ABSTRACTS FOR CONTRIBUTED TALKS
DESY Theory Workshop
28 Sept.–1 Oct. 2004

1. Leptogenesis and dark matter from a sneutrino condensate

Rouzbeh Allahverdi

TRIUMF, 4004 Wesbrook Mall, Vancouver, B.C., V6T 2A3 Canada

We explore the possibility that the decay of a right-handed sneutrino condensate can be the source of leptogenesis and gravitino dark matter. It is shown that the dark matter abundance can be obtained for gravitinos in the mass range 1 MeV-10 GeV, provided that the decay temperature of the condensate is below 10^6 GeV. Low-scale soft leptogenesis is preferred among different leptogenesis mechanisms for the success of scenario.

Related papers: —

2. Cosmic star formation history and supernova relic neutrinos

Shin'ichiro Ando

Department of Physics, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

We investigate the flux, event rate, and future implications of supernova relic neutrinos (SRNs), especially to the cosmic star formation history. In the detection energy range $E_e > 10$ MeV, which will possibly be a background-free region in the near future, the SRN event rate is found to be 1–2 yr^{-1} at a water Cerenkov detector with a fiducial volume of 22.5 kton, depending on the adopted neutrino spectrum. We simulate the expected signal with one set of the reference models by using the Monte Carlo method and then analyze these pseudodata with several free parameters, obtaining the distribution of the best-fit values for them. In particular, we use a parameterization such that $R_{\mathrm{SN}}(z) = R^0_{\mathrm{SN}}(1+z)^\alpha$, where $R_{\mathrm{SN}}(z)$ is the comoving supernova rate density at redshift z and R^0_{SN} and α are free parameters. The obtained 1σ errors for these two parameters are found to be $\delta\alpha/\langle\alpha\rangle = 30\%$ (7.8%) and $\delta R^0_{\mathrm{SN}}/\langle R^0_{\mathrm{SN}}\rangle = 28\%$ (7.7%) for a detector with an effective volume of 22.5 kton $\times$ 5 yr (440 kton $\times$ 5 yr), where one of the parameters is fixed. On the other hand, if we fix neither of the values for these two parameters, the expected errors become rather large, $\delta\alpha/\langle\alpha\rangle = 37\%$ and $\delta R^0_{\mathrm{SN}}/\langle R^0_{\mathrm{SN}}\rangle = 55\%$, even with an effective volume of 440 kton $\times$ 5 yr.

Related papers: astro-ph/0401531

3. Is There a Peccei-Quinn Phase Transition?

Alexey Anisimov

MPI Physik, Munich, Germany

The nature of axion cosmology is usually said to depend on whether the Peccei-Quinn (PQ) symmetry breaks before or after inflation. The PQ symmetry itself is believed to be an accident, so there is not necessarily a symmetry during inflation at all. We explore these issues in some simple models, which provide examples of symmetry breaking before and after inflation, or in which there is no symmetry during inflation and no phase transition at all. One effect of these observations is to relax the constraints from isocurvature fluctuations due to the axion during inflation. We also observe new possibilities for evading the constraints due to cosmic strings and domain walls, but they seem less generic.

Related papers: —

4. Influence of quintessence on structure formation

Sepehr Arbabi Bidgoli

Institute for Studies in Theoretical Physics and Mathematics, Iran, Tehran, P.O.Box 19395-5531

Recently a simple parametrization scheme for the contribution of a time-variable dark energy term to cosmological dynamics was proposed by C. Wetterich (astro-ph/0403289). Here we discuss the dependence of the processes of cosmological structure formation on the deviation from a pure Λ-term, expressed by $w_0 \neq -1$ and the fraction of early dark energy Ω_e. In particular we give numerical solutions for the evolution of density perturbations δ and we present a numerical fit for $dln(a)/dln(\delta)$ which relates the peculiar velocity field to local density contrast. Also we calculate the dynamical growth of underdensity regions in a background universe where a quintessence term is present. These regions correspond to voids in the galaxy distribution observed in redshift surveys.

Related papers: —

5. Cosmology with time-varying constants

Florian Bauer

Physik-Department T30d, James-Franck-Straße, 85748 Garching, Germany

We study cosmological solutions where the cosmological constant and the gravitational constant depend on time. The time variation of other constants is also considered.

Related papers: —

6. Low-scale leptogenesis and soft SUSY breaking

Lotfi Boubekeur

Physics Department, Lancaster University, Lancaster LA1 4YB, UK

We investigate the possibility of low-scale leptogenesis in the minimal supersymmetric standard model extended with right handed (s)neutrinos. We demonstrate that successful leptogenesis can be easily achieved at a scale as low as $\sim$ TeV where lepton number and CP violation comes from soft supersymmetry breaking terms. The scenario is shown to be compatible with neutrino masses data.

