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Big Science Workflows and Orchestration: Opportunities in medical physics

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Opportunities in computing for medical physics: general considerations

- All the proposed deliverables will support research in medical physics in Australia
 - Deliverable 1: Data orchestration (movement, workflow, popularity, access).
 - Deliverable 2: Software access
 - Deliverable 3: Computing access to data
 - Deliverable 4: Large-scale data access
 - Deliverable 5: Training and Community
- Depending on the specific application, some deliverables may be more important than others

Some use cases scenarios

WITHIN RESEARCH OF THE CENTRE FOR MEDICAL RADIATION
PHYSICS, UNIVERSITY OF WOLLONGONG

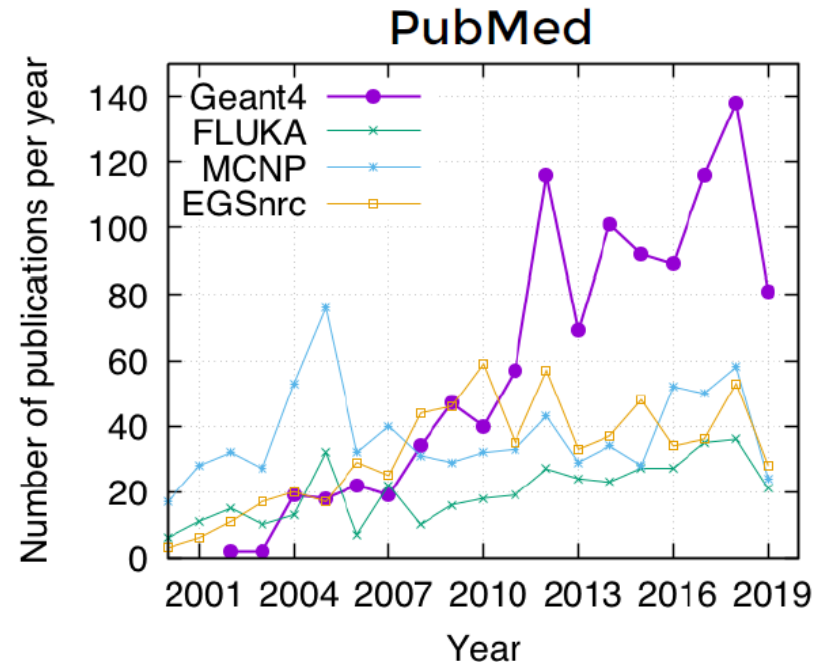


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Monte Carlo simulations for medical physics

Applications

- Verification of radiotherapy Treatment Planning Systems
- Improvement/optimisation of QA instrumentation
- Dosimetry and production of radiopharmaceuticals
- Imaging (e.g. PET, SPECT, CT)
- Detector design
- Radiation protection in Earth Labs, aviation and space
 - Design shielding solutions
- Modelling of Medical Accelerators for hadron therapy



Courtesy of Carlo Mancini,
Sapienza, Rome, Italy



Monte Carlo for Treatment Planning System (TPS)

- MC used for verification of TPS
 - Too slow in terms of execution for many applications (conventional X-ray radiotherapy, Microbeam Radiation Therapy, hadron therapy)
- However, access to extensive computing resources could change the paradigm
- **Key point:** computing power and resources
- **Note:** confidentiality is crucial when dealing with TPS and images

Data Orchestration	Software access	Computing access to data	Large-scale data access

Useful, important

Study of the effect of radiation at sub-cellular level

- Applications: radiotherapy and radiation protection (especially in space missions)
- Very computing demanding as particle interactions are modelled one by one (no condensed history approach)

Data Orchestration	Software access	Computing access to data	Large-scale data access

Useful, important

Research for space exploration

- Space Medicine
 - Radiation effects in humans and electronics
 - Australian Space Agency Program : Moon to Mars, \$50M grants allocated today
 - New direction at CMRP
- Monte Carlo based radiation protection studies in the Moon and Mars environments
 - Including shielding
- Including industrial partners: confidentiality is important

Data Orchestration	Software access	Computing access to data	Large-scale data access

Useful, important

Radiomics

- Extraction of a large number of features from medical images
 - using data-characterisation algorithms, I
 - machine learning algorithms
- Large datasets
- Often confidential information within inter-institutional agreements
 - Security is crucial

Data Orchestration	Software access	Computing access to data	Large-scale data access

Useful, important



Summary

- The proposed project will definitively support computing based research in medical physics, at national level
 - Common platform and methodologies
 - Enhancement of national and international collaborations
 - Easier use of software tools
 - More efficient use of computing resources
- Security is very important for specific applications, especially if hospitals may be users of this platform or if industrial partners are involved
- Good user documentation should be provided for the wider community (also for non experts)
- Maybe something to look into: use the platform for education purposes, e.g. in Depth studies of High School students, tertiary education

