Introduction to Workshop

Reuven Opher

In this introductory talk, I will discuss briefly what I consider to be some of the major challenges, both theoretical and observational of new physics in space.

I. BLACK HOLES (BHs)

- How were the BHs at the center of galaxies formed?
- Did primordial BHs form?
- Can we observe the primordial BHs?
- Can we observe BHs at the center of galaxies?
- Can we observe the spin of a BH?
- Can we extract energy from a rotating BH?
- Does BH evaporation cease when the mass of an evaporating BH approaches the Planck mass?
- Can we observe the BHs and gravitons, predicted by extra dimension theories?

II. EVOLUTION OF GALAXIES

- What is the explanation for the close correlation between:
  1-the central BH mass;
  2-the bulge mass;
  3-the central virial velocity; and
  4-the bulge luminosity?
- What is the explanation for the observed intensive stellar formation near central BHs?
- Mergers imply the creation of galaxies that have two BHs at an average separation ~ pc at their centers. Can we observe the predicted ejection of stars in the region < pc?

III. THE PRIMORDIAL UNIVERSE AND DARK ENERGY (DE)

- Are the primordial and present accelerations of the Universe both due to the vacuum energy produced by one-loop quantum fluctuations?
- Is the primordial and present acceleration of the Universe due to the Casimir vacuum energy of a compactified extra dimension □ 100 μ?

IV. DARK MATTER (DM)

- What is the distribution of sub-halos of DM in the halo of our galaxy?
- What is the large scale distribution of DM?
- The galaxy distribution fluctuation spectrum should follow the DM fluctuation spectrum. What is the ratio of the two spectra?
- Do we now have definite evidence that DM is not simply baryon matter with a modified law of gravity?

V. ASTROPARTICLES – UHECR

- Are UHE photons ($E \sim 10^{20}$ eV) damped by strong galactic and extragalactic magnetic fields (~ μG)?
- Are UHECR produced by rapidly rotating BHs?

VI. GRAVITATIONAL WAVES (GWs)

• How close are we to detecting directly GWs?
• Can we use GWs to study fundamental physics, such as:
  1-QCD (quantum chromodynamics) in the cores of neutron stars; and
  2-DE with GW standard candles?
• Can we increase the sensitivity of GW detectors from GRBs (gamma ray bursts), using the coincidence of the GWs with the emitted gamma rays?

VII. COSMIC MICROWAVE BACKGROUND (CMB)

• Can we determine accurately the primordial GWs in the CMB (B-Mode) and, therefore, the ratio of GW tensor modes to density fluctuation scalar modes?
• Can we detect primordial magnetic fields with the CMB?

VIII. PLASMA ASTROPHYSICS

• How are highly collimated jets from AGNs formed?
• Is the origin of the reionization of the Universe at z~10 due to
  1-radiation from first stars; or
  2-primordial magnetic fields?
• Can we determine the intergalactic magnetic field from the UHECR scattering data?

IX. THE TOPOLOGY OF THE UNIVERSE

• Is there a connection between:
  1-the north-south asymmetry of the CMB;
  2-alignmente of the low multipoles of the CMB; and
  3-the topology of the Universe?

SESSION I

Dark Matter

E.W. Kolb
The University of Chicago, U.S.A.

Observations suggest that most of the matter in the universe is some dark non-baryonic material. After a very brief review of the evidence for dark matter, I will talk about some possible dark matter candidates, and concentrate on the prospects for detection of WIMP (weakly interacting massive particle) dark matter at accelerators, in low-background direct-detection experiments, and from signals of their annihilation in astronomical objects.

What we know, and don't know, about the Origin of High Energy Cosmic-Rays (UHECRs)

E. Waxman
Weizmann Inst. of Science, Israel

The sources and the acceleration mechanism of UHECRs, cosmic-rays with energies exceeding 10^{19} eV are unknown, and for many years have been the issue of much debate. In the first part of this lecture, the main constraints that are implied by UHECR observations on the properties of candidate UHECR sourceswill be described, and the main open questionswill be identified. In the second part of the lecture, the contribution ofhigh energy neutrino detectors to the effort of addressing these questions will be discussed. It will be shown that these detectors may play a key role in the near future in resolving the main open questions, and that the detection of high energy neutrinos from extra-Galactic sources will not only provide constraints on the identity and underlying physics of UHECR sources, but may furthermore provide information on fundamental neutrino properties.

Measuring the Properties of the Milky Way Halo with Dark Matter Directional Detection

Daniele S.M. Alves, Sonia El Hedri, Jacob Wacker
Stanford University / SLAC

In the case of a positive signal in dark matter direct detection experiments, directional information may be able constraint significantly the dark matter particle properties and its local velocity distribution. I will discuss how using stability arguments such as the Jeans Theorem, one might infer the global velocity profile, and consequently, the dark matter density profile of the Milky Way halo.

POSTERS OF SESSION I

Painel 01

Constraints on Astrophysical Variables of the SGR1806-20

Rafael Alves Batista
IFGW/UNICAMP

A giant flare from the Soft Gamma-Ray Repeater SGR 1806-20 was observed on December 27th, 2004. The radiation mechanism of the flare initial peak is controversial. In this work, we use data from Pierre Auger Observatory to estimate the upper limit for the flux of neutrons coming from the direction of the SGR 1806-20 in coincidence with the giant flare. We also use this result to constrain kinematic variables related to the initial mechanism of the flare. Our results combined with the absence of neutrinos in AMANDA data favor scenarios of a small baryon content in the initial stage of the flare.

Painel 02

Combined Bounds in MaVaNs Models

Daniel Francisco Boriero (UNICAMP), Pedro Cunha de Holanda

Mass Varying Neutrinos (MaVaNs) models couples the neutrino with a scalar field in such way that neutrino mass become variable. These models have been used separately to explain both cosmological coincidence through a tracking mechanism as well as oscillation among flavours through a additional matter effect besides standard MSW effect. We developed a special model which is applicable to explain both effects and we extracted some combined bounds from cosmological data and also from oscillation measured in solar and terrestrial neutrinos.

Painel 03

How well can we Measure the Deceleration Parameter from H(z) Data

Joel C. Carvalho (UFRN - ON/MCT) and Jailson S. Alcaniz (ON/MCT)

The currently on going project at the Atacama and SALT telescopes is expected to measure the Hubble parameter for thousands of objects with an accuracy between 15% and 3%. In this work we investigate the possibility to determine the dynamical behavior of the Hubble flow in a totaly model independent fashion, based on the future (incoming) data. To this end, we use Monte Carlo simulation based on the ΛCDM model to generate samples with different characteristics and calculate the deceleration parameter. We conclude that a reliable value of q(z) can be achieved depending the method used to recover H(z) from determinations of galaxy age.

Painel 04

Calibration of the Synchrotron Emission Map of the Radio Telescope Gem Using the Absolute Temperature Data of the ARCADE 2 Experiment

Chinaglia M. and Wuensche C.A. (INPE)

The motivation of this work is to produce a map of synchrotron emission at 2.3 GHz with signal/noise optimized using data from GEM experiment (Galactic Emission Mapping) in order to assist the separation process of foregrounds in the data analysis of Cosmic Microwave Background (CMB). Our goal is to calibrate the maps of synchrotron emission produced with the telescope GEM with temperature measurements (total intensity) of the ARCADE 2 experiment (Absolute Radiometer for Cosmology, Astronomy and Diffuse Emission). Data will be used in the GEM 2.3 GHz and in ARCADE 2 frequencies of 3 GHz, 8 GHz and 10 GHz. The ARCADE 2 has two channels of observation for each frequency, used to produce average temperature maps that have been combined into a synthetic map of 2.3 GHz. Then degrade the maps GEM (resolution ~ 2 degrees) for the resolution of the ARCADE 2 (resolution of ~ 11 degrees) and studied the differences between the two maps. We will generated histograms, maps combined (using templates of 408 MHz Haslam and 23 GHz WMAP 7 years), comparative maps of spectral index in the frequencies of interest (2.3 GHz, 3 GHz, 8 GHz and 10 GHz) and histograms of the regions in common between the two maps. Those results will be used to produce a new synchrotron emission template and apply it to produce a map type ILC (Internal Linear Combination) of the CMB.

SESSION II

The Promise of Gravitational Waves

M.C. Miller
University of Maryland, U.S.A.

Within the next few years, ground-based gravitational wave detectors will be operating at a sensitivity that is expected to reveal tens of binary compact object mergers per year. This will open up a new era in astrophysics and fundamental physics, which will enable precision tests of general relativity in strong gravity as well as telling us entirely new things about stellar evolution, dynamics, and the properties of neutron stars and black holes. I will discuss the basics of gravitational radiation and the most likely sources, from the expected compact binaries to speculative but exciting sources such as lumpy neutron stars, supernovae, and a background from the early universe.

