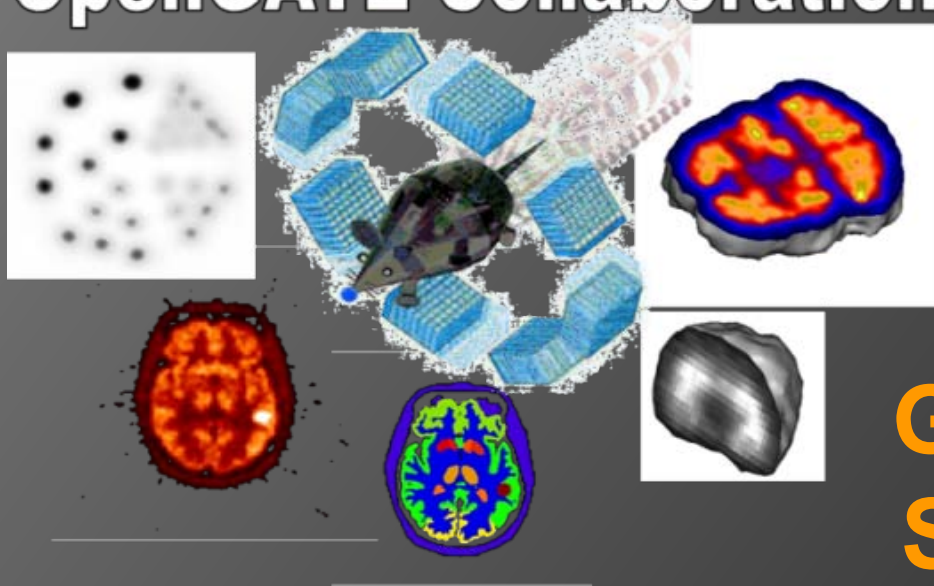


OpenGATE Collaboration



GATE Monte Carlo Simulation Toolkit

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School of Medicine
University of Patras*



Overview

- Introduction
- GATE quick tour !
- Monte Carlo in Nuclear Medical Imaging
(SPECT – PET)

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Introduction – What is GATE

**GATE: Geant4 Application for Emission Tomography,
*Transmission Tomography and Radiotherapy***

History

- Open-source software dedicated to the simulation of imaging (SPECT, PET, CT and RT) and based on the Geant4 toolbox
- First release of GATE in May 2004
- 19 releases since that date (last release GATE v7)

Introduction – What is GATE

**GATE: Geant4 Application for Emission Tomography,
*Transmission Tomography and Radiotherapy***

Technical Features

- GATE is based on Geant4 (written in C++)
- GATE is user-friendly without any C++ writing (using macros)
- GATE is flexible enough to model almost any detector design
- GATE can handle analytical or voxelized phantoms
- GATE can run on a cluster architecture and on grid

Introduction – What is GATE

**GATE: Geant4 Application for Emission Tomography,
*Transmission Tomography and Radiotherapy***

Broad range of applications

- Detector Design
- Optimization of acquisition and processing protocols
- Assessment of quantification methods
- Estimation of the system matrix used in tomographic reconstruction
- Use of voxelized anthropomorphic models (CT – MR images)
- Dosimetry

Introduction – OpenGATE Collaboration

- 16 labs, sharing developments and validation studies regarding GATE, and working together to make these developments publicly available
- OpenGATE collaborators meet twice a year, and communicate any time via a gate-devel mailing list
- The OpenGATE collaboration steering committee consists of one representative of each of the 16 labs

The role of the collaboration is:

- Upgrade GATE to follow the Geant4 releases
- Add new functionalities to GATE
- Organize training schools

