Higgs dynamics in the early universe

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Title: Higgs dynamics in the early universe
Issue Date: 2019-07-02

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Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof.mr. C.J.J.M. Stolker,
volgens het besluit van het College voor Promoties
te verdedigen op dinsdag 2 juli 2019
klokke 13.45 uur

door

Jorinde Marjolein van de Vis

geboren te Delft
in 1991

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ISBN 978-90-8593-406-6
An electronic version of this thesis can be found at https://openaccess.leidenuniv.nl

This work is part of the research program ‘Observing the Big Bang’ with project number 160, which is financed by the Netherlands Organization for Scientific Research (NWO). This work was carried out at Nikhef.

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

Contents

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**rder **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.