Related papers: hep-ph/0404038

7. Monoenergetic photons from annihilating KK dark matter.

Torsten Bringmann

Department of Physics, Stockholm University AlbaNova University Center, SE-10691 Stockholm, Sweden

In models with so-called universal extra dimensions the extra dimensions are compactified on an orbifold. As a result, the lightest Kaluza-Klein excitation (LKP) is cosmologically stable and provides an interesting dark matter candidate. We consider here the astrophysical signatures of such a possibility. In particular, we calculate the (loop-suppressed) direct annihilation into photons. Detection possibilities seem promising for the next generation's detectors, providing a possible smoking gun signature for such dark matter candidates.

Related papers: Work in progress

8. Dark energy, non-linear perturbations and structure formation

Carsten van de Bruck

Department of Applied Mathematics, The University of Sheffield, Hounsfield Road, Hicks Building, Sheffield S3 7RH, UK

Non-linear cosmological perturbations and their role in dark energy cosmologies are discussed. After a brief review of the results of first and second order perturbation theory, the results of the spherical collapse model is given. The results imply that (mildly non-linear) perturbations in the dark energy component might not be negligible and have some effect on the formation of galaxies and clusters of galaxies. I will summarize possible observational consequences.

Related papers: astro-ph/0401504, to appear in Astronomy and Astrophysics

9. Patch cosmology and (non)commutative braneworlds

Gianluca Calcagni

Dipartimento di Fisica, Università di Parma, Parco Area delle Scienze 7/A, 43100 Parma, Italy

We review extra-dimensional and 4D cosmological scenarios through an effective Friedmann equation on a brane. Some features involving noncommutative geometry and scalar/tachyon slow-roll inflation are considered.

Related papers: hep-ph/0402126, hep-th/0406006, hep-ph/0406057, astro-ph/0407543 and unpublished UPRF preprints

10. Brane gas cosmology with fluxes

Antonio Campos

Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg, Germany

Brane gas cosmology provides a dynamical decompactification mechanism inspired by string theory for explaining the number of spacetime dimensions we observe today. In this talk I will discuss the role of the gauge sector of supergravity theories in this cosmological scenario.

Related papers: Phys. Lett. B 586 (2004) 133 (hep-th/0311144) and work in progress

11. Low-energy effective action of a Gauss-Bonnet brane world

Nicolas Chatillon

Service de Physique Théorique, CEA/Saclay—Orme des Merisiers, F-91191 Gif-sur-Yvette Cedex, France

We consider the low energy effective action of a warped brane world model where matter is confined on a 4d brane while Einstein-Hilbert-Gauss-Bonnet gravity propagates in a 5d curved bulk ; curvature terms on the branes are also considered. The results differs from the Randall-Sundrum effective gravity.

Related papers: —

12. Axino CDM confronts the CMSSM

Laura Covi

CERN, Theory Unit — Physics Deptartment, CERN, 1211 Geneva 23, Switzerland

We describe the scenario of an axino LSP and CDM candidate and discuss its consequences for the CMSSM parameters space, in particular highlighting the difference with the neutralino CDM case.

Related papers: hep-ph/0402240

13. Phantom cosmologies

Mariusz P. Dabrowski

Institute of Physics, University of Szczecin, Wielkopolska 15, 70-451 Szczecin, Poland

Some basic properties of the phantom ($p < -\rho$) cosmological models are going to be studied. In particular, phantom duality and phantom oscillations are to be discussed. The imposition of the phantom matter on the brane and its consequences for observations will be studied. Finally, the relations to superstring and cyclic models are going to be investigated.

Related papers: hep-th/0307128, astro-ph/0210156 and work in progress

14. On signature change in cosmology

Farhad Darabi

Department of Physics, Azarbaijan University of Tarbiat Moallem, Tabriz, 53714-161, Iran

The problem of signature change in cosmology is investigated in the context of a spontaneous symmetry breaking scenario. It is shown that, given a Higgs type scalar field potential over a manifold, one may introduce a structure including an internal vector N_μ and a metric $\mathcal{G}_{\mu\nu}$ which is degenerate everywhere before symmetry breaking and becomes non-degenerate, with Euclidean and Lorentzian signatures separated by a degenerate hypersurface, once the symmetry breaking begins. A time asymmetric law is introduced to prefer the Lorentzian metric as the real metric of the world.

Related papers: —

15. Signatures of supersymmetry from ultra high energy cosmic rays

Anindya Datta

INFN, Sezione di Roma, Dip. di Fisica, Universita La Sapienza, Piazzale Aldo Moro 2, I-00185, Roma, Italy

We discuss signatures in the underground detectors coming from the interactions of ultra-high-energy (UHE) neutralinos arising in top-down models of UHE cosmic rays.

Related papers: —

16. SUSY seesaw, leptogenesis and lepton flavor violation at linear colliders

Frank Deppisch

Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany

We study lepton flavor violating slepton production and decay at a future linear collider in the context of the SUSY seesaw model in minimal supergravity scenarios. Furthermore,

the possibility to measure mSUGRA atypical slepton mass differences is investigated. We correlate these signals with lepton flavor violating rare decays and seesaw leptogenesis.

