

BetaDosim

Software for the interpolation of the dose rate due to the beta emission of radionuclides

User manual

version 1.0, date: 14.01.2015

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The software "BetaDosim" has been produced within the course of the calculation of the dose rate due to beta emitting radionuclides. Details can be found in the publication: "R. Behrens, *Simulation of the dose rate per activity of beta-emitting radionuclides*, [Rad. Prot. Dosim. \(2015\) Vol. 167, No. 4, pp 653](#)". The interpretation of the results and the conclusions drawn from them are not within the responsibility of PTB.

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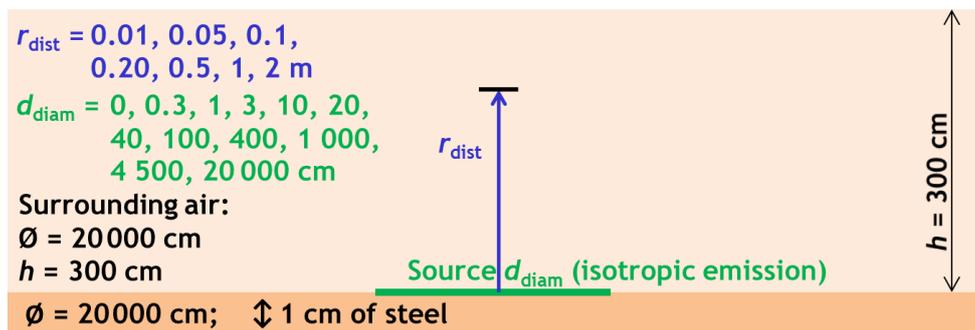
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2 Short description of BetaDosim

2.1 Range of application

The software "BetaDosim" interpolates the dose rate per activity of plane radioactive sources located on a steel plate, see figure below. The output is the dose rate per activity due to the beta emission of a radionuclide with a given beta endpoint energy, $E_{\beta, \max}$, a given source diameter, d_{diam} , and at a given distance from the source, r_{dist} , with air between the source and the point of interest. The following parameter ranges are covered:

- $0.157 \text{ MeV} < E_{\beta, \max} < 3.54 \text{ MeV}$
- $0 \text{ cm} < d_{\text{diam}} < 20000 \text{ cm}$
- $0.01 \text{ m} < r_{\text{dist}} < 2.0 \text{ m}$



Source geometry used for the simulations.

The most recent version of the software is freely available for download from PTB's webpage[1]. Details regarding the method of interpolation are contained in a paper by M. Reginatto and R. Behrens[2]. Details regarding the calculation of the dose rate per activity are contained in a paper by R. Behrens[3].

2.2 Uncertainties

According to the paper mentioned above[2], the uncertainties can be described as follows: The uncertainty of the interpolated values are mostly in the order of about 10 % or less, only in a few cases a factor of two may be reached (especially if the dose rate strongly varies when one or more of the input parameters is varied, i.e. when steep gradients are present).

3 Instructions for running BetaDosim

3.1 Preparation

The software is a java application (suitable for all types of hardware on which java is installed). Thus, you need to install Java on your device (www.java.com).

3.2 Download

The most recent version of the software is freely available for download from PTB's webpage[1]. After the download, simply extract the contents of the downloaded zip-file to any location on your device. You will then have a folder named "BetaDosim" containing all files.

3.3 Using BetaDosim

To start, double click on the file “BetaDosim.jar”. The screen will look like the image shown on the right.

To specify the location for the output files, click on “File” and then “Output Files Directory”.

Either enter values for all three parameters within the limits given above (section 0) or enter values for only two of the parameters.

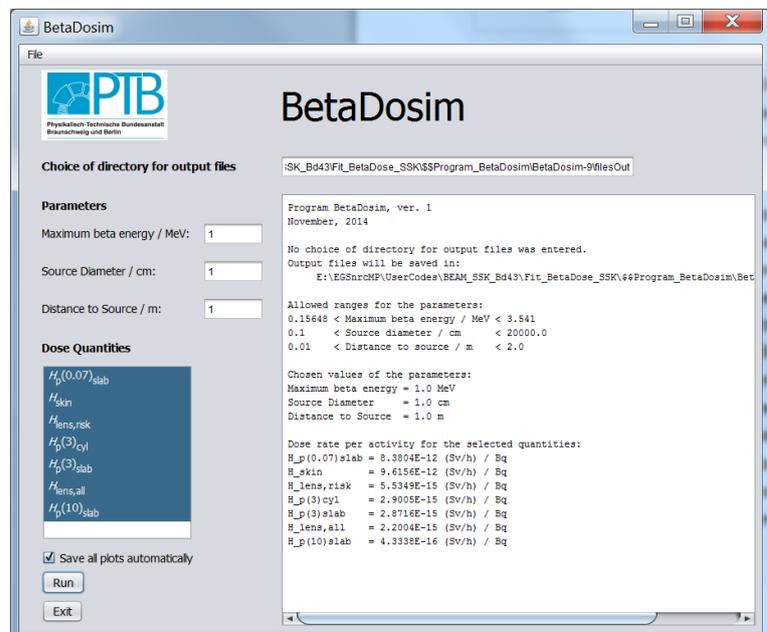
To choose a dose quantity, click on it. To choose more than one, press and hold the “Ctrl”-key and then click on all the dose quantities that you are interested in.

