bartlett1999

The standard cosmological model and CMB anisotropies (article)

Author

Bartlett, J.G.

Journal

NewAR

Year

1999

Volume

43

Pages

83-109

Keywords

cosmic microwave background, cosmology - general

Abstract

This is a course on cosmic microwave background (CMB) anisotropies in the standard cosmological model, designed for
beginning graduate students and advanced undergraduates. ``Standard cosmological model'' in this context means a Universe
dominated by some form of cold dark matter (CDM) with adiabatic perturbations generated at some initial epoch, e.g.,
Inflation, and left to evolve under gravity alone (which distinguishes it from defect models). The course is primarily
theoretical and concerned with the physics of CMB anisotropies in this context and their relation to structure formation. Brief
presentations of the uniform Big Bang model and of the observed large-scale structure of the Universe are given. The bulk of
the course then focuses on the evolution of small perturbations to the uniform model and on the generation of temperature
anisotropies in the CMB. The theoretical development is performed in the (pseudo-)Newtonian gauge because it aids
intuitive understanding by providing a quick reference to classical (Newtonian) concepts. The fundamental goal of the course
is not to arrive at a highly exact nor exhaustive calculation of the anisotropies, but rather to a good understanding of the
basic physics that goes into such calculations.

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2010-03-28 07:05:56 -0600

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2010-03-28 07:08:31 -0600

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Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/bartlett1999.pdf

Remote URLs

basilakos2009

Hubble expansion and structure formation in time varying vacuum

models (article)

Author

Basilakos, S. and Plionis, M. and Sola, J.

Journal

PhRvD

Year

2009

Volume

80

Pages

083511

Keywords

cosmic microwave background, cosmology - general, cosmology - theory

Abstract

We investigate the properties of the FLRW flat cosmological models in which the vacuum energy
density evolves with time, ┌ðtÞ. Using different versions of the ┌ðtÞ model, namely, quantum field
vacuum, power series vacuum and power law vacuum, we find that the main cosmological functions such
as the scale factor of the Universe, the Hubble expansion rate H, and the energy densities are defined
analytically. Performing a joint likelihood analysis of the recent supernovae type Ia data, the cosmic
microwave background shift parameter and the baryonic acoustic oscillations traced by the Sloan Digital
Sky Survey galaxies, we put tight constraints on the main cosmological parameters of the ┌ðtÞ scenarios.
Furthermore, we study the linear matter fluctuation field of the above vacuum models. We find that the
patterns of the power series vacuum ┌ ¼ n1H þ n2H2 predict stronger small scale dynamics, which
implies a faster growth rate of perturbations with respect to the other two vacuum cases (quantum field and
power law), despite the fact that all the cosmological models share the same equation of state parameter.
In the case of the quantum field vacuum ┌ ¼ n0 þ n2H2, the corresponding matter fluctuation field
resembles that of the traditional cosmology. The power law vacuum (/ a n) mimics the classical
quintessence cosmology, the best fit being tilted in the phantom phase. In this framework, we compare the
observed growth rate of clustering measured from the optical galaxies with those predicted by the current
┌ðtÞ models. Performing a Kolmogorov-Smirnov statistical test we show that the cosmological models
which contain a constant vacuum (CDM), quantum field vacuum, and power law vacuum provide

growth rates that match well with the observed growth rate. However, this is not the case for the power
series vacuum models (in particular, the frequently adduced / H model) in which clusters form at
significantly earlier times (z 4) with respect to all other models (z 2). Finally, we derived the
theoretically predicted dark matter halo mass function and the corresponding distribution of cluster-size
halos for all the models studied. Their expected redshift distribution indicates that it will be difficult to
distinguish the closely resembling models (constant vacuum, quantum field, and power law vacuum),
using realistic future x-ray surveys of cluster abundances. However, cluster surveys based on the Sunayev-
Zeldovich detection method give some hope to distinguish the closely resembling models at high
redshifts.

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2010-02-24 18:14:34 -0700

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Remote URLs

benoit2004

First detection of polarization of the submillimetre diffuse galactic dust emission by Archeops (article)

Author

Beniot, A. and Amblard, A. and Ansari, R. and Aubourg, E. and Bargot, S. and Bartlett, J.G. and Bernard, J.P. and Bhatia, R.S. an Blanchard, A. and Bock, J.J. and Boscaleri, A. and Bouchet F.R. and Bourrachot, A. and Camus, P. and Couchot, F. and de Bernardis, P. and Delabrouille, J. and Desert F.X. and Dore, O. and Douspis, M. and Dumoulin, L. and Dupac, X. and Filliatre, P. and Fosalba, P. and Ganga, K. and Gannaway, F. and Gautier, B. and Girard, M.

Journal

A&A

Year

2004

Volume

424

Pages

571-582

Keywords

cosmology - general, cosmic microwave background, cosmology - observations, interstellar - dust, extinction, polarization

Abstract

We present the first determination of the Galactic polarized emission at 353 GHz by Archeops. The data were taken during the Arctic
night of February 7, 2002 after the balloon-borne instrument was launched by CNES from the Swedish Esrange base near Kiruna. In addition
to the 143 GHz and 217 GHz frequency bands dedicated to CMB studies, Archeops had one 545 GHz and six 353 GHz bolometers mounted in
three polarization--sensitive pairs that were used for Galactic foreground studies. We present maps of the I, Q, U Stokes parameters over 17%
of the sky and with a 13 arcmin resolution at 353 GHz (850 μm). They show a significant Galactic large scale polarized emission coherent on
the longitude ranges [100, 120] and [180, 200] deg. with a degree of polarization at the level of 4--5%, in agreement with expectations from
starlight polarization measurements. Some regions in the Galactic plane (Gem OB1, Cassiopeia) show an even stronger degree of polarization
in the range 10--20%. These findings provide strong evidence for a powerful grain alignment mechanism throughout the interstellar medium
and a coherent magnetic field coplanar to the Galactic plane. This magnetic field pervades even some dense clouds. Extrapolated to high
Galactic latitude, these results indicate that interstellar dust polarized emission is the major foreground for PLANCK--HFI CMB polarization
measurements.

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Date-Modified

2010-05-26 21:07:55 -0600

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Remote URLs

bond2002

The Cosmic Microwave Background & Inflation, Then & Now (article)

Author

Bond, J.R. and Contaldi, C. and Pogosyan, D. and Mason, B. and Myers, S. and Pearson, T. and Pen, U. and Prunet, S. and Readhead, T. and Sievers, J.

