A search for transient reductions in the inflaton speed of sound in cosmological data, and other topics

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Stellingen

Behorend bij het proefschrift

A search for transient reductions in the speed of sound of the inflaton in cosmological data, and other topics

I. Fits of reductions of the speed of sound to the Planck temperature power spectrum predict oscillatory bispectrum features that are close enough to the sensitivity threshold of Planck's bispectrum estimation.

(*Chapter 2*)

II. Used properly, standard Metropolis-Hastings Markov chain Monte Carlo methods can accurately map complicated multi-modal, non-Gaussian probability density functions.

(*Chapter 2*)

III. Even though Large Scale Structure data are, at the current experimental state, not as powerful in detecting features of inflation as Cosmic Microwave Background data, the former can provide evidence to back up fits to the latter.

(*Chapter 3*)

IV. The description of Bravais lattices as root lattices of semi-simple Lie algebras, though common in the literature, falls short in describing the geometry of the symmetric toroidal orbifolds on which Heterotic strings are compactified.

(*Chapter 5*)

V. The negative results in the search for oscillatory features performed in Fergusson et al. 2014 may change once the small-scale bispectrum of Planck is included. Moreover, the addition of small scales to the search makes absolutely necessary to consider oscillations with a non-trivial envelope.

Fergusson et al., arXiv:1412.6152

VI. An ISW-lensing ($\star$) signature was detected in the Planck bispectrum in Ade et al. 2014, with a significance of 2.6σ. This significance may get notably reduced if the ISW-lensing bispectrum is fitted jointly with certain templates of primordial non-Gaussianity.

Ade et al., Astron.Astrophys. **571** (2014) A24

($\star$) ISW: Integrated Sachs-Wolfe effect.

VII. In Martin et al. 2014 the authors find no evidence to support any of a number of extended inflationary scenarios against the standard scenario. Their results, based on Planck's 2013 data, may change dramatically if actual CMB bispectrum data are included in the evidence computation.

Martin et al., JCAP **1403** (2014) 039

VIII. Contrary to claims in Hebecker & Trapletti 2004, cited for almost ten years (e.g. Fischer et al. 2013), in order to achieve a non-local breaking of the Grand Unified Theory in an orbifold, it is not sufficient for the orbifold to have a non-trivial fundamental group made up of freely-acting discrete symmetries.

Hebecker & Trapletti, Nucl.Phys. **B713** (2005) 173-203
Fischer et al., JHEP **1307** (2013) 080

IX. Bayesian statistics is sometimes criticised because of the dependence of its results on prior probability density functions, which must be chosen by the researcher. However, prior choices are arguably an intrinsic part of all physical models, and their introduction is not a trick to get the results that one desires – it is being frank about an unavoidable choice of assumptions and exposing them clearly.

X. The right tool for writing a paper collaboratively is a version control system (VCS). Simple cloud storage systems, such as *Dropbox*, either do not provide the necessary features, or these features are not so readily at hand.

XI. Use of non-open-source tools and non-standard, non-documented file formats should be avoided as much as possible in science, since they put barriers to reproducibility. If those tools don't exist, public funding should be allocated to develop them, as it is the case for experiments.

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