Related papers: hep-ph/0310053

17. Indirect signals from light neutralinos

Fiorenza Donato

INFN and University of Torino, via Giuria 1, 10125 Torino, Italy

We examine indirect signals produced by neutralino self-annihilations, in the galactic halo or inside celestial bodies, in the frame of an effective MSSM model without gaugino-mass unification at a grand unification scale. We compare our theoretical predictions with current experimental data of gamma-rays and antiprotons in space and of upgoing muons at neutrino telescopes. Results are presented for a wide range of the neutralino mass, though our discussions are focused on light neutralinos. We find that only the antiproton signal is potentially able to set constraints on very low-mass neutralinos, below 20 GeV. The gamma-ray signal, both from the galactic center and from high galactic latitudes, requires significantly steep profiles or substantial clumpiness in order to reach detectable levels. The up-going muon signal is largely below experimental sensitivities for the neutrino flux coming from the Sun; for the flux from the Earth an improvement of about one order of magnit ude in experimental sensitivities (with a low energy threshold) can make accessible neutralino masses close to O, Si and Mg nuclei masses, for which resonant capture is operative.

Related papers: hep-ph/0401186 (PRD in press)

18. Absorption dips: Detection of the cosmic neutrino background

Birgit Eberle

DESY, Notkestr. 85, 22607 Hamburg, Germany

Annihilation of extreme high energy cosmic neutrinos on cosmic background anti-neutrinos (or vice versa) at the Z-resonance leads to sizable dips in the neutrino flux to be observed at Earth. The high-energy edges of these dips are fixed, via the resonance energies, by the neutrino masses alone. Their depths are determined by the cosmic neutrino background density, by the cosmological parameters determining the expansion rate of the universe, by the large redshift history of the cosmic neutrino sources and the steepness of the energy injection spectrum. We find that, with the presently planned neutrino detectors (ANITA, Auger, EUSO, OWL, RICE, and SalSA) operating in the relevant energy regime above 10^{21} eV, the detection of the cosmic neutrino background by measuring absorption dips becomes a realistic possibility. It requires, however, the existence of extremely powerful neutrino sources, which should be opaque to nucleons and high-energy photons to evade present constraints. Furthermore, the neutrino mass spectrum must be quasi-degenerate to optimize the dip, which implies $m_\nu \gtrsim 0.1$ eV for the lightest neutrino. With a second

generation of neutrino detectors, these demanding requirements can be relaxed considerably.

Related papers: hep-ph/0401203

19. 500 GeV Neutralinos and Extragalactic Background Radiation

Dominik Elsässer

Universität Würzburg Institut für Theoretische Physik und Astrophysik, Am Hubland, D-97074 Würzburg

In models with so-called universal extra dimensions the extra dimensions are compactified on an orbifold. As a result, the lightest Kaluza-Klein excitation is cosmologically stable and provides an interesting dark matter candidate. We investigate the gamma ray signal from various annihilation processes of KK particles and compare this with supersymmetric dark matter scenarios.

Related papers: astro-ph/0405235 and astro-ph/0405347

20. Gamma rays from annihilating KK dark matter

Martin Eriksson

Department of Physics, Stockholm University, AlbaNova University Center, SE-10691 Stockholm, Sweden

In models with so-called universal extra dimensions the extra dimensions are compactified on an orbifold. As a result, the lightest Kaluza-Klein excitation is cosmologically stable and provides an interesting dark matter candidate. We investigate the gamma ray signal from various annihilation processes of KK particles and compare this with supersymmetric dark matter scenarios.

Related papers: —

21. Defletions of UHECRs in extra galactic magnetic fields

Dario Grasso

Scuola Normale Superiore, P.zza Dei Cavalieri, 7, I-56126 Pisa, Italy

We performed simulations of extra galactic magnetic fields in the nearby universe under the assumption that they are the outcome of an MHD amplification process which started from a magnetic seed generated at high redshift. These simulations succeed reproducing Faraday rotation measurements in galaxy clusters and provides new clues on the intensity and geometrical structure of magnetic fields in low density regions like filaments, sheets and voids. We construct associated maps of deflections of protons under the action of the Lorentz force at energy ... (*something missing by transmission error*).

Related papers: astro-ph/0310902

22. Baryogenesis from the quark-gluon plasma physics

Dmitri Grigoriev

NUI Maynooth, Ireland

Recent developments in the quark-gluon plasma physics can be relevant way beyond the usual QCD phenomena at heavy ion collisions. We show that due to the non-Abelian Landau-Pomeranchuk-Migdal effect the decay products of superheavy particles (e.g. inflatons) provide a very efficient local superheating of the primaeval plasma in the early Universe. If such decays are sufficiently active just after the electroweak phase transition, a reasonably large baryon asymmetry can be generated.