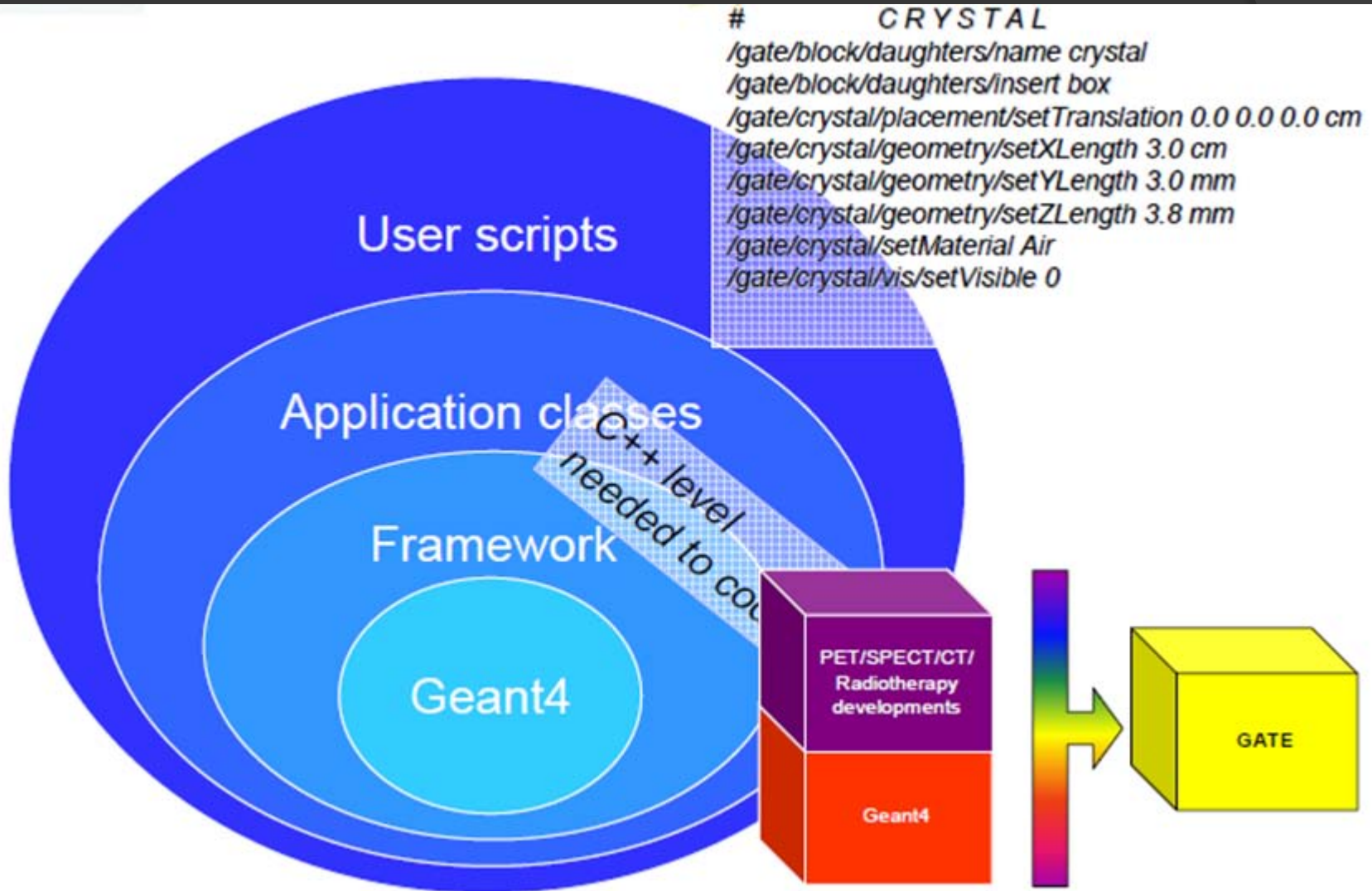
Introduction – GATE landmarks

- “GATE: A simulation toolkit for PET and SPECT,”
S. Jan et al., Phys. Med. Biol. 49, 4543–4561 (2004)
- “GATE V6: A major enhancement of the GATE simulation platform enabling modelling of CT and radiotherapy”
S. Jan et al., Phys. Med. Biol. 56, 881-901 (2011)
- “A review of the use and potential of the GATE Monte Carlo simulation code for radiation therapy and dosimetry applications”
D. Sarrut et al., Med. Phys. June (2014) Under press
- GATE url: <http://www.opengatecollaboration.org/>