The Precessing Jet in the Core of NGC 1275 (3C84)

Zulema Abraham & Danilo Teixira (IAG/USP), Anderson Caproni (UNICSUL)
Diego Falceta-Gonçalves (EACH/USP)

NGC 1275 is a giant elliptical galaxy at the center of the Perseus cluster of galaxies. It is associated to a strong radio source (3C84) and presents X-ray emission that extends well into the intergalactic medium. The X-ray maps present multiple misaligned pairs of cavities, some of them coincident with maxima in the radio emission, which had been interpreted as bubbles inflated by a precessing radio jet. Falceta-Gonçalves et al. (2010, ApJ 713, L74) using 3D hydrodynamical simulations found that bubbles can be formed only under some restricted precession conditions, and proposed that the Bardeen-Peterson effect could be responsible for the torques driving this precession. In the present work we study the radio structure expected from a jet precessing according to this process and obtain the precession parameters that are compatible with both the radio image and the inflation of the X-ray bubbles. Using other properties of the radio galaxy, like bolometric luminosity and mass of the central black hole, we were also able to put limits on the rotation rate of the black hole.

Effects of Large-Scale Inhomogeneities on Supernova Data Analysis

Luca Amendola, Kimmo Kainulainen, Valerio Marra, Miguel Quartin (IF/UFRJ)

We reanalyze the supernovae data from the Union Compilation including the weak lensing effects caused by inhomogeneities. We compute the lensing probability distribution function for each background solution described by the parameters Ω_M, Ω_L and w in the presence of inhomogeneities, approximately modeled with a single-mass population of halos. We then perform a likelihood analysis in the space of FLRW-parameters and compare our results with the standard approach. We find that the inclusion of lensing can move the best-fit model significantly towards the cosmic concordance of the flat LCDM model, improving the agreement with the constraints coming from the cosmic microwave background and baryon acoustic oscillations.

Closing the Loop of Gravitational Arcs

M. Makler
CBPF

Gravitational arcs may provide powerful probes of the mass distribution in galaxies and galaxy clusters, allowing us to constrain properties of the Dark Matter and baryonic processes in the lenses. However, statistical studies are hindered by the low number of strong lensing systems know to date and by the systematics involved in arc statistics and in inversion methods. The number of arcs will increase by about an order of magnitude with the upcoming next generation wide field surveys, such as the Dark Energy Survey (DES). Now a significant effort has to be devoted to control the systematics. First, the arc-finding methods must be characterized and optimized and their selection functions determined. Second, the robustness of arc inversion methods has to be tested in order to determine which quantities are really constrained by the arcs and to establish realistic error bars. To these ends, realistic simulations are needed at the image level. Only an end-to-end approach will allow for a more complete understanding of the systematics: starting with a lens model, simulating arcs in images, running arc-finders, using lens inversion methods to recover the mass distributions, and finally comparing the output to the input models. We are developing some tools to close this loop, which will be reported in this contribution. In particular we will describe arc simulations that are being performed for DES and preliminary analyses on these simulated images. We will also present preliminary results on two arc surveys currently under way that can be seen as a preparation for the upcoming DES data: the SOAR Gravitational Arc Survey (SOGRAS) and the CFHT Stripe-82 Survey (CS82).

POSTERS OF SESSION II

Painel 05

Origin of the Magnetic Fields in the GRB Afterglow Region

Gustavo Rocha da Silva, Rafael S.de Souza & Reuven Opher (IAG/USP)

The downstream magnetic field, implied by afterglow observations in GRBs, is higher than that of the upstream field (~ μG), by a factor ~ 10^6. Observations indicate that the magnetic field in the downstream region must remain high over distances 10^{10} δ, where δ is the plasma skin depth. Electromagnetic instabilities are believed to create magnetic fields, however only on the order of δ. In this paper we suggest the creation of seed magnetic fields in the afterglow region. We evaluate the magnitude of the spontaneous magnetic field fluctuations in the downstream region as predicted by the Fluctuation-Dissipation Theorem. Magnetic fluctuations as high as 10^{-2}G could be produced. These seed fields could be amplified by rotation and turbulence that exist in the GRB jets to the implied values up to ~G values.

Painel 06

Gravitational Arcs in the Perturbative Approach: Application to the Pseudo-Elliptical Navarro-Frenk-White Model and Limits of Validity

Habib S. Dúmet-Montoya[1], Gabriel Caminha[1], Mandeep S. Gill[2], Martin Makler[1]
[1] LIneA -- ICRA -- Brazilian Center for Physics Research
[2] The Ohio State University and SLAC National Accelerator Laboratory

Most studies involving gravitational arcs are performed using ray-tracing methods that can be time consuming, hindering the exploration of the large parameter space of lens and source properties and the cosmological model. Recently, Alard (2007) proposed a perturbative approach for tangential arcs using an approximate solution around the Einstein ring. This method may have a wide range of applications, from generating fast arc simulations to the inverse problem of determining the mass distribution from the arcs. In this work, we present a comparison between the Perturbative Approach and the fully numerical solution, aiming to determine the domain of validity of this semi-analytic modeling. We apply the two implementations of the perturbative approach (Alard 2007, 2008) to the Pseudo-Elliptical Navarro-Frenk-White (PNFW) lens model. We obtain the tangential caustic and critical curves as function of the lens parameters, as well as the images of elliptical sources. The contours of the arcs are presented and analyzed for different combinations of lens and source parameters and their properties (such as length and width) are compared to the numerical solution provided by the gravlens code (Keeton 2001). We also compare the caustics and critical curves with the numerical solution obtained with our PNFW code (Dúmet-Montoya et al. 2010). These results allow us to set the first limits on the domain of validity for the perturbative approach in the case of the PNFW model.

Painel 07

Correlations among the Axial Ratio of Gravitational Arcs and the Source Properties through Simulations

Pedro da Cunha Ferreira (UFRN), Martín Makler (CBPF)

The study of arcs generated by the strong gravitational lensing provides a unique tool to constrain the matter distribution of galaxies and clusters of galaxies. Since it is a purely gravitational effect it i) probes the total lens matter (baryonic + dark) and ii) is independent of the physical processes that occur on the lens. In particlar, this work focuses on galaxy clusters, where arcs provide information on scales not often acessible to other observables. A preliminary approach to assess the potential of arcs in determining the mass of the lens is to look for correlations between properties of the images and of the lenses, for example between the axial ratio (length/width) of the arcs and the local distortion (ratio between the eigenvalues of the Jacobian of the transformation source-image). Moreover, to develop an efficient method to calculate the arc cross section (and test existing methods) it is necessary to determine the above mentioned correlation as a function of the source and lens properties. Finally, the hability to make a fast estimate of the axial ratio of arcs is very important to select sources for realistic arc simulations. In this work we develop tools to simulate gravitational arcs using the *gravlens* code (Keeton 2001, ArXiv:0102340). We use elliptical lenses with a Navarro, Frenk and White (NFW) profile, and uniform elliptical sources. We obtain the images of a large number of sources and measure their morphology, comparing the axial ratio with the local distortion. We have also used the approximation of Keeton (2001, ApJ 562, 160) to predict the axial ratio taking into account the elliticity and orientation of the sources. We find that the source ellipticity has a fundamental role in the axial ratio of the arcs.

Painel 08

Studying Sphere Seismic Noise Isolation in Schenberg Detector

Carlos Frajuca e Fábio da Silva Bortoli (IFSP)
Nadja Simão Magalhães (Unifesp)
Odylio D. Aguiar (INPE)

A spherical gravitational wave (GW) detector has a heavy ball-shaped mass which vibrates when a GW passes through it. Such motion is monitored by transducers and the respective electronic signal is digitally analysed One of such detectors, SCHENBERG, will have resonant frequencies around 3.2 kHz with a bandwidth near 200 Hz. ”Mário Schenberg” is a spherical resonant-mass gravitational wave detector weighting 1.15ton, being built in the Departament of Materials at the University of São Paulo. The sphere with 65cm in diameter will be made of a copper-aluminum alloy with 6% Al. The frequencies of running resonant-mass detectors typically lay below 1 kHz, making the transducer development for this higher frequency detector somewhat more complex. This wok simulates the sphere seismic isolation to find the attenuation in the seismic noise obtained by the new suspension implemented in the Schenberg detector.