Related papers: hep-ph/0310100

23. Neutrino effects in a supernova mantle with strong magnetic field

Alexander Gvozdev

Dept. of Theor. Physics, Yaroslavl State University, Sovietskaya 14, 150000 Yaroslavl, Russia

The problem of a successful SN explosion with collapse of a central part is still far from its solution. It is obvious that such factors as a rotation of collapsar, an effect of strong magnetic fields and a heating of a stalled shock wave by neutrino flux should be taken into account. In particular, at present time the convectional (C. Thompson et al., 2001; H.-T. Janka et al., 1999, 2001) and rotational (S. Balbus and J. Hawley, 1991, 1999) magnetohydrodynamic instabilities in the SN mantle are the subjects of intensive investigations. Such instabilities could result in a generation of the strong smallscale magnetic fields in which novel processes become kinematically opened. In particular, such a process as $\nu_i \to \nu_i e^+ e^-$ $(i = e, \mu, \tau)$ can play an important role in a heating of the stalled shock wave in the framework of the neutrino-driven mechanism (H. Bethe and J. Wilson, 1985) and be competitive with the direct URCA process when the field strength is $\gtrsim 10^{15}$. In the framework of the magnetorotational model of a SN explosion (G. Bisnovatyi-Kogan, 1971) the effects of the parity violation in neutrino–nucleon processes are discussed. It is shown, that neutrinos transfer to medium a sufficiently large net momentum along the direction of the magnetic field. Thus, a part of the mantle with the strong toroidal magnetic field spins-up in one hemisphere and spins-down in the other one of the SN remnant. We discuss the connection of this phenomenon with the possibility of a one-side SN explosion and anomalously large kick velosities of the SN remnant.

Related papers: —

24. Sneutrino LSP and gravitino problem

Koichi Hamaguchi

DESY, Theory Group, Notkestrasse 85, Lab. 2a, D-22603 Hamburg, Germany

If the lightest supersymmetric particle (LSP) is the sneutrino, its thermal relic abundance exceeds the current bounds from direct dark matter search unless the pair annihilation

cross section is significantly enhanced. Hence, most of the models predicting sneutrino LSP are already excluded, even if sneutrino makes up only fractional part of dark matter. As a by-product, a scenario with the gravitino decaying only into sneutrino and neutrino, as a solution to the gravitino problem, is also disfavored. This scenario can be consistent if thermal abundance of sneutrino is significantly suppressed. Even in this case, however, sneutrinos are produced nonthermally by gravitino decay, leading to an upper bound on reheating temperatures.

Related papers: Work in progress

25. Hybrid inflation with a U(1) gauge symmetry

Jan Hamann

DESY, Notkestr. 85, 22603 Hamburg, Germany

I will present a U(1)-symmetric hybrid inflation model and analyse the decay of the false vacuum for different values of the parameters. Also, I shall discuss the effect of the gauge sector on the dynamics of the model.

Related papers: Work in progress with Laura Covi (CERN)

26. The power spectrum of SUSY-CDM on sub-galactic scales

Stefan Hofmann

Department of Physics, Stockholm University, AlbaNova University Center, SE-106 91 Stockholm, Sweden

The formation of large scale structure is independent of the nature of the cold dark matter (CDM), however the fate of very small scale inhomogeneities depends on the micro-physic of the CDM particles. We investigate the matter power spectrum for scales that enter the Hubble radius well before matter-radiation equality, and follow its evolution until the time when the first inhomogeneities become non-linear. Our focus lies on weakly interacting massive particles (WIMPs) and as a concrete example we analyze the case when the lightest supersymmetric particle is a bino. We show that collisional damping and free-streaming of WIMPs lead to a matter power spectrum with a sharp cut-off at about 10^{-6} solar masses and a maximum close to that cut-off. We also calculate the transfer function for the growth of the inhomogeneities in the linear regime. These three effects (collisional damping, free-streaming and gravitational growth) are combined to provide a WMAP normalized primordial CDM power spectrum, which could serve as an input for high resolution CDM simulations. The smallest inhomogeneities typically enter the non-linear regime at a redshift of about 60.

Related papers: astro-ph/0309621

27. Towards a renomalizable Standard Model with a composite Higgs scalar

Jörg Jäckel

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We investigate the possibility of constructing a renormalizable standard model with purely fermionic matter content. The Higgs scalar is replaced by point-like fermionic self-interactions with couplings growing large at the Fermi scale. An analysis of the UV behavior in the point-like approximation reveals a variety of non-Gaussian fixed points for the fermion couplings. If real, such fixed points would imply nonperturbative renormalizability and evade triviality of the Higgs sector. For point-like fermionic self-interactions and weak gauge couplings, one encounters a hierarchy problem similar to the one for a fundamental Higgs scalar.

