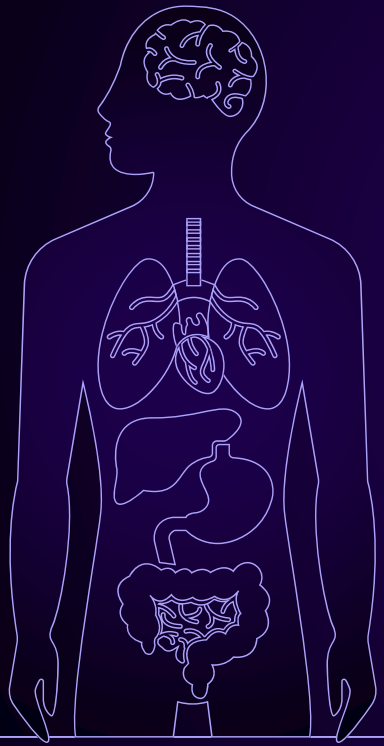
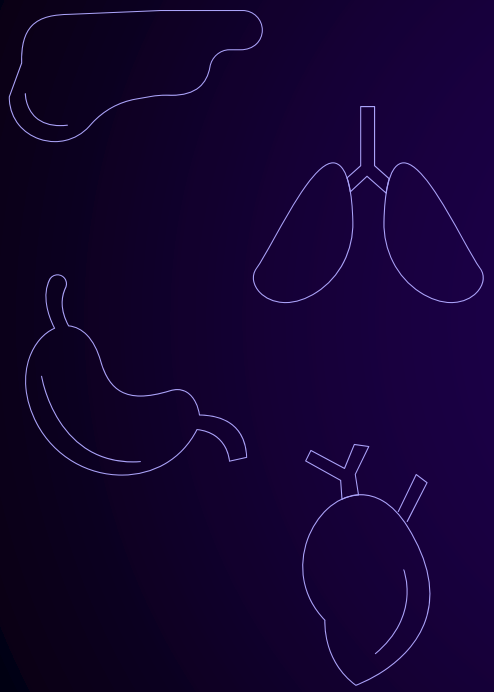


COMPARATIVE STUDY OF INTERNAL DOSE CALCULATION : MONTE CARLO VS MIRD

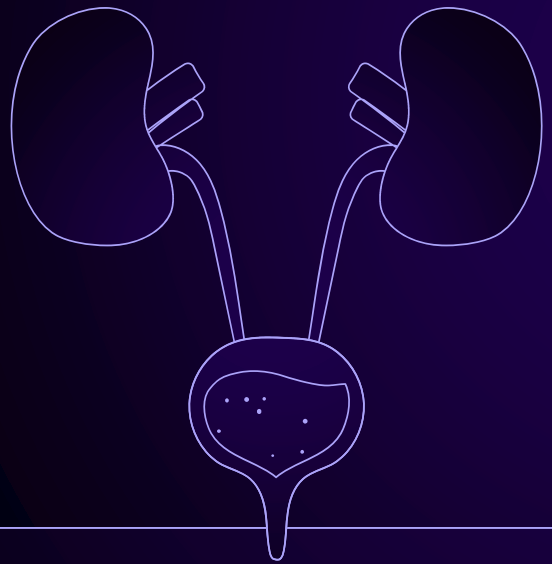
Presented by : Fatima Zahra AHLAF

CONTENTS

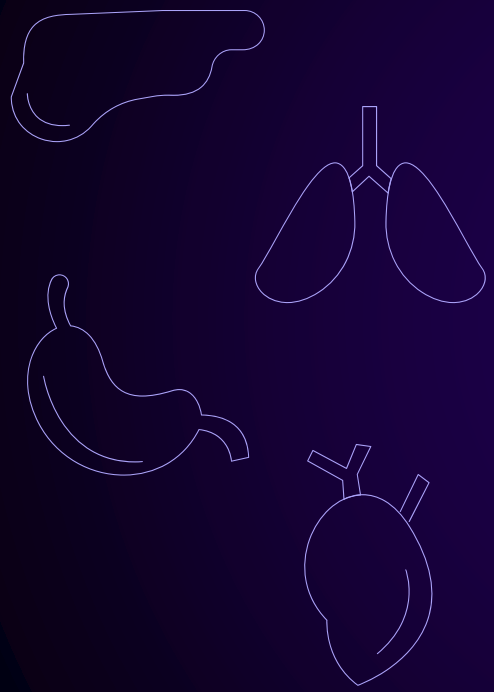


01

INTRODUCTION : INTERNAL DOSIMETRY



The Monte Carlo method and the method proposed by the Medical Internal Radiation Dose (MIRD) committee are among the most widely used methods for estimating absorbed dose in nuclear medicine.