SESSION III

On the Magnetic Origin of Jets from Accretion Disks

R.V.E. Lovelace
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The first proposal that astrophysical jets arise from an ordered magnetic field threading an accretion disk around a black hole (BH) or star was made by the author in 1975 and 1976. Since that time there have been thousands of papers investigating the theory of magnetically mediated jets, magnetohydrodynamic (MHD) simulations of the jet formation, and comparisons of predictions with observations. There are two main regimes: (1) the hydromagnetic regime, in which energy and angular momentum are carried by both the electromagnetic field and the kinetic flux of matter, which is relevant to the jets from magnetized young stellar objects (YSO); and (2) the Poynting flux regime, in which energy and angular momentum from the disk are initially carried predominantly by the electromagnetic field, which is relevant to extragalactic and microquasar jets from disks around BHs and possibly to the jets of gamma-ray burst sources. Both regimes have been discovered and analyzed in MHD simulations by our group and others. In the case of YSO it remains unknown whether the jets are from a distributed magnetic disk-wind or from a localized disk-magnetosphere interaction as in the X-wind model of Shu. Future high resolution observations with ALMA may clarify this. In the case of jets from BH accretion disks the relative contribution of the spin-down of the accretion disk versus the spin-down of the black hole remains unknown. Observations and modeling of black hole jets may clarify this issue. Particularly in the case of jets from BH systems an important question is where does the large-scale magnetic field in the disk come from? In the case of jets from YSO the magnetic field may come entirely from the star's dynamo generated field. What controls the advection/diffusion of the magnetic field in disks where the magnetorotational instability (MRI) is active? Recent work by our group argues that the disk's surface layers are non-turbulent and thus highly conducting (Spitzer conductivity) because the MRI is suppressed high in the disk where the magnetic and radiation pressures are much larger than the thermal pressure. This effect is important in that it leads to the build up of a strong ordered magnetic field in the inner regions of the disks around black holes from a weak ambient field. The jets from disks around massive black holes in active galaxies have amazing properties not understood. In some cases they are observed to carry electrical current (greater than 10**17 A) over distances larger than 10 kpc and in other cases they give in situ acceleration of particles to TeV energies.

Gravitational Wave Detection: a Summary of the Status of the Research on the Subject by Brazilian Cientists

Nadja Simão Magalhães
UNIFESP

In this talk I will present a summary of the status of the ongoing research by Brazilian groups on the detection of gravitational waves. The area is highly interdisciplinary, involving theoreticians and experimentalists of different backgrounds. Including data analysis, sources and instrumentations, the presentation also will report on the construction of the national detector, SCHENBERG.

Absorption and Scattering by Acoustic Holes

Luís Carlos Bassalo Crispino & Ednilton Santos de Oliveira (UFPA, Brasil)
Samuel Richard Dolan (Southampton University, United Kingdom)

Black holes play an important role in modern physics. For many years, they were considered merely a mathematical curiosity arising from Einstein's field equations. In more recent decades there has emerged strong evidence for their presence in binary systems and galactic centers. Aside from the growing observational data, it is clear that the idea of a black hole has its own attractive power. Indeed, black holes have captured the imagination of a generation of physicists. Naturally, the possibility that black hole analogues may be created in the laboratory has attracted widespread interest. Analogues are artificial systems with some of the key properties of black holes. In 1981, Unruh proposed the idea of a dumb hole: a region of fluid from which no sound may escape. A dumb hole, or acoustic hole, is bounded by an apparent horizon: a surface through which the normal flow velocity is equal to the speed of sound in the fluid. We analyze the absorption of planar acoustic waves by two kinds of acoustic holes, namely: (i) the canonical acoustic hole, and (ii) the draining bathtub. The canonical acoustic hole can be thought as a spherically symmetric static spacetime experienced by sound waves in a perfect irrotational barotropic fluid with constant energy density and sound velocity. The draining bathtub is a (2 + 1)-dimensional rotating acoustic hole formed by a draining fluid flow, which is the simplest analogue to exhibit both a horizon and an ergoregion, which are key features of rotating (Kerr) black holes. We also analyze the scattering of planar acoustic waves by the canonical acoustic hole, comparing our results with the ones for the scattering of planar scalar waves by static black holes. The scattering is studied for arbitrary values of the incident wave frequency and of the deflection angle. We obtain accurate numerical results from the partial wave method for the scattering cross sections, showing that they are in excellent agreement with analytical approximations.

Spherical Collapse in Chameleon Models

R. Rosenfeld
IFT/UNESP

We study the gravitational collapse of an overdensity of nonrelativistic matter under the action of gravity and a chameleon scalar field. We show that the spherical collapse model is modified by the presence of a chameleon field. In particular, we find that even though the chameleon effects can be potentially large at small scales, for a large enough initial size of the inhomogeneity the collapsing region possesses a thin shell that shields the modification of gravity induced by the chameleon field, recovering the standard gravity results. We analyse the behaviour of a collapsing shell in a cosmological setting in the presence of a thin shell and find that, in contrast to the usual case, the critical density for collapse depends on the initial comoving size of the inhomogeneity.

Unveiling Galaxy Evolution with Spectral Synthesis

Laerte Sodre Jr.
IAG/USP

Galaxy spectra encode information on the age and metallicity distributions of the stars that constitute a galaxy and retrieving this information from the spectra is a powerful way to obtain a deeper understanding of galaxy formation and evolution. We have been using spectral synthesis techniques to describe the spectrum of a galaxy as a superposition of spectra of simple stellar populations. In this presentation I will briefly highlight some interesting results on galaxy evolution obtained with the application of these techniques to large samples of galaxy spectra.

Os Projetos JPAS e Pau-Brasil Sul

Claudia Mendes de Oliveira (IAG/USP) (para a colaboração JPAS/Pau-Brasil)

Faremos uma descrição dos projetos JPAS e Pau-Brasil Sul que propõem surveys do céu inteiro em 40 bandas feitos com telescópios de 2.6m localizados na Espanha e no Chile. Descreveremos as motivações científicas e a situação atual do projeto.

Substructures in the Intracluster Gas

Gastao B. Lima Neto
IAG/USP

Clusters of galaxies are the largest and youngest collapsed structures in the universe, which can provide fundamental information on the cosmological assembly of matter. In this work, I will present detailed analysis of nearby galaxy clusters observed by Chandra and XMM-Newton X-ray satellites, focusing on the observed gas spatial distribution. Many of these objects have similar morphologies, which exhibit spiral-like substructure. These features are analogous to those found in numerical hydrodynamic simulations of cluster collisions with non-zero impact parameter. Our investigation suggests that these spiral-like structures may be caused by off-axis collisions that will lead to minor mergers. Since these features occur in regions of high density, they may confine radio emission from the central galaxy producing, in some cases, unusual radio morphology.

The Flow of the Universe

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The recent demonstration of the Poincaré conjecture by Grigory Perelman suggests a new process called "geometrical flow" which has potential applications to several branches of physics and in particular to cosmology. In the next ten minutes we will outline the original tool used by Perelman, called the “Ricci flow" introduced by Richard Hamilton in 1982, showing why it is not adequate for Einstein’s gravitation. However, the concept of geometric flow is more general and older, introduced

by John Nash in 1956 is suitable for applications to physics and cosmology. Our preliminary results show that it is compatible with the observed acceleration of the universe.

Tilted Winds of Weak-Lined T Tauri Stars: 3D Simulations

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3D numerical magnetohydrodynamic simulations of the wind and magnetospheric structures of weak-lined T Tauri stars were performed in the case of a misalignment between the axis of rotation of the star and its magnetic dipole moment vector. We study the effects caused by different model parameters, namely the misalignment angle θt, the stellar period of rotation, the plasma-β, and the heating index γ. Our simulations take into account the interplay between the wind and the stellar magnetic field during the time evolution. The system reaches a periodic behavior with the same rotational period of the star. We show that the magnetic field lines present an oscillatory pattern. Furthermore, we obtain that by increasing θt, the wind velocity increases, especially in the case of strong magnetic field and relatively rapid stellar rotation. Our models allow us also to study the interaction of a magnetized wind with a magnetized extra-solar planet. We find that a close-in Jupiter-like planet orbiting at 0.05 AU presents a radio power that is $\sim$5 orders of magnitude larger than the one observed in Jupiter, which suggests that the stellar wind from a young star has the potential to generate strong planetary radio emission that could be detected in the near future with LOFAR.

POSTERS OF SESSION III

Painel 09

Dínamos Magnéticos e Campos Magnéticos Primordiais em Fontes Extragalácticas e no Universo

L. Garcia de Andrade
IF-UERJ

Utilizando a equação de dinamos MHD em relatividade geral derivada recentemente por Marklund e Clarkson (MNRAS-2005) obtemos valores para o contraste magnetico similares aos observacionais obtidos p Reinhardt (Acta cosmologica-1979) de 1.7. Nosso valor apresenta desvios de 2.0 devido a perturbações n expansão do universo. Na recombinação obtemos valores p o meio intergalactico de 10^{-11}G que esta de acordo com as observações astronomicas.

Painel 10

The Power Spectrum of Radial Densities in the Einstein-De Sitter Cosmological Model

Amanda Reis Lopes (OV/UFRJ), Marcelo Byrro Ribeiro (IF/UFRJ)

This work studies the power spectrum (PS) of radial cosmological densities in the Einstein-de Sitter (EdS) cosmological model. It is well known in the literature that the the Fourier transform of the 2-point correlation function, that is, the PS, behaves as a power law (Park et al. 1994). By using definitions of radial density statistics advanced by Ribeiro (2005) we obtained their respective PS, which also behave as power-laws. We also discussed another quantity analogous to the correlation function, called radial correlation (Ribeiro 1995), whose PS has a power-law feature as well. We also found that the radial correlation changes with samples sizes, but this behaviour does not happen with its respective PS, that is, the radial PS does not significantly change when different sample sizes are used.