Journal

arXiv

Year

2002

Number

arXiv:astro-ph/0210007v1

Keywords

cosmic inflation, cosmic microwave background

Abstract

The most recent results from the Boomerang, Maxima, DASI, CBI and VSA CMB experiments significantly increase the case for accelerated expansion in the early universe (the
inflationary paradigm) and at the current epoch (dark energy dominance). This is especially

so when
combined with data on high redshift supernovae (SN1) and large scale structure (LSS), encoding
information from local cluster abundances, galaxy clustering, and gravitational lensing. There are
``7 pillars of Inflation" that can be shown with the CMB probe, and at least 5, and possibly 6, of
these have already been demonstrated in the CMB data: (1) the effects of a large scale gravitational
potential, demonstrated with COBE/DMR in 1992-96; (2) acoustic peaks/dips in the angular power
spectrum of the radiation, which tell about the geometry of the Universe, with the large first peak
convincingly shown with Boomerang and Maxima data in 2000, a multiple peak/dip pattern shown
in data from Boomerang and DASI (2nd, 3rd peaks, first and 2nd dips in 2001) and from CBI
(2nd, 3rd, 4th, 5th peaks, 3rd, 4th dips at 1-sigma in 2002); (3) damping due to shear viscosity
and the width of the region over which hydrogen recombination occurred when the universe was
400000 years old (CBI 2002); (4) the primary anisotropies should have a Gaussian distribution (be
maximally random) in almost all inflationarymodels, the best data on this coming fromBoomerang;
(5) secondary anisotropies associated with nonlinear phenomena subsequent to 400000 years, which
must be there and may have been detected by CBI and another experiment, BIMA. Showing the 5
``pillars" involves detailed confrontation of the experimental data with theory; e.g., (5) compares
the CBI data with predictions from two of the largest cosmological hydrodynamics simulations
ever done. DASI, Boomerang and CBI in 2002, AMiBA in 2003, and many other experiments
have the sensitivity to demonstrate the next pillar, (6) polarization, which must be there at the
~ 7% level. A broad-band DASI detection consistent with inflation models was just reported. A
7th pillar, anisotropies induced by gravity wave quantum noise, could be too small to detect. A
minimal inflation parameter set, {wb,wcdm,Wtot ,WQ,wQ,ns,tC,s8}, is used to illustrate the power
of the current data. Aftermarginalizing over the other cosmic and experimental variables, we find the
current CMB+LSS+SN1 data give Wtot = 1.00+.07
−.03, consistent with (non-baroque) inflation theory.
Restricting to Wtot = 1, we find a nearly scale invariant spectrum, ns = 0.97+.08
−.05. The CDM density,
wcdm = Wcdmh2 = .12+.01
−.01, and baryon density, wb ≡ Wbh2 = .022+.003
−.002, are in the expected range.

(The Big Bang nucleosynthesis estimate is 0.019$\pm$0.002.) Substantial dark (unclustered) energy
is inferred, WQ ≈ 0.68$\pm$ 0.05, and CMB+LSS WQ values are compatible with the independent
SN1 estimates. The dark energy equation of state, crudely parameterized by a quintessence-field
pressure-to-density ratio wQ, is not well determined by CMB+LSS (wQ < −0.4 at 95% CL), but when combined with SN1 the resulting wQ < −0.7 limit is quite consistent with the wQ=−1
cosmological constant case.

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Remote URLs

calabrese2009

Cosmological constraints on the matter equation of state (article)

Author

Calabrese, E. and Migliaccio, M. and Pagano, L. and De Troia, G.

Journal

PhRvD

Year

2009

Volume

80

Pages

063539

Keywords

cosmology - general, cosmology - theory, cosmic microwave background, hubble parameter

Abstract

We investigate the impact of a nonstandard time evolution of the dark matter component on current
cosmological bounds from cosmic microwave background (CMB) anisotropies. We found that a less than
0.1% variation in the effective dark matter equation of state wdm can drastically change current CMB
bounds on the matter density, the Hubble parameter and the age of the Universe. A flat universe without
dark energy could provide an excellent fit to current CMB data, providing that wdm 10 2.

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2010-02-24 18:23:48 -0700

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Remote URLs

calabrese2010

Non-Gaussianity in WMAP data due to the correlation of CMB lensing potential with secondary anisotropies (article)

Author

Calabrese, E. and Smidt, J. and Amblard, A. and Cooray, A. and Melchiorri, A. and Serra, P. and Heavens, A. and Munshi, D.

Journal

PhRvD

Year

2010

Volume

81

Pages

043529

Keywords

cosmic microwave background

Abstract

We measure the skewness power spectrum of the CMB anisotropies optimized for a detection of the
secondary bispectrum generated by the correlation of the CMB lensing potential with integrated Sachs-
Wolfe effect and the Sunyaev-Zel'dovich effect. The covariance of our measurements is generated by
Monte Carlo simulations of Gaussian CMB fields with noise properties consistent with WMAP 5-year
data. When interpreting multifrequency measurements we also take into account the confusion resulting
from unresolved radio point sources. We analyze Q, V and W-band WMAP 5-year raw and foregroundcleaned
maps using the KQ75 mask out to lmax ¼ 600. We find no significant evidence for a nonzero non-
Gaussian signal from the lensing-secondary correlation in all three bands and we constrain the overall
amplitude of the cross-power spectrum between CMB lensing potential and the sum of SZ and ISW
fluctuations to be 0:42 0:86 and 1:19 0:86 in combined V and W-band raw and foreground-cleaned
maps provided by the WMAP team, respectively. The point-source amplitude at the bispectrum level
measured with this skewness power spectrum is higher than previous measurements of point-source non-
Gaussianity. We also consider an analysis where we also account for the primordial non-Gaussianity in

addition to lensing-secondary bispectrum and point sources. The focus of this paper is on secondary
anisotropies. Consequently the estimator is not optimized for primordial non-Gaussianity and the limit we
find on local non-Gaussianity from the foreground-cleaned V þW maps is fNL ¼ 13 ± 62, when
marginalized over point sources and lensing-ISW/SZ contributions to the total bispectrum.

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2010-02-24 18:49:13 -0700

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Remote URLs

Challinor2009

Lecture notes on the physics of cosmic microwave background anisotropies (article)

Author

Challinor, A. and Peiris, H.

Journal

arXiv

Year

2009

Number

0903.5158v1

Keywords

cosmic microwave background, cosmic inflation

Abstract

We review the theory of the temperature anisotropy and polarization of the cosmic microwave background (CMB) radiation, and describe what we have learned from current CMB
observations. In particular, we discuss how the CMB is being used to provide precise measurements
of the composition and geometry of the observable universe, and to constrain the physics of the early
universe. We also briefly review the physics of the small-scale CMB fluctuations generated during
and after the epoch of reionization, and which are the target of a new breed of arcminute-resolution
instruments.

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2010-02-24 18:49:50 -0700

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2010-02-24 18:51:54 -0700

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Remote URLs

chluba2010

Cosmological recombination: feedback of helium photons and its effect on the recombination spectrum (article)

Author

Chluba, J. and Sunyaev, R.

Journal

MNRAS

Year

2010

Volume

402

Pages

1221-1248

Keywords

atomic processes, radiative transfer, cosmic microwave background, cosmology - theory

Abstract

In this paper, we consider the reprocessing of high-frequency photons emitted by He II and He I during the epoch of cosmological recombination by He I and HI. We demonstrate that, in
comparison to computations which neglect all feedback processes, the number of cosmological
recombination photons that are related to the presence of helium in the early Universe could
be increased by ~40--70 per cent. Our computations imply that per helium nucleus ~3--6 additional photons could be produced. Therefore, a total of ~12--14 helium-related photons per helium atom are emitted during cosmological recombination. This is an important addition
to cosmological recombination spectrum which in the future may render it slightly easier to determine the primordial abundance of helium using differential measurements of the cosmic microwave background (CMB) energy spectrum. Also, since these photons are the only witnesses of the feedback process at high redshift, observing them in principle offers a way to check our understanding of the recombination physics. Here, most interestingly, the feedback of He II photons on He I leads to the appearance of several additional, rather narrow spectral features in the He I recombination spectrum at low frequencies. Consequently,
the signatures of helium-related features in the CMB spectral distortion from cosmological recombination at some given frequency can exceed the average level of ~17 per cent several times. We find that in particular the bands around $\nu \sim 10$, ~35, ~80 and ~200 GHz seem to be affected strongly. In addition, we computed the changes in the cosmological ionization history, finding that only the feedback of primary He I photons on the dynamics of He II→He I
recombination has an effect, producing a change of $N_e/N_e \sim +0.17$ per cent at $z \sim 2300$. This result seems to be ~2--3 times smaller than the one obtained in earlier computations

for
this process, however, the difference will not be very important for the analysis of future CMB
data.

