

Ibericos2009. Program

	Thursday 16	Friday 17
9:00 – 9:20	Inscription	
9:20 – 9:40	Welcome	“The impact of the matter density uncertainty on the dark energy reconstruction”, Pedro P. Avelino
9:40 – 10:00	“First MCMC lessons on cosmography”, Ruth Lazkoz	"Measurement of a large scale flows with clusters of galaxies", Fernando Atrio-Barandela
10:00 – 10:20	“Varying constants and fundamental physics”, Carlos Martins	“The evolution of cool core clusters”, Joana Santos
10:20 – 10:40	“Electromagnetic nature of dark energy”, Antonio L. Maroto	“Fractal distribution of matter in the MareNostrum Universe”, J. Gaité
10:40 – 11:20	Coffee break	
11:20 – 11:40	“Cosmic Parallax, Gaia and Real-Time Cosmology”, Miguel Quartín	“Is Lambda really there?”, Juan García-Bellido
11:40 – 12:00	“Exact scalar field cosmologies: a unified approach”, José Pedro Mimoso	“Large Non Gaussianity in two-component hybrid inflation”, Ki Young Choi
12:00 – 12:20	“Large-scale cosmic flows and moving dark energy”, Jose Beltrán	“Preheating in the Standard Model of Particle Physics”, Daniel G. Figueroa
12:20 – 12:40	“DBI models for the unification of dark matter and dark energy”, Irene Sendra	“Cosmological Perturbations in a new type of Generalised Chaplygin Gas”, Pedro Frazão
12:40 – 15:00	Lunch	
15:00 – 15:20	“Gravitational wave astronomy for the new millennium”, Victor Cardoso	“Conformal invariance and the multiverse”, Jaume Garriga
15:20 – 15:40	“New Directions in Numerical Relativity”, Helvi Wittek	“The quantum state of the multiverse”, Salvador Robles-Pérez

15:40 – 16:00	“Separating expansion from contraction and generalizing TOV condition in spherically symmetric models with pressure”, Morgan Le Delliou	“Covariant Effective Action for Loop Quantum Cosmology a la Palatini”, Gonzalo J. Olmo
16:00 – 16:30	Coffee break	
16:30 – 16:50	“Big Rip Avoidance Via Black Holes Production”, Diego Pavón	“Noncommutative Quantum Mechanics”, Catarina Bastos
16:50 – 17:10	“Quantum defrost of the big freeze singularity”, Mariam Bouhmadi López	“Dynamical Stability of Y-junctions in Cosmic Strings”, Gustavo Niz
17:10 – 17:30	“Singularities in Loop Quantum Cosmology”, Antonio Cardoso	“Is the CMB cold spot a gate to extra dimensions?”, Alvaro de la Cruz-Dombriz
17:30 – 18:15	Round table: <u>Mariam Bouhmadi López</u>	Round table: <u>José M. M. Senovilla</u>

All the talks are of equal length (15+5 minutes).

Wireless connection

SSID: INVITADOS

PASSWORD: 4HA7n8PUBvgi1XC2

Computer room

C/ Serrano, 121, 2nd floor, office 208

Ibericos2009. Talks and abstracts

Talk title: "Measurement of a large scale flows with clusters of galaxies"

Name: Fernando Atrio-Barandela (atrio@usal.es)

Abstract: Peculiar velocities of galaxies, derived using distance estimators, are plagued with systematic effects and are unreliable beyond 100Mpc/h. Kashlinsky & Atrio-Barandela (2000) proposed to measure peculiar velocities of clusters of galaxies using the temperature anisotropies on the Cosmic Microwave Background generated by the hot X-ray emitting. Using this technique we have recently found a bulk flow velocity of amplitude 600-1000 km/s in the same direction as the CMB dipole and encompassing a sphere of 300Mpc/h radius. We shall discuss the cosmological implications of this measurement.

Talk title: " The impact of the matter density uncertainty on the dark energy reconstruction."