Painel 11

Gravitational Waves from the Cosmological Quark-Hadron Phase Transition

G. Lugones & V. R. de Castro Mourão Roque (Universidade Federal do ABC)

Gravitational waves are possibly the only direct evidence to study the Early Universe in times preceding the matter-radiation decoupling. The future launch of LISA (Laser Interferometer Space Antenna) will possibly provide a precise instrument for measuring this radiation. In this work we calculate the gravitational wave background produced by the quark-hadron phase transition approximately 1 microsecond after the Big Bang. To this end, we performe one-dimensional numerical simulations of the hydrodynamic evolution of the primordial fluid and obtain the spectrum of gravitational waves generated by its motion. For the solution of the relativistic Euler equations, we use the conservative Godunov method with the Riemann solver of Roe. First, we consider that the transition is a crossover and obtain the gravitational signal produced by small perturbations in the plasma, employing an equation of state based on recent lattice QCD results. Then, we consider a first order phase transition producing defagrations and detonations which in turn generate gravitational waves. Finally, the spectra of gravitational waves obtained from numerical simulations is compared with the LISA sensitivity curve.

Painel 12

A Large Change in the Predicted Number of Small Halos due to a Small Amplitude Oscillating Inflaton Potential

Luiz Felipe S. Rodrigues & Reuven Opher
IAG/USP

A smooth inflaton potential is generally assumed when calculating the primordial power spectrum, implicitly assuming that a very small oscillation in the inflaton potential creates a negligible change in the predicted halo mass function. We show that this is not true. We find that a small oscillating perturbation in the inflaton potential in the slow-roll regime can alter significantly the predicted number of small halos. A class of models derived from supergravity theories gives rise to inflaton potentials with a large number of steps and many transplanckian effects may generate oscillations in the primordial power spectrum. The potentials we study are the simple quadratic (chaotic inflation) potential with superimposed small oscillations for small field values. Without leaving the slow-roll regime, we find that for a wide choice of parameters, the predicted number of halos change appreciably. For the oscillations beginning in the 10^7-10^8 solar masses range, for example, we find that only a 5% change in the amplitude of the chaotic potential causes a 50% suppression of the number of halos for masses between 10^7-10^8 solar masses and an increase in the number of halos for masses $<10^6$ solar masses by factors ~15-50. We suggest that this might be a solution to the problem of the lack of observed dwarf galaxies in the range 10^7-10^8 solar masses. This might also be a solution to the reionization problem where a very large number of Population III stars in low mass halos are required.

Painel 13

Barred Galaxies and the Circularisation of Dark Matter Haloes

Rubens E. G. Machado (IAG/USP & Laboratoire d'Astrophysique de Marseille)
E. Athanassoula (Laboratoire d'Astrophysique de Marseille)

Cosmological N-body simulations indicate that the dark matter haloes of galaxies should be generally triaxial. Yet, the presence of a baryonic disc is believed to modify the shape of the haloes. We study how bar formation is affected by halo triaxiality and how, in turn, the presence of the bar influences the shape of the halo. We performed a series of collisionless and hydrodynamical numerical simulations, using elliptical discs as initial conditions. Triaxial halos tend to become more spherical and we show that part of the circularisation of the halo is due to disc growth, but part must be attributed to the formation of a bar. We find that the presence of gas in the disc is a more efficient factor than halo triaxiality in inhibiting the formation of a strong bar.

SESSION IV

Formation of Galaxies at High Redshifts Using Cosmological Simulations

T. Theuns
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Numerical simulations have been very powerful tools for understanding the formation of structure in the Universe. State of the art dark matter-only simulations now routinely follow the growth of perturbations from the largest scales of clusters and filaments, to the very small scales of that of sub-structure in dark matter haloes of galaxies. However the complexity and non-linearity of baryonic physics makes it very hard to understand the relation between the wealth of structure in the dark matter, and the properties of gas and stars associated with it. In the basic paradigm of galaxy formation, baryons are thought to fall into dark matter potential wells, and shock heat. If they can cool they can become self gravitating and form stars. Super nova explosions associated with massive stars may however heat the gas again, or even blow it out of the potential well, thereby providing negative feedback. In doing so they enrich the gas with metals, which enhances cooling and hence provides positive feedback. The physics of the detailed interplay between cooling, star formation, and feedback is not well understood and numerically very challenging. Some important aspects of the physics is currently necessarily represented by "sub-grid" models, that encode our prejudice over what should happen if we were able to resolve smaller-scale phenomena. will describe an ambitious set of numerical simulation, called OWLS and GIMIC, that are designed to study the physical and astrophysical aspects of galaxy formation. In particular I will discuss how well these simulation fair by comparing the simulated universe to the observed one on a range of scales, from dwarf galaxies and satellites, to Milky Way-like galaxies, galaxy groups and clusters, and the intergalactic medium, both at high and low redshifts.

Supernovas, Formação de Estrutura e Efeito Sachs-Wolfe Integrado em Modelos Unificados de Energia e Matéria Escuras

J.C. Fabris (UFES), O. Piattella, H.E.S. Velten

Existem hoje uma ampla classe de modelos unfiicados de energia e matéria escuras, incluindo gas de Chaplygin e suas generalizações, modelos viscosos, campos escalares com auto-interação. Fazemos uma confrontação deles modelos com dados observacionais de supernovas tipo Ia, espectro de potência da aglomeração da matéria e efeito Sachs-Wolfe integrado. A confrontação com os dados do espectro de potência são particularmente severos com os modelos do tipo gas de Chaplygin, enquanto o efeito Sachs-Wolfe integrado parece praticamente excluir os modelos viscosos.

POSTERS OF SESSION IV

Painel 14

Generalized Non-Commutative Inflation

Ulisses D.A.S. Machado
IAG/USP

Non-commutative geometry indicates a deformation of the energy-momentum dispersion relation $f(E) \equiv \frac{E}{pc} (\neq 1)$ for massless particles. This distorted energy-momentum can affect the radiation dominated phase of the universe at sufficiently high temperature. The formalism by which this deformation is taken into account in cosmology was developed by Alexander, Brandenberger and Magueijo (2003). These authors studied a specific one parameter family of *f(E)* which can produce inflation for a suitable range of its parameter: the α family of curves $f(E)=1+(\lambda E)^{\alpha}$ (the λ-parameter sets the energy scale of the non-commutative inflation period).The choice of *f(E)* plays the same role as the potential for conventional scalar field in conventional inflationary models. In the scalar field models, the slow roll condition on the potential is the central condition in order to produce inflation. We investigate here the analogous slow-roll conditions on *f(E)* in order to extend the number of possible inflationary models. Some choices of *f(E)* do not lead to acceptable inflation. Although some *f(E)* may lead to inflation, they may not produce the necessary ~60 e-folds of inflation. Even though they produce the necessary number of e-folds of inflation, they may have a graceful exit problem and produce an eternal inflation period. We derive here a set of conditions on *f(E)* to produce a successful period of inflation analogous to slow-roll conditions on scalar field potentials. Using these conditions and a functional sequence approach, we elaborate an algorithm (and a proof that it actually works) to systematically obtain infinitely many one parameter families of *f(E)* that are assured, by construction, to contain an interval for the parameter that leads to a successful inflation period. We additionally suggest a different interpretation of this model which permits a link with a much larger class of physical theories other than the non-commutative space-time.

Painel 15

Efeitos Quânticos na Gravitação

G. Matsas
IFT/UNESP

É bem sabido que o fato da interação gravitacional ser débil em relação às demais faz com que ela seja TIPICAMENTE dominante em escalas astrofísicas ou cosmológicas, enquanto que efeitos quânticos são PRINCIPALMENTE importantes em escalas microscópicas onde as grandezas relevantes rivalizam com a diminuta constante de Planck. Apesar disso, a mecânica quântica não possue NENHUMA escala de tamanho que a impeça de ser importante em regimes macroscópicos. Neste painel argumentaremos por meio de exemplos que a mecânica quântica tem mais a dizer para a astrofísica e cosmologia do que a sabedoria popular sugere. Para tanto, revisitaremos alguns efeitos, culminando com um novo efeito quântico potencialmente importante para a astrofísica recentemente descoberto por dois brasileiros: William Lima e Daniel Vanzella http://physics.aps.org/synopsis-for/10.1103/PhysRevLett.104.161102

Painel 16

Determination of Correction Parameters Quantum General Relativity with Variable Gravitational Constant

Ilya Shapiro & Sebastião Mauro Filho (Universidade Federal de Juiz De Fora)

In recent work has been shown to be appropriate to modify the Einstein-Hilbert action to account for quantum corrections, so that the Newtonian gravitational constant is logarithmic function of radial coordinate. In the limit of low energies this approach introduces a correction to the Newtonian potential, so that you can explain with great precision the rotation curves of galaxies. We apply this method to approximate approach the Chandrasekhar limit for white dwarf and the movement of precession of the perihelion of Mercury, we find relationships that allow us to determine from observational data the parameter free theory. The results depend greatly on the accuracy of data, but as a first consideration we estimate that it must be less than 10^{-4}.