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GATE core



GATE – official modelled systems

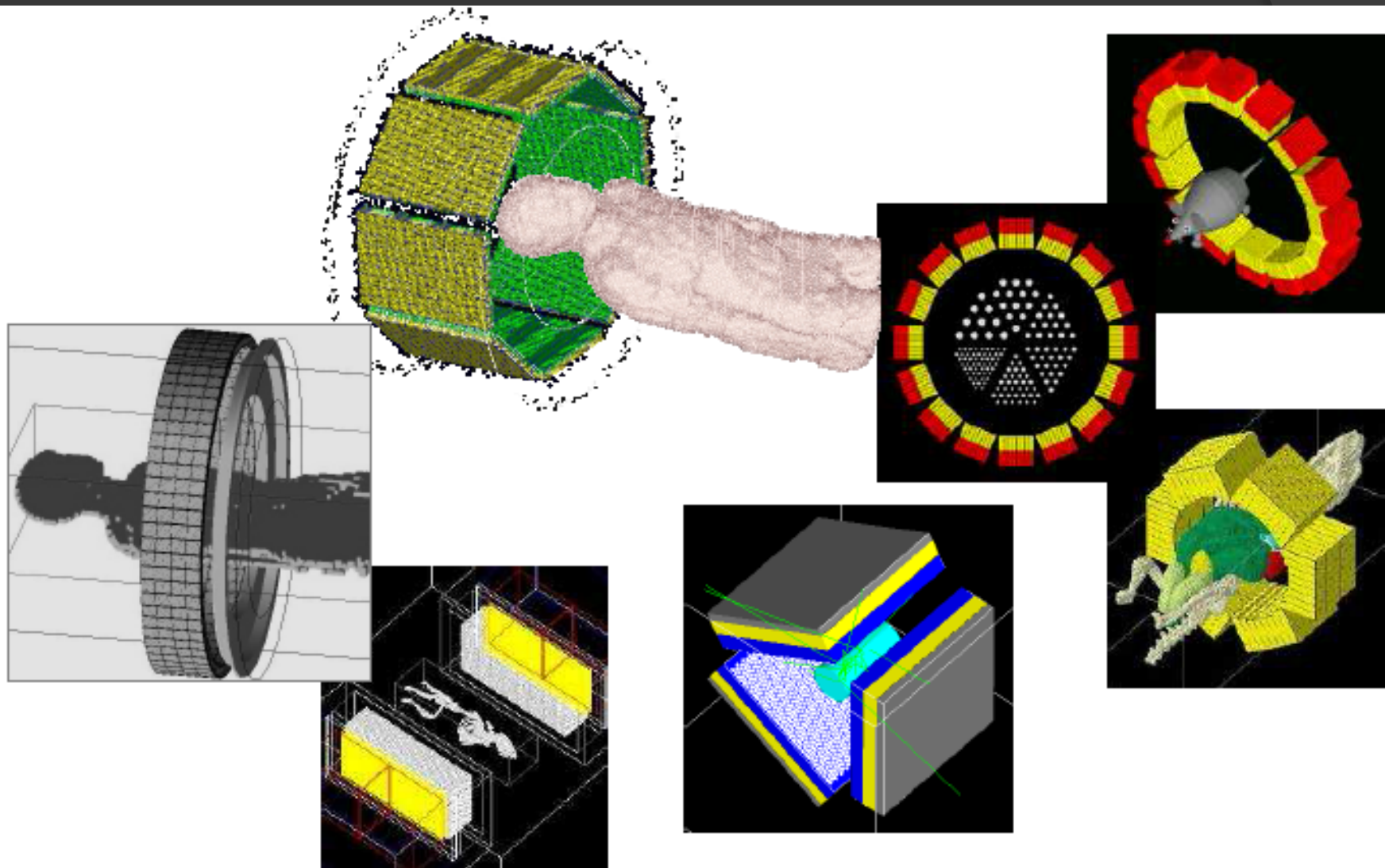
➤ PET Systems

ECAT EXACT HR+
ECAT HRRT, Siemens
Hi-Rez, Siemens
Allegro Philips
GE Advance, GEMS
MicroPET P4, Concorde
MicroPET Focus 220, Siemens
Mosaic, Philips

➤ SPECT Systems

IRIX, Philips
AXIS, Philips
DST Xli, GEMS
Millennium VG Hawk-Eye, GEM
ECAM Dual-Head, Siemens