Press the “Run” button and the results will be shown, see next section 3.4.

3.4 Results

If you have entered values for all three parameters, the result will be a single value of the dose rate per activity for the chosen quantities.

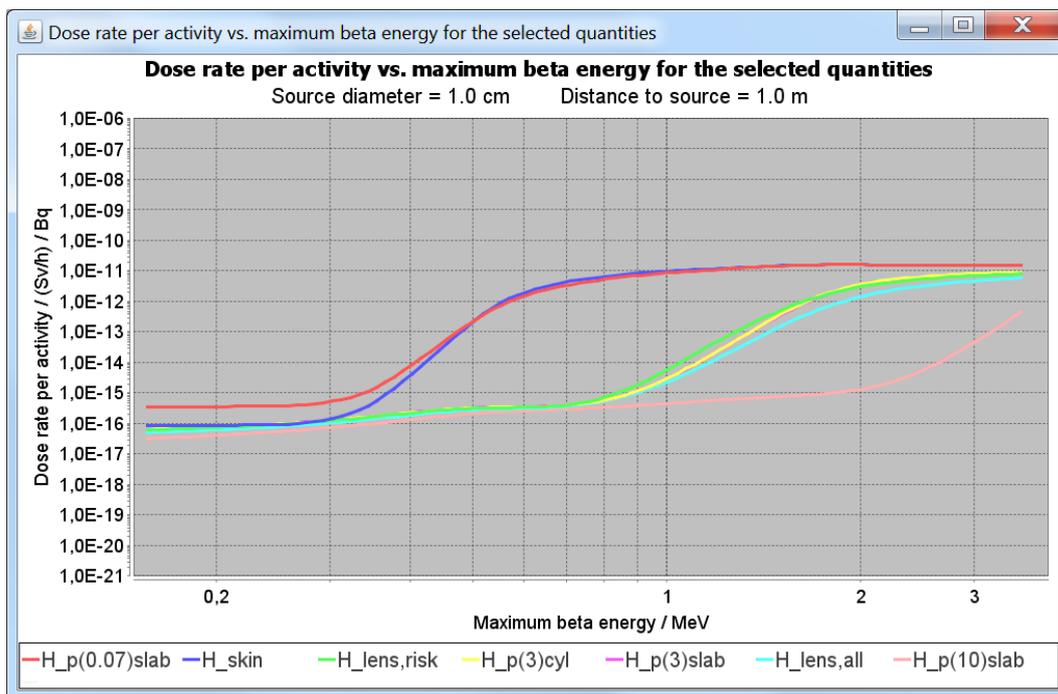
If you have entered only two parameters, the result will be a graph with the third parameter (i.e., the one for which no value was entered) varying within its limits, see below. Again, results will be shown for the chosen quantities. The graphs are automatically saved in jpeg-format to the “filesOut” folder. If you do not want to save the graphs automatically, uncheck the option “Save all plots automatically”.



All results are valid for a beta emission probability of $e_{\beta} = 1.0$. For radionuclides with $e_{\beta} \neq 1.0$, the results have to be multiplied with the respective value of e_{β} .

For radionuclides that emit more than one beta partial spectrum, the total dose rate is given by

$$\dot{H}_{\beta;R} = \sum_{k=1}^n \left\{ \dot{H}_{\beta;Ek} \cdot e_{\beta;k} \right\}$$
 where $\dot{H}_{\beta;R}$ is the doserate due to the beta spectrum emission of the radionuclide R emitting n partial beta spectra, $\dot{H}_{\beta;Ek}$ is the doserate interpolated to E_k (the maximum beta energy of the k -th partial beta spectrum of R), and $e_{\beta;k}$ is the emission probability of the k -th partial beta spectrum.



There are several options when displaying the plots:

- To *zoom in*, press the left mouse button and simultaneously move over the range of interest, from the upper left to the lower right.
- To *zoom out*, press the left mouse button and simultaneously move over any range inside the graph, from the lower right to the upper left (reverse direction).
- If you do a mouse right-click inside the graph, a *context menu* appears. This menu offers several more possibilities, like
 - adjusting the *design properties* of the headline, the axes, etc.,
 - *copying* the whole graph to the clipboard,
 - *saving* the graph as a png-file,
 - *printing* the graph,
 - *zooming* in or out.

4 Program history

The program was initially made available in November 2014, Version 1.0. Later changes of the program will be described here.

5 References

1. M. Reginatto. *BetaDosim: Software for the interpolation of the dose rate due to the beta emission of radionuclides*. www.ptb.de/cms/en/fachabteilungen/abt6/BetaDosim.html
2. M. Reginatto and R. Behrens, *Multi-parameter interpolation of beta radiation dose rates using radial basis functions*. Rad. Prod. Dosim (2015) [doi: 10.1093/rpd/ncu466](https://doi.org/10.1093/rpd/ncu466)
3. R. Behrens, *Simulation of the dose rate per activity of beta-emitting radionuclides*. Rad. Prot. Dosim. (2015) Vol. 167, No. 4, pp 653

6 Contact

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