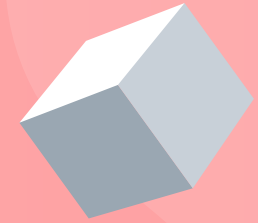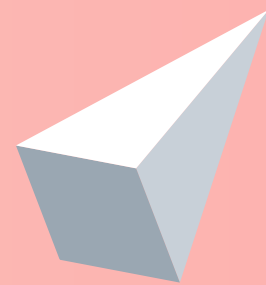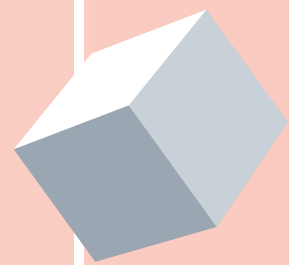PRESENTED BY
MS GUDANI TSHIVHASE
NORTH-WEST UNIVERSITY

SUPERVISED BY
DR ALEXEY ZHEMCHUGOV

COMPUTATIONAL SIMULATION OF RADIATION PROTECTION USING THE GEANT4 TOOLKIT

THE
OUTLINE

INTRODUCTION

- Aims and objectives
- About Geant4
- Monte Carlo simulations
- Ambient dose equivalent

Aims and Objectives

AIM

To learn how to build and compile Geant4 and utilise its features for further application beyond the JINR project

OBJECTIVES

1. Build Geant4 software
2. Calculate flux-to-dose equivalent factor
3. Compare simulation results with experimental data.

About Geant4

PROJECT TOOLKIT

- Developed in CERN
- Simulations are based on the Monte Carlo method
- The software takes into account interactions with materials and external electromagnetic field

Monte Carlo simulations

- Method provides:
  - Histories of particles
  - Flux
  - Spectrum
- Radiation protection: relationship between flux and dose

Ambient dose equivalent

photons

ICRU sphere

H*(d)
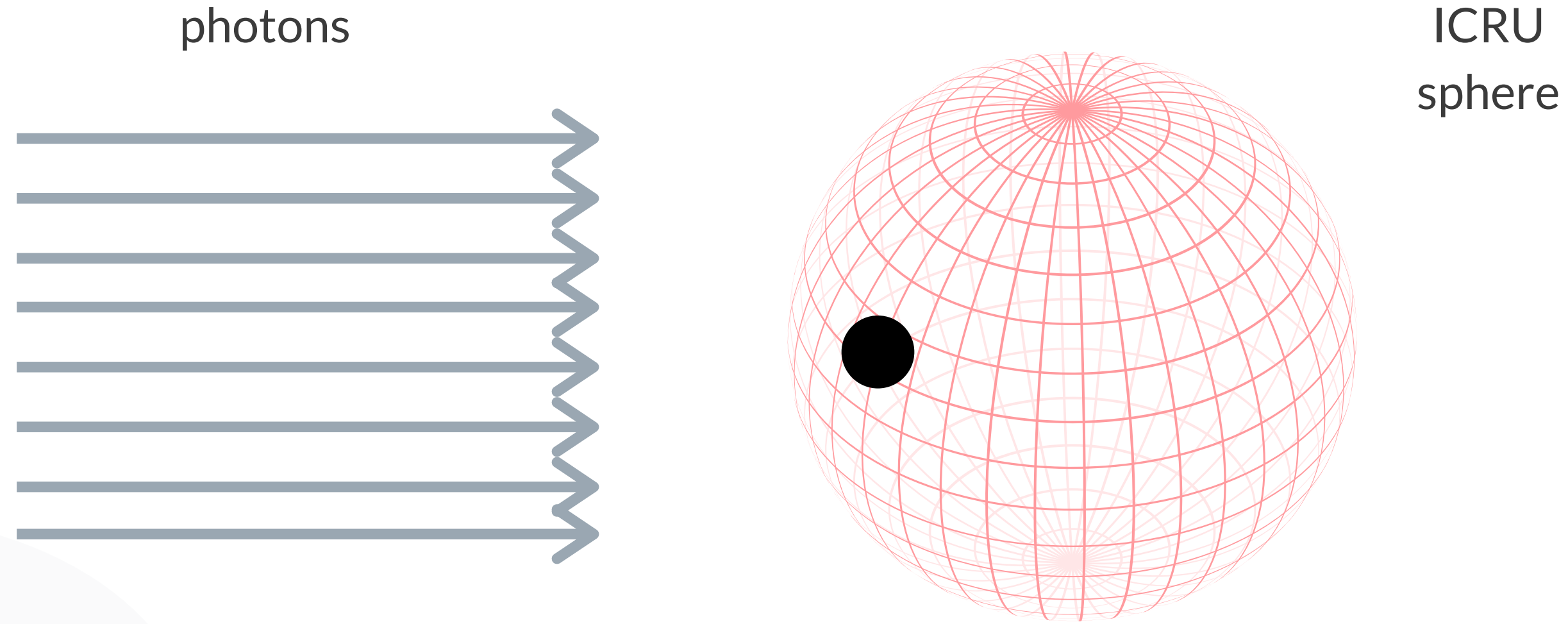
currently recommendedd = 10 mm

METHODOLOGY

- Software and hardware used

Methodology

- Geant4 toolkit should be provided with:
  - geometry
  - primary generator
  - physics models
- Interpretation of data: Root
- All of which is C++ based