Related papers: hep-ph/0312034

28. Exorcising $w < -1$

Nemanja Kaloper

University of California, Department of Physics, Davis, CA 95616, USA

We show that the combined dimming of Type Ia supernovae induced by both a cosmological constant and the conversion of photons into axions in extra-galactic magnetic fields can impersonate dark energy with an equation of state $w < -1$. An observer unaware of the presence of photon-axion conversion would interpret the additional dimming as cosmic acceleration faster than that induced by a cosmological constant alone. We find that this mechanism can mimic pressures as negative as $w \simeq -1.38$. Our model does not have any ghosts, phantoms and the like. It is fully consistent with the conventional effective field theory in curved space. We also show that in this case some of the observational constraints on the axions are relaxed.

Related papers: —

29. Cosmic background neutrinos from core-collapse supernovae

Manoj Kaplinghat

University of California, Department of Physics, Davis, CA 95616, USA

Related papers: —

30. Dynamical CP violation from early universe

Balaji Katlai Rangaswamy

McGill University, Department of Physics, Rutherford Physics Building, 3600 University Street, McGill University, Montreal, PQ, Canada H3A2T8

Based on a proposal by Dolgov, we show that the asymmetrical dynamical evolution of fields in the early Universe provides a new source for CP violation. This can lead to baryogenesis without any additional CP-violating interactions. The magnitude of this CP violation is time-dependent. In particular, it vanishes (or is very small) in the late Universe after the fields have relaxed (or are in their final approach) to their vacuum values. We provide an explicit model realization for this mechanism.

Related papers: —

31. Gravireggeons in extra dimensions and interactions of cosmic neutrinos with nucleons

Alexandre Kisselev

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The results on non-perturbative gravity effects, related to extra spatial dimensions which can be comparable with (or larger than) the SM contributions, are presented. The case of cosmic neutrino gravitational interaction with atmospheric nucleons is considered in detail.

Related papers: hep-ph/0311356 (to be published in EPJC

32. Isospin-3/2 and -1/2 resonances in one pion electro- and neutrinoproduction

Olga Lalakulich

Theoretische Physik III, Dortmund Universität 44221 Dortmund, Germany

One pion neutrinoproduction is one of the processes occuring at neutrino interaction with nuclear targets at SBL and LBL neutrino experiments, which dominantes at neutrino energies about 1GeV. Cross sections for one pion electro- and neutrinoproduction are calculated within the framework of the isobar model. Besides the leading contribution from P33(1232) resonace, the following isospin-1/2 resonances are taken into acount: P11(1440), D13(1520), S11(1535). The results are compared with the existing experimental data.

Related papers:

33. Non-Abelian gravitating solitons with negative cosmological constant

George Lavrelashvili

Department of Theoretical Physics, A. Razmadze Mathematical Institute, M. Aleksidze 1, GE-0193 Tbilisi, Georgia

Static, spherically symmetric solutions in the Einstein-Yang-Mills theory with the negative cosmological constant are discussed. Combination of numerical and analytical methods lead to a clear picture of the 'moduli space' of the solutions. Different aspects and in particular the stability of the asymptotically AdS solutions are discussed. Regions with any number of 'topological' ('sphaleron') and 'gravitational' instabilities are identified in the moduli space. While for Bartnik-McKinnon solutions there is always a non-vanishing equal number of instabilities of both types, this degeneracy is lifted for asymptotically AdS solutions and there exist stable solutions, genuine sphalerons with exactly one unstable mode and so on. The boundaries of these regions are determined.

Related papers: Classical and Quantum Gravity, **21** (2004) 1667-1683

34. Bounds on the reheating temperature from dilaton destabilization

Oleg Lebedev

DESY Theory Group, 22603 Hamburg, Germany

Finite temperature effects have a destabilizing action on the dilaton. At high temperature, the dilaton runs away to an unphysical vacuum. This constrains the reheating temperature of the early universe (10^{11} GeV), as well as inflationary models.

Related papers: hep-th/0404168

35. Spontaneous compactifications as self-tuning the cosmological constant

Hyun Min Lee

Physikalisches Institut der Universität Bonn, Nussallee 12, D-53115 Bonn, Germany

We explore solutions of six dimensional gravity coupled to a non-linear sigma model in the presence of co-dimension two branes. We find compactifications induced by a scalar spherical manifold, being finite volume and free of singulairities. We discuss the self-tuning features of these brane solutions.

Related papers: hep-th/0407208

36. Radiating Braneworlds

Emily Leeper

Institute of Cosmology and Gravitation, Mercantile House, Hampshire Terrace, Portsmouth University, Portsmouth PO1 2EG, UK

A class of exact solutions for a radiating braneworld model is presented and discussed. The affects of asymmetry on this type of model is also demonstrated.

Related papers: gr-qc/040808

37. A Brane model with two asymptotic regions

Musongela Lubo

The Abdus Salam International Centre for Theoretical Physics (ICTP), P.O.Box 586, 34100 Trieste, Italy

Some brane world models rely on a generalization of the Melvin magnetic universe. We argue that the geometric interpretation of Kip. S. Thorne of this geometry restricts the kind of potential a complex scalar field can display to keep the same asymptotic behavior. While a finite energy is not obtained for an ordinary Higgs field in this interpretation, this is the case for a potential displaying a broken phase and an unbroken one. We use for technical simplicity and illustrative purposes an ad hoc potential which however shares some features with those obtained in some supergravity models. We construct a sixth dimensional cylindrically symmetric solution which has two asymptotic regions: the Melvin-like metric on one side and a flat space displaying a conical singularity on the other. The causal structure of the configuration is discussed, the possibilty of localizing fermionic fields on the brane analyzed.

