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Calculation of specific absorbed fractions in body using Monte-Carlo simulations

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We calculated specific absorbed fractions (SAF) to estimate absorbed doses in the breast tissue of adult female. Reference adult female phantom was used as a model of the body. An in-house program was written to convert the phantom to the format suitable for Monte-Carlo simulations.
SAF from monoenergetic radiation were calculated. They were adjusted to masses of organs and tissues that include the mass of blood. Adjusted SAF were compared to SAF published by International Commission on Radiological Protection (ICRP) to verify the model.
S-values (unit doses per nuclear transformation) from Iodine-131 in thyroid were derived from SAF. These values were compared to [1] as an additional verification. Because of comparatively low energy the radiation from Iodine-131 is attenuated by tissues of the body. S-values to small organs and tissues and organs and tissues that are distant from thyroid have high uncertainty caused by Monte-Carlo method even using high number of histories.
One of the most challenging problem is calculation of dose from radionuclides distributed over the body. When simple source is simulated, it is considered that radionuclide is distributed uniformly over the source region. However tissues of body have various densities and the radionuclide has various mass activity in them. A new algorithm was proposed in [2] to calculate SAF from radionuclide distributed in the whole body. The algorithm requires the statistical weight of source particles to be equal to the density of corresponding tissues in gram per cubic centimeter. Electron and photon radiation should be treated differently. Electrons which are emitted from bone tissue are not taken into account. Difficulties of implementation of this approach are discussed in this talk.

1. S. Lamart et al., Rad. Prot. Dosim **168**, 92 (2016).
2. W.E. Bolch et al., Ann. of the ICRP. **45** 5-73 (2016).

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