

Contents

1	Introduction	1
1.1	Hypernuclear Physics - A General Description	1
1.1.1	Why do we study Hypernuclei?	4
1.1.2	Soft Core Baryon-Baryon Interactions	6
1.2	Experimental Facilities for Hypernuclear Physics Program	10
1.3	A Survey of Earlier Theoretical Studies	12
1.4	Objective of the Present Work	26
2	Strange and Multi-Strange s- and p-Shell Hypernuclei	29
2.1	Hamiltonians of the s - and p -Shell Hypernuclei	29
2.1.1	Hypernuclei ${}^9_{\Lambda}\text{Be}$, ${}^{10}_{\Lambda\Lambda}\text{Be}$ and ${}^{13}_{\Lambda}\text{C}$	30
2.1.2	Strange and Multi-Strange Hypernuclei ${}^6_{\Lambda\Xi}\text{He}$, ${}^7_{\Lambda\Lambda\Xi}\text{He}$, ${}^9_{\Xi}\text{Be}$, ${}^{10}_{\Lambda\Xi}\text{Be}$, ${}^{11}_{\Lambda\Lambda\Xi}\text{Be}$ and ${}^{13}_{\Xi}\text{C}$	31
2.2	Potential Models	32
2.2.1	Two-body Baryon-Baryon, Baryon- α and $\alpha\alpha$ Potentials	32
2.2.2	Phenomenological Three-body $\Lambda\alpha\alpha$ and $\alpha\alpha\alpha$ Potentials	38
2.3	Trial Wave Functions	38
2.3.1	Wave Functions for ${}^9_{\Lambda}\text{Be}$, ${}^{10}_{\Lambda\Lambda}\text{Be}$ and ${}^{13}_{\Lambda}\text{C}$	38
2.3.2	Wave Functions for ${}^6_{\Lambda\Xi}\text{He}$, ${}^7_{\Lambda\Lambda\Xi}\text{He}$, ${}^9_{\Xi}\text{Be}$, ${}^{10}_{\Lambda\Xi}\text{Be}$, ${}^{11}_{\Lambda\Lambda\Xi}\text{Be}$ and ${}^{13}_{\Xi}\text{C}$	41
2.4	Variational Monte Carlo Procedure for the Energy Calculations	41
2.5	Results and Discussions	43
2.5.1	s -Shell Hypernuclei	44
2.5.2	p -Shell Hypernuclei	47
2.6	Summary	56
3	Energy of the Excited States of ${}^9_{\Lambda}\text{Be}$	59
3.1	Hamiltonian of the System ${}^9_{\Lambda}\text{Be}$	59
3.2	Two- and Three-Body Potentials	61
3.2.1	Baryon-Baryon and $\alpha\alpha$ Potentials	61
3.2.2	Dispersive ΛNN and TPE $\Lambda NN V_{\Lambda NN}^{2\pi}$ Potentials	63

3.3	Variational Wave Functions	64
3.4	Energy Calculation and Moments	65
3.4.1	Magnetic and Quadrupole Moments	66
3.5	Results and Discussion	69
3.5.1	Ground States of ${}^5_{\Lambda}\text{He}$ and ${}^9_{\Lambda}\text{Be}$	69
3.5.2	Degenerate Doublet ($3^+/2, 5^+/2$) of ${}^9_{\Lambda}\text{Be}$	69
3.6	Summary	74
4	The Ground and 2^+ Excited States of the System ${}^{10}_{\Lambda\Lambda}\text{Be}$	77
4.1	Hamiltonian of the System ${}^{10}_{\Lambda\Lambda}\text{Be}$	77
4.2	Trial Wave Functions	79
4.3	Energy Calculation and Quadrupole Moment	80
4.4	Results and Discussion	80
4.4.1	Ground States of ${}^6_{\Lambda\Lambda}\text{He}$ and ${}^{10}_{\Lambda\Lambda}\text{Be}$	81
4.4.2	Excited 2^+ of ${}^{10}_{\Lambda\Lambda}\text{Be}$	83
4.5	Summary	85
5	Cluster versus Partial A-Body Models for ${}^9_{\Lambda}\text{Be}$ and ${}^{10}_{\Lambda\Lambda}\text{Be}$	87
6	Conclusions	89
	Bibliography	91