02

MONTE CARLO AND MIRD METHODS

MONTE CARLO METHOD

PARADIM (A PHITS-Based Application for Radionuclide Dosimetry in Meshes **)**

PARaDIM is a graphical user interface-based application designed to configure/run Monte Carlo particle transport simulations via the PHITS code to compute 3D and mean region-level (organ-level) absorbed doses, dose rates, and S-values in tetrahedral mesh-type computational phantoms.

PHITS (**P**article and **H**eavy **I**on **T**ransport code **S**ystem)

PHITS is a general purpose Monte Carlo particle transport simulation code developed under collaboration between JAEA, RIST, KEK and several other institutes.

Version of PHITS (v.3.34)

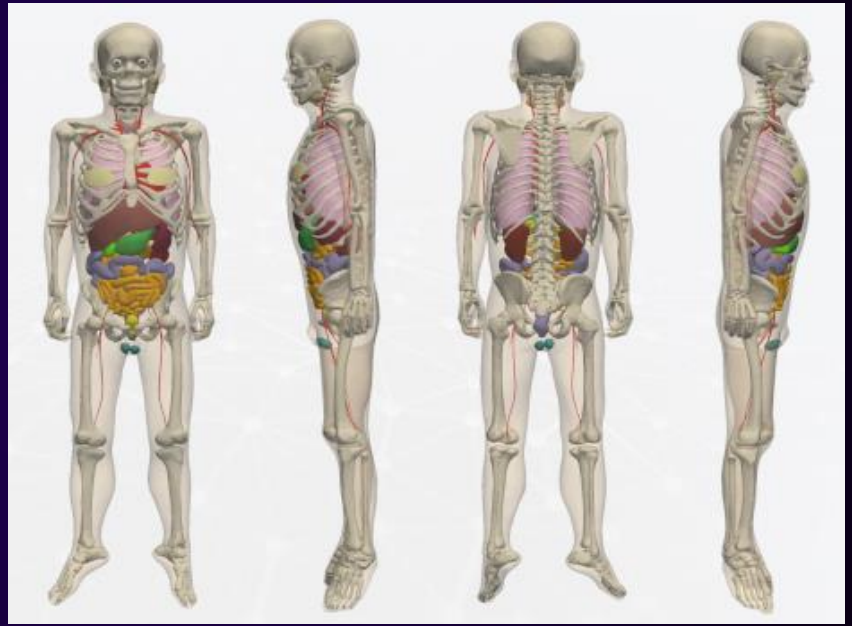
PHITS
Particle and Heavy Ion Transport code System

PHANTOMS USED

THRK-Man :

Korean male reference phantom derived from the HDRK-Man (High Definition Reference Korean Man) voxel phantom.