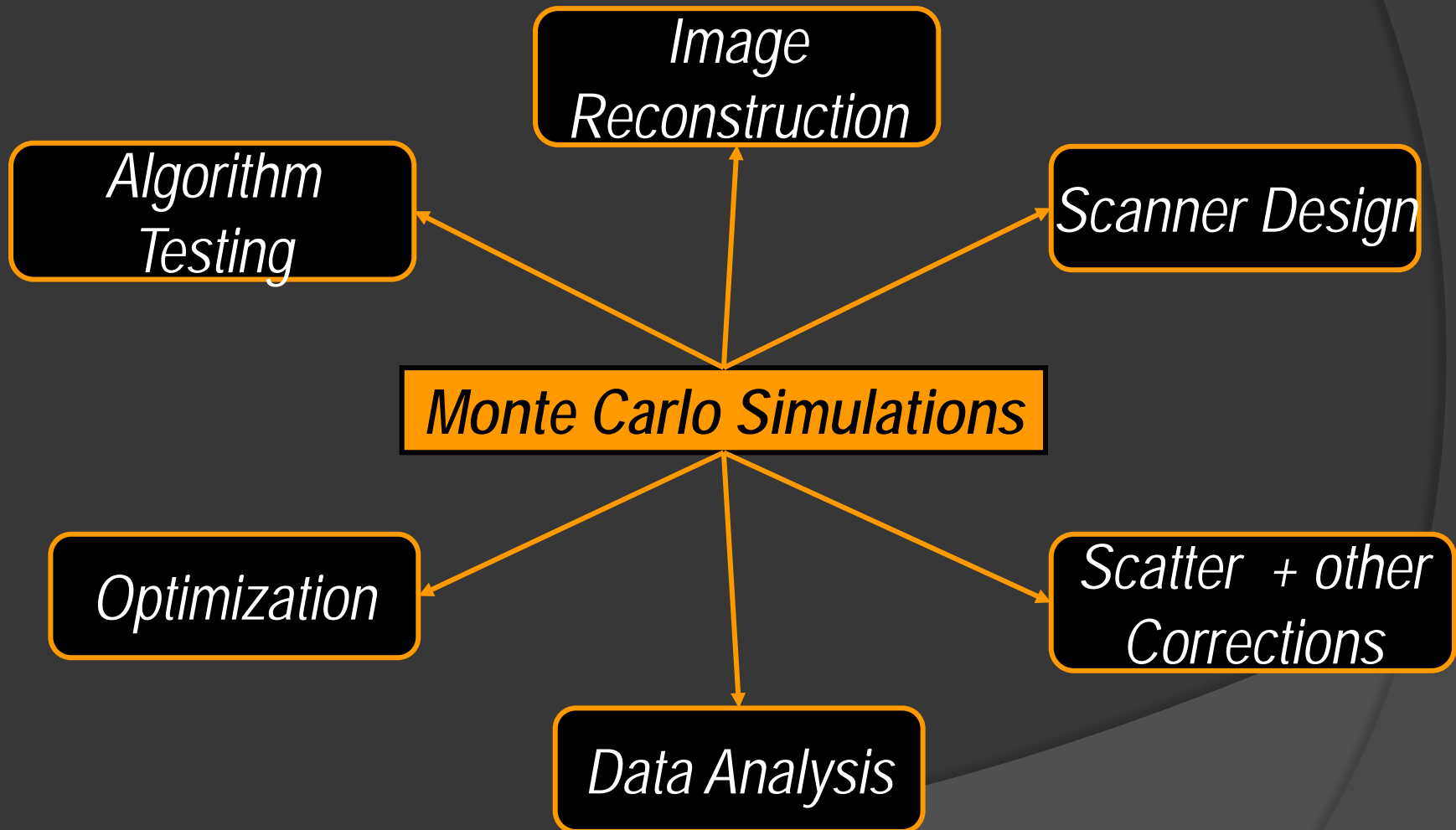
Numerical Phantoms & Detector Designs



Overview

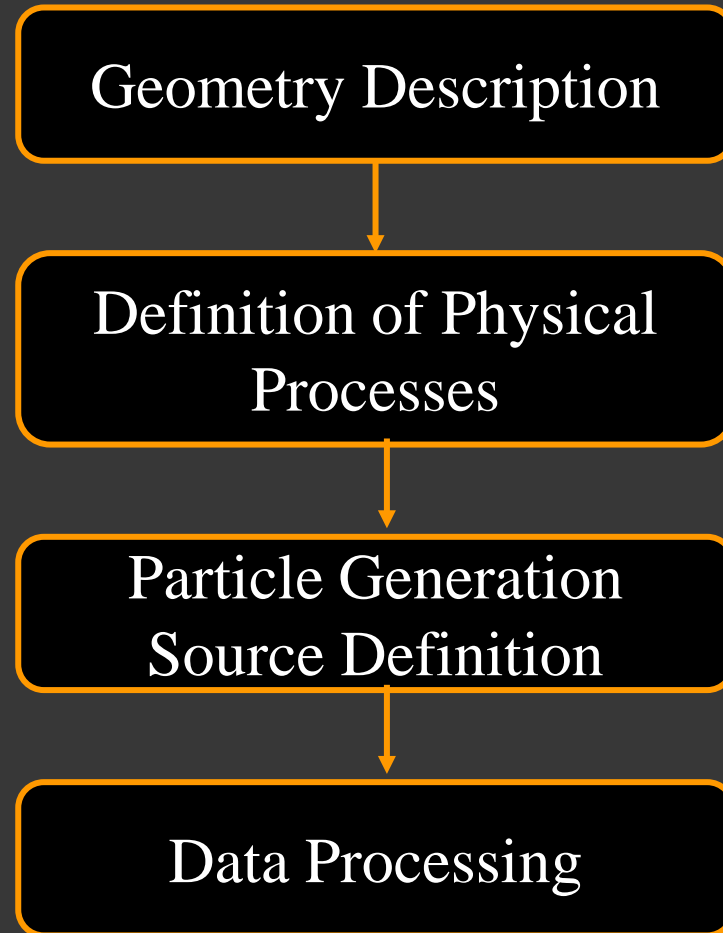
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Monte Carlo (I): Applications in Nuclear Medicine



Monte Carlo (II):

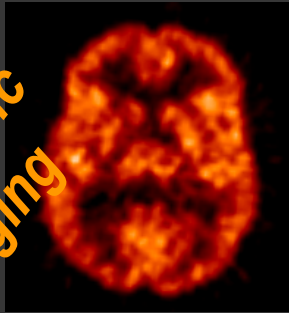
Basic steps in Nuclear Medical Imaging



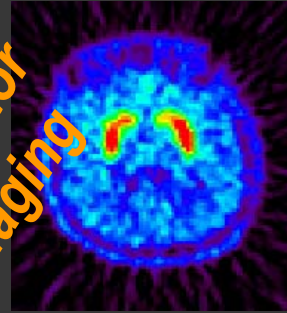
What could we do with MC simulations?

Realistic Simulations – clinical situations

