European Organization for Nuclear Research

Geant4

A toolkit to simulate the interaction of particles with matter

Collaborators also from non-member institutions, including
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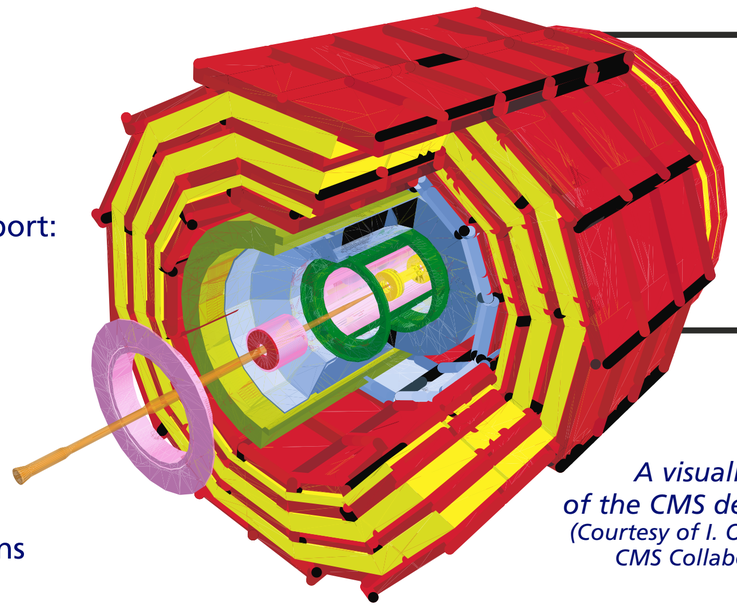
Concept

Geant4 simulates the passage of particles through matter.
It provides a complete set of tools for all domains of radiation transport:

- Geometry and Tracking
- Physics processes and models
- Biasing and Scoring
- Graphics and User Interfaces
- Propagation in fields.

Geant4 physics processes describe electromagnetic and nuclear interactions of particles with matter, at energies from eV to TeV.
A choice of physics models exists for many processes providing options for applications with different accuracy and time requirements.



A visualization of the CMS detector
(Courtesy of I. Osborne, CMS Collaboration)

The toolkit is developed, maintained and supported by Geant4, a world-wide collaboration of about 100 scientists from many institutions, contributing in their area of expertise. Developers interact constantly with users, and combine efforts to validate physics results for application in high energy physics experiments, space and medical studies.

Applications

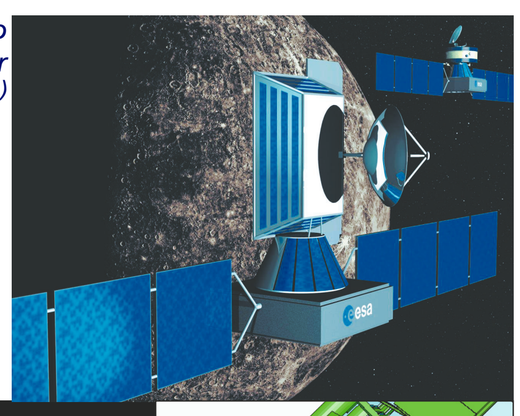
High energy and nuclear physics detectors
- **ATLAS, CMS, HARP and LHCb at CERN and BaBar at SLAC**

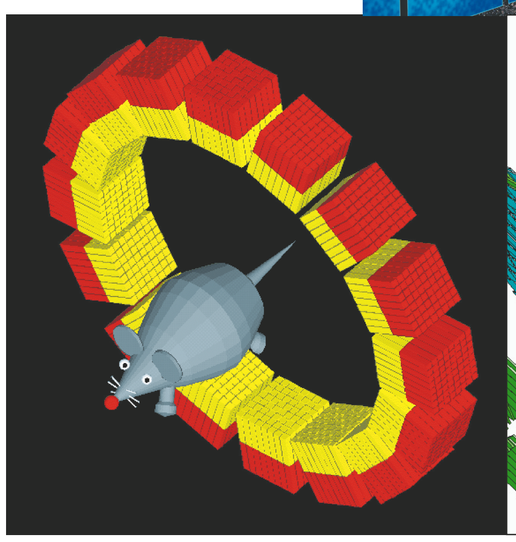
Accelerator and shielding
- Linacs for medical use