Vertices: 61,652
Tetrahedrons: 404,008

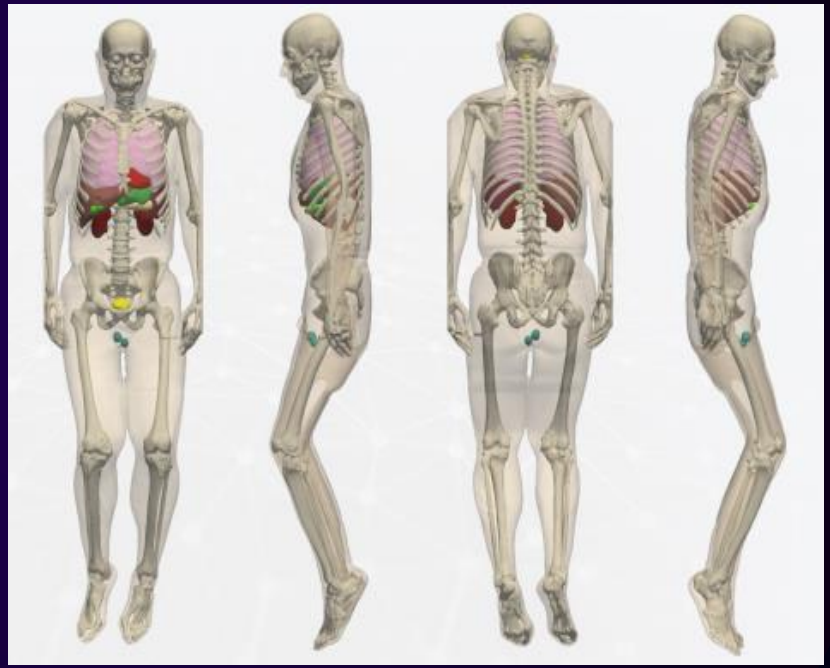


PHANTOMS USED

PD-1-MELANOMA :

Patient-specific phantom derived from segmentation of PET/CT image from the TCIA PD-1-NOT a MELANOMA collection.

Vertices: 201,603
Tetrahedrons: 1,270,110



MIRD METHOD

MEDICAL INTERNAL RADIATION DOSE (MIRD)

Medical Internal Radiation Dose (MIRD) committee has been the primary reference data in nuclear medicine dose assessment, for several years .

The MIRD method is based on a mathematical model that simplifies dose calculations

PHANTOMS USED

Reference Man ICRP Publication 23

Organ	Adult
Adrenals	14
Bladder content	200
Bladder wall	45
Breast	361
Stomach content	250
Stomach wall	150
Small intestine (SI)	1 040
SI wall	640
ULI content	220
ULI wall	210
LLI content	135
LLI wall	160
Heart content	454
Heart wall	316
Kidneys	310
Liver	1 800
Gallbladder content	56
Gallbladder wall	11
Lungs	1 000
Muscle	28 000
Ovaries	11
Pancreas	100
Red marrow	1 500
Cortical bone	4 000
Trabecular bone	1 000
Bone surfaces	120
Spleen	180
Testes	35
Thyroid	20
Uterus	80
Total body	70 000
Blood volume (ml)	5 200

Masses (g) of selected organs and tissues

RADIONUCLIDES USED

ARSENATE As-72

Organ (S)	F_S	T	a	$\tilde{A}_S/A_0$		
				^{72}As	^{74}As	^{76}As
Total body (excluding bladder contents)	1.0	0.5 hr	0.35	17.8 hr	3.81 d	18.0 hr
		1 d	0.28			
		10 d	0.37			
Kidneys	0.015	1 d	0.4	27 min	2.26 hr	28 min
		10 d	0.6			
Liver	0.07	1 d	0.4	1.93 hr	10.2 hr	1.94 hr
		10 d	0.6			
Spleen	0.005	1 d	0.4	8.3 min	44 min	8.3 min
		10 d	0.6			
Bladder contents	1.0			1.25 hr	1.87 hr	1.25 hr

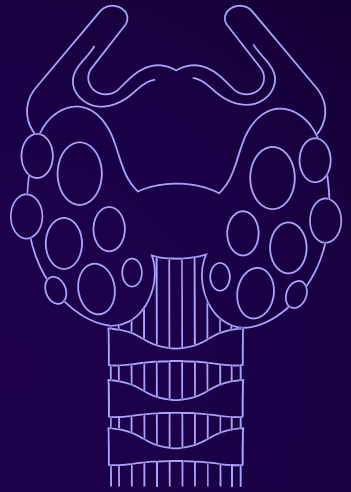
FLUORIDE F-18

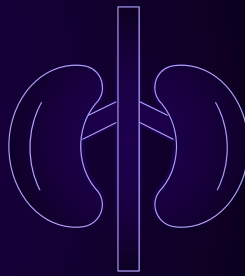
Organ (S)	F_S	T	a	$\tilde{A}_S/A_0$
Total body (excluding bladder contents)	1.0	10 min	0.13	1.98 hr
		3.2 hr	0.37	
		∞	0.50	
Bone surfaces	0.5	20 min	−1.0	1.12 hr
		∞	1.0	
Kidneys	0.5			1.5 min
Bladder contents	0.5			25.1 min

