

Cell Damage from Alpha Particle Radiation

Comparing In Vitro Data to Simulated Data Using GEANT4

Ida Plahter Rosenqvist

Physics
60 ECTS study points

Department of Physics
Faculty of Mathematics and Natural Sciences

Ida Plahter Rosenqvist

Cell Damage from Alpha Particle Radiation

Comparing In Vitro Data to Simulated Data Using
GEANT4

Supervisors:
Sunniva Siem
Kevin Ching Wei Li

Abstract

Sammendrag

Det skal være et sammendrag på norsk i Ph.d.-avhandlinger. Det er like greit å ha det i en masteroppgave også. Det kan være utfordrende å skrive, men det er nyttig.

Contents

List of Tables	vii
List of Figures	vii
Preface	ix
Acknowledgements	xi
I Introduction	1
1 Introduction	3
II Models of Cell Death	5
2 Introduction	7
3 Theory	9
3.1 The Interactions of Radiation with Matter	9
3.2 Cellular Response to Radiation	9
3.3 Models of Cell Survival	9
3.4 The Decay Dynamics of ^{212}Pb	9
4 Experimental Methods	11
4.1 Clonogenic Assays	11
4.2 Simulations Using GEANT4	11
5 Results	13
7 Discussion	19
III Conclusion	17
7 Discussion	19
Appendices	21
A The First Appendix	23
B The Second Appendix	25

List of Tables

List of Figures

Preface

Acknowledgements

Part I

Introduction

Chapter 1

Introduction

Part II

Models of Cell Death

Chapter 2

Introduction

Chapter 3

Theory

3.1 The Interactions of Radiation with Matter

3.1.1 Interactions of Charged Particles

3.1.2 Interactions of Neutral Particles

3.1.3 Linear Energy Transfer

3.2 Cellular Response to Radiation

3.3 Models of Cell Survival

3.3.1 The Linear-Quadratic Model

3.4 The Decay Dynamics of ^{212}Pb

3.4.1 Decay Scheme of ^{212}Pb

3.4.2 Model of Cellular Uptake of Radionuclides

3.4.3 Modified Bateman Equations

Chapter 4

Experimental Methods

4.1 Clonogenic Assays

4.1.1 Experimental Setup

4.1.2 Measurements of Cell Survival

4.2 Simulations Using GEANT4

4.2.1 Monte Carlo Particle Transport Codes

4.2.2 GEANT4DNA

4.2.3 Geometric Setup

4.2.4 Implementation of Decay Dynamics

Chapter 5

Results

Chapter 6

Discussion

Part III

Conclusion

Chapter 7

Discussion

Appendices

Appendix A

The First Appendix

Appendix A. The First Appendix

Appendix B

The Second Appendix