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2010-02-24 18:53:10 -0700

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2010-02-24 18:56:42 -0700

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Remote URLs

clifton2009

What the small angle CMB really tells us about the curvature of the Universe (article)

Author
Clifton, T. and Ferreira, P.G. and Zuntz, J.

Journal
JCAP

Year
2009

Volume
07

Number
029

Keywords
cosmic microwave background, cosmology - general

Abstract
It is well known that observations of the cosmic microwave background (CMB)
are highly sensitive to the spatial curvature of the Universe, k. Here we find that what is in fact being tightly constrained by small angle fluctuations is spatial curvature near the surface of last scattering, and that if we allow k to be a function of position, rather than taking a constant value everywhere, then considerable spatial curvature is permissible within our own locale. This result is of interest for the giant void models that attempt to explain the supernovae observations without Dark Energy. We find such voids to be compatible with
the observed small angle CMB, but they must be either very deep (and unnaturally empty) or exist in a positively curved Universe.

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2010-03-28 20:29:40 -0600

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2010-03-28 20:31:53 -0600

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Remote URLs

dawson2006

Final results from the BIMA CMB anisotropy survey and search for the signature of teh Sunyaev-Zel'dovich effect (article)

Author

Dawson, K.S. and Holzapfel, W.L. and Carlstrom, J.E. and Joy, M. and LaRoque, S.J.

Journal

ApJ

Year

2006

Number

647

Month

13-24

Keywords

cosmic microwave background, cosmology - observations, galaxies - clusters - general

Abstract

We report the final results of our study of the cosmic microwave background (CMB) with the BIMA array. Over
1000 hr of observation were dedicated to this project exploring CMB anisotropy, on scales between 10 and 20 in
eighteen 6A6 FWHMfields. In the analysis of the CMBpower spectrum, the visibility data are divided into two bins,
corresponding to different angular scales. Modeling the observed excess power as a flat band of average multipole
leA ¼ 5237, we find ┌T2
1 ¼ 220þ140
120 K2 at 68%confidence and T2
1 > 0 K2 with 94.7%confidence. In a second
band, with averagemultipole of leA ¼ 8748, we find ┌T2
2 consistent with zero and an upper limit of 880 K2 at 95%
confidence. An extensive series of tests and supplemental observations with the VLA provide strong evidence
against systematic errors or radio point sources being the source of the observed excess power. The dominant source
of anisotropy on these scales is expected to be the Sunyaev-Zel'dovich (SZ) effect in a population of distant galaxy
clusters. If the excess power is due to the SZ effect, we can place constraints on the normalization of the matter
power spectrum ┐8 ¼ 1:03þ0:20
0:29 at 68% confidence. The distribution of pixel fluxes in the BIMA images is found to be consistent with simulated observations of the expected SZ background and rules out instrumental noise or radio
sources as the source of the observed excess power, with confidence similar to the detection of excess power.
Follow-up optical observations to search for galaxy overdensities anticorrelated with flux in the BIMA images, as

might be expected from the SZ effect, proved to be inconclusive.

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2010-05-26 21:08:30 -0600

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2010-05-26 21:11:03 -0600

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Remote URLs

debernardis1993

ARGO: a balloon-borne telescope for measurements of the millimeter diffuse sky emission (article)

Author

de Bernardis, P. and Aquilini, E. and Boscaleri, A. and De Petris, M. and Gervasi, M. and Martinis, L. and Masi, S. and Natale, V. and Palumbo, P. and Scaramuzzi, F. and Valenziano, L.

Journal

A&A

Year

1993

Volume

271

Pages

683-696

Keywords

instrumentation - photometers, telescopes, cosmology - general, cosmic microwave background

Abstract

We describe a millimeter Cassegrain Telescope, optimized for balloon observations of Cosmic Microwave Background (CMB) anisotropies.

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2010-05-26 21:11:47 -0600

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2010-05-26 21:15:26 -0600

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Remote URLs

deBernardis2003

Investigating the Early Universe with the Cosmic Microwave Background Anisotropy (article)

Author

de Bernardis, P. and Ade, P.A.R. and Bock, J.J. and Bond, J.R. and Borrill, J. and Boscaleri, A. and Coble, K. and Contaldi, C. and Crill, B.P. and De Troia, G. and Ferreira, P.G. and Ganga, K. and Giacometti, M. and Hivon, E. and Hristov, V.V. and Iacoangeli, A. and Jaffe, A.H. and Jones, W.C.

and Lange, A.E. and Martinis, L. and Masi, S. and Mason, P. and Mauskopf, P.D. and Melchiorri, A. and Montroy, T. and Nati, F. and Netterfield, C.B. and Pascale, E. and Piacentini, F. and Pogosyan, D. and Polenta, G. and Pongetti, F. and Prunet, S. and Romero, G.E. and Ruhl, J.E. and Scaramuzzi, F.

Journal

MmSAI

Year

2003

Volume

75

Pages

75

Keywords

cosmic microwave background, cosmology - general

Annote

Several experiments (including BOOMERanG, MAXIMA, DASI, VSA, CBI) have recently detected very low contrast structures in the Cosmic Microwave Background (CMB), the otherwise isotropic radiation coming from the early Universe. These structures have a contrast of the order of 25 ppm and a dominant angular size of one degree. In the current cosmological model, these structures result from acoustic oscillations of the primeval plasma within the horizon at recombination (z » 1100). In the framework of the Hot Big Bang theory with the inflationary hypothesis, the statistical properties of the image of the CMB allow us to measure most of the cosmological parameters.

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2010-03-28 20:32:35 -0600

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2010-08-04 15:09:47 -0600

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Remote URLs

dicke1965

Cosmic black-body radiation (article)

Author

Dicke, R.H. and Peebles, P.J.E. and Roll, P.G. and Wilkinson, D.T.

Journal

ApJ

Year

1965

Volume

142

Pages

414-419

Keywords

cosmic microwave background, cosmology - general

Abstract

One of the basic problems of cosmology is the singularity characteristic of the familiar cosmological solutions of Einstein's field equations.