Name: Pedro Pina Avelino

Abstract: I will discuss the impact of the fractional matter density uncertainty in the reconstruction of the equation of state of dark energy considering both standard reconstruction methods, based on the dynamical effect that dark energy has on the expansion of the Universe, as well as non-standard methods, in which the evolution of the dark energy equation of state with redshift is inferred through the variation of fundamental couplings such as the fine structure constant, α , or the proton-to-electron mass ratio, μ . I will also briefly discuss other fundamental questions which need to be answered if varying couplings are to be successfully used to probe the nature of the dark energy.

Talk title: " Noncommutative Quantum Mechanics "

Name: Catarina Bastos (cbastos@fisica.ist.utl.pt)

Abstract: We address the phase space formulation of a noncommutative extension of quantum mechanics in arbitrary dimension, displaying both spatial and momentum noncommutativity. By resorting to a covariant generalization of the Weyl-Wigner transform and to the Seiberg-

Witten map we construct an isomorphism between the operator and the phase space representations of the extended Heisenberg algebra. This map provides a systematic approach to derive the entire structure of noncommutative quantum mechanics in phase space. We construct the extended starproduct, Moyal bracket and propose a general definition of noncommutative states. We study the dynamical and eigenvalue equations of the theory and prove that the entire formalism is independent of the particular choice of Seiberg-Witten map. Our approach unifies and generalizes all the previous proposals for the phase space formulation of noncommutative quantum mechanics. For concreteness we rederive these proposals by restricting our formalism to some 2-dimensional spaces.

Talk title: " Large-scale cosmic flows and moving dark energy "

Name: Jose Beltrán (jobeltra@fis.ucm.es)

Abstract: Large-scale matter bulk flows with respect to the cosmic microwave background have very recently been detected on scales 100 Mpc/h and 300 Mpc/h by using two different techniques showing an excellent agreement in the motion direction. However, the unexpectedly large measured amplitudes are difficult to understand within the context of standard LCDM cosmology. In this work we show that the existence of such a flow could be signaling the presence of moving dark energy at the time when photons decoupled from matter. We also comment on the relation between the direction of the CMB dipole and the preferred axis observed in the quadrupole in this scenario.

Talk title: " Singularities in Loop Quantum Cosmology "

Name: Antonio Cardoso (antonio.cardoso@port.ac.uk)

Abstract: We show that simple scalar field models can give rise to curvature singularities in the effective Friedmann dynamics of Loop Quantum Cosmology (LQC). We find singular solutions for spatially flat Friedmann-Robertson-Walker cosmologies with a canonical scalar field and a negative exponential potential, or with a phantom scalar field and a positive potential. While LQC avoids big bang or big rip type singularities, we find sudden singularities where the Hubble rate is bounded, but the Ricci curvature scalar diverges. We conclude that the effective equations of LQC are not in themselves sufficient to avoid the occurrence of singularities.

Talk title: " Gravitational wave astronomy for the new millennium "

Name: Victor Cardoso

Abstract: These are exciting times for gravitational wave research: current detectors are working at design sensitivity and theoretical waveforms are now known very accurately. The first direct detection of gravitational waves, Einstein's 100 year-old prediction, is expected to take place in the near future. I will describe the new challenges lying ahead in the field and the potential of this new field to answer fundamental questions.

Talk title: " Large Non Gaussianity in two-component hybrid inflation "

Name: Ki Young Choi (kiyoung.choi@uam.es)

Abstract: Non-Gaussianity in cosmic microwave background is a crucial observable which can discriminate among a lot of inflation models. In this talk I show the two-field hybrid inflation model which may generate a large non-Gaussianity during slow-roll inflation generally characterised by a large f_{NL} , τ_{NL} and a small g_{NL} . For certain parameter values we can satisfy $\tau_{NL} \gg f_{NL}^2$. The bispectrum is of the local type but may have a significant scale dependence. I also include the effect of the waterfall field, which can lead to a significant change in the observables after the waterfall field is destabilised, depending on the couplings between the waterfall and inflaton fields.

Talk title: " Is the CMB cold spot a gate to extra dimensions?"