Painel 17

Application of Statistical Tests to Study the Distribution of Arrival Directions of Cosmic Rays Detected by the Pierre Auger Observatory

Camile Mendes, Carola Dobrigkeit
UNICAMP

The study of the distribution of arrival directions of cosmic rays at Earth is a promising way to obtain information about their origin and propagation in the galactic and intergalactic space. The data of the Pierre Auger Observatory allow studying cosmic rays of the highest energy observed so far, in the region of 10^{18} eV and above. In this work we apply four statistical tests to the data obtained by the Pierre Auger Observatory from January 2004 to March 2009, looking for evidence of anisotropy in the distribution of their arrival directions and discussing the probability of the distribution being isotropic.

Painel 18

Quadratic Gravity and Homogenous Solutions

Daniel Müller
Universidade de Brasília

Renormalization at the one loop level predicts deviations for the General Relativity theory. The effective action is a quadratic gravity theory, which is not a peculiarity of gravitation. For instance, the vacuum polarization by very strong classical electromagnetic fields, in the sense of Euler-Heisenberg, introduce non linear corrections into Maxwell's Lagrangian. According to quantum field theory in curved space-time, it is expected that this quadratic gravity theory should be the correct one soon after the Planck era, and also for the final stages of black hole evaporation. The imposition of homogeneity is a very strong assumption and yet provides first generalizations by allowing large scale anisotropy. We will present some Bianchi type I and VII_A solutions, which represent the anisotropic generalization of the "flat" $R \times E^3$ and "open" $R \times H^3$ models. Isotropization will be discussed.

SESSION V

Dark Energy

E.W. Kolb
The University of Chicago, U.S.A.

The expansion velocity of the universe seems to be accelerating. Among the possible explanations are 1) a cosmological constant, 2) an ultra-light scalar field, 3) a modification of general relativity, or the backreaction of inhomogeneities. After briefly reviewing the observation evidence for acceleration, I will discuss the possible explanations and then concentrate on the backreaction explanation.

Violation of Causality of Gäodel-Type in Palatini f(R) Gravity Theories

M.J. Rebouças
CBPF

The $f(R)$ gravity theories in the Palatini approach have been recently used as an alternative way to explain the observed late accelerating expansion of the Universe with no need of invoking either dark energy or extra spatial dimension. If gravity is governed by a $f(R)$ theory a number of issues should be reexamined in this framework, including the violation of causality of Gödel-type on nonlocal scale. We examine the question as to whether the Palatini $f(R)$ gravity theories permit space-times in which the causality is violated. We show that every perfect-fluid Gödel-type solution of Palatini $f(R)$ gravity with density ρ and pressure p that satisfy the weak energy condition $\rho + p \geq 0$ is necessarily isometric to the Gödel geometry, demonstrating therefore that these theories present causal anomalies in the form of closed time-like curves. We concretely examine the Gödel-type perfect-fluid solutions in specific $f(R) = R - \alpha/R^n$ Palatini $f(R)$ gravity theory, where the free parameters α and n have been recently constrained by a diverse set of observational data. We show that for positive matter density and for α and n within the interval permitted by the observational data, this theory does not admit the Gödel geometry as a perfect-fluid solution of its field equations. In this sense, this theory remedies the causal pathology in the form of closed time-like curves which is allowed in general relativity. We derive an expression for a critical radius r_c (beyond which the causality is violated) for an arbitrary Palatini $f(R)$ theory, thus making apparent that the violation of causality depends on the form of $f(R)$ and on the matter content components. We also examine the violation of causality of Gödel-type by considering a single scalar field as the matter content. For this source we show that Palatini $f(R)$ gravity gives rise to a unique Gödel-type solution with no violation of causality.
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f(R) Theories - Stability of Stars

S. Domont e S.E. Jorás
IF-UFRJ

The very existence of static sphericallly symmetric solutions puts strong constraints on modified gravity theories -- the so-called f(R). Even when one is able to find a numeric solution that interpolates the metric from the center of a star up to a de Sitter universe, the necessary fine tunning may be simply too strong to allow the existence of such objects in the real world. We will show studies on the stability of such solutions for homogeneous stars.

The Dark Matter Density at the Sun's Location

Christiane Frigerio Martins
UFABC

We derive the value of the dark matter density at the Sun’s location ($\rho_{\odot}$) without globally mass-modeling the Galaxy. The proposed method relies on the local equation of centrifugal equilibrium and is independent of i) the shape of the dark matter density profile, ii) knowledge of the rotation curve from the galaxy center out to the virial radius, and iii) the uncertainties and the non-uniqueness of the bulge/disk/dark halo mass decomposition. The result can be obtained in analytic form and it explicitly includes the dependence on the relevant observational quantities and takes their uncertainties into account. By adopting the reference, state-of-the-art values for these, we find $\rho_{\odot}$ = 0.43(11)(10) GeV/cm^3 , where the quoted uncertainties are respectively due to the uncertainty in the slope of the circular-velocity at the Sun location and the ratio between this radius and the length scale of the stellar exponential thin disk. We obtained a reliable estimate of $\rho_{\odot}$, that, in addition has the merit of being ready to take into account any future change/improvement in the measures of the observational quantities it depends on.

Effective QFT and What it can tell us about Galaxies Rotation Curves

Ilya L. Shapiro
UFJF

The effective approach to quantum field theory is a useful instrument for investigating possible new forces. The main idea of this approach is the separation of high energy phenomena from the once at low energies. As a result one can, in principle, extract a useful information on the quantum contributions which we can not calculate explicitly. It is remarkable that within this framework one can achieve a very good fit for the rotation curves for the sample of distinct galaxies without invoking the CDM concept.

Using Sunyaev-Zeldovich Clusters to Probe the Large Scale Mass Distribution in the Lambda-CDM Universe

Carlos Alexandre Wuensche
INPE

We discuss a formalism to identify SZ clusters in blind SZ surveys using CMB maps. The developed algorithm is an adaptation of JADE (Joint Approximate Diagonalization of Eigenmatrices) and is an ICA (Independent Component Analysis) based method. We call our adaptation C-JADE and use it to identify SZ clusters in simulated CMB maps, as seen by the PLANCK satellite. Our simulations include Galaxy foregrounds in the corresponding PLANCK frequencies and instrumental noise, also scaled to PLANCK frequencies. Our maps are smoothed to the PLANCK resolution and we build a catalog with the recovered clusters, after running the simulated maps through our pipeline. The catalogs are used to compare the numbers of "discovered" to the standard Lambda-CDM predictions of N(z) and dN(z) versus z. An ongoing effort now is to use figures of N(z) and dN(z) of alternative cosmologies to generate simulated maps which can be compared to our forecasting and to the PLANCK data, expected to be released late 2011.

A Cosmological Concordance Model with Dynamical Vacuum Term

Saulo Carneiro
UFBA

We shown that the production of dark particles in the late-time FLRW spacetime provides a cosmological model in accordance with precise observational tests. The matter production backreaction leads in this context to a vacuum energy density scaling linearly with the Hubble parameter, which is compatible with the vacuum expectation value of the QCD condensate in a low-energy expanding spacetime. Both the cosmological constant and coincidence problems are alleviated in this scenario.

Testing the Distance-Duality Relation with Galaxy Clusters and Supernovae Ia

J. A. S. Lima
IAG-USP

The Etherington's reciprocity relation (Etherington 1933) is of fundamental importance in cosmology. Its most useful version in the astronomical context, sometimes referred as distance-duality relation, relates the luminosity distance (D_L) with the angular diameter distance (D_A) by the expression:

$$\frac{D_L}{D_A}(1+z)^{-2} = 1$$

This relation is valid for all cosmological models based on Riemannian geometry, being dependent neither on Einstein field equations nor the nature of matter-energy content. It only requires that source and observer are connected by null geodesics in a Riemannian spacetime and that the number of photons are conserved. Therefore, it remains true for spatially homogeneous and isotropic (anisotropic) cosmologies, as well as for inhomogeneous models. In my short talk, I wil discuss a new model-independent cosmological test for the distance-duality (DD) relation **[1]**. D_L distances are given by two sub-samples of SNe Ia taken from Constitution data (2009) whereas D_A distances are provided by two samples of galaxy clusters (De Fillipis et al. 2005 and Bonamente et al. 2006) derived by combining Sunyaev-Zeldovich effect (SZE) and X-ray surface brightness. The SNe Ia redshifts were carefully chosen to coincide with the ones of the associated galaxy cluster sample ($z<0.005$) thereby allowing a direct test of DD relation. Since for very low redshifts, $D_L \sim D_A$, we have tested the DD relation by assuming that it can be parametrized by a function - $\eta(z)$ - defined by two different expressions. In the best scenario (linear parametrization), it is found that for de Fillipis et al. sample (eliptical geometry), a result only marginally compatible with the DD relation is derived whereas for the Bonamente et al. sample (spherical geometry) the constraint is much more restrictive.