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2010-02-24 18:57:44 -0700
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2010-02-24 19:00:16 -0700
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Remote URLs

gamow1948
The Origin of Elements and the Separation of Galaxies (article)
Author
Gamow, G.A.
Journal
PhRv
Year
1948
Volume
74
Pages
505-506
Keywords
cosmology - general, cosmic microwave background, nuclear reactions - nuclear synthesis - abundances
Abstract
The successful explanation of the main features of the abundance curve of chemical elements by the hypothesis of the "unfinished building up process", permits us to get certain information concering the densities and temperatures which must have existed in the universe during the early stages of its expansion.
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2010-03-28 20:43:16 -0600
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2010-03-28 20:45:20 -0600
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/ Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/gamow1948.pdf
Remote URLs

gawiser2000
The cosmic microwave background radiation (article)
Author
Gawiser, E. and Silk, J.
Journal
PhR

Year
2000
Volume
333-334
Pages
245-267
Keywords
cosmology - general, cosmic microwave background
Abstract
We summarize the theoretical and observational status of the study of the Cosmic Microwave Background
radiation. Its thermodynamic spectrum is a robust prediction of the Hot Big Bang cosmology and has been
con"rmed observationally. There are now 75 observations of Cosmic Microwave Background anisotropy,
which we present in a table with references. We discuss the theoretical origins of these anisotropies and
explain the standard jargon associated with their observation. (2000 Elsevier Science B.V. All rights
reserved.
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2010-03-28 20:47:44 -0600
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2010-03-28 20:52:14 -0600
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Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/Gawiser2000.pdf
Remote URLs

gundersen1995

Degree-scale anisotropy in the cosmic microwave background: SP94 results (article)

Author
Gundersen, J.O. and Lim, M. and Staren, J. and Wuensche, C.A. and Figueiredo, N. and Gaier, T.C. and Koch, T. and Meinhold, P.R. and Seiffert, M.D. and Cook, G. and Segale, A. and Lubin, P.M.
Journal
ApJ
Year
1995
Volume
443
Pages
L57-L60
Month
April
Keywords

cosmic microwave background, cosmology - observations

Abstract

We present results from two observations of the cosmic microwave microwave backtground (CMB) performed from teh South Pole during the 1992-1994 austral summer.

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Remote URLs

gurzadyan2009

Flat Universe with hyperbolic voids (article)

Author

Gurzadyan, V.G. and Kocharyan, A.A.

Journal

EPL

Year

2009

Volume

86

Pages

29002

Month

April

Keywords

cosmic microwave background, cosmology - general

Abstract

The properties of geodesics flow are studied in a Friedmann-Robertson-Walker metric perturbed due to the inhomogeneities of matter. The basic, averaged Jacobi equation is derived,
which reveals that the low-density regions (voids) are able to induce hyperbolicity, even if the global
curvature of the Universe is zero or slightly positive. It is shown that the energy independence
is a characteristic property of these geometric effects. The importance of these conclusions is
determined by the temperature independent ellipticity of excursion sets and regions of different
randomness found in Kolmogorov Cosmic Microwave Background (CMB) maps.

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2010-03-28 20:52:43 -0600

Date-Modified

2010-03-28 20:58:50 -0600

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Remote URLs

hinshaw2009

Five-year wilkinson microwave anisotropy probe observations: data processing, sky maps and basic results (article)

Author

Hinshaw, G. and Weiland, J.L. and Hill, R.S. and Odegard, N. and Larson, D. and Bennett, C.L. and Dunkley, J. and Gold, B. and Greason, M.R. and Jarosik, N. and Komatsu, E. and Nolta, M.R. and Page, L. and Spergel, D.N. and Wollack, E. and Halpern, M. and Kogut, A. and Limon, M. and Meyer, S.S. and Tucker, G.S. and Wright, E.L.

Journal

ApJS

Year

2009

Volume

180

Pages

225-245

Month

February

Keywords

cosmic microwave background, cosmology - observations, early universe, dark matter, spacecraft - instruments, instrumentation - detectors, telescopes

Abstract

We present new full-sky temperature and polarization maps in five frequency bands from 23 to 94 GHz, based on
data from the first five years of the Wilkinson Microwave Anisotropy Probe (WMAP) sky survey. The new maps
are consistent with previous maps and are more sensitive. The five-year maps incorporate several improvements in
data processing made possible by the additional years of data and by a more complete analysis of the instrument
calibration and in-flight beam response. We present several new tests for systematic errors in the polarization
data and conclude that W-band polarization data is not yet suitable for cosmological studies, but we suggest
directions for further study. We do find that Ka-band data is suitable for use; in conjunction with the additional
years of data, the addition of Ka band to the previously used Q- and V-band channels significantly reduces
the uncertainty in the optical depth parameter, τ . Further scientific results from the five-year data analysis are
presented in six companion papers and are summarized in Section 7 of this paper. With the five-year WMAP
data, we detect no convincing deviations from the minimal six-parameter ΛCDM model: a

flat universe dominated
by a cosmological constant, with adiabatic and nearly scale-invariant Gaussian fluctuations. Using WMAP data
combined with measurements of Type Ia supernovae and Baryon Acoustic Oscillations in the galaxy distribution,
we find (68% CL uncertainties): Ωbh2 = 0.02267+0.00058
−0.00059, Ωch2 = 0.1131 $\pm$ 0.0034, ΩΛ = 0.726 $\pm$ 0.015,
ns = 0.960 $\pm$ 0.013, τ = 0.084 $\pm$ 0.016, and Δ2
R = (2.445 $\pm$ 0.096) × 10−9 at k = 0.002 Mpc−1. From these
we derive σ8 = 0.812 $\pm$ 0.026, H0 = 70.5 $\pm$ 1.3 kms−1 Mpc−1, Ωb = 0.0456 $\pm$ 0.0015, Ωc = 0.228 $\pm$ 0.013,
Ωmh2 = 0.1358+0.0037
−0.0036, zreion = 10.9$\pm$1.4, and t0 = 13.72$\pm$0.12 Gyr. The new limit on the tensor-to-scalar ratio is
r < 0.22 (95% CL), while the evidence for a running spectral index is insignificant, dns/d ln k = −0.028 $\pm$ 0.020
(68% CL). We obtain tight, simultaneous limits on the (constant) dark energy equation of state and the spatial
curvature of the universe: −0.14 < 1 +w < 0.12 (95% CL) and −0.0179 < Ωk < 0.0081 (95% CL). The number
of relativistic degrees of freedom, expressed in units of the effective number of neutrino species, is found to be
Neff = 4.4 $\pm$ 1.5 (68% CL), consistent with the standard value of 3.04. Models with Neff = 0 are disfavored
at >99.5% confidence. Finally, new limits on physically motivated primordial non-Gaussianity parameters are
−9 < flocal
NL < 111 (95% CL) and−151 < f
equil
NL < 253 (95% CL) for the local and equilateralmodels, respectively.

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Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/hinshaw2009.pdf

Remote URLs

komatsu2009

Five-year Wilkinson microwave anisotropy probe observations: cosmological interpretations (article)

Author

Komatsu, E. and Dunkley, J. and Nolta, M.R. and Bennett, C.L. and Gold, B. and Hinshaw, G. and Jarosik, N. and Larson, D. and Limon, M. and Page, L. and Spergel, D.N. and Halpern, M. and Hill, R.S. and Kogut, A. and Meyer, S.S. and Tucker, G.S. and Weiland, J.L. and Wollack, E. and Wright, E.L.

