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Nota di contenuto	Supervisor's Foreword; Preface; Contents; 1 Introduction and

Theoretical Background; 1.1 A Short Sketch of the Standard Model of Cosmology; 1.2 The Role of Inflation; 1.2.1 Inflation as an Improvement of the Standard Model; 1.2.2 Basic Concept of Inflation; 1.3 The Cosmic Microwave Background Radiation; 1.3.1 Origin; 1.3.2 Characteristics; 1.3.3 Notations; 1.4 The Challenge of Anomalies in the CMB; References; 2 Methods for Testing the Non-Gaussianity of the CMB; 2.1 Statistical Tests for Non-Gaussianity; 2.1.1 Basic Framework; 2.1.2 Surrogates on the Complete Sky
2.1.3 Surrogates on an Incomplete Sky2.2 Measures for Non-Gaussianity; 2.2.1 Overview Over Currently Used Measures; 2.2.2 The Scaling Index Method; References; 3 Observations of the CMB with the WMAP Satellite; 3.1 Framework of the Observation; 3.2 Foreground and Systematic Effects; 3.2.1 Origin and Characteristics; 3.2.2 Methods of Foreground Reduction; References; 4 Scaling Indices Applied to the WMAP 5-Year Data; 4.1 Introduction; 4.2 WMAP Data and Simulations; 4.3 Weighted Scaling Index Method; 4.3.1 Formalism; 4.3.2 Coping with Boundary Effects; 4.4 Results
4.4.1 Band-wise and Co-added Map Analysis4.4.2 Local Features; 4.5 Summary; 4.6 Conclusions; References; 5 Surrogates and Scaling Indices Applied to the WMAP 7-Year Data; References; 6 Extending the Analysis of the WMAP 7-Year Data; 6.1 Introduction; 6.2 Data Sets; 6.3 Generating Surrogate Maps; 6.4 Weighted Scaling Indices and Test Statistics; 6.5 Results; 6.6 Conclusions; References; 7 Applying the Surrogate Approach to Incomplete Skies; References; 8 Conclusions; AppendixSimplifications of the Cut Sky Approach; A.1...Constant Latitude CutsSimplifications of the Cut Sky Approach
A.2...The Householder TransformationReferences

Sommario/riassunto

This work deals with the search for signatures of non-Gaussianities in the cosmic microwave background (CMB). Probing Gaussianity in the CMB addresses one of the key questions in modern cosmology because it allows us to discriminate between different models of inflation, and thus concerns a fundamental part of the standard cosmological model. The basic goal here is to adapt complementary methods stemming from the field of complexity science to CMB data analysis. Two key concepts, namely the method of surrogates and estimators for local scaling properties, are applied to CMB data analysis. All results show strong non-Gaussianities and pronounced asymmetries. The consistency of the full sky and cut sky results shows convincingly for the first time that the influence of the Galactic plane is not responsible for these deviations from Gaussianity and isotropy. The findings seriously call into question predictions of isotropic cosmologies based on the widely accepted single field slow roll inflation model.
