

# Contents

<b>1</b>	<b>Introduction</b>	<b>3</b>
<b>2</b>	<b>Lattice setup</b>	<b>5</b>
<b>3</b>	<b>Definitions of the topological charge</b>	<b>6</b>
3.1	Index of the overlap Dirac operator . . . . .	6
3.2	Wilson-Dirac operator spectral flow . . . . .	8
3.3	Spectral projectors . . . . .	10
3.4	Field theoretic definition . . . . .	11
3.5	Smoothing procedures . . . . .	13
3.5.1	Gradient Flow . . . . .	14
3.5.2	Cooling . . . . .	15
3.5.3	APE (Array Processor Experiment) smearing . . . . .	15
3.5.4	Stout Smearing . . . . .	16

3.5.5	HYP (Hyperbolic) smearing . . . . .	17
3.5.6	Perturbative relation between smoothing techniques . . . . .	18
<b>4</b>	<b>Results</b>	<b>23</b>
4.1	Numerical equivalence between different smoothers . . . . .	23
4.2	Field theoretic topological charges on a single configuration . . . . .	26
4.3	Monte Carlo histories and distribution histograms . . . . .	29
4.4	Correlations between different definitions . . . . .	31
4.4.1	Main comparison . . . . .	32
4.4.2	Comparison of fermionic definitions . . . . .	35
4.4.3	Comparison of different smoothing actions and flow times for gradient flow	38
4.4.4	Comparison of different discretizations of the topological charge operator	38
4.4.5	Comparison of gluonic definitions . . . . .	41
4.5	Correlation towards the continuum limit . . . . .	44
4.6	Topological susceptibility . . . . .	45
<b>5</b>	<b>Conclusions</b>	<b>48</b>