*Metabolic
imaging*



*Receptor
imaging*



Oncology

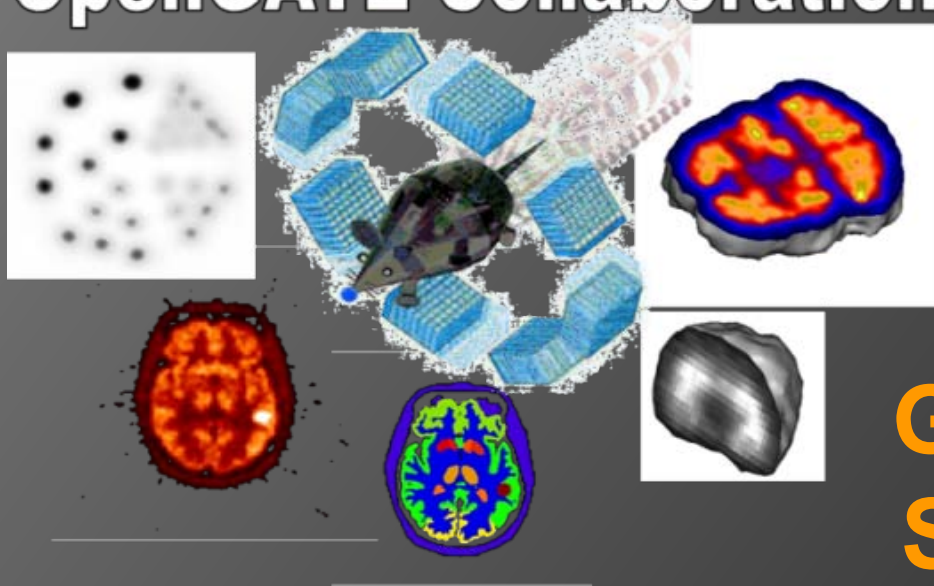


Use MC to optimize:

- Acquisition protocol
(injected dose, acquisition time, threshold... dedicated for each patient)
- Algorithms for data corrections and reconstruction
- Quantitative analysis
- Dosimetry studies

- **We need something more than simple phantoms...**

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