

# Contents

Resumen	ii
Abstract	ii
List of Figures	x
Introduction	1
<b>1 The <math>\Lambda</math>CDM model of cosmology</b>	<b>8</b>
1.1 Background dynamics	8
1.2 The Friedmann-Lemaître-Robertson-Walker universe	9
1.3 $\Lambda$ CDM model	11
1.4 Cosmic Microwave Background	12
1.5 "Old" problems in cosmology	14
1.5.1 Flatness problem	14
1.5.2 Horizon problem	15
1.6 "New" problems of cosmology	16
1.6.1 Scale invariance	16
1.6.2 Coherent Hubble perturbations	17
<b>2 Inflation</b>	<b>18</b>
2.1 de-Sitter space	18
2.2 Single field slow-roll inflation	20
2.3 Perturbation theory in Inflation	23
2.4 Primordial statistics of the early universe	26
2.5 Quantum fluctuations in de-Sitter space	28
2.5.1 Free Field action for scalars	29
2.5.2 Canonical quantization	30
2.5.3 Free Field action for tensors	31
2.5.4 in-in formalism	32
2.6 From Quantum fluctuations to Power Spectrum	33
2.7 Multi-field inflation	34
<b>3 Scale invariance of the primordial tensor power spectrum</b>	<b>36</b>

3.1	Correlation of power spectra . . . . .	38
3.1.1	Preliminaries . . . . .	38
3.1.2	Rapidly time varying backgrounds . . . . .	39
3.1.3	In-in formalism . . . . .	40
3.1.4	Features from varying Hubble parameters . . . . .	42
3.1.5	Including the effects of a varying sound speed . . . . .	43
3.2	A quantitative discussion . . . . .	44
3.2.1	Resonant features . . . . .	45
3.2.2	Predictions for the low $\ell$ tensor power spectrum . . . . .	48
<b>4</b>	<b>Axion excursions of the landscape during inflation</b>	<b>51</b>
4.1	Axions in inflation . . . . .	52
4.2	The in-in formalism . . . . .	53
4.3	Computing $n$ -point functions . . . . .	54
4.4	Probability distribution function in the long-wavelength limit . . . . .	57
4.5	Discussion . . . . .	59
4.5.1	Isocurvature fluctuations after inflation . . . . .	60
4.5.2	Role of inflation to determine SM properties . . . . .	60
4.5.3	Dark matter . . . . .	61
	<b>Conclusions</b>	<b>61</b>
	<b>Bibliography</b>	<b>64</b>