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Higgs dynamics in the early universe

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Higgs dynamics in the early universe

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The cover shows bubbles of broken electroweak symmetry in a first order phase transition.

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Publications

This thesis is based on the following publications

- [1] *Electroweak stability and non-minimal coupling*, M. Postma and J. van de Vis JCAP, **1705**, 004 (2017), hep-ph/1702.07636.
- [2] *Preheating after Higgs Inflation: Self-Resonance and Gauge boson production*, E.I. Sfakianakis and J. van de Vis, Phys. Rev. **D99**, 083519 (2019), hep-ph/1810.01304.
- [3] *Electroweak Baryogenesis and the Standard Model Effective Field Theory*, J. de Vries, M. Postma, J. van de Vis and G. White, JHEP **01**, 089 (2018), hep-ph/1710.04061.
- [4] *The role of leptons in electroweak baryogenesis*, J. de Vries, M. Postma and J. van de Vis, JHEP **04**, 024 (2019), hep-ph/1811.11104.

Other publications

- [5] *Spinning bodies in curved spacetime*, G. d'Ambrosi, S. Satish Kumar, J. van de Vis and J. W. van Holten, Phys. Rev. **D93**, 044051, (2016), gr-qc/1511.05454.
- [6] *Ultrametricity increases the predictability of cultural dynamics*, A.I. Băbeanu, J. van de Vis and D. Garlaschelli, New J. Phys. **20**, 10 (2018), soc-ph/1712.05959.

Abbreviations

BAU	B aryon A symmetry of the U niverse
BBN	B ig B ang N ucleosynthesis
BD	B unch- D avies
BSM	B eyond the S tandard M odel
CMB	C osmic M icrowave B ackground
CP	C harge- P arity
CPV	C harge- P arity V iolating
CTP	C losed T ime P ath
DM	D ark M atter
EDM	E lecric D ipole M oment
EFT	E ffective F ield T heory
EOM	E quation O f M otion
EW	E lectro W eak
EWBG	E lectro W eak B aryo G enesis
EWPT	E lectro W eak P hase T ransition
FOPT	F irst O rders P hase T ransition
GUT	G rand U nified T heories
HBB	H ot B ig B ang
LHC	L arge H adron C ollider
MSSM	M inimal S upersymmetric S tandard M odel
RGE	R enormalization G roup E quation
RG	R enormalization G roup
SM	S tandard M odel
vev	v acuum e xpectation v alue
VIA	V ev I nsertion A pproximation

Notation and Conventions

We will work in units where

$$\hbar = c = k_B = 1,$$

where $\hbar$ is the reduced Planck constant, c the speed of light and k_B the Boltzmann constant. In this system

$$[\text{energy}] = [\text{mass}] = [\text{temperature}] = [\text{time}]^{-1} = [\text{length}]^{-1}.$$

The reduced Planck mass is defined by

$$m_{\text{pl}} = \frac{1}{\sqrt{8\pi G}},$$

with G Newton's constant.

In chapters 1 through 4 we use a metric with signature $(-, +, +, +)$. In the remainder of the thesis we use a metric with signature $(+, -, -, -)$.

The sign convention of the antisymmetric tensor in two dimensions ϵ^{ab} is $\epsilon^{12} = 1$. Similarly, ϵ^{abc} with $\epsilon^{123} = 1$ is the antisymmetric tensor in three dimensions.