Name: ALVARO DE LA CRUZ-DOMBRIZ (DOMBRIZ@FIS.UCM.ES)

Abstract: One of the most striking features found in the cosmic microwave background data is the presence of an anomalous Cold Spot in the temperature maps made by the Wilkinson Microwave Anisotropy Probe (WMAP). This Cold Spot has been interpreted as the result of the presence of a collapsing texture, perhaps coming from some early universe Grand Unified Theory phase transition. In this work we propose an alternative explanation based on a completely different kind of texture which appears in a natural way in a broad class of brane-world models. This type of textures known as brane-skyrmions can be understood as holes in the brane which make possible to pass through them along the extra-dimensional space. The typical scales needed for the proposed brane-skyrmions to correctly describe the observed Cold Spot can be as low as the electroweak scale.

Talk title: " Preheating in the Standard Model of Particle Physics "

Name: Daniel G. FIGUEROA (daniel.figueroa@uam.es)

Abstract: We study the details of the production of all the matter in the Universe during ReHeating, just after inflation. In particular, in the

context of a model in which the Higgs field of the Standard Model (SM) is non-minimally coupled to Gravity, we can compute the distribution of energy among all the species of the SM that are produced during reheating.

Talk title: " Cosmological Perturbations in a new type of Generalised Chaplygin Gas."

Name: Pedro Frazão (pedrofraz@gmail.com)

Abstract: We propose a new early scenario for the Universe where there is a smooth transition between an early de Sitter-like phase which is followed by a radiation dominated era. In this model, the matter content is modelled either by a scalar field or a new modified generalised Chaplygin gas. Such a description is similar in spirit to that introduced by Kamenshchik et al. to unify the dark sectors of the universe. We study the scalar and tensorial cosmological perturbations - density perturbations and gravitational waves, respectively - generated by quantum fluctuations of the scalar field. In particular, we calculate the gravitational wave power spectrum, as would be measured today, following the method of the Bogoliubov coefficients. We show that the high frequencies range of the spectrum depends strongly on one of the parameter of our new model. This fact is of great relevance because of high frequencies limits that one should pursuit in the new era of gravitational waves detectors.

Talk title: " Fractal distribution of matter in the MareNostrum Universe "

Name: Jose Gaité (jose.gaité@upm.es)

Abstract: Galaxy surveys and cosmological simulations provide evidences of a fractal distribution of matter. I introduce the fundamentals of the fractal description of large scale structure and present the results of a fractal analysis of the output of a recent large simulation of the evolution of dark matter and gas with the MareNostrum supercomputer.

Talk title: " Is Lambda really there?"

Name: Juan García-Bellido (juan.garciabellido@uam.es)

Abstract: La distribución de materia que observamos a nuestro alrededor hasta distancias de cientos de Megaparsecs es muy inhomogénea, con estructuras enormes como los supercúmulos y los supervacios. Hoy en día se cree que dicha distribución surgió a partir de fluctuaciones cuánticas primordiales generadas en el Universo primitivo, durante un proceso de expansión acelerada llamado Inflación. Dichas fluctuaciones se han observado en forma de pequeñas anisotropías en la temperatura del fondo de radiación de microondas, y están de acuerdo con las predicciones de inflación. La materia oscura y la materia ordinaria caen en los pozos de potencial generados por dichas fluctuaciones y forman, por colapso gravitacional, las galaxias y los cúmulos de galaxias. Según el paradigma inflacionario, ciertas fluctuaciones inusuales podrían dejar

grandes vacios en la distribución de materia, que se corresponderían con estructuras inmensas, más allá de lo observado por los recientes catálogos de galaxias. Si se confirma que habitamos uno de estos enormes vacíos, podríamos explicar la disminución en el brillo de las supernovas lejanas sin necesidad de incluir la misteriosa energía oscura, cuyas propiedades desafían nuestra intuición. Afortunadamente, en un futuro próximo podremos descartar estas teorías alternativas, gracias a nuevos catálogos de galaxias que exploran el universo profundo hasta escalas del Gigaparsec.

Talk title: " Conformal invariance and the multiverse"

Name: Jaume Garriga (garriga@cosmos.phy.tufts.edu)

Abstract: We explore the idea that the dynamics of the inflationary multiverse is encoded in its future boundary, where it is described by a lower dimensional theory which is conformally invariant in the UV. We propose that a measure for the multiverse, which is needed in order to extract quantitative probabilistic predictions, can be derived in terms of the boundary theory by imposing a UV cutoff. In the inflationary bulk, this is closely related to the so-called scale factor cutoff measure.

