

Contents

1	Introduction	1
1.1	Standard Model and the Weak Interaction	2
1.2	Flavor Physics	6
1.3	The B_s^0 Meson and CP violation	12
1.4	The Weak Phase ϕ_s	15
1.4.1	Measuring ϕ_s	18
1.4.2	Probing New Physics	20
1.4.3	Higher Order Effects in ϕ_s	21
2	The LHCb Detector	23
2.1	Tracking Systems	25
2.2	Particle Identification	28
2.3	Calorimetry	29
2.4	The trigger system	30
2.5	The $B_s^0 \rightarrow J/\psi \bar{K}^{*0}$ Decay in LHCb	33
3	High Level Trigger Muon Identification in Run 2	37
3.1	HLT1 Muon-ID in the LHC Run 2	37
3.1.1	HLT1 muon algorithm	38
3.2	Matching VELO tracks to Muon Hits	41
3.2.1	The MatchVeloMuon algorithm	41
3.2.2	Upgrade to MatchVeloTTMuon	43
4	Data Analysis	51
4.1	Candidate Selection	51
4.1.1	Multivariate Based Selection	52
4.1.2	Reflection Backgrounds	55
4.1.3	sWeighting and Invariant Mass Distribution	58
4.2	Angular Analysis	62

4.2.1	Angular Dependence	63
4.2.2	Acceptance	65
4.2.3	Acceptance Corrections	76
4.2.4	$K\pi$ Invariant Mass	79
4.2.5	Production and Detection Asymmetries	82
4.2.6	Likelihood fit and Total Decay Rate	84
4.3	Normalization of $B_s^0 \rightarrow J/\psi K^- \pi^+$	90
4.4	Results	93
4.4.1	Parameters of Interest	94
4.4.2	Systematic Uncertainties	94
4.4.3	Likelihood Scans	100
4.4.4	Pseudo-experiments Study	105
5	Controlling Penguins in ϕ_s	109
5.1	Amplitude Structure of $B_s^0 \rightarrow J/\psi \phi$	109
5.2	Hadronic Factors and $SU(3)$ Symmetry	111
5.3	Formalism	112
5.4	Estimating Penguin Parameters	115
5.4.1	The $B_s^0 \rightarrow J/\psi \bar{K}^{*0}$ Channel	116
5.4.2	The $B^0 \rightarrow J/\psi \rho^0$ Channel	117
5.4.3	Fitting Strategy	118
5.5	Results	120
5.5.1	Further Crosschecks	122
A	Additional Tables	127
B	Horizontal Weighting	135
	References	141
	Summary - Samenvatting	147
	Acknowledgments	163