Journal
ApJS
Year
2009
Volume
180
Pages
330-276
Month
February
Keywords
cosmic microwave background, cosmology - observations, dark matter, early universe, instrumentation - detectors, spacecraft - instruments, telescopes
Abstract
The Wilkinson Microwave Anisotropy Probe (WMAP) 5-year data provide stringent limits on deviations from the
minimal, six-parameter Λ cold dark matter model. We report these limits and use them to constrain the physics of
cosmic inflation via Gaussianity, adiabaticity, the power spectrum of primordial fluctuations, gravitational waves,
and spatial curvature. We also constrain models of dark energy via its equation of state, parity-violating interaction,
and neutrino properties, such as mass and the number of species. We detect no convincing deviations from the
minimal model. The six parameters and the corresponding 68% uncertainties, derived from the WMAP data
combined with the distance measurements from the Type Ia supernovae (SN) and the Baryon Acoustic Oscillations
(BAO) in the distribution of galaxies, are: Ωbh2 = 0.02267+0.00058
−0.00059, Ωch2 = 0.1131$\pm$0.0034, ΩΛ = 0.726$\pm$0.015,
ns = 0.960 $\pm$ 0.013, τ = 0.084 $\pm$ 0.016, and Δ2
R = (2.445 $\pm$ 0.096) × 10−9 at k = 0.002 Mpc−1. From these,
we derive σ8 = 0.812 $\pm$ 0.026, H0 = 70.5 $\pm$ 1.3 kms−1 Mpc−1, Ωb = 0.0456
$\pm$ 0.0015, Ωc = 0.228 $\pm$ 0.013,
Ωmh2 = 0.1358+0.0037
−0.0036, zreion = 10.9 $\pm$ 1.4, and t0 = 13.72 $\pm$ 0.12 Gyr. With the WMAP data combined with
BAO and SN, we find the limit on the tensor-to-scalar ratio of r < 0.22 (95% CL), and that ns > 1 is disfavored
even when gravitational waves are included, which constrains the models of inflation that can produce significant
gravitational waves, such as chaotic or power-law inflation models, or a blue spectrum, such as hybrid inflation
models. We obtain tight, simultaneous limits on the (constant) equation of state of dark energy and the spatial
curvature of the universe: −0.14 < 1 +w < 0.12 (95% CL) and −0.0179 < Ωk < 0.0081 (95% CL). We provide
a set of ``WMAP distance priors,'' to test a variety of dark energy models with spatial

curvature. We test a timedependent
w with a present value constrained as −0.33 < 1 + w0 < 0.21 (95% CL). Temperature and dark matter
fluctuations are found to obey the adiabatic relation to within 8.9% and 2.1% for the axion-type and curvaton-type
dark matter, respectively. The power spectra of TB and EB correlations constrain a parity-violating interaction,
which rotates the polarization angle and converts E to B. The polarization angle could not be rotated more than
−5.○9 < Δα < 2.○4 (95% CL) between the decoupling and the present epoch. We find the limit on the total mass
of massive neutrinos of

mv < 0.67 eV (95% CL), which is free from the uncertainty in the normalization
of the large-scale structure data. The number of relativistic degrees of freedom (dof), expressed in units of the
effective number of neutrino species, is constrained as Neff = 4.4 $\pm$ 1.5 (68%), consistent with the standard
value of 3.04. Finally, quantitative limits on physically-motivated primordial non-Gaussianity parameters are
−9 < flocal
NL < 111 (95% CL) and−151 < f
equil
NL < 253 (95% CL) for the local and equilateralmodels, respectively.

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2010-03-28 21:18:15 -0600

Local Files

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Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/Komatsu2009.pdf

Remote URLs

langlois2004

Inflation, quantum fluctuations and cosmological perturbations (article)

Author

Langlois, D.

Journal

arXiv

Year

2004

Number

arXiv:hep-th/0405053v1

Keywords

cosmic microwave background, cosmic inflation

Abstract

These lectures are intended to give a pedagogical introduction to
the main current picture of the very early universe. After elementary

reviews of general relativity and of the standard Big Bang model, the following subjects are discussed: inflation, the classical relativistic theory of cosmological perturbations and the generation of perturbations from scalar field quantum fluctuations during inflation.

Date-Added

2010-05-26 21:22:49 -0600

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2010-05-26 21:24:59 -0600

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/ Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/langois2004.pdf

Remote URLs

lasenby2009

The Cosmic Microwave Background and Fundamental Physics (article)

Author

Lasenby, A.

Journal

SSRv

Year

2009

Volume

148

Pages

329-346

Keywords

cosmic microwave background, early universe, cosmology - general, gravity

Abstract

A brief overview of the links between the CosmicMicrowave Background (CMB) and fundamental physics is given. After a summary of the basics of the CMB, and of current observations, topics are considered including the generation of perturbations, inflation and string theory, evidence for parity violation, variation of the fundamental constants, restrictions on alternative theories of gravity, primordial non-Gaussianity, early- and late-time Bianchi universes and topological defects.

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2010-02-24 19:05:22 -0700

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2010-02-24 19:08:21 -0700

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/ Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/Lasenby2009.pdf

Remote URLs

mortonson2009

Testing flatness of the universe with probes of cosmic distances and

growth (article)

Author

Mortonson, M.J.

Journal

PhRvD

Year

2009

Volume

80

Pages

123504

Keywords

cosmology - general, cosmic microwave background

Abstract

When using distance measurements to probe spatial curvature, the geometric degeneracy between
curvature and dark energy in the distance-redshift relation typically requires either making strong
assumptions about the dark energy evolution or sacrificing precision in a more model-independent
approach. Measurements of the redshift evolution of the linear growth of perturbations can break the
geometric degeneracy, providing curvature constraints that are both precise and model independent.
Future supernova, CMB, and cluster data have the potential to measure the curvature with an accuracy of
┌ð┌KÞ ¼ 0:002, without specifying a particular dark energy phenomenology. In combination with
distance measurements, the evolution of the growth function at low redshifts provides the strongest
curvature constraint if the high-redshift universe is well approximated as being purely matter dominated.
However, in the presence of early dark energy or massive neutrinos, the precision in curvature is reduced
due to additional degeneracies, and precise normalization of the growth function relative to recombination
is important for obtaining accurate constraints. Curvature limits from distances and growth compare
favorably to other approaches to curvature estimation proposed in the literature, providing either greater
accuracy or greater freedom from dark energy modeling assumptions, and are complementary due to the
use of independent data sets. Model-independent estimates of curvature are critical both for testing
inflation and for obtaining unbiased constraints on dark energy parameters.

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2010-03-28 21:19:03 -0600

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Remote URLs

nakashima2010

Constraining the time variation of the coupling constants from cosmic microwave background: effect of QCD (article)

Author

Nakashima, M. and Ichikawa, K. and Nagata, R. and Yokoyama, J.

Journal

JCAP

Year

2010

Volume

30

Number

01

Keywords

cosmic microwave background, cosmology - parameters, cosmology - theory

Abstract

We investigate constraints on the time variation of the fine structure constant between the recombination epoch and the present epoch, ┌α/α ≡ (αrec − αnow)/αnow, from cosmic microwave background (CMB) taking into account simultaneous variation of other physical constants, namely the electron mass me and the proton mass mp. In other words, we consider the variation of Yukawa coupling and the QCD scale QCD in addition to the electro-magnetic coupling. We clarify which parameters can be determined from CMB temperature anisotropy in terms of singular value decomposition. Assuming a relation among variations of coupling constants governed by a single scalar field (the dilaton), the 95% confidence level (C.L.) constraint on ┌α/α is found to be −8.28 × 10−3 < ┌α/α < 1.81 × 10−3, which is tighter than the one obtained by considering only the change of α and me. We also obtain the constraint on the time variation of the proton-to-electron mass ratio μ ≡ mp/me to be −0.52 < ┌μ/μ < 0.17 (95% C.L.) under the same assumption. Finally, we also implement a forecast for constraints from the PLANCK survey.