[1] R. F. L. Holanda, J. A. S. Lima, M. B. Ribeiro, APJL **722**, L233- L237 (2010).

POSTERS OF SESSION V

Painel 19

Identification of Galaxy Clusters in the CMB Maps using the Sunyaev-Zel'dovich Effect

Camila Paiva Novaes & Carlos Alexandre Wuensche (INPE)

The Cosmic Microwave Background (CMB) is considered one of the most important astrophysical observables. The study of their properties (spectrum, angular distribution and polarization) is used to understand the mechanisms of structure formation in the Universe. Secondary processes for the production of temperature fluctuations, generated after the recombination, mask the primary signal of the CMB, hindering the study of their intrinsic properties. One such process is known as the Sunyaev-Zel'dovich effect (SZ), caused by inverse Compton scattering of CMB photons. SZ effect measurements are used to estimate cosmological observables such as the Hubble constant, the relationship between angular diameter - distance and the parameter ω of the equation of state of dark energy. The Planck satellite, launched in 2009 by the European Space Agency, is dedicated to the study of CMB and one of the expected results of data analysis is the separation of signals contaminating the CMB, including the SZ effect. This paper presents the analysis of the distribution of SZ clusters in CMB maps that simulate the observations of the Planck satellite. The clusters were produced from temperature profiles of the "isothermal β-model" and then combined with synthetic CMB maps generated in HEALPix (Hierarchical Equal Area iso-Latitude pixelization) format to test an identification algorithm of the type *blind survey*. JADE (Joint Approximate Diagonalization of Eigenmatrices) is an algorithm based on Independent Component Analysis (ICA) and is effective in extracting non-Gaussian components. Preliminary results show that the method is effective in identifying the position and intensity of the SZ effect in each cluster.

Painel 20

Absorption by (2+1)-Dimensional Rotating Acoustic Holes

Ednilton S. Oliveira and Luís C. B. Crispino
Universidade Federal do Pará

Sam R. Dolan
University of Southampton

We present an analysis of the absorption of acoustic waves by a black hole analogue in (2 + 1) dimensions generated by a fluid flow in a draining bathtub. We show that the low-frequency absorption length is equal to the acoustic hole circumference and that the high-frequency absorption length is four times the ergoregion radius. For intermediate values of the wave frequency, we compute the absorption length numerically and show that our results are in excellent agreement with the low- and high-frequency limits. We analyze the occurrence of superradiance, manifested as negative partial absorption lengths for corotating modes at low frequencies.

Painel 21

Termodinâmica Generalizada e Aglomerados de Galáxias

Clovis Belbute Peres e Horácio Alberto Dottori (IF/UFRGS)

Os aglomerados de galáxias são as maiores estruturas gravitacionais em situação de quase-equilíbrio, mas apesar dos esforços de pesquisa das últimas décadas, pouco conhecemos de suas estruturas e composição. Muito do conhecimento atual baseia-se no entendimento da termodinâmica do gás em equilibrio quasi-hidrostático. No presente trabalho investigamos as termodinâmicas generalizadas e seu papel na descrição das componentes gasosa e escura dos aglomerados. Uma comparação com valores observados é apresentada para uma amostra de aglomerados próximos.

Painel 22

Supernova Constraints on a Λ(T) Model with Curvature

Cássio Pigozzo
UFBA

Among various cosmological models that describe the dynamics and evolution of the universe, observations seem to favor the flat ΛCDM, in which dark energy is associated with the cosmological constant with equation of state of vacuum. The low value of this energy density observed today compared to the estimated by quantum field theory motivates the study of alternative models which justify this difference by a time variation of the cosmological term. A model with cosmological term proportional to the Hubble parameter has been investigated, but now in the case that curvature is allowed. Despite that is not possible to find exact solutions, numerical approximations were used to constrained this model by type Ia supernovae data, and the results were compared with general case of ΛCDM, that means, the one in which curvature is also allowed. The BIC analysis of the supernovae Ia tests using Union2 and Constitution compilations tells us that Λ(t) is weakly favored over ΛCDM, and the opposite happens when using SDSS (with MLCS2k2 and SALT-II light-curve fitters) samples. All data give us the best fit of Λ(t) model at closed universes, while ΛCDM results on universes also closed but with lower values of "curvature density parameter" (Ωk), with exception of the SDSS-MLCS2k2, when is obtained an opened universe.

SESSION VI

Neutron Stars and the Extremes of Matter

M.C. Miller
University of Maryland, U.S.A.

The cores of neutron stars contain matter that cannot be replicated in laboratories: its density is several times that of atomic nuclei, with a temperature much less than the characteristic Fermi energy, and there is a strong asymmetry between the number of neutrons and protons. Existing nuclear models predict a wide variety of dominant compositions, from mostly nucleons to hyperons to quark matter to condensates. Only by observing neutron star properties such as their masses, radii, and cooling behavior can we get clues about this form of matter. I will discuss the current constraints on cold supranuclear matter from neutron star observations, followed by an exploration of the expected advances from observations of gravitational waves from coalescing neutron stars.

Instabilities of Accretion Disks around Rotating Stars and Black Holes

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An extensive literature exists on the instabilities of accretion disks around rotating stars and black holes. In the absence of instabilities the disks would accrete only very slowly at a rate determined by the microscopic viscosity in contradiction with observations. The seminal 1973 paper by Shakura and Sunyaev proposed that the disks were turbulent with a viscosity characterized by a dimensionless constant alpha less than or of order unity. However, the hydrodynamic Keplerian disks are stable according to the Rayleigh criterion and laboratory experiments on analogous Couette flow have been found to be stable by Ji and collaborators. Thus there is no apparent mechanism for generating turbulence in hydrodynamic Keplerian disks. A robust mechanism for generating turbulence in weakly magnetized disks (Alfvén speed less than sound speed) was developed by Balbus and Hawley and others based on the instability discovered by Velikhov and Chandrasekhar. Most of the magnetohydrodynamic (MHD) simulation studies of the development of this instability and its nonlinear turbulent saturation have been based on the shearing-box approximation (where the MHD equations are solved in a small patch of the disk) and indicate an effective value of alpha between 0.01 and 0.1. The necessary global MHD simulations - a major challenge of computational physics - are being done by a number of groups. Important problems exist for the hydrodynamic and MHD stability of non-Keplerian disks and self-gravitating disks. For non-magnetized, self-gravitating disks with sufficiently high surface density (Toomre Q of order unity), Gammie has shown that there is a turbulent viscosity due to the self-gravity which may be important at large distances (100 AU) in the disks around newly formed stars. In disks with non-monotonic distributions of potential vorticity, there is Rossby wave instability (RL, Li, and Colgate) that leads to the formation of anticylclonic vortices which may be important in concentrating dust particles and thereby triggering planet formation. The interaction of an accretion disk with the magnetosphere of a rotating star with a misaligned dipole magnetic field has been investigated with 3D MHD simulations by Romanova et al. and found to exhibit a Rayleigh-Taylor instability for certain conditions. The disk-magnetosphere interface may also exhibit a Kelvin-Helmholtz instability.

Probing the Time Dependence of Dark Energy

Jailson Alcaniz
ON/MCT

We discuss a model-independent approach to investigate a possible time-dependence of the dark energy equation of state. We apply this methodology to the current data of type Ia supernova and baryon acoustic oscillations. For some combinations of these data, we show that there is a departure from a non-evolving dark energy component at intermediary redshifts. The approach developed here may be useful to probe a possible evolving dark energy component when applied to upcoming observational data.

POSTERS OF SESSION VI

Painel 23

Critics, Questions, Puzzles, Speculations on Nonextensive Thermodynamics, Nonextensive Entropy. One Sea of Doubts

Carlos Pinheiro (UFRRJ) & Gentil O. Pires

The nonextensive thermodynamics and nonextensive entropy has largerly been discussed in lots of papers (htt://arxiv.org/find/ cond-mat/1/au:+Tsallis C/0/1/0/all/0/1) but without explaination of profound and new ideas and conceptions such as new definition of thermodynamics equilibrium, the meaning of q-parameter, generalization of all Boltzmann ideas and, in particular, the real significance of H-theorem under the new point of view of nonextensive thermodynamics. On this letter we upreise questions, we do some critics on Tsallis entropy, we make puzzles on nonextensive thermodynamics, and finally, if we admit the nonextensive entropy as some kind of generlization of Boltzmann entropy we carry up some speculations associated with many time like diretions, we developped new routes of physical evolutions for physical systems. We speculated about the possible connections between Tsallis entropy and multiple time like dimensions; finally we try to make a linking between statistical physics and gravitation but we do that only as an open problem to be thought and considered. The real connection between nonextensive entropy and multiple time dimensions have been considered in another paper [7].

