

# Table of contents

<b>Abbreviations</b>	<b>xiii</b>
<b>List of figures</b>	<b>xxi</b>
<b>List of tables</b>	<b>xxix</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Present scenario of neutrinos . . . . .	3
1.1.1 Theoretical developments: . . . . .	3
1.1.2 Experimental developments: . . . . .	5
1.2 Standard Model(SM) . . . . .	6
1.2.1 Particle interactions and their Lagrangian . . . . .	7
1.2.2 Deficiencies of SM . . . . .	12
1.3 Physics beyond Standard Model . . . . .	12
1.3.1 Neutrino mass and mixing . . . . .	12
1.3.1.1 Neutrino mass . . . . .	12
1.3.1.2 Neutrino Oscillation . . . . .	14
1.3.1.3 Neutrino mass models . . . . .	18
1.3.2 Baryon Asymmetry of the Universe (BAU) . . . . .	24
1.3.2.1 Fundamentals for leptogenesis . . . . .	25

1.3.3	Dark matter . . . . .	26
1.3.3.1	WIMP dark matter . . . . .	27
1.3.3.2	FIMP dark matter . . . . .	30
1.3.3.3	keV sterile neutrino: another probable DM candidate . . . . .	31
1.3.4	Neutrinoless double beta decay( $0\nu\beta\beta$ ) . . . . .	32
1.3.5	Lepton flavor violation (LFV) . . . . .	34
1.4	Discrete flavor symmetry . . . . .	35
1.4.1	$Z_N$ : Abelian discrete symmetry . . . . .	36
1.4.2	$A_4$ : Non-Abelian discrete symmetry . . . . .	37
1.5	Outline of the thesis . . . . .	39
<b>2</b>	<b>Dark matter and leptogenesis in the minimal scotogenic model</b>	<b>41</b>
2.1	Introduction . . . . .	42
2.2	Scotogenic model . . . . .	44
2.3	Bounds on this model . . . . .	49
2.3.1	Lepton flavor violating processes . . . . .	49
2.3.2	Stability constraints . . . . .	51
2.3.3	Perturbativity constraints . . . . .	51
2.3.4	Unitarity bounds . . . . .	51
2.4	Phenomenology in scotogenic framework . . . . .	52
2.4.1	Baryogenesis via leptogenesis . . . . .	52
2.4.2	Neutrinoless double beta decay . . . . .	56
2.4.3	Dark matter . . . . .	57
2.5	Numerical analysis and results . . . . .	60
2.6	Summary . . . . .	69

---

<b>3 Study of one zero texture Yukawa matrix in a flavor symmetric scotogenic model</b>	<b>73</b>
3.1 Introduction . . . . .	74
3.2 Flavor symmetric scotogenic model . . . . .	76
3.3 Constraints on the model . . . . .	79
3.3.1 Neutrinoless double beta decay . . . . .	79
3.3.2 Lepton Flavor Violation(LFV) . . . . .	80
3.3.3 Baryon asymmetry of the Universe(BAU) . . . . .	83
3.3.4 Scalar dark matter . . . . .	86
3.4 Results and analysis . . . . .	89
3.5 Summary . . . . .	94
<b>4 FIMP dark matter and low scale leptogenesis in a flavor symmetric neutrino two Higgs doublet model (<math>\nu</math>2HDM)</b>	<b>97</b>
4.1 Introduction . . . . .	98
4.2 Flavor symmetric neutrino two higgs doublet model . . . . .	99
4.3 Leptogenesis in $\nu$ 2HDM . . . . .	105
4.4 FIMP dark matter in $\nu$ 2HDM . . . . .	109
4.5 Analysis and results . . . . .	111
4.6 Summary . . . . .	123
<b>5 Sterile dark matter, baryogenesis and neutrinoless double beta decay in a <math>A_4 \otimes Z_8</math> based <math>\nu</math>2HDM</b>	<b>125</b>
5.1 Introduction . . . . .	126
5.2 $A_4 \otimes Z_8$ realization of extended $\nu$ 2HDM . . . . .	127
5.3 Sterile Dark Matter . . . . .	132
5.3.1 Constraints on non resonant sterile dark matter . . . . .	134

5.4	Leptogenesis . . . . .	136
5.5	Numerical analysis and results . . . . .	138
5.5.1	Neutrinoless double beta decay . . . . .	141
5.5.2	Results . . . . .	144
5.6	Summary . . . . .	146
<b>6</b>	<b>Conclusion and future outlook</b>	<b>149</b>
6.1	Conclusion . . . . .	150
6.1.1	Chapter 2 . . . . .	150
6.1.2	Chapter 3 . . . . .	152
6.1.3	Chapter 4 . . . . .	153
6.1.4	Chapter 5 . . . . .	155
6.2	Future outlook . . . . .	156
<b>A</b>	<b>Appendix</b>	<b>159</b>
	<b>Bibliography</b>	<b>163</b>