DATA ANALYSIS

- Geometry obtained

DATA ANALYSIS

Logical volume: world volume
Physical volume: ICRU tissue
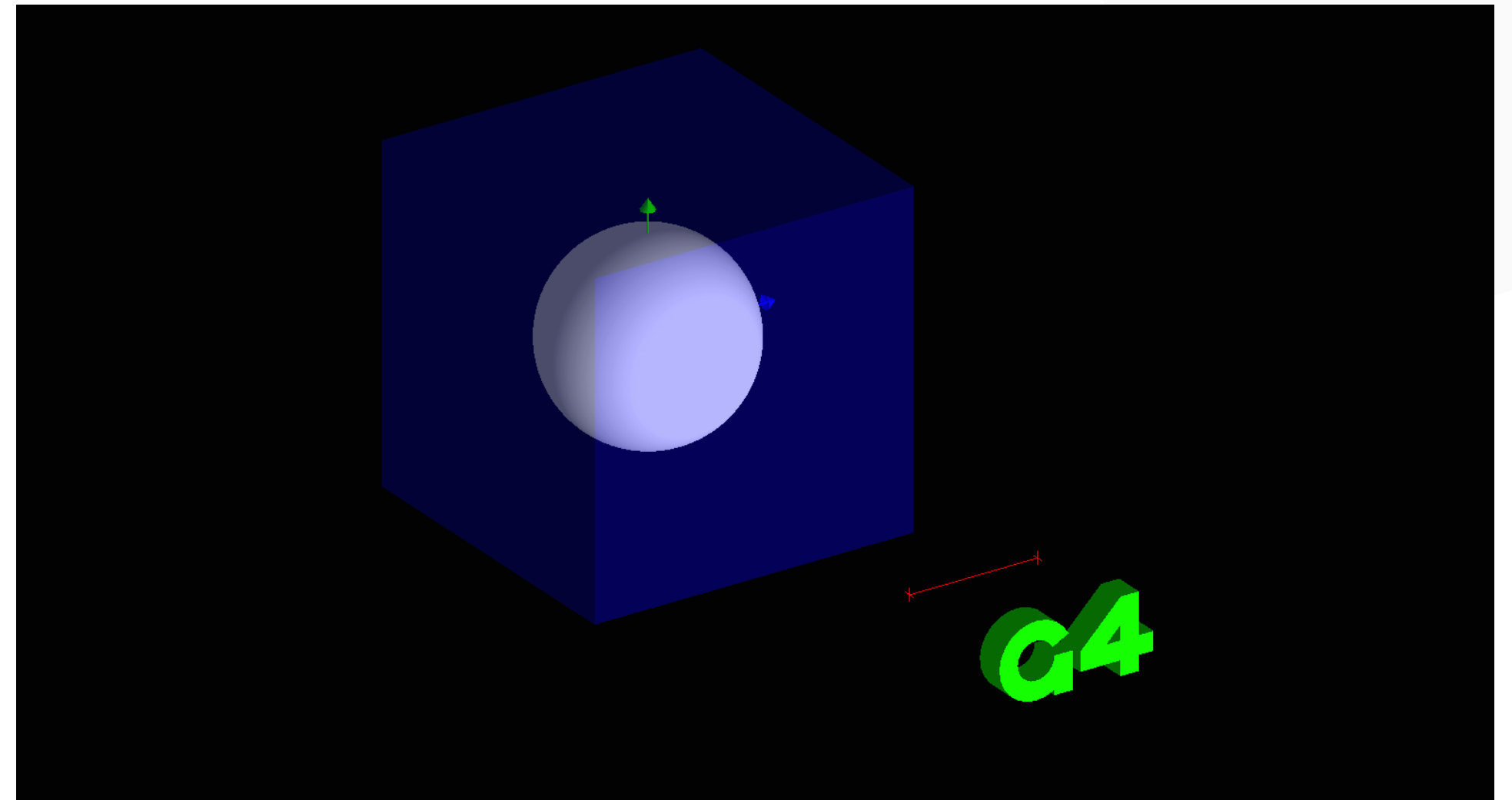Solid: Sensor box

