

# MCNP Overview

from a Medical Physics Perspective

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# Abstract

- This presentation reviews the current status and issues of MCNP with respect to Medical Physics issues. Other efforts, such as the MP geometry database, MCNP Primer and MP Workshops are also discussed.

# Overview

- Code Description
- Code Status
- Code Issues
- CMPWG Efforts:
  - Medical Physics Primer
  - MCNP Input Deck for MP problems
  - MCNP MP Workshops

# MCNP

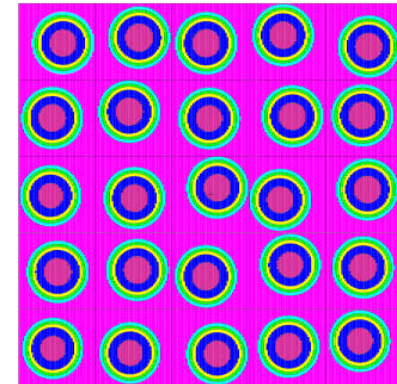
- Monte Carlo N – Particle
- Coupled Monte Carlo Simulation of:
  - Neutron (  $10^{-5}$  eV – 150 MeV)
  - Photons ( 1 keV – 100 GeV)
  - Electrons/Positrons ( 1 keV – 1 GeV)
  - Protons (100 MeV – 100 GeV ) + others
- Current cross section data: pre-ENDF/B VII
- General Purpose 3D geometry, sources, tallies, variance reduction techniques, parallel options
- International user base for wide variety of applications

# Code Status

- MCNP5 RSICC 1.40 to RSICC shortly.
  - $e^-$  physics , mesh tally / plotting, improvements
  - Positron sources
  - Free distribution for limited time.
- MCNP6 proton, muon, pion, etc.  
development continuing (~FY07 release)
- MCNP / MCNPX merger discussions
  - Combined distribution from RSICC

# Neglected Existing Capabilities

- Time dependence of Source and Tallies.
  - Simulate progress of radioisotope through body
- Randomized lattice geometry
  - Nasal cavities / bone matrix ?
- PIKMT Card
  - Force reactions with particular elements

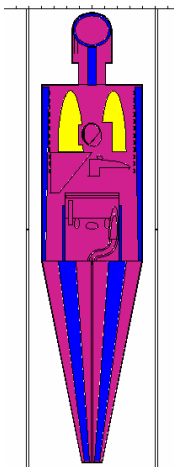


# Code Issues / Requests

- Support large (CT-based) lattice models
  - Memory, speed, file sizes
  - Startup times
  - CT conversion techniques.
  - Direct support of DICOM
- Smaller geometries – DNA
- Pre-defined Radioisotope Sources (Decay Sources)
- Accelerator emittance
- Materials Library
- Photon diffraction
- HTML output
- Moving Geometries
  - Walking, Breathing
- Source rotation & separate tallies (for CT scans)
- Adjoint capability to speed up calculations
- File names

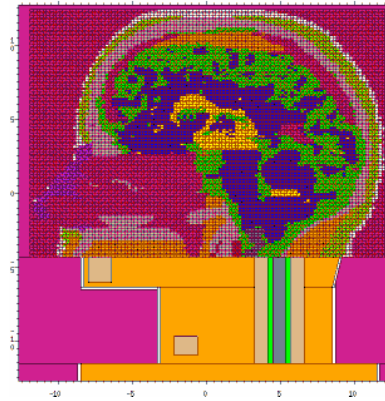
# MCNP Input Database

- Collection of free input decks
- Small but growing # of contributors
- Distribution w/ MCNP & MCNP website
- Includes QUADOS efforts (Next EU comp?)



MIRD Phantom by  
Sanghyun Park,  
Hanyang University,  
Korea

Zubal Head by Jeff  
Evans, Ohio State



Male Pelvis by Mark Wyatt



# MCNP MP Primer

- Masters Thesis by Alexis Lazarine, TAMU
- Steps new users through typical examples
  - Brachytherapy, external beam therapy, radioisotope therapy
- Examples calculate doses, specific absorbed fractions (MIRD phantom organs), radiographs
- Distributed with MCNP & MCNP website
- Completed by ANS Winter Meeting (Presentation)

# MCNP MP Workshops

- 1/2 Day lecture on using MCNP
  - Advanced Lattice (CT-based) geometry
  - Dose / flux calculations
- 1<sup>st</sup> given at Monte Carlo 2005 (Chattanooga)
  - ~ 60 people in attendance.
- 2<sup>nd</sup> at RPSD, April 2006 (Carlsbad, NM), with emphasis on electron / photon transport & physics
  - Taught by T. Goorley and G. Hughes