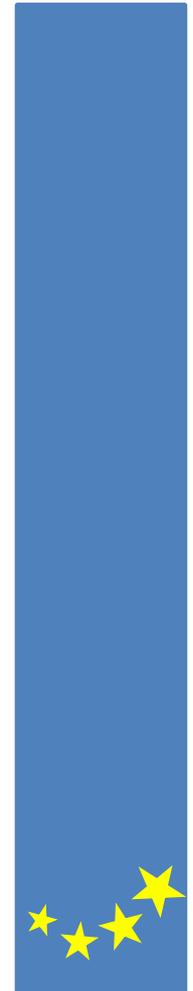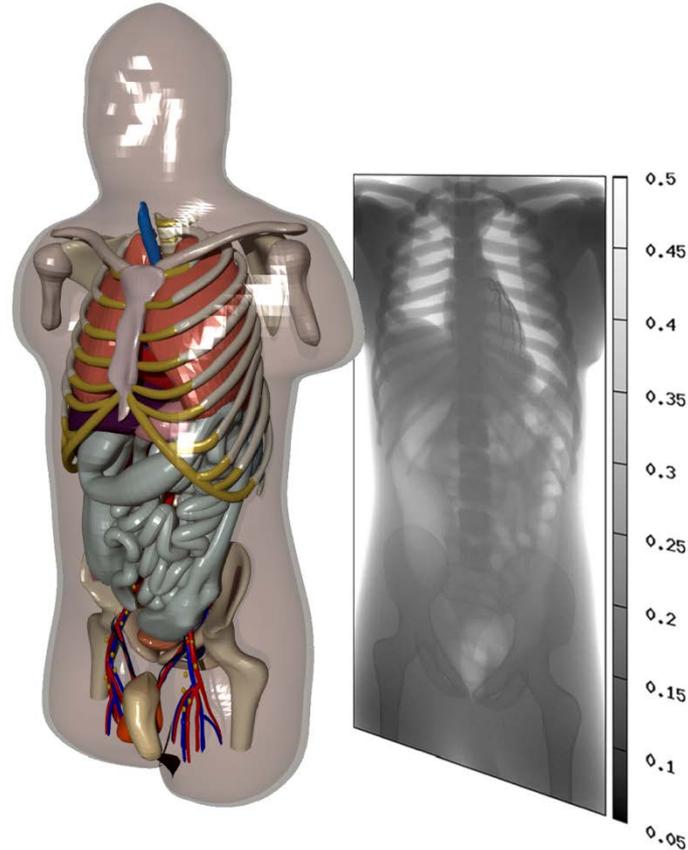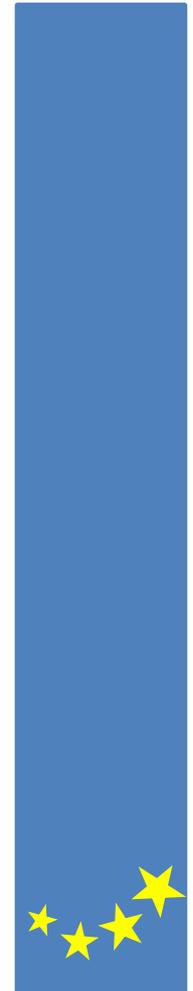**Module MPE03:**

Monte Carlo simulation
of x-ray imaging and dosimetry

Module summary

An introductory, **practically oriented**, course on the use of **Monte Carlo** simulation methods for medical physics applications in **radiology**

Learning outcomes

- Assess the adequacy of Monte Carlo algorithms for a given practical problem in x-ray imaging.

- Construct simplified models of x-ray transport problems to efficiently simulate them with PENELOPE/penEasy and MANTIS.

- Apply Monte Carlo simulation for the estimation of the absorbed dose to the patient.

- Manage a simulation project from beginning (conceptual modelling) to end (analysis of results).
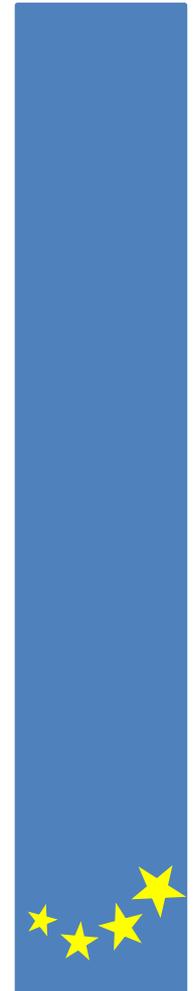
Take home messages

- Monte Carlo simulation of radiation transport is the golden standard in radiation transport calculations due to its accurate modeling of interaction processes, its suitability for dealing with complex geometries and its conceptual simplicity.

- Monte Carlo simulation has numerous applications in medical radiation physics and, in particular, in radiology and its associated dosimetry. It is a useful tool that can provide information with a degree of detail that would be very difficult to achieve experimentally or with other methods.

- It is important not only to master the operation of a simulation code (PENELOPE/penEasy in this case), but also to understand the assumptions made in the physics models that underlie the algorithms, since this information is key to assess the limits of applicability of the code.

- Proficiency in the use of Monte Carlo codes can only be achieved through extensive practise. A first experience in this direction is provided by solving practical problems in radiology and dosimetry using a step-by-step approach.

- Understanding the coupling between ionizing radiation and light photons in some x-ray digital detectors is crucial for their assessment. In this module this topic is addressed in the context of the MANTIS family of Monte Carlo codes.

Comments from participants

«Enabled a real understanding of how Monte Carlo algorithms work»

«The on-site phase was great and it outreached my expectations»

«Practical lessons were building step-by-step to a full simulation»

«The practical sessions were very well prepared and directly related to my day-to-day medical physics work»

«During the face-to-face phase we were provided with excellent examples and exercises»

«The infrastructure during the face-to-face part was excellent»

«Module lecturers were very well prepared and helpful»