Related papers: Preprint to appear shorly

38. Recent developments in second order cosmological perturbation theory

Karim Malik

Physics Department, Lancaster University, Lancaster LA1 4YB, UK

I will briefly outline how to construct gauge-invariant cosmological perturbations up to second order. I will then illustrate the method by giving a simple example, relevant for testing models of structure formation in the very early universe.

Related papers: astro-ph/0307055

39. Cosmological gravitational instability with compactification

Johannes Martin

University of Toronto, 60 St. George St., Toronto M5S 1A7, Ontario, Canada

Gravitational dynamics of perturbations around the FRW geometry is one of the pillar of cosmology. Cosmology based on the modern theories with higher dimensions shall also embrace the problem of perturbations around the outer FRW space/compact inner space geometry. I will outline the progress towards this theory developed in our group at CITA. The starting point will be the physical spectrum of perturbations of compactifications to four dimensional de Sitter space, which is a good approximation to an early stage of inflation and late time universe dominated by dark energy. Generic to de Sitter compactifications is a gravitational instability in the scalar sector of perturbations. This was seen numerically in simulations (hep-th/0309001) and understood analytically (hep-th/0309002). The non-perturbative asymptotics of the instability are understood as well. I show possibilities to lift the tachyonic mode and construct stable compactifications. It requires stabilizing bulk scalar fields or form fluxes. The perturbations of the additional ingredients mix non-trivially with the gravitational perturbations (hep-th/0401189) leaving a distinct signature for observations/phenomenology in cosmology and particle physics.

Related papers: hep-th/0309001, hep-th/0401189 and work in progress

40. Supernova neutrino physics with a megaton detector

Alessandro Mirizzi

Dipartimento di Fisica, Università degli Studi di Bari, Via Amendola 173, 70126 Bari, Italy

Future detection of supernova neutrino bursts by large underground detectors will provide us with important information on the core-collapse explosion mechanism and on neutrino properties. In this context, we investigate the discovery potential of a possible future water-Cherenkov Megaton detector in: (1) Studying model-independent signatures of the shock-wave propagation in the time and energy domain. (2) Observing the neutronization and accretion neutrino bursts and thus testing explosion models. (3) Seeing pre-supernova neutrino signals during the silicon burning phase and thus "foreseeing" SN collapse. (4) Detecting signals from extragalctic supernovae and from supernova relic neutrinos.

Related papers: Work in progress with G. L. Fogli, E. Lisi, and D. Montanino; to appear as a preprint.

41. Neutrino decay and the supernova relic neutrino background

Daniele Montanino

Università degli Studi di Lecce, Dipartimento di Scienza dei Materiali, via Arnesano, 73100 Lecce, Italy

If neutrinos are massive they can also decay. After a brief review on the present limits on visible and invisible neutrino decay, we show how it is possible to (dis)prove invisible

long life neutrino decay by means of the detection of the neutrinos coming from all past supernovae.

Related papers: hep-ph/0401227

42. Cosmic acceleration and extra dimensions: Constraints on modifications of the Friedmann equation

Tuomas Multamaki

NORDITA, Blegdamsvej 17, DK-2100 Copenhagen, Denmark

An alternative to dark energy as an explanation for the present phase of accelerated expansion of the Universe is that the Friedmann equation is modified, e.g. by extra dimensional gravity, on large scales. We explore a natural parametrization of a general modified Friedmann equation, and find that the present supernova type Ia and cosmic microwave background data prefer a correction of the form $1/H$ over a cosmological constant. We also explore the constraints that can be expected in the future, and find that there are good prospects for distinguishing this model from the standard cosmological constant to very high significance if one combines supernova data with a precise measurement of the matter density.

Related papers: astro-ph/0404402

43. Cosmic neutrino oscillations triggered by dark energy

Heinrich Päs

Institut für Theoretische Physik, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

We consider neutrinos with varying masses which arise in scenarios relating neutrino masses to the dark energy density in the universe. We point out that the neutrino mass variation can lead to level crossing and thus a cosmo MSW effect, having dramatic consequences for the flavor ratio of astrophysical neutrinos and the composition of the relic neutrino background.

