

Thesis

Contents

1	Nuclear structure	5
1.1	NN interaction	5
1.1.1	Experimental evidence	5
1.1.2	Physical properties	5
1.1.3	Meson exchange	5
1.2	Nuclear phenomenology	5
1.2.1	Nuclear density	5
1.2.2	Nuclear radius	5
1.2.3	Deformed nuclei	5
1.2.4	Pairing	5
1.3	Mean field approach	5
1.3.1	Woods-Saxon potential	5
1.3.2	Nuclear Spin-Orbit interaction	5
1.3.3	Shell structure	5
2	Hartree-Fock Theory	7
2.1	Preliminaries	7
2.1.1	Variational principle	7
2.1.2	Slater determinant	7
2.2	Formal theory	7
2.3	Hartree-Fock method	7
3	Numerical methods	9
3.1	Finite differences	9
3.2	Numerical mesh	9
3.3	Differential operators	9
4	General Conjugate Gradient	11
4.1	Conjugate gradient	11
4.2	Non-linear conjugate gradient	11
4.3	General conjugate gradient	11

5	Skyrme interaction	13
5.1	Energy functional	13
5.2	Coulomb field	13
5.3	Results for Oxygen-16	13
6	Results on deformed nuclei	15

Chapter 1

Nuclear structure

1.1 NN interaction

1.1.1 Experimental evidence

1.1.2 Physical properties

1.1.3 Meson exchange

1.2 Nuclear phenomenology

1.2.1 Nuclear density

1.2.2 Nuclear radius

1.2.3 Deformed nuclei

1.2.4 Pairing

1.3 Mean field approach

1.3.1 Woods-Saxon potential

1.3.2 Nuclear Spin-Orbit interaction

1.3.3 Shell structure

Chapter 2

Hartree-Fock Theory

2.1 Preliminaries

2.1.1 Variational principle

2.1.2 Slater determinant

2.2 Formal theory

2.3 Hartree-Fock method

Chapter 3

Numerical methods

3.1 Finite differences

3.2 Numerical mesh

3.3 Differential operators

Chapter 4

General Conjugate Gradient

4.1 Conjugate gradient

4.2 Non-linear conjugate gradient

4.3 General conjugate gradient

Chapter 5

Skyrme interaction

5.1 Energy functional

5.2 Coulomb field

5.3 Results for Oxygen-16

Chapter 6

Results on deformed nuclei