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2010-02-24 19:09:18 -0700

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2010-02-24 19:13:34 -0700

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Remote URLs

odman2003

Constraining the shape of the CMB: A peak-by-peak analysis (article)

Author

Odman, C.J. and Melchiorri, A. and Hobson, M.P. and Lasenby, A.

Journal

PhRvD

Year

2003

Volume

67

Pages

083511

Keywords

cosmic microwave background, cosmology - general

Abstract

The recent measurements of the power spectrum of cosmic microwave background anisotropies are consistent
with the simplest inflationary scenario and big bang nucleosynthesis constraints. However, these results
rely on the assumption of a class of models based on primordial adiabatic perturbations, cold dark matter and
a cosmological constant. In this paper we investigate the need for deviations from the L-CDM scenario by first
characterizing the spectrum using a phenomenological function in a 15 dimensional parameter space. Using a
Monte Carlo Markov chain approach to Bayesian inference and a low curvature model template we then check
for the presence of new physics and/or systematics in the CMB data. We find an almost perfect consistency
between the phenomenological fits and the standard L-CDM models. The curvature of the secondary peaks is
weakly constrained by the present data, but they are well located. The improved spectral resolution expected
from future satellite experiments is warranted for a definitive test of the scenario.

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Remote URLs

odwyer2005

The cosmic microwave background anisotropy power spectrum from the BEAST experiment (article)

Author

O'Dwyer, I.J. and Bersanelli, M. and Childers, J. and Figueiredo, N. and Halevi, D. and Huey, G. and Lubin, P.M. and Maino, D. and Mandolesi, N. and Marvil, J. and Meinhold, P.R., and Mejia, J. and Natoli, P. and O'Neil, H. and Pina, A. and Seiffert, M.D. and Stebor, N.C. and Tello, C. and Villela, T. and Wandelt, B.D. and Williams, B. and Wuensche, C.A.

Journal

ApJS

Year

2005

Volume

158

Pages

93-100

Month

May

Keywords

cosmic microwave background, cosmology - observations, large-scale structure of universe

Abstract

The Background Emission Anisotropy Scanning Telescope (BEAST) is a 2.2 m off-axis telescope with an eightelement
mixed Q-band (38--45 GHz) and Ka-band (26--36 GHz) focal plane, designed for balloon-borne and
ground-based studies of the cosmic microwave background (CMB). Here we present the CMB angular power spectrum
calculated from 682 hr of data observed with the BEAST instrument. We use a binned pseudo-Cl estimator (the
MASTER method). We find results that are consistent with other determinations of the CMB anisotropy for angular
wavenumbers l between 100 and 600. We also perform cosmological parameter estimation. The BEAST data
alone produce a good constraint on ┌k ┌ l ┐ ┌tot ¼ ┐0:074 └ 0:070, consistent with a flat universe. A joint parameter
estimation analysis with a number of previous CMB experiments produces results consistent with previous
determinations.

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2010-05-26 21:25:25 -0600

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Remote URLs

penzias1965

A measurement of excess antenna temperature at 4080 Mc/s (article)

Author

Penzias, A.A. and Wilson, R.W.

Journal
ApJ
Year
1965
Volume
142
Pages
419-421
Keywords
cosmic microwave background
Abstract
Measurements of the effective zenith noise temperature of the 20-foot horn-reflector antenna.
Date-Added
2010-02-24 19:56:01 -0700
Date-Modified
2010-02-24 20:02:49 -0700
Local Files
/ Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/penzias1965.pdf
Remote URLs

penzias1966

Determination of the microwave spectrum of Galactic radiation (article)

Author
Penzias, A.A. and Wilson, R.W.
Journal
ApJ
Year
1966
Volume
146
Pages
666
Keywords
cosmic microwave background
Abstract
Drift-curve observations of the galactic plane were made at 4080 Mc/s in five declinations selected for freedom from descrete sources.
Date-Added
2010-02-24 20:14:08 -0700
Date-Modified
2010-02-24 20:15:57 -0700
Local Files
/ Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/penzias1966.pdf
Remote URLs

penzias1969

Observational constraints on a discrete-source model to explain the microwave background (article)

Author

Penzias, A.A. and Schraml, J. and Wilson, R.W.

Journal

ApJ

Year

1969

Volume

157

Pages

49

Month

July

Keywords

cosmic microwave background

Abstract

We present an experimental limit to the small-scale anisotrphy of the microwave background at 3.5mm.

Date-Added

2010-02-25 09:47:04 -0700

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2010-02-25 09:48:41 -0700

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/Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/penzias1969.pdf

Remote URLs

pierpaoli2000

Still flat after all these years! (article)

Author

Pierpaoli, E. and Scott, D. and White, M.

Journal

arXiv

Year

2000

Number

arXiv:astro-ph/0004003v1

Keywords

cosmology - general, cosmic microwave background

Abstract

The Universe could be spatially flat, positively curved or negatively curved. Each option has been popular at various times, partly affected by an understanding that models tend to evolve away from flatness. The curvature of

the Universe is amenable to measurement, through tests such as the determination of the angles of sufficiently large triangles. The angle subtended by the characteristic scale on the Cosmic Microwave sky provides a direct test, which has now been realised through a combination of exquisite results from a number of CMB experiments.
After a long and detailed investigation, with many false clues, it seems that the mystery of the curvature of the Universe is now solved. It's an open and shut case: the Universe is flat!

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2010-03-28 21:25:57 -0600

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Remote URLs

pietrobon2010

Needlet bispectrum asymmetries in the WMAP 5-year data (article)

Author

Pietrbon, D. and Cabella, P. and Balbi, A. and Crittenden, R. and de Gasperis, G. and Vittorio, N.

Journal

MNRAS

Year

2010

Volume

402

Pages

L34-L38

Keywords

methods - data analysis, cosmic microwave background, early universe

Abstract

We apply the needlet formalism to the Wilkinson Microwave Anisotropy Probe 5-year data, looking for evidence of non-Gaussianity in the bispectrum of the needlet amplitudes. We confirm earlier findings of an asymmetry in the non-Gaussianity between the Northern and Southern Galactic hemispheres. We attempt to isolate which scales and geometrical configurations
are most anomalous and find that the bispectrum is most significant on large scales and in the more co-linear configurations and also in the `squeezed' configurations. However, these anomalies do not appear to affect the estimate of the non-linear parameter f NL, and we
see no significant difference between its values measured in the two hemispheres

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Remote URLs

rasanen2009

Relation between the isotropy of the CMB and the geometry of the universe (article)

Author

Rasanen, S.

Journal

PhRvD

Year

2009

Volume

79

Pages

123522

Keywords

cosmic microwave background

Abstract

The near isotropy of the cosmic microwave background (CMB) is considered to be the strongest
indication for the homogeneity and isotropy of the Universe, a cornerstone of most cosmological analysis.
We derive new theorems which extend the Ehlers-Geren-Sachs result that an isotropic CMB implies that
the Universe is either stationary or homogeneous and isotropic, and its generalization to the almost
isotropic case. We discuss why the theorems do not apply to the real Universe, and why the CMB
observations do not imply that the Universe would be nearly homogeneous and isotropic.

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Remote URLs

ratra2008

The Beginning and Evolution of the Universe (article)

Author

Ratra, B. and Vogeley, M.S.