spherical phantom 30 cm diameter
sensor 5x5x3 volume

tissue equivalent material with
density 1g/cm^3
mass composition:
- 76.2% Oxygen
- 11.1% Carbon
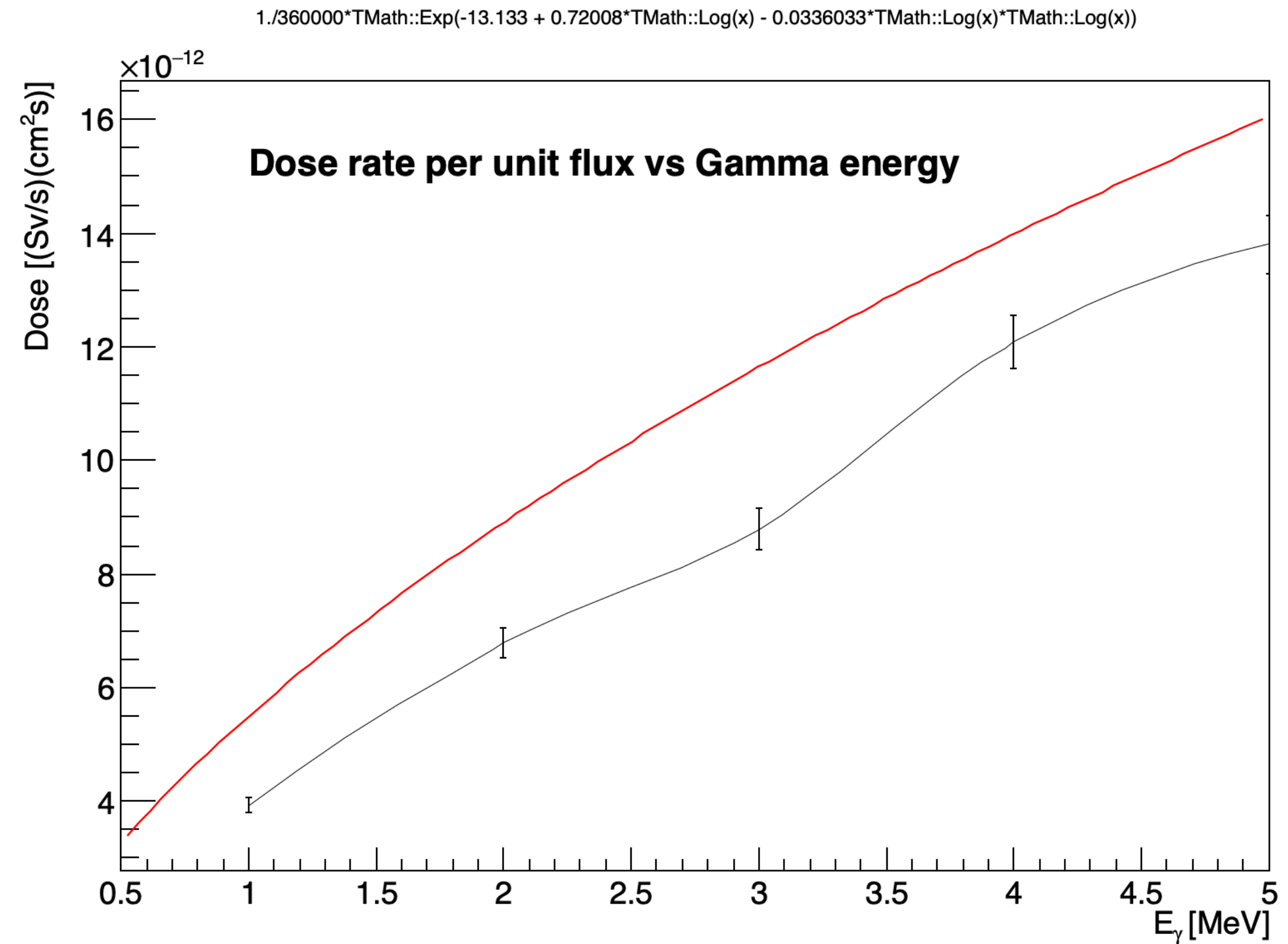- 10.1% Hydrogen
- 2.6% Nitrogen

RESULTS AND DISCUSSION
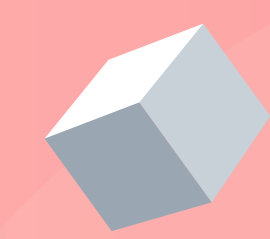
- Simulation vs experimental data

RESULTS

**Simulation data vs
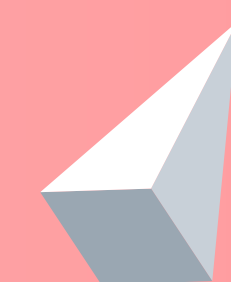Experimental data**

1./360000*TMath::Exp(-13.133 + 0.72008*TMath::Log(x) - 0.0336033*TMath::Log(x)*TMath::Log(x))

Experimental from: ORNL/RSIC-45/R1

CONCLUSION

1. **ON RESULTS**
2. **ON THE SOFTWARE**

ACKNOWLEDGEMENTS

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VLADISLAV ROZKHOV

Scientist at the DLNP

DZHELEPOV LABORATORY OF NUCLEAR PROBLEMS (DLNP)

ITHEMBA LABS AND THE NATIONAL RESEARCH FOUNDATION (NRF)

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3. F.H.Attix, Introduction to Radiological Physics and Radiation Dosimetry (2004) Wiley-VCH, Weinheim.

4. L.M. Linger, D.K. Trubey (1982) Specific Gamma-Ray Dose Constants for Nuclides; Important to Dosimetry and Radiological Assessment; ORNL/RSIC-45/R1

THANK YOU

ANY QUESTIONS?