Biokinetic data

03

RESULTS





ARSENATE AS-72

Table 1 : The absorbed dose calculated with the PD-1-MELANOMA phantom in different organs in (mGy/MBq)

Organ	***Monte Carlo***	***MIRD***
Stomach wall	2.9	2.5
Bone	2.25	2.2
Liver	9.29	8.7
Lungs	2.5	2.3
Pancreas	2.8	2.7

Table 2: The absorbed dose calculated with the THRK-Man phantom in different organs in (mGy/MBq)

Organ	***Monte Carlo***	***MIRD***
Stomach wall	2.68	2.5
Bone	2.16	2.2
Liver	8.97	8.7
Lungs	2.44	2.3
Pancreas	3.00	2.7

FLUORIDE F-18

Table 1 : The absorbed dose calculated with the PD-1-MELANOMA phantom in different organs in (mGy/MBq)

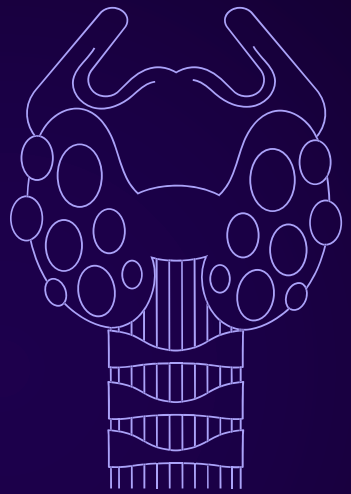
Organ	*Monte Carlo*	*MIRD*
Stomach wall	1.16	1.2
Bone	1.09	1
Liver	1.15	1.2
Lungs	1.07	1.1
Pancreas	1.29	1.2

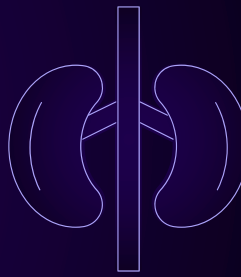
Table 2: The absorbed dose calculated with the THRK-Man phantom in different organs in (mGy/MBq)

Organ	*Monte Carlo*	*MIRD*
Stomach wall	1.17	1.2
Bone	1.06	1
Liver	1.16	1.2
Lungs	1.14	1.1
Pancreas	1.20	1.2