Journal

PASP

Year

2008

Volume

120

Pages

235-265

Keywords

cosmology - general, cosmology - theory, cosmic microwave background

Abstract

We review the current standard model for the evolution of the Universe from an early inflationary
epoch to the complex hierarchy of structure seen today. We summarize and provide key references for the following
topics: observations of the expanding Universe; the hot early Universe and nucleosynthesis; theory and observations
of the cosmic microwave background; Big Bang cosmology; inflation; dark matter and dark energy; theory of
structure formation; the cold dark matter model; galaxy formation; cosmological simulations; observations of galaxies,
clusters, and quasars; statistical measures of large-scale structure; and measurement of cosmological parameters.
We conclude with discussion of some open questions in cosmology. This review is designed to provide a
graduate student or other new worker in the field an introduction to the cosmological literature.

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Remote URLs

reichardt2009

High-resolution CMB power spectrum from the complete ACBAR data set

(article)

Author

Reichardt, C.L. and Ade, P.A.R. and Bock, J.J. and Bond, J.R. and Brevik, J.A. and Contaldi, C. and Daub, M.D. and Demsey, J.T. and Goldstein, J.H. and Holzapfel, W.L. and Kou, C.L. and Lange, A.E. and Lueker, M. and Newcomb, M. and Peterson, J.B. and Ruhl, J. and Runyan, M.C. and Staniszewski, Z.

Journal

ApJ

Year

2009

Volume

649

Pages

1200-1219

Month

April

Keywords

cosmic microwave background, cosmology - observations

Abstract

In this paper, we present results from the complete set of cosmic microwave background (CMB) radiation
temperature anisotropy observations made with the Arcminute Cosmology Bolometer Array Receiver (ACBAR)
operating at 150 GHz. We include new data from the final 2005 observing season, expanding the number
of detector hours by 210% and the sky coverage by 490% over that used for the previous ACBAR release.
As a result, the band-power uncertainties have been reduced by more than a factor of two on angular scales
encompassing the third to fifth acoustic peaks as well as the damping tail of the CMB power spectrum. The
calibration uncertainty has been reduced from 6% to 2.1% in temperature through a direct comparison of the
CMB anisotropy measured by ACBAR with that of the dipole-calibrated WMAP5 experiment. The measured
power spectrum is consistent with a spatially flat, ΛCDM cosmological model. We include the effects of weak
lensing in the power spectrum model computations and find that this significantly improves the fits of the models
to the combined ACBAR+WMAP5 power spectrum. The preferred strength of the lensing is consistent with
theoretical expectations. On fine angular scales, there is weak evidence (1.1 σ) for excess power above the
level expected from primary anisotropies. We expect any excess power to be dominated by the combination
of emission from dusty protogalaxies and the Sunyaev--Zel'dovich effect (SZE). However, the excess observed by
ACBAR is significantly smaller than the excess power at $\ell > 2000$ reported by the CBI experiment operating at
30 GHz. Therefore, while it is unlikely that the CBI excess has a primordial origin; the combined ACBAR and
CBI results are consistent with the source of the CBI excess being either the SZE or radio source contamination.

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Remote URLs

rubino-martin2010

Estimating the impact of recombination uncertainties on the cosmological parameter constraints from cosmic microwave background experiments (article)

Author

Rubino-Martin, J.A. and Chluba, J. and Fendt, W.A. and Wandelt, B.D.

Journal

MNRAS

Year

2010

Volume

Online Early

Keywords

cosmic microwave background, cosmology - parameters, cosmology - observations

Abstract

We use our most recent training set for the RICO code to estimate the impact of recombination
uncertainties on the posterior probability distributions which will be obtained from future cosmic microwave background experiments, and in particular the Planck satellite. Using a Monte Carlo Markov Chain (MCMC) analysis to sample the posterior distribution of the cosmological parameters, we find that Planck will have biases of −0.7, −0.3 and −0.4σ for nS,bh2 and log(1010AS), respectively, in the minimal six-parameter cold dark matter model, if the description of the recombination history given by RICO is not used. The
remaining parameters (e.g. τ or dmh2) are not significantly affected. We also show that the cosmology dependence of the corrections to the recombination history modelled with RICO has
a negligible impact on the posterior distributions obtained for the case of the Planck satellite.
In practice, this implies that the inclusion of additional corrections to existing recombination codes can be achieved using simple cosmology-independent `fudge functions'.
Finally, we also investigated the impact of some recent improvements in the treatment of hydrogen recombination which are still not included in the current version of our training set
for RICO, by assuming that the cosmology dependence of those corrections can be neglected.
In summary, with our current understanding of the complete recombination process, the expected biases in the cosmological parameters inferred from Planck might be as large as−2.3,
−1.7 and−1σ for nS,bh2 and log(1010AS), respectively, if all those corrections are not taken into account. We note that although the list of physical processes that could be of importance
for Planck seems to be nearly complete, still some effort has to be put into the validation of the results obtained by the different groups.
The new RICO training set as well as the fudge functions used for this paper are publicly available on the RICO webpage.

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Date-Modified
2010-02-25 10:03:35 -0700
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Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/Rubino-Martın2010.pdf
Remote URLs

sachs1967
Perturbations of a cosmological model and angular variations of the microwave background (article)
Author
Sachs, R.K. and Wolfe, A.M.
Journal
ApJ
Year
1967
Volume
147
Pages
73
Keywords
cosmology - general, cosmic microwave background
Abstract
We consider general-relativistic, spatially homogeneous, and isotropic k=0 cosmological models with either pressure zero or pressure one-third the energy density.

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2010-03-28 21:31:51 -0600
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2010-03-28 21:35:15 -0600
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Volumes/JASON_MAS1/masters_degree/HET625_cosmology_large_scale_structure/essay/references/sachs1967.pdf
Remote URLs

strukov1992
The Relikit-1 experiment - new results (article)
Author
Strukov, I.A. and Brukhanov, A.A. and Skulachev, D.P. and Sazhin, M.V.
Journal
MNRAS
Year
1992
Volume

258

Pages

37-40

Keywords

spacecraft - satellites, cosmic microwave background, cosmology - observations, large-scale structure of universe

Abstract

We present ew results from reduction of data from the space experiment Relikt-1 (investigation of the anisotropy of the cosmic microwave background at 37 GHz).

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2010-05-26 21:35:48 -0600

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Remote URLs

subrahmanyan2000

An Australia Telescope survey for CMB anisotropies (article)

Author

Subrahmanyan, R. and Kesteven, M.J. and Ekers, R.D. and Sinclair, M. and Silk, J.

Journal

MNRAS

Year

2000

Volume

315

Pages

808-822

Keywords

techniques - interferometric, cosmic microwave background, cosmology - observations, radio continuum - general

Abstract

We have surveyed six distinct `empty fields' using the Australia Telescope Compact Array (ATCA) in an ultracompact configuration with the aim of imaging, with a high brightness sensitivity, any arcminute-scale brightness-temperature anisotropies in the background radio sky. The six well-separated regions were observed at a frequency of 8.7 GHz, and the survey regions were limited by the ATCA primary beams which have a full width at half-maximum of 6 arcmin at this frequency; all fields were observed with a resolution of 2 arcmin and an rms thermal noise of 24mJy beam21. After subtracting foreground confusion detected in higher resolution images of the fields, residual fluctuations in Stokes I images are consistent with the expectations from thermal noise and weaker (unidentified) foreground sources; the Stokes Q and U images are consistent with expectations from thermal noise.
Within the sensitivity of our observations, we have no reason to believe that there are any Sunyaev$\pm$Zeldovich holes in the microwave sky surveyed. Assuming Gaussian-form CMB

anisotropy with a `flat' spectrum, we derive 95 per cent confidence upper limits of Qflat , 10$\pm$11 mK in polarized intensity and Qflat , 25 mK in total intensity. The ATCA filter function peaks at l ^ 4700 and has half-maximum values at l ^ 3350 and 6050.

