
43	A letter indicating whether spectrum printing to a file should be done	<b>y</b> = print <b>n</b> = don't print	y

For an example of an acceptable input file, see the file Input.inp in your AASI/bin directory. Creating a ASCII text file with the example values in the above table as rows also results in an acceptable input file.

### 5.3.2. The detector file format

Like the input, the detectors are described by text files with given format:

Line	Description	Values	Example
1	A string specifying the name of this detector	a string enclosed in ‘ ’	‘450PIPS’
2	A float specifying the detector radius	> 0	10.0
3	A float specifying the detector resolution (keV FWHM)	> 0	14.0
4	Three floats giving the detector responses fast, intermediate and slow components	>0, >0, >0	10.0, 50.0, 1000
5	Three floats specifying total tailing, fast / intermediate area ratio and slow / intermediate area ratio	[0, 1] ,>0,>0	1.0, 12.0, 0.25
6	Two integers specifying the dead layer material Z and A	>0,>0	6, 12
7	A float specifying the thickness of the active volume of the detector in micron	> 0	200.0

For an example of a detector file, see the file Detector.det in your AASI/bin directory. Creating a ASCII text file with the example values in the above table as rows also results in an acceptable detector file.

### 5.3.3. Input file format for geometric efficiency calculation

The geometric efficiency calculation can be performed by using a file of the following format:

Line	Description	Values	Example
1	A letter specifying whether this file is used for geometric efficiency calculation	<b>y</b>	y
2	A letter specifying whether a point source shall be used	<b>y</b> = use point source <b>n</b> = don't use point source	y
2.1	If the value on line 2 is <b>y</b> , then this line will contain two floats specifying the x and y coordinates of the point source. If the value on line 2 is <b>n</b> this line is omitted.	<b>any, any</b>	14.0, 10.0
3	If the value on line 2 is <b>n</b> , then this line will contain four floats specifying the detector radius, source offset, source radius and SDD. If the value on line 2 is <b>y</b> , then this line will contain two floats specifying detector radius and SDD	>0, >0,>0,>0 or >0,>0	10.0,0.0, 10.0, 10.0
5	A float specifying the desired standard deviation for the calculation (in %).	>0	0.1
6	A letter	<b>n</b>	n

Creating a ASCII text file with the example values in the above table as rows also results in an acceptable input file for geometric efficiency calculation.

## 5.4. Output files from the simulation

Running a simulation produces various output files that are often left on the disc for convenience; they may still be of use later. The following files will be generated by the front end when a simulation is run:

AASI			
		bin	
	L	Input__gen.dat	- A generated file that is fed to the simulator as input. This file is left on disc after running, but will be overwritten next time a simulation is performed.
		Detector__gen.dat	- A generated file that contains the detector used with the generated input. This file is left on disc after running, but will be overwritten next time a simulation is performed.
		Gec__gen.dat	- This file is generated for the geometric efficiency calculation.
		dummycoincidence.ccf	- This file is generated when no coincidence data storing is specified.

The simulator on the other hand generates the following files as output:

AASI			
		bin	
	L	results.dat	- A generated file that contains the spectrum resulting from the simulation. The data consists of energy - counts pairs. The energy refers to the left edge of the energy bin.
		position.dat	- A generated file that contains the positions of the alpha emitters in the source matrix. This file is not always generated. The data is of the form x,y,r,z per row. Where $r = \sqrt{x^2+y^2}$ ;
		result.phd	- Same as results.dat but in phd format.
		tracking.dat	- A generated file that contains paths of electrons. This file is not always generated. The data is of form energy,x,y,z per row.

When coincidences are enabled and the coincidence output file will have the following format:

Column	Name	Description
1	Elib	Line energy (library value) keV of peak.
2	Ehigh	Width of the coincidence box in keV
3	RelHt	Relative number of counts in coincidence box wrt. the peak.

Example:

```
%Elib           Ehigh           RelHt
5485.560        10.00000        1.1349183E-02
5485.560        20.00000        3.2852896E-02
5485.560        30.00000        4.7786031E-03
5485.560        40.00000        3.2852896E-02
```

Rows starting with '%' symbol are comments.

When alpha particle tracking is enabled the outputfile tracking.dat will have the following format:

Column	Name	Description
1	Energy	Energy of the particle in keV
2	X	X-coordinate of the particle
3	Y	Y-coordinate of the particle
4	Z	Z-coordinate of the particle

Example:

```
3.4859    0.0000    0.0000    0.5733
3.3821    0.0300   -0.0248    0.5846
3.3744    0.1195   -0.1377    0.6442
3.2674    0.1267   -0.1450    0.6489
3.1210    0.2361   -0.2194    0.7334
3.1184    0.3095   -0.2544    0.9268
3.0994    0.3110   -0.2545    0.9302
3.0821    0.3247   -0.2556    0.9526
2.9557    0.3385   -0.2519    0.9718
2.9028    0.0000    0.0000    0.0000
```

Each successive row is a point on a trajectory. A new trajectory begins when the energy value of a row exceeds that of the preceding row.