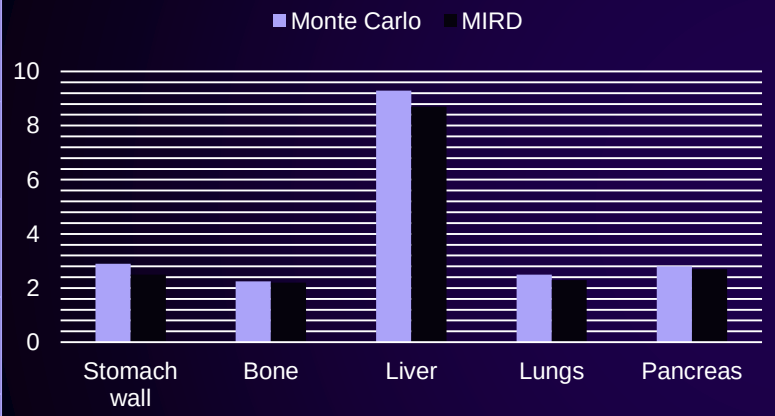
04

COMPARISON OF THE MONTE CARLO METHOD AND THE MIRD METHOD

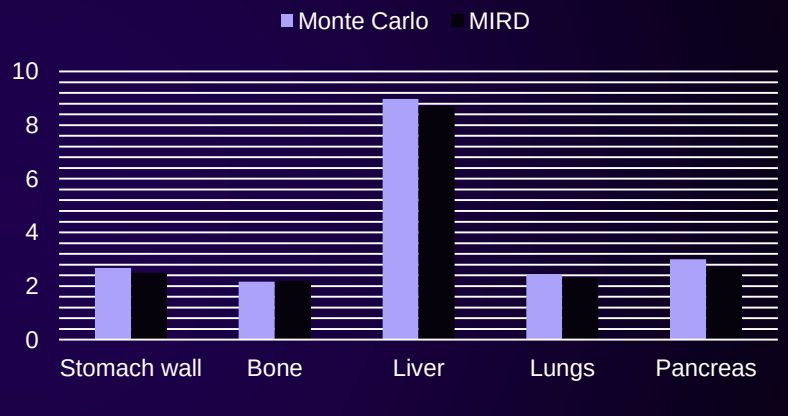




ARSANATE AS-72

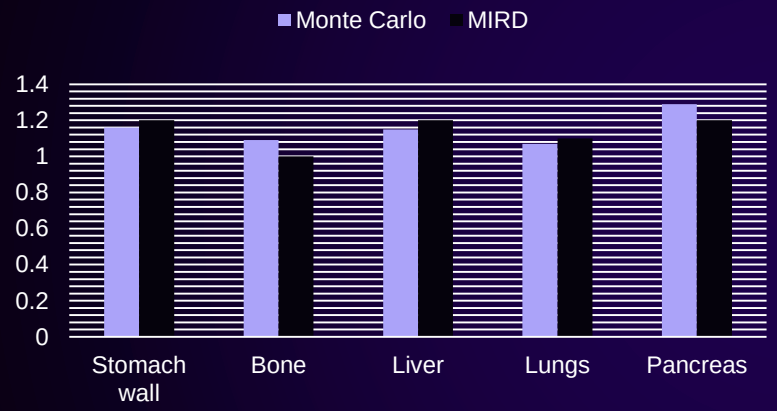


Comparison diagram of absorbed dose Monte Carlo method and MIRD method for PD-1-MELANOMA

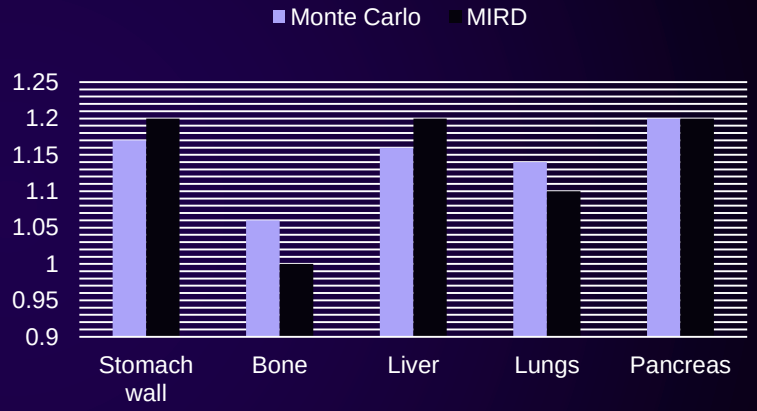


Comparison diagram of absorbed dose Monte Carlo method and MIRD method for THRK-Man

FLUORINE F-18



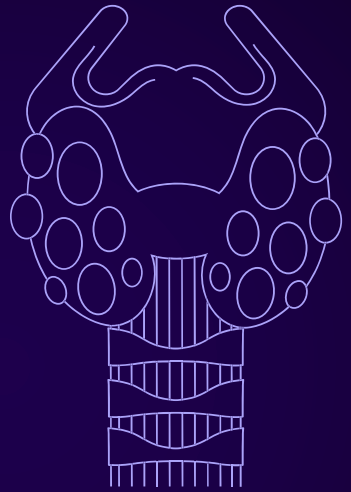
Comparison diagram of absorbed dose Monte Carlo method and MIRD method for PD-1-MELANOMA

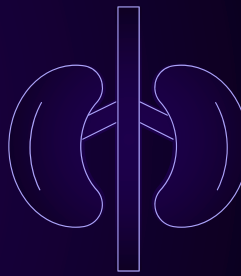


Comparison diagram of absorbed dose Monte Carlo method and MIRD method for THRK-Man

05

CONCLUSION





To conclude, the comparable results achieved by the Monte Carlo and MIRD methods emphasize their validity and reliability in calculating absorbed doses. This similarity enables us to regard both approaches as equivalent, offering flexible choices for dosimetry studies.

THANK YOU FOR YOUR ATTENTION!