

Contents

Forward	11
1 Polarized beams	13
1.1 Introduction	13
1.2 Conventions for coordinate systems	15
1.3 Ion sources for polarized protons	17
1.4 Lamb-shift sources	23
1.5 Depolarizing resonances	26
1.6 Determination of beam asymmetries	29
1.7 Dependence on the source parameters	33
1.8 The first depolarizing resonance	37
1.9 Polarization of a deuteron beam	46
1.9.1 Beam polarization characteristics: spin 1 case	47
1.9.2 Polarized deuterium ion source	49
1.9.3 Dependence on the source parameters	53
1.9.4 Deuteron tensor polarizations	59
1.10 Polarized beams of free neutrons	60
1.10.1 Deuteron Break-up	61
1.10.2 Proton-neutron backward scattering	63
1.10.3 Proton-neutron reactions on light nuclei	65
1.10.4 Production of low energy polarized neutrons	71
1.10.5 Production of low energy polarized deuterons	72
1.11 Rotation of the polarization direction	75
2 Polarized targets	79
2.1 Introduction	79
2.2 Figure of merit	82
2.3 Magnetic systems for polarized targets	84

2.4	Polarized proton targets	86
2.4.1	Materials for polarized proton targets	87
2.4.2	Measuring the proton target polarization	89
2.5	Polarization procedure	90
2.6	Polarized deuteron targets	94
2.6.1	Figure of merit for deuteron targets	94
2.6.2	Measuring the deuteron vector polarization	95
2.6.3	Materials used for polarized deuteron targets	97
2.6.4	Use of ^6LiD in a polarized deuteron target	98
2.6.5	SATURNE results for ^6LiD targets	101
2.7	Other polarized targets	103
2.7.1	HD targets	103
2.7.2	Polarized ^3He targets	104
2.7.3	Jet targets	104
2.8	General comments on polarized targets	106
3	Beam polarimetry	107
3.1	Introduction	107
3.2	Proton and neutron beam polarimeters	109
3.2.1	Experimental setup	109
3.2.2	Polarization measurement	111
3.2.3	Target-independent monitors	117
3.3	Deuteron polarimeters	118
3.3.1	The deuteron charge-exchange reaction	119
3.3.2	The deuteron vector polarization	123
3.3.3	Polarization of the nucleons in the deuteron	123
3.4	Measurement after deceleration	125
3.5	The Primakoff polarimeter	127
3.6	Coulomb-nuclear interference	132
3.7	Polarimetry of scattered particles	135
3.8	Conclusions	141
4	Total cross sections	143
4.1	Introduction	143
4.2	Total pp cross section measurements	144
4.3	Total elastic cross sections	146
4.4	Electromagnetic corrections	149
4.5	The pp transmission ratio	151
4.5.1	Misalignment effects	156

CONTENTS

4.6	Results for the pp total cross sections	157
4.7	The np transmission ratios	161
4.7.1	Systematic effects	165
4.8	Results for the np total cross sections	166
5	Conclusions	173
A	The Gray code detector	175
A.1	Binary and Gray codes	176
A.2	Description of the Gray code detector	177
A.3	Electronics for the GC detector	181
A.3.1	Coincidence circuit and decoder	181
A.4	Application of the GC detector	183
A.4.1	Electronic suppression of beam-rate effects	185
A.4.2	Data taking logic	188
B	Data tables	191
B.1	Proton-proton total cross sections	191
B.2	Neutron-proton total cross sections	199
C	Curriculum vitae of František Lehar	205
	Bibliography	207