Painel 24

Effective Potential via Riemann Normal Coordinates

Ilya L. Shapiro & Baltazar J. Ribeiro (Universidade Federal de Juiz de Fora)
Flávia Sobreira (Instituto de Física Teórica, UNESP, São Paulo, Brazil)

The subject of quantum corrections to the scalar potential becomes increasingly important due to the recent progress in the Higgs-based models of inflation for the non-minimal coupling case. Motivated by the relevance of this problem, we calculate the one-loop quantum corrections for the classical potential of the $\lambda\, \phi^4$ - theory in curved space-time. The scalar field has non-minimal coupling. The calculation is performed by using the "cut-off" regularization method in the local momentum representation, which is allowed in Riemann normal coordinates. The divergences and leading logarithms of the effective potential obtained in this way are compatible with the results founded by usual renormalization-group method and covariant Schwinger-DeWitt technique. At the same time, there are some differences in the sub-leading part, and this difference may be, in principle, relevant compared to the higher-loop effects.

Painel 25

Impact of Primordial Magnetic Fields on the Gas Content of Dark Matter Halos

Luiz Felippe S. Rodrigues & Reuven Opher
IAG/USP

Many observations indicate that magnetic fields are present in every galaxy and galaxy cluster. These fields could be explained by the existence (and consequent amplification) of seed magnetic fields produced in the primordial universe. Despite such evidences, galaxy formation studies (particularly semi-analytical models) do not take into account the presence of primordial magnetic fields (PMFs). We calculated the filtering mass (FM) and its evolution with z considering the presence of a PMF. The FM characterizes how much gas can be accreted by a halo: when the filtering mass is equal to the halo mass, the baryon mass fraction is half the cosmic baryon fraction. We find a significant growth of the FM for values of PMF well inside the observational limits. Our analysis covers different geometries for the PMF, namely: homogeneous fields and randomly oriented dipole-like and ring-like fields.

Painel 26

Accretion of Dark Energy into Black Holes

Manuela Gibim Rodrigues (UNICAMP), Alex Bernardini

In the last years, the interpretation of the cosmological scenario suffered uncountable modifications because of contribution of research in SNe Ia and galactic core. These studies demonstrate the presence of exotics components in the universe, the dark matter and the dark energy. Quintessencial models describe this dark energy as a scalar field coupled to gravity, considering the entire universe permeated by it. In the vicinity of a black hole, this field should be absorbed, modifying its distributions of mass. This accretion of this exotic mass has been interconnected at the case of primordial black holes, suggesting a possible mechanism for the formation of supermassive black holes.

SESSION VII

Gamma-Ray Bursts (GRBs): Some Open Questions

E. Waxman
Weizmann Inst. of Science, Israel

GRBs are the most luminous explosions known. Phenomenological arguments strongly suggest that they are generated by rapid mass accretion onto newly born stellar mass black holes, which leads to the generation of a relativistic jetted outflow. However, the models are largely phenomenological, the identity of the sources is not known, and their physics is not understood. Our current understanding of GRBs will be described, with emphasis on the open questions.

Particle Acceleration by Magnetic Reconnection in Accretion Disk/Jet Systems

E. M. de Gouveia Dal Pino
IAG/USP

In recent work we demonstrated that magnetic reconnection can have an important role on the heating and particle acceleration in jet/accretion disk systems. In the case of relativistic jets, violent reconnection events may heat the coronal/disk gas and accelerate the plasma to relativistic velocities through a diffusive first-order Fermi-like process within the reconnection site which can produce relativistic ejections or plasmons. The resulting power-law electron distribution is compatible with the synchrotron radio spectrum observed during the outbursts of these sources. We have built a diagram of the magnetic energy rate released by violent reconnection as a function of the black hole (BH) mass spanning 10^9 orders of magnitude that shows that the estimated magnetic reconnection power is sufficient to explain the observed radio luminosities of the outbursts, from microquasars to low luminous AGNs. In this talk, we will show the results of numerical simulations that indicate that this acceleration mechanism within reconnection sheets can be very efficient. In addition, the magnetic reconnection events cause the heating of the coronal gas which can be conducted back to the disk to enhance its thermal soft x-ray emission as observed during outbursts in microquasars. The decay of the hard x-ray emission after a radio flare could also be explained in this model due to the escape of relativistic electrons (which are believed to be responsible for the hard x-ray by inverse Compton scattering of soft x-rays) with the evolving jet outburst. In the case of YSOs, a similar magnetic reconnection model could produce the observed x-ray flares and help heating the jet launching basis as observed in some sources.

Casimir-Polder Potential between an Atom and a Cylinder in the Presence of a Cosmic String

Valdir Bezerra
UFPB

We derive the exact expression for the Casimir-Polder potential for a polarizable stable or metastable atom interacting with an ideal metal cylindrical shell in the presence of a cosmic string, using the Green function method. A discussion concerning the possible astrophysical implications of the obtained results is presented.

POSTERS OF SESSION VII

Painel 27

Auxiliary Fields Representation for Modified Gravity Models

Davi C. Rodrigues (Universidade Estadual de Campinas)
Filipe de O. Salles (Universidade Federal de Juiz de Fora)
Ilya L. Shapiro (Universidade Federal de Juiz de Fora)
Alexei A. Starobinsky (Landau Institute for Theoretical Physics, Moscow)

We consider tensor-multiscalar representations for several types of modified gravity actions. The first example is the theory with the action representing an arbitrary smooth function of scalar curvature *R* and *R*, the integrand of the Gauss-Bonnet term and the square of the Weyl tensor. We present a simple procedure leading to an equivalent theory of metric and four auxiliary scalars and specially discuss calibration of the cosmological constant and the condition of the existence of dS-like solutions in the case of empty universe. The second example is the Eddington-like gravity action. In this case we show, in particular, the equivalence of the theory to GR with the cosmological constant term, with or without use of the first-order formalism, and also discuss some possible generalizations.

Painel 28

Evolution of Spherical Non-Uniform Perturbations in the Universe

T.S Pereira, R. Rosenfeld, A. Sanoja (IFT/UNESP)

We study the evolution of inhomogeneous spherical perturbations in the universe in a way that generalizes the spherical top hat collapse in a straightforward manner. For that purpose we will derive a dynamical equation for the density contrast in the context of a Lemaître-Tolman-Bondi metric and construct solutions with and without a cosmological constant for the evolution of a spherical perturbation with a given initial radial profile.

Painel 29

Deriving H_0 from Ages of Old High Redshift Objects, H(z) and Baryon Acoustic Oscillations: the Case for the Chaplygin Gas

Rose Clívia Santos (UNIFESP) & José Fernando de Jesus (IAG/USP)

The discovery that the expansion of the Universe is accelerating is the most challenging problem of modern cosmology. In the context of general relativity, there are many dark energy candidates to explain the observed acceleration. In this work we focus our attention on two kinds of simplified Chaplygin gas cosmological accelerating models recently proposed in the literature. In the first scenario, the simplified Chaplygin gas works like a Quintessence model while in the second one, it plays the role of a Quartessence (an unification of the dark sector). Firstly, in order to limit the free parameters of both models, we discuss the age of high redshift objects with special emphasis to the old quasar APM 08279+5255 at $z = 3.91$. The basic finding is that this old high redshift object constrain severely the simplified Chaplygin cosmologies. Secondly, through a joint analysis involving the baryon acoustic oscillations (BAO), H(z) and a sample of old high redshift galaxies (OHRGs) we also estimate the value of the Hubble parameter, H_0. Our approach suggests that the combination of these three independent phenomena provides an interesting method to constrain the Hubble constant.

Painel 30

A Fractal Distribution of Galaxies at $0.05 < z < 5.0$

G. Conde S. (OV/UFRJ), M. B. Ribeiro (IF/UFRJ)

The aim of this work is to use the fractal dimension to characterize the galaxy distribution for three catalogues covering the following redshifts: $0.05 < z < 1.00$ (CNOC2 survey), $0.45 < z < 3.81$ (FDF survey) and $0.5 < z < 5.0$ (FDF survey). Taking into account that i=L, z, the analyzed data are the differential density (g_i) and the integral density (g_i^*) which are both expressed in terms of the luminosity distance (d_L) and the redshift distance (d_Z). These data were calculated by Irribarem (2009) and Lopes (2009), who have used the FLRW cosmological model with H_0 = 70 Km s^{-1} Mpc^{-1}, W_{m0} = 0.3 e W_Λ = 0.7. These densities follow a power-law where the exponent includes the fractal dimension D, therefore it is possible to determine this value by applying a linear fit. With this in mind, the results are, for the first catalogue at $0.05 < z < 0.1$, a single fractal dimension is found around D = 2.53 $\pm$ 0.02. For the other two catalogues, at least two fractal dimensions are found suggesting that the distribution at $0.45 < z < 5.0$ could be a multifractal. Finally, at $4.0 < z < 5.0$, the dimension was found to be negative, which suggests that the distribution doesn’t follow a power-law anymore.