Medicine
- **Radiotherapy**
  - photon, proton and light ion beams
  - brachytherapy
  - boron and gadolinium neutron capture therapy
- **Simulation of scanners**
  - PET & SPECT with GATE (Geant4 Application for Tomographic Emission)

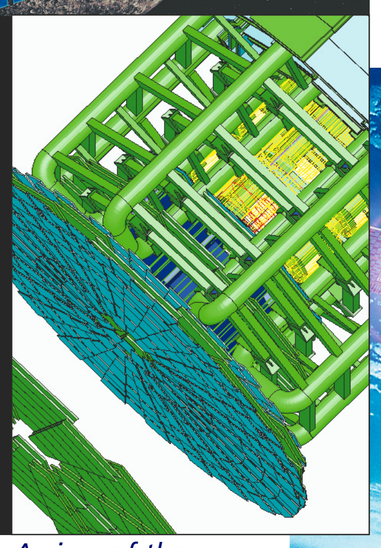
Space
- **Satellites**
  - effect of space environment on components (especially electronics)
  - shielding of instruments
  - charging effects
- **Space environment**
  - cosmic ray cut-offs
- **Astronauts**
  - dose estimates

The BepiColombo Mercury orbiter
(Courtesy of ESA)





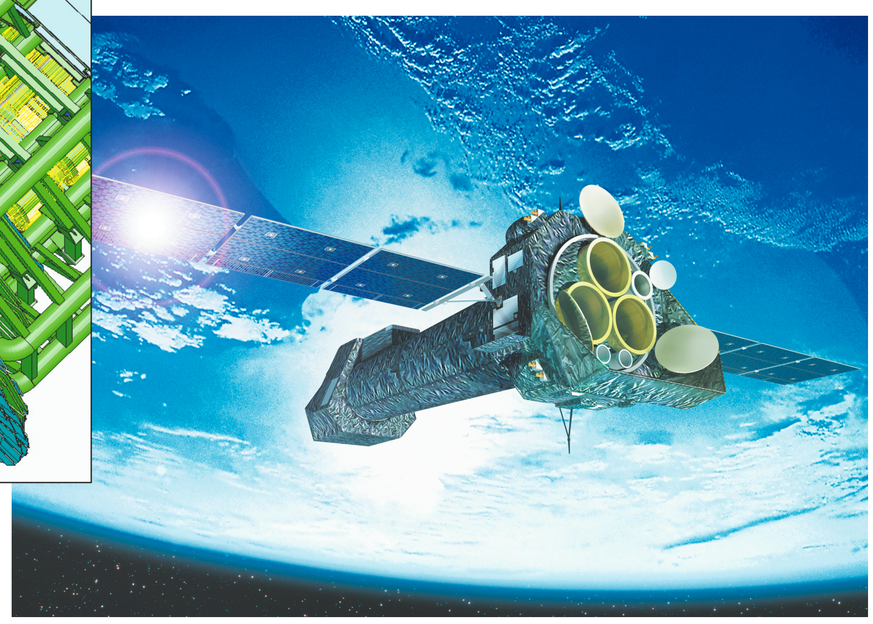
Simulation of small PET scanner using GATE
(Courtesy of the OpenGATE collaboration)



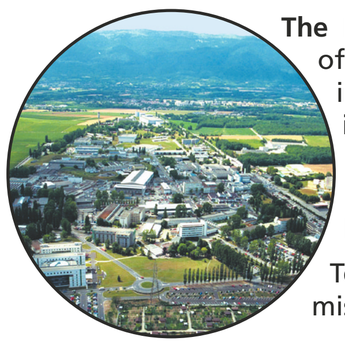
A view of the ATLAS detector
(Courtesy of S. Tanaka, ATLAS collaboration)

Advantages

- Simulates the geometries of complex setups efficiently
- Provides configurations of physics processes for application areas
- Enables user to tailor simulation components and address accuracy needs
- Performant and adaptable
- Easy to embed into specific applications



XMM-Newton X-ray telescope: the effects of the radiation environment on its instruments was modeled with Geant4 prior to launch in 1999
(Courtesy of ESA)



The European Organization for Nuclear Research (CERN), one of the world's foremost particle physics laboratories, has introduced an active Technology Transfer policy to establish its competence in European industrial and scientific environments, and to demonstrate clear benefits of the results obtained from the considerable resources made available to particle physics research.

Technology Transfer is an integral part of CERN's principal mission of fundamental research.

CERN Technology Transfer

http://knowledgetransfer.web.cern.ch/technology-transfer/external-partners/geant4