Related papers: astro-ph/0311131

44. Extended Quintessence with an exponential coupling

Valeria Pettorino

Università Federico II Napoli, via Cintia, Complesso di Monte Sant'Angelo, Napoli, Italy

We investigate the cosmological effects arising in scalar field dark energy scenarios when an explicit coupling exists between the field and the Ricci scalar in the fundamental Lagrangian. We focus on couplings with exponential shape, as suggested in string/dilatonic scenarios, characterized by important variations of the effective gravitational constant at relevant cosmological epochs. Such scenarios have never been considered in the general context of linear cosmological perturbation theory in scalar-tensor cosmology. We first

study the trajectories of the field, consisting of an early phase (R-boost) dominated by the effective gravitational potential and of a late, tracking phase in which the field imprints cosmic acceleration. Then we investigate the effects on the cosmic microwave background anisotropies and density power spectrum, emphasising the geometric projection on the acoustic peaks and the Integrated Sachs-Wolfe.

Related papers: —

45. Curvaton scenario with low scale inflation

Marieke Postma

ICTP, Strada costiera 11, 34100 Trieste, Italy

In the curvaton scenario not the inflaton field is responsible for the observed density perturbations, as is traditionally assumed, but some other field—the curvaton field. In the post inflationary universe the curvaton comes to dominate the energy density and its primordial perturbation gets imprinted on the space-time metric. In its simplest form the curvaton paradigm requires the Hubble parameter during inflation to be bigger than 10^8 GeV, but this bound may be evaded in non-standard settings. In the heavy curvaton scenario the curvaton mass increases significantly after the end of inflation. We analyze the bound in this set up, taking into account the upper bound on the curvaton mass from direct decay. We will show that it is possible to lower the bound on the inflationary scale in principle, but it may be difficult in practice.

Related papers: astro-ph/0403213

46. Gauge couplings at high temperature and the relic gravitino abundance

Michael Ratz

DESY, Notkestrasse 85, D-22603 Hamburg, Germany

At temperatures above a critical temperature T_*, which depends on the supersymmetry breaking mass scales, gauge couplings decrease like $T^{-\alpha}$, $\alpha > 1$. This has important cosmological consequences. In particular it leads to a relic gravitino density which becomes independent of the reheating temperature for $T_R > T_*$.

Related papers: —

47. Local Structures in a cosmological background with cosmological constant

Nematollah Riazi and M.R. Bordbar

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We investigate the structure and evolution of local spherical structures in a cosmological background with cosmological constant. Calculations are performed in the framework of

GR, with a generalized time-dependent, spherically symmetric, asymptotically RW metric, supported by an anisotropic fluid with a general equation of state.

Related papers: —

48. Astrophysical probes of quantum gravity

Alexander Sakharov

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The reconciliation of general relativity and quantum field theory in a true quantum theory of gravity remains elusive. In such a theory the vacuum presumably needs to be treated as a dynamical medium—a space-time foam which can violate Lorentz invariance and the principle of equivalence as well. We discuss possible manifestations of space-time foam using observations of gamma-ray bursts. In particular applying wavelet transforms to gamma ray bursts light curves with known redshifts we are able to establish the most model independent limit on a possible violation of Lorentz invariance. Finally we comment on the interpretation of the constraint on quantum gravity provided by synchrotron radiation from the Crab Nebula.

Related papers: "Synchrotron radiation and quantum gravity" by J. Ellis , N. E. Mavromatos, D. V. Nanopoulos and A. S. Sakharov, Nature 428 (2004)

49. Probing extra dimensions with gravitational waves

Sergey Solodukhin

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We study the propagating gravitational waves as a tool to probe the extra dimensions. The higher-dimensional corrections to the purely four-dimensional law of propagation then are not exponentially suppressed (as it is so in the case of static configurations described by the Newton's law) but have a power law. This makes the waves more convenient tool for the search of the manifestations of the extra dimensions. We make a number of certain predictions for the behavior of the gravitational signal that are specifically due to the signal propagation through the extra dimension. So that it might be possible to discover the extra dimensions by just looking at the sky through the "gravitational telescope".

Related papers: hep-th/0307011

50. The end of the dark ages in MOND

Slawomir Stachniewicz

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We study the evolution of a spherically symmetric density perturbation in the Modified Newtonian Dynamics (MOND) model applied to the net acceleration over Hubble flow. The

background cosmological model is a Λ-dominated, low-Ω_b Friedmann model with no Cold Dark Matter. We include thermal processes and non-equilibrium chemical evolution of the collapsing gas. We find that under these assumptions the first low-mass ($M \leq 3 \times 10^4 M_\odot$) objects may collapse as soon as for $z \sim 30$ what is in a quite good agreement with recent WMAP results. Lower value of a_0 would lead to much slower collapse of such objects.

Related papers: —

51. Axinos as Dark Matter in the Universe

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The axino is the fermionic superpartner of the axion. Assuming the axino is the lightest supersymmetric particle and stable due to R-parity conservation, we compute the relic axino density from thermal reactions in the early Universe. From the comparison with the WMAP results, we find that thermally produced axinos could provide the dominant part of cold dark matter, for example, for an axino mass of 100 keV and a reheating temperature of 10^6 GeV.