## 6. MENU REFERENCE

### 6.1. Main window menus

#### The 'File' menu

File → Open input & detector	Opens an AASI input file and the detector file associated with that input file. You will be prompted to select the desired file and the simulation state will then be set to be that of the selected input file.
File → Save input	Saves the current state of the simulation as an AASI input file. Note that this does not save the detector.
File → Save input as...	Saves the current state of the simulation as an AASI input file. You will be prompted for the filename. Note that this does not save the detector.
File → Save detector	Saves the current state of the detector as an AASI detector file. Note that this does not save rest of the input parameters.
File → Save input as...	Saves the current state of the detector as an AASI detector file. You will be prompted for a file name. Note that this does not save rest of the input parameters. The detector file saved will be the one used by the input.
File → Exit	Quits the program. Any unsaved changes will be lost!

#### The 'View' menu

View → Sketch window	Toggles the sketch window visible. The sketch window provides visual cues to the measurement setup.
View → Log window	Toggles the log window visible. The log window provides a log of the output from the simulation code.
View → Notes window	Toggles the notes window visible. The notes window displays user provided notes about the current input file.
View → Look & Feel	This submenu contains a variable number of entries. The look and feel of the program is automatically determined at startup based on the operating system used. However extensive testing on every OS is practically impossible, so this option is provided should there be problems with the appearance of the program. The contents of this submenu depend on the Look And Feels installed on your system. The 'Metal' one should provide unified cross-platform L&F.
View → Simulation info browser	The simulation info window displays more advanced information about the last simulation run.

### The 'Run' menu

Run → Run simulation	Runs the simulation with the current state of the simulation options and parameters. For further information see section 3.5.1.2 <a href="#">Running the simulation using the run menu</a>
Run → Run geometric efficiency calculation	Displays the geometric efficiency calculation window allowing you to calculate the geometric efficiency. For more information see section 3.5.2.2 <a href="#">Calculating geometric efficiency using the run menu</a>

### The 'Window' menu

Window → Tile	Tiles all visible windows on the current page.
Window → Cascade	Cascades all visible windows on the current page.
Window → Minimize all	Minimizes all windows on the current page
Window → Maximize all	Maximizes all windows on the current page

### The 'Help' menu

Help → Help	Displays the help browser
Help → Show the welcome screen	Displays the welcome page.
Help → About...	Displays the about box with version information and credits.

## 6.2. Simulation plot window menus

### The 'File' menu

File → Open...	Opens a spectrum from a file. The opened spectrum will be added into the plot.  Note that when opening a .fig format file, all the existing graphs and annotations will be deleted!
File → Save currently selected graph	Saves the currently selected graph to disk.
File → Save plot as figure...	Saves all the graphs in the plot window as a figure.
File → Print..	Prints the plot.
File → Page setup & preview...	Lets you control the page orientation, scaling and other options for printing.

### The 'Edit' menu

Edit → Copy selected graph in Excel format	Copies the currently selected graph to the clipboard as an Excel format table with two columns: first one with energies and the second one with corresponding number of counts. The clipboard contents can then be pasted into Excel.
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Edit → Copy selected graph in Matlab format	Copies the currently selected graph to the clipboard as a Matlab format vector with two columns: first one with energies and the second one with corresponding number of counts. The clipboard contents can then be pasted into the Matlab command window.
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### The 'View' menu

View → Show properties pane	Lets you show / hide the properties pane in the right edge of the simulation plot window.
View → Show toolbar	Lets you show / hide the toolbar at the bottom of the simulation plot window.

### The 'Zoom' menu

Zoom → Zoom all	Modifies the plot range so that the whole extents of all graphs are visible.
Zoom → Zoom in	Zooms in on the x-axis
Zoom → Zoom out	Zooms out on the x-axis
Zoom → Pan right	Pans the view to the right.
Zoom → Pan left	Pans the view to the left.

### The 'Graphs' menu

Graphs → Remove all graphs	Removes all graphs from the plot.
Graphs → Remove currently selected graph	Removes the currently selected graph from the plot
Graphs → Bring currently selected graph to the front	Brings the currently selected graph to the front, causing the selected graph to be drawn on top of other graphs
Graphs → Send currently selected graph to the back	Sends the currently selected graph to the back, causing all other graphs to be drawn on top of the selected graph
Graphs → Select next graph	Causes the next graph to be set as the currently selected graph. Can be used to cycle through the graphs in the plot.
Graphs → Select previous graph	Causes the previous graph to be set as the currently selected graph. Can be used to cycle through the graphs in the plot.

### The 'Annotations' menu

Annotations → Add text	Adds a text annotation. Point the mouse to where you want the text placed and left click to place the text.
Annotations → Add line	Adds a line annotation. Point the mouse to where you want the annotation to begin and left click and drag to place the annotation.
Annotations → Add text tag	Adds a text tag annotation. Point the mouse to where you want the text tag placed and left click to place the text tag.
Annotations → Add line tag	Adds a line annotation. Point the mouse to where you want the line tag to begin and left click and drag to define the line tag.

Annotations → Remove selected  
annotation

Removes the currently selected annotation

Annotations → Remove all  
annotations

Removes all annotations from the plot.