Talk title: " First MCMC lessons on cosmography"

Name: Ruth Lazkoz

Abstract:

Talk title: " Separating expansion from contraction and generalizing TOV condition in spherically symmetric models with pressure."

Name: Morgan Le Delliou (Morgan.LeDelliou@uam.es)

Abstract: We investigate spherically symmetric solutions with pressure and discuss the existence of a dividing shell separating expanding and collapsing regions. We perform a 3+1 splitting and obtain gauge invariant conditions relating not only the intrinsic spatial curvature of the shells to the ADM mass, but also a function of the pressure which we introduce and that generalises the Tolman-Oppenheimer-Volkov equilibrium condition. We also analyse particular cases like the Lemaitre-Tolman dust models with a cosmological constant as an example of a Λ -CDM model. These models provide simple, but physically interesting illustrations of our results.

Talk title: " Electromagnetic nature of dark energy "

Name: Antonio L. Maroto (maroto@fis.ucm.es)

Abstract: We show that the presence of a temporal electromagnetic field on cosmological scales generates an effective cosmological constant which can account for the accelerated expansion of the universe. Primordial electromagnetic quantum fluctuations produced during electroweak scale inflation could naturally explain the presence of this field and also the measured value of the dark energy density. The theory is compatible with all the local gravity tests, and is free from classical or quantum instabilities. Thus we see that, not only the true nature of dark energy can be established without resorting to new physics, but also the value of the cosmological constant finds a natural explanation in the context of standard inflationary cosmology. This mechanism could be discriminated from a true cosmological constant by upcoming observations of CMB anisotropies and large scale structure.

Talk title: "Varying constants and fundamental physics"

Name: Carlos Martins (Carlos.Martins@astro.up.pt)

Abstract: Spectroscopic studies that require extreme wavelength precision need customized wavelength calibration procedures beyond that usually supplied by the standard data reduction pipelines. An example of such studies is the measurement of the values of the fundamental constants at early times in the universe. I will report on recent progress in this direction, and present results of new measurements of the electron-to-proton mass ratio. Time permitting I will also comment on some implications of these and other results for Equivalence Principle tests and dark energy phenomenology, and describe some future European-wide initiatives in this area.

Talk title: " Exact scalar field cosmologies: a unified approach. "

Name: José Pedro Mimoso (jpmimoso@cii.fc.ul.pt)

Abstract: We present a mechanism that generates the exact solutions of scalar field cosmologies in an unified way. This applies both to standard and phantom scalar fields in the framework of Einstein's General Relativity, and to extended scenarios based on generalized gravity theories such as Scalar-Tensor theories. The existence of form-invariant dualities between the solutions is also discussed.

Talk title: " Quem defrost of the big freeze singularity"

Name: Paulo Moniz (prlvmoniz@gmail.com)

Abstract: TBA.

Talk title: " Dynamical Stability of Y-junctions in Cosmic Strings"

Name: Gustavo Niz (gustavo.niz@nottingham.ac.uk)

Abstract: Trilinear vertices of macroscopic strings are allowed in different stringy models, providing new observational predictions from cosmic string networks. For example, in cosmic superstring models these Y-shaped junctions are the results of a composite formed by fundamental strings and D 1-branes which split into their basic elements. Moreover, even in the simplest Abelian gauge models one can also obtain Y-junctions for a sufficiently small gauge boson mass. Therefore, these composite are favoured energetically but their dynamical stability remains uncertain. Following the evolution of a simple configuration with Y-junctions, we show there are two possibilities: either the Y-junctions are stable or they split into multiple junctions. Our results are based on comparing Nambu-Goto and field theory simulations.

Talk title: " Covariant Effective Action for Loop Quantum Cosmology a la Palatini."

Name: Gonzalo J. Olmo (olmo@iem.cfmac.csic.es)

Abstract: In loop quantum cosmology, non-perturbative quantum gravity effects lead to the resolution of the big bang singularity by a quantum bounce without introducing any new degrees of freedom. Though fundamentally discrete, the theory admits a continuum description in terms of an effective Hamiltonian. I will describe an algorithm to obtain the corresponding effective action, establishing in this way the covariance of the theory for the first time. This result provides new insights on the continuum properties of the discrete structure of quantum geometry and opens new avenues to extract physical predictions such as those related to gauge invariant cosmological perturbations.

