Status of the ***EduGATE*** *Project*

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with contributions from

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BERGISCHE UNIVERSITÄT WUPPERTAL

Computer Simulation In Science (CSIS)

- new Master course at University of Wuppertal (international/english)
- topic: imaging in medicine
- focus on physical and computational background of imaging in medicine, including computer simulation

- special topics: imaging for medical applications
- application of simulation → system design etc.
- image reconstruction
- image analysis and data visualisation

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- based to a large part on:
  - GATE
  - ROOT / C++
  - but also: **develop / use Python-based analysis interface** including tools for image reconstruction

Computer Simulation In Science (CSIS)

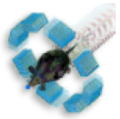
- installation of GATE / EduGATE project on university cluster

- Easy-GATE-installation-master

→ students have easy access to GATE / EduGATE

→ students use the same GATE and ROOT version

→ used during lecture & exercises



Motivation to extend the EduGATE project

- teach it in an IEEE Short Course:
  → Atlanta 2017, Sydney 2018, **Manchester 2019?**

- initially EduGATE was intended to provide very simple introductory examples to support newcomers using GATE

- simple and very basic examples turned out to be useful during lectures
  → basic detector & imaging physics
  → helpful for courses with students from different study programmes (physics, engineering, computer sciences,...)

Using GATE to Educate → EduCGATE

List of Examples – Collection 2018+

GATE v7.2
GATE v8.0

- **Coin_Chan**
  from coincidence channel to a PET system
  extended version: studying „scatter“ effects

- **Gamma_Camera**
  basic imaging features of a Gamma camera

- **SPECT_to_Reco**
  including reconstruction from projections (based on IDL / GDL)
  needs new reco part based on C++ / Python / Fiji

- **Spectro**
  analysing energy spectra of radioactive isotopes
  linking to the book „Physics in Nuclear Medicine“ (Cherry et al.)

List of Examples – Collection 2018+

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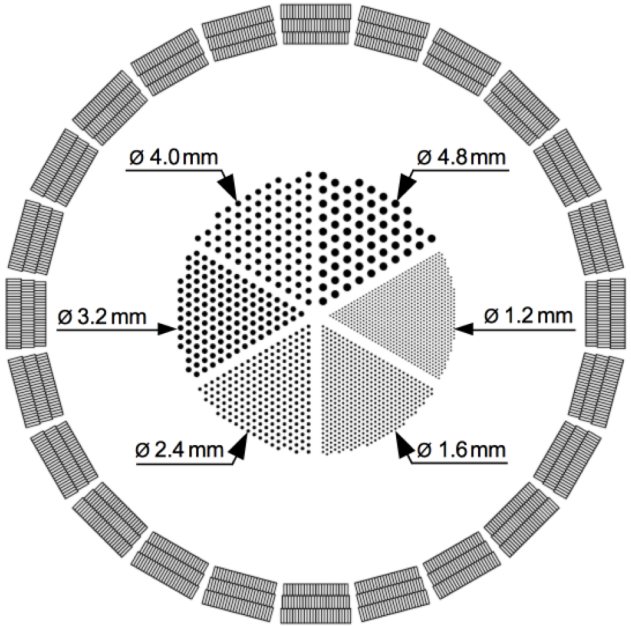
- **Spectrometry_Gamma**
  actually two modules (basic & extended)
  linking to the book „Physics in Nuclear Medicine“ (Cherry et al.)
- **MR_PET**
  available in two versions, Particle and Ion Sources
  explore the fate of positron or electron in a MR system
- **Attenuation***
  a Monte Carlo approach based on an „unrealistic“ system
- **Cherenkov***
  optical photons, cherenkov and scintillation → fast PET detectors
- **Multilayer_PET***
  expectations for higher spatial resolution using 1 to 4 crystal layers
- +

Further Activities → Mirjam Lenz (PhD student)

- working on novel PET detector for a new UHF MRI compatible BrainPET insert
- multiple simulation studies, with and without optical photons
- HPC system JURECA: simulations with high statistics
  → normalisation and phantoms inside new scanner geometries



example: hot rod phantom

normalisation: 10,000 core-hours

phantom (ø 20cm): 7,200 core-hours

reconstruction with in-house software PRESTO

Further Activities → Mirjam Lenz (PhD student)

- difficulty with optical photons:
  - DAVIS model not yet available for used crystal + reflector combination in crystal arrays
  - UNIFIED model possible, but requires careful estimation of many parameters
  - multilayer geometries require HPC system
- validated digitiser for Philips Digital Photon Counting (dSiPMs)
  - running on HPC system JURECA

  → generalisation of the module along with digitiser for analogue SiPMs?

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