SESSION VIII

Structure of Galaxies at Low Redshifts Using Csomological Simulations

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Numerical simulations have been very powerful tools for understanding the formation of structure in the Universe. State of the art dark matter-only simulations now routinely follow the growth of perturbations from the largest scales of clusters and filaments, to the very small scales of that of sub-structure in dark matter haloes of galaxies. However the complexity and non-linearity of baryonic physics makes it very hard to understand the relation between the wealth of structure in the dark matter, and the properties of gas and stars associated with it. In the basic paradigm of galaxy formation, baryons are thought to fall into dark matter potential wells, and shock heat. If they can cool they can become self gravitating and form stars. Super nova explosions associated with massive stars may however heat the gas again, or even blow it out of the potential well, thereby providing negative feedback. In doing so they enrich the gas with metals, which enhances cooling and hence provides positive feedback. The physics of the detailed interplay between cooling, star formation, and feedback is not well understood and numerically very challenging. Some important aspects of the physics is currently necessarily represented by “sub-grid” models, that encode our prejudice over what should happen if we were able to resolve smaller-scale phenomena. will describe an ambitious set of numerical simulation, called OWLS and GIMIC, that are designed to study the physical and astrophysical aspects of galaxy formation. In particular I will discuss how well these simulation fair by comparing the simulated universe to the observed one on a range of scales, from dwarf galaxies and satellites, to Milky Way-like galaxies, galaxy groups and clusters, and the intergalactic medium, both at high and low redshifts.

Effects of a Cut, Lorentz-Boosted Sky on the Angular Power Spectrum

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The largest fluctuation in the observed CMB temperature field is the dipole, its origin being usually attributed to the Doppler Effect - the Earth's velocity with respect to the CMB rest frame. The lowest order boost correction to temperature multipolar coefficients appears only as a second order correction in the temperature power spectrum, C_ℓ Since v/c - 10-3, this effect can be safely ignored when estimating cosmological parameters [4-7]. However, by cutting our galaxy from the CMB sky we induce large-angle anisotropies in the data. In this case, the corrections to the cut-sky C_ℓs show up already at first order in the boost parameter. In this paper we investigate this issue and argue that this effect might turn out to be important when reconstructing the power spectrum from the cut-sky data.

A Galaxy Photometric Redshift Catalog for the Sloan Digital Sky Survey Coadd

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In this work we present a photometric redshift catalog for galaxies in the SDSS (Sloan Digital Sky Survey) coadd. The SDSS coadd corresponds to a supplementary area of the SDSS where multiple exposures were added in a stack to achieve deeper magnitude limits. The SDSS Coadd covers 250 sq deg on the equator in the range -50 < RA < 60 (Stripe 82). We used the ANN method to get photo-z's and the Nearest Neighbour Error (NNE) to estimate the photo-z's errors for ~ 13 million of objects classified as galaxies in the SDSS coadd with magnitude $r < 24.5$. The photo-z and the photo-z error estimators were trained and validated on a sample of ~ 120,000 of galaxies that have SDSS coadd photometry and spectroscopic redshift (spec-z) measured by SDSS, 2SLAQ (2 degree Field-SDSS Luminous Red Galaxies And Quasi-Stellar Objects), DEEP2 (Deep Extragalactic Evolutionary Probe), CNOC2 (Canadian Network for Observational Cosmology), VVDS (VIsible imaging Multi-Object Spectrograph - Very Large Telescope Deep Survey) and the WiggleZ Dark Energy Survey. We used and compared results obtained using different photometric observables such as magnitudes, colors and concentration parameters. Here the concentration parameter is the ratio between the radii the encircles 50% and 90% of the Petrosian Flux and, since it correlates well with galaxy morphological type, it is useful to break the degeneracy between redshift and type. For the best ANN method we have tried, we find that 68% of the galaxies in the validation set have a photo-z error smaller than $\sigma_{68} = 0.036$.

High Redshift Cosmological Densities from Luminosity Function Data

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The galaxy luminosity function (LF) presented in Gabasch et.al. (2004), obtained from a I-band selected dataset of the FORS Deep Field (FDF) galaxy survey in the redshift range $0.5 < z < 5.0$, is studied in the context of a model connecting the relativistic cosmology number densities theory with the LF astronomical data and practice (Ribeiro and Stoeger 2003), as well as the relativistic radial distribution of galaxies presented in Ribeiro (2005) and Albani et.al. (2007). General observational expressions such as differential number counts, differential number densities and other related observables are derived in a FLRW cosmological model with non-zero cosmological constant such that $\Omega_{m_0} = 0.3$ and $\Omega_\Lambda = 0.7$. Selection functions in the five bandwidths of the dataset are calculated from the LF data of the FDF survey, allowing us to study the relativistic radial distribution of galaxies in the FDF survey field and to confirm its dependence on the distance definition. Preliminary results confirm the previous indication advanced in Albani et.al. (2007) of a power-law behavior at high redshifts when the number densities are defined in terms of the luminosity and redshift distances.

A Statistically Self-Consistent Type Ia Supernova Data Analysis

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The type Ia supernovae are one of the main cosmological probes nowadays and are used as standardized candles in distance measurements. The standardization processes, among which SALT2 and MLCS2k2 are the most used ones, are based on empirical relations and leave room for a residual dispersion in the light curves of the supernovae. This dispersion is introduced in the chi squared used to fit the parameters of the model in the expression for the variance of the data, as an attempt to quantify our ignorance in modeling the supernovae properly. The procedure used to assign a value to this dispersion is statistically inconsistent and excludes the possibility of comparing different cosmological models. In addition, the SALT2 light curve fitter introduces parameters on the model for the variance that are also used in the model for the data. In the chi squared statistics context the minimization of such a quantity yields, in the best case scenario, a bias. An iterative method has been developed in order to perform the minimization of this chi squared but it is not well grounded. We propose an analysis of the type Ia supernovae data that is based on the likelihood itself and makes it possible to address both inconsistencies mentioned above in a straightforward way.

POSTERS OF SESSION VIII

Painel 31

Angular Correlation Function for Photometric Galaxy Survey

Flávia Sobreira (IFT/UNESP), Fernando de Simoni, Rogério Rosenfeld

In this work we will present a method to constrain cosmological parameters and study the nature of dark energy through the Baryon Acoustic Oscilation using the angular correlation function. For a realistic model it is necessary introduce effects like redshift distortion, photo-z including catastrophic photo-z outliers, non-linearity and the error due the survey take only a partial sky coverage. This method is relevant for Dark Energy Survey project which is a photometric galaxy survey.

Painel 32

Propagation of Neutrinos through Dark Matter

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The interaction of neutrinos with various dark matter candidates is studied. We show that ultra-high energy extragalactic neutrino flux can be strongly suppressed by the interaction with ultra-light scalar fields depending of the coupling constant value. Also we analyse the interaction of galatic neutrinos interaction with this dark matter candidates using different galatic dark matter profiles. This is done in the context of a future galatic supernova neutrino and also in the context of supernova diffuse neutrino fluxes.

Painel 33

Unified and Interacting Models of the Cosmological Dark Sector

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We argue that the accelerated expansion of the Universe can be understood either as a consequence of a cosmic viscosity [1, 2] or as the result of an interaction in the dark sector [3, 4]. A viscous universe shares the same homogeneous and isotropic background dynamics as a generalized Chaplygin gas (GCG). But different from the latter it is characterized by a non-adiabatic perturbation dynamics. Matter power spectrum data favor viscous models over GCG models [1, 6]. Alternatively, the present accelerated expansion of the Universe is shown to result as a pure interaction phenomenon within the dark sector[3, 5]. The possibility that a time varying interaction may give rise to a transient phase of acceleration is also discussed [4]. Such type of dynamics, apparently favored by a recent data analysis [7], cannot be obtained within the LCDM model.

References

[1] W.S. Hipólito-Ricaldi, H.E.S. Velten and W. Zimdahl, JCAP 0906 (2009) 016.
[2] W.S. Hipólito-Ricaldi, H.E.S. Velten and W. Zimdahl, Phys. Rev. D 82, 063507 (2010).
[3] W. Zimdahl and D. Pavón, Class. Quantum Grav. 24, 5641 (2007).
[4] J.C. Fabris, B. Fraga, N. Pinto-Neto and W. Zimdahl, JCAP 1004 (2010) 008.
[5] I. Durán, D. Pavón and W. Zimdahl, JCAP 1007 (2010) 018.
[6] J.C. Fabris, H.E.S. Velten and W. Zimdahl, Phys. Rev. D 81, 087303 (2010).
[7] A. Shafieloo, V. Sahni and A.A. Starobinsky, Phys. Rev. D 80, 101301 (2009).