

# Table of Contents

Acknowledgements v

## Table of Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Our Current Views of Nature's Building Blocks . . . . .	1
1.2	Deep Inelastic Scattering . . . . .	5
1.2.1	Kinematics and Variables in DIS . . . . .	6
1.2.2	Deep Inelastic Scattering Differential Cross Sections . . . . .	7
1.2.3	Bjorken Scaling . . . . .	9
1.3	Theoretical Models for the DIS Structure Functions . . . . .	10
1.3.1	Quark Parton Model . . . . .	11
1.3.2	Regge Theory . . . . .	12
1.4	Quantum Chromodynamics . . . . .	15
1.5	DIS Sum Rules . . . . .	21
1.5.1	Gottfried Sum Rule . . . . .	21
1.5.2	Adler Sum Rule . . . . .	22
1.5.3	Gross-Llewellyn Smith Sum Rule . . . . .	22
1.5.4	Unpolarized Bjorken Sum Rule . . . . .	22
1.5.5	Polarized Bjorken Sum Rule . . . . .	23
1.5.6	Gerasimov-Drell-Hearn Sum Rule . . . . .	23
1.6	Non-Perturbative QCD Effects . . . . .	24
1.6.1	Target Mass Correction . . . . .	24
1.6.2	Higher Twist . . . . .	25
1.7	Nuclear Effects . . . . .	26
<b>2</b>	<b>Overview of DIS Experiments and Parameterizations</b>	<b>29</b>
2.1	Introduction . . . . .	29
2.2	DIS Experiments and Results . . . . .	30
2.2.1	NMC . . . . .	31
2.2.2	CCFR . . . . .	33
2.2.3	NUTEV . . . . .	34
2.2.4	CHORUS . . . . .	37
2.2.5	CDHSW . . . . .	39
2.2.6	SMC . . . . .	40
2.2.7	COMPASS . . . . .	40
2.2.8	HERMES . . . . .	42

2.2.9	JLab Experiments . . . . .	43
2.3	Parameterizations and Results . . . . .	44
2.3.1	MRST and MSTW2008 . . . . .	45
2.3.2	CTEQ . . . . .	45
2.3.3	GRV . . . . .	46
2.3.4	NNPDF . . . . .	47
<b>3</b>	<b>On the Solution of DGLAP Evolution Equation</b>	<b>49</b>
3.1	Introduction . . . . .	49
3.2	Methods of Solution of DGLAP Evolution Equation . . . . .	51
3.3	A Regge Inspired Approach to Solve the DGLAP Equation . . . . .	54
3.3.1	Regge Ansatz with $Q^2$ Dependent Coefficient and Constant Intercept . . . . .	55
3.3.2	Regge Ansatz with $Q^2$ Dependent Intercept and Constant Coefficient . . . . .	57
3.4	Fitting Analysis of Our Models . . . . .	58
3.5	Solution of DGLAP Equation for $F_i^{NS}$ with the Regge Ansatz . . . . .	59
<b>4</b>	<b>Small-<math>x</math> Behaviour of <math>F_2^{NS}(x, Q^2)</math> Structure Function</b>	<b>65</b>
4.1	Introduction . . . . .	65
4.2	Solution of DGLAP Evolution Equations with the Initial Input $F_2^{NS}(x, t) = A(t)x^{0.5}$ . . . . .	68
4.3	Solution of DGLAP Evolution Equations with the Initial Input $F_2^{NS}(x, t) = Bx^{(1-bt)}$ . . . . .	71
4.4	Results and Discussion . . . . .	74
4.5	Summary . . . . .	79
<b>5</b>	<b>Small-<math>x</math> Behaviour of <math>xF_3(x, Q^2)</math> Structure Function</b>	<b>81</b>
5.1	Introduction . . . . .	81
5.2	Solution of DGLAP Evolution Equations with the Initial Input $xF_3(x, t) = A(t)x^{0.5}$ . . . . .	84
5.3	Solution of DGLAP Evolution Equations with the Initial Input $xF_3(x, t) = Bx^{(1-bt)}$ . . . . .	87
5.4	Results and Discussion . . . . .	90
5.5	Summary . . . . .	97
<b>6</b>	<b>Small-<math>x</math> Behaviour of <math>xg_1^{NS}(x, Q^2)</math> Structure Function</b>	<b>99</b>
6.1	Introduction . . . . .	99
6.2	Solution of DGLAP Evolution Equations with the Initial Input $xg_1^{NS}(x, t) = A(t)x^{0.5}$ . . . . .	103
6.3	Solution of DGLAP Evolution Equations with the Initial Input $xg_1^{NS}(x, t) = Bx^{(1-bt)}$ . . . . .	105
6.4	Results and Discussion . . . . .	107
6.5	Summary . . . . .	111

<b>7</b>	<b>Sum Rules Associated with Non-singlet Structure Functions</b>	<b>113</b>
7.1	Introduction . . . . .	113
7.2	The General Strategy Adopted in Determining Sum Rules . . . . .	115
7.3	Determination of Gottfried Sum Rule . . . . .	116
7.4	Determination of Gross-Llewellyn Smith Sum Rule . . . . .	120
7.5	Determination of Bjorken Sum Rule . . . . .	125
7.6	Summary . . . . .	129
<b>8</b>	<b>Nuclear Effects in Non-Singlet Structure Functions and Sum Rules</b>	<b>131</b>
8.1	Introduction . . . . .	131
8.2	Shadowing Effect in Nuclear Deep Inelastic Scattering . . . . .	133
8.3	Nuclear Shadowing Effect in the Non-singlet Structure Functions . . . . .	136
8.3.1	Shadowing Effect in $F_2^{NS}(x, Q^2)$ . . . . .	138
8.3.2	Shadowing Effect in $xF_3^{NS}(x, Q^2)$ . . . . .	140
8.3.3	Shadowing Effect in $xg_1^{NS}(x, Q^2)$ . . . . .	141
8.4	Shadowing Effect in the Sum Rules . . . . .	142
8.4.1	Shadowing Correction to Gottfried Sum Rule . . . . .	142
8.4.2	Shadowing Correction to GLS Sum Rule . . . . .	143
8.4.3	Shadowing Correction to Bjorken Sum Rule . . . . .	144
8.5	Summary . . . . .	146
<b>9</b>	<b>Higher Twist Effects in Non-Singlet Structure Functions and Sum Rules</b>	<b>149</b>
9.1	Introduction . . . . .	149
9.2	Higher Twist in Non-Singlet Structure Functions . . . . .	152
9.2.1	Higher Twist Effect in $F_2^{NS}$ Structure Function . . . . .	152
9.2.2	Higher Twist Effect in $xF_3^{NS}$ Structure Function . . . . .	154
9.3	Higher Twist Effect in Sum Rules . . . . .	154
9.3.1	Higher Twist Effect in Gross-Llewellyn Smith Sum Rule . . . . .	156
9.3.2	Higher Twist Effect in Bjorken Sum Rule . . . . .	157
9.4	Summary . . . . .	158
<b>10</b>	<b>Conclusion</b>	<b>159</b>
	<b>Bibliography</b>	<b>163</b>