Talk title: " Big Rip Avoidance Via Black Holes Production"

Name: Diego Pavón (diego.pavon@uab.es)

Abstract: We consider a cosmological scenario in which the expansion of the Universe is dominated by phantom dark energy and black holes which condense out of the latter component. The mass of black holes decreases via Hawking evaporation and by accretion of phantom fluid but new black holes arise continuously whence the overall evolution can be rather complex. We study the corresponding dynamical system to unravel this evolution and single out scenarios where the big rip singularity does not occur.

Talk title: "Cosmic Parallax, Gaia and Real-Time Cosmology"

Name: Miguel Quartin

Abstract: Refined astrometry measurements allow us to detect large-scale deviations from isotropy through real-time observations of changes in the angular separation between sources at cosmic distances. This "cosmic parallax" effect is a powerful consistency test of FRW metric and may set independent constraints on cosmic anisotropy. We apply this novel general test to LTB void-model cosmologies with off-center observers and show that future satellite missions such as Gaia might achieve accuracies that would put limits on the off-center distance which are competitive with CMB dipole constraints. We finish with a discussion on the new field of Real-Time.

Talk title: "The quantum state of the multiverse."

Name: Salvador Robles-Pérez (salvarp@imaff.cfmac.csic.es)

Abstract: We analyze the quantum state of a many-universe system, made up of homogeneous and isotropic universes, which are filled with a perfect fluid. This many-universe system can describe either a multiverse made up of parent universes or a space-time foam formed by popping baby universes. Both cases will be briefly presented. Moreover, it will be shown that the quantum states involved at a quantum mechanical multiverse whose single universes are accelerated are given by squeezed states having no classical analogs.

Talk title: "The evolution of cool core clusters."

Name: Joana Santos (jsantos@oats.inaf.it)

Abstract: Galaxy clusters are important astrophysical laboratories and cosmological probes. While a good understanding of the present day cluster population is emerging, our knowledge on distant clusters and the cosmological implications of their properties is still sparse. Galaxy clusters are filled with hot, X-ray emitting gas, the intracluster medium (ICM). The physical processes that govern the behavior of the ICM are complex and include non gravitational phenomena. Cool cores (CCs) are a manifestation of these intricate processes. In the local Universe, CCs dominate the cluster population with a fraction of about 70%. The study of the formation and evolution of cool cores bears implications on the use of galaxy clusters as cosmological probes. In this talk I present our investigation on the abundance of CCs in the most distant sample (redshift $z=[0.7-1.4]$) currently available in the archive of the CHANDRA X-ray observatory. We find that, in this redshift regime, the majority of the clusters are in an intermediate state of cooling. This is consistent with the hierarchical formation scenario, in which these systems are relatively young and therefore did not have the time to develop a strong cool core. This is the first study on the detection and characterization

of CCs in the most distant clusters currently known. This result has an impact on the evolution of the ICM of clusters and our observational results can be used as an input to cosmological simulations to constrain models of cluster formation and evolution.

Talk title: " DBI models for the unification of dark matter and dark energy."

Name: Irene Sendra (irene_sendra@ehu.es)

Abstract: We propose a model based on a DBI action for the unification of dark matter and dark energy. This is supported by the results of the study of its background behaviour at early and late times, and reinforced by the analysis of the evolution of perturbations. We also perform a Bayesian analysis to set observational constraints on the parameters of the model using type Ia SN, CMB shift and BAO data. Finally, to complete the study we investigate its kinematics aspects, such as the effective equation of state parameter, acceleration parameter and transition redshift. Particularizing those parameters for the best fit one appreciates that an effective phantom is preferred.

Talk title: " New Directions in Numerical Relativity"

Name: Helvi Witek (helvi.witek@ist.utl.pt)

Abstract: We will give an overview about achievements in numerical relativity throughout the last years including recent breakthroughs and results. The major part of the presentation will be adressed to our work in progress on numerical simulations of black hole binaries in non-asymptotically flat spacetimes. We will show first test results.