Related papers: hep-ph/0405158, hep-ph/0406021

52. Electroweak-scale inflation, inflaton-Higgs mixing and the scalar spectral index

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Electroweak-scale inflation is a necessary ingredient of recent models of electroweak baryogenesis. Moreover, it is interesting to see if minimal extensions of the Standard Model (SM) of particle physics can lead to inflation, and what constraints the SM physics then puts on such a model. Next to the SM and baryogenesis constraints there are the ones coming from the cosmic microwave background, and we find that the WMAP constraint on the scalar spectral index is difficult to satisfy for low-scale inflation models. To illustrate our points we present a specific model that satisfies all constraints. The inflaton-Higgs coupling in this model leads to the falsifiable prediction of two types of scalar particles with decay widths similar to that of the SM Higgs.

Related papers: hep-ph/0404128

53. Scanning the Space of Observables

Pascal Vaudrevange

Canadian Institute for Theoretical Astrophysics CITA, University of Toronto 60 St. George Street Toronto, Ontario CANADA M5S 3H8

We propose a new method to scan the $(n_s, r, dn/d\log k)$ space of observables of inflationary models using an expansion of the Hubble parameter $H(N)$ in terms of Chebyshev polynomials. We demonstrate that the space of allowed models is wide open in the (r, n) plane. To lowest order in slow roll, our results apply to models with arbitrary numbers of scalar fields.

Related papers: –

54. From heaviness to lightness: quantum fluctuations of a scalar field with time dependent mass during inflation

Filippo Vernizzi

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Quantum fluctuations of fields which are light during inflation are very important as are thought to be the origin of primordial perturbations in the universe. These can be generated directly by the inflaton field or by a lighter field, the so called curvaton. I study the quantum fluctuations of a scalar field whose effective mass is varying during inflation, due to the coupling to other fields. I discuss its spectrum and I present a model where effects in the primordial perturbations could be observed.

Related papers: —

55. Can dark energy evolve to the Phantom?

Alexander Vikman

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Dark energy with the equation of state $w(z)$ rapidly evolving from the dust like ($w \simeq 0$ at $z \sim 1$) to the phantom like ($-1.2 \lesssim w \lesssim -1$ at $z \simeq 0$) has been recently proposed as the best fit for the supernovae Ia data. Assuming that a dark energy component with an arbitrary scalar-field Lagrangian $p(\varphi, \nabla_\mu\varphi)$ dominates in the flat Friedmann universe, we analyze the possibility of a dynamical transition from the states $(\varphi, \dot{\varphi})$ with $w \geq -1$ to those with $w < -1$ or vice versa. We have found that generally such transitions are physically implausible because they are either realized by a discrete set of trajectories in the phase space or are unstable with respect to the cosmological perturbations. This conclusion is confirmed by a comparison of the analytic results with numerical solutions obtained for simple models. Without the assumption of the dark energy domination, this result still holds for a certain class of dark energy Lagrangians, in particular, for Lagrangians quadratic in $\nabla_\mu\varphi$. The result is insensitive to topology of Friedmann universe as well.

Related papers: astro-ph/0407107

56. Creation of particles in a tunneling universe

Sergei Winitzki

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We examine the particle production during tunneling in quantum cosmology. We consider a minisuperspace model with a massive, conformally coupled scalar field and a uniform radiation background. In this model, we construct a semiclassical wave function describing a small recollapsing universe and a nucleated inflating universe ("tunneling from something"). We find that the quantum states of the scalar field in both the initial and the nucleated universe are close to the adiabatic vacuum, the number of created particles is small, and their backreaction on the metric is negligible. We show that the use of the semiclassical approximation is justified for this wave function. Our results imply that the creation of the universe from nothing can be understood as a limit of tunneling from a small recollapsing universe.

Related papers: gr-qc/0305025

57. Gravitational clustering of relic neutrinos and implications for their detection

Yvonne Wong

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We study the gravitational clustering of relic neutrinos onto cold dark matter halos, using numerical simulations as well as approximate semi-analytical methods. We discuss also some possible methods for detecting these neutrinos.

Related papers: hep-ph/0408241

58. Dark matter and the baryon asymmetry of the universe

Gabrijela Zaharijas

New York University

A mechanism to generate the baryon asymmetry of the Universe which preserves the net baryon number created in the Big Bang is presented. If dark matter particles carry baryon number B_X, and $\sigma_{\bar{X}}^{\rm annih} < \sigma_X^{\rm annih}$, the $\bar{X}$'s freeze out at a higher temperature and have a larger relic density than X's. If $m_X \lesssim 4.5\, B_X$ GeV and the annihilation cross sections differ by $\mathcal{O}(10\%)$ or more, this type of scenario naturally explains the observed $\Omega_{DM} \approx 5\,\Omega_b$. The talk also focuses on Dark Matter constraints applicable to the dark matter with (anti)baryon number, such as low mass DM searches in the detectors on the Earth and the constraints on the DM annihilation against nucleons from the released Internal Heat of Uranus.

Related papers: —