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Remote URLs

tenorio1999

Bigger uncertainties and the Big Bang (article)

Author

Tenorio, L. and Stark, P.B. and Lineweaver, C.H.

Journal

InvPr

Year

15

Number

1999

Pages

329-341

Keywords

cosmic microwave background, cosmology - general

Annote

We use Bayesian hierarchical models and recent results from the theory of minimax confidence interval estimation to study the effect of prior information in a cosmological inverse
problem. We consider the effect of prior information on uncertainty estimates of a linear functional
Lxof an infinite-dimensional modelx, given noisy observations y D Kx+x. The model represents
the cosmic microwave background (CMB), which is the radiation left over from the Big Bang. The
linear functional is related to the important cosmological question of whether theCMBtemperature
varies with direction in the sky; such variation is required by cosmological theories to account for
the observed large-scale heterogeneity of matter and energy in the Universe. Evidence of this
heterogeneity is the non-zero quadrupole term in the CMB detected by the COBE satellite in 1992.
Estimation of the quadrupole is an interesting ill-posed problem that requires more information than
cosmologists expected. Previously published quadrupole estimates relied on constraints such as

artificially truncating the spherical harmonic expansion of the CMB fluctuations, or on modelling
the effect of unestimated high-frequency terms, without accounting for model uncertainty. If these
implicit constraints were relaxed, the uncertainty would be several to dozens of times larger than
reported in the astrophysical literature. We study the dependence of quadrupole estimates to a
series of increasingly stringent constraints. We show that no useful estimates can be obtained from
COBE data without assuming a particular class of prior cosmological models. Even restricting the
spectrum to lie in a two-parameter family of models commonly used in cosmology does not suffice
without positing a prior probability distribution on those two parameters.

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Remote URLs

tomita2008

Second order gravitational effects onCMBtemperature anisotropy indominated flat universes (article)

Author

Tomita, K. and Inoue, K.T.

Journal

PhRvD

Year

2008

Volume

77

Pages

103522

Keywords

cosmic microwave background, cosmology - general

Abstract

We study second order gravitational effects of local inhomogeneities on the cosmic microwave
background radiation in flat universes with matter and a cosmological constant .We find that the
general relativistic correction to the Newtonian approximation is negligible at second order provided that
the size of the inhomogeneous region is sufficiently smaller than the horizon scale. For a

spherically
symmetric top-hat type quasilinear perturbation, the first order temperature fluctuation corresponding to
the linear integrated Sachs-Wolfe effect is enhanced (suppressed) by the second order one for a
compensated void (lump). As a function of redshift of the local inhomogeneity, the second order
temperature fluctuations due to evolution of the gravitational potential have a peak before the matter-
equality epoch for a fixed comoving size and a density contrast. The second order gravitational effects
from local quasilinear inhomogeneities at a redshift z 1 may significantly affect the cosmic microwave
background.

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Remote URLs

tucker1997

Anisotropy in the microwave sky: Results from the first flight of the balloon-borne anisotropy measurement (BAM) (article)

Author

Tucker, G.S. and Gush, H.P. and Halpern, M. and Shinkoda, I.

Journal

ApJ

Year

1997

Volume

475

Pages

L73-L76

Month

February

Keywords

cosmic microwave background, cosmology - observations

Abstract

Results are reported from the first flight of a new balloon-borne instrument, BAM (Balloon-borne Anisotropy
Measurement), designed to search for cosmic microwave background (CMB) anisotropy. The instrument uses a
cryogenic differential Fourier transform spectrometer to obtain data in five spectral channels whose central

frequencies lie in the range 3.7-- 8.5 cm21. The spectrometer is coupled to an off-axis prime focus telescope; the
combination yields difference spectra of two regions on the sky defined by 0$7 FWHM beams separated by 3$6.
Single differences obtained at 10 sky positions show statistically significant fluctuations. Assuming Gaussian
correlated anisotropy, for the band average 3.1--9.2 cm21, one finds DTyT 5 3.121.1 13.1 3 1025 (90% confidence
interval) for a correlation angle of 1$2. This corresponds to Qflat 5 35.926.3 117.7 mK (1 s).

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valenziano1998

APACHE96. CMBR Anisotropy Experiment at Dome C (conference)

Author

Valenziano, L. and Attolini, M.R. and Burigana, C. and Malaspina, M. and Ventura, G. and Villa, F. and Dall'Oglio, G. and Pizzo, L. and Cosimi, R. and Miriametro, A. and Martinis, L. and Piccirillo, L. and Bersanelli, M. and Morgante, G.

Booktitle

Astrophysics From Antartica

Year

1998

Editor

Novak, G. and Landsberg, R.H.

Volume

141

Pages

81

Organization

ASP

Series

ASP Conference Series

Keywords

cosmic microwave background, cosmology - observations

Abstract

We describe a new experiment devoted to measure the CMBR anisotropies at millimetric wavelengths.

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Remote URLs

wilson1979

The cosmic microwave background radiation (article)

Author

Wilson, R.W.

Journal

RvMP

Year

1979

Volume

51

Number

3

Pages

433

Keywords

cosmic microwave background

Abstract

Radio astronomy has added greatly to our understanding of the structure and dynamics of the universe.

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Remote URLs

wolfe1969

Discrete source models to explain the microwave background radiation (article)

Author

Wolfe, A.M. and Burbidge, G.R.

Journal

ApJ

Year

1969

Volume

156

Pages

345

Keywords

cosmic microwave background, cosmology - general

Abstract

Using the homogeneous and isotropic, spatially flat Friedmann and steady-state world models we consider the background radiation generated by a cosmic population of intense sources.

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Remote URLs

yamazaki2010

New constraints on the primordial magnetic field (article)

Author

Yamazaki, D.G. and Ichiki, K. and Kajino, T. and Mathews, G.J.

Journal

PhRvD

Year

2010

Volume

81

Pages

023008

Keywords

cosmic microwave background, cosmology - general, cosmology - parameters

Abstract

We present the newest statistical and numerical analysis of the matter and cosmic microwave background power spectrum with effects of the primordial magnetic field (PMF) included. New limits to the PMF strength and power spectral index are obtained based upon the accumulated data for both the matter and CMB power spectra on small angular scales. We find that a maximum develops in the probability distribution for a magnitude of the PMF of jB┌j ¼ 0:85 ┌ 1:25ð┌1┐Þ nG on a comoving scale of at 1 Mpc, corresponding to upper limits of <2:10 nG (68% CL) and <2:98 nG (95% CL). While for the power spectral index we find nB ¼ ┐2:37þ0:88 ┐0:73ð┌1┐Þ, corresponding to upper limits of < ┐ 1:19 (68% CL) and < 0:25 (95% CL). This result provides new constraints on models for magnetic field generation and the physics of the early universe. We conclude that future observational programs for the CMB and matter power spectrum will likely provide not only upper limits but also lower

limits to the PMF
parameters.

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2010-02-25 10:06:03 -0700

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