Bayesian comparison of non-standard cosmologies using type Ia supernovae and BAO data

Beethoven dos Santos

We use the most recent type Ia supernovae (SNe Ia) observations to perform a statistical comparison between the standard ΛCDM model and its extensions (wCDM and $w(z)$CDM) and some alternative cosmologies, namely: the Dvali--Gabadadze--Porrati (DGP) model, a power-law $f(R)$ scenario in the metric formalism and an example of vacuum decay ($\Lambda(t)$CDM) cosmology in which the dilution of pressureless matter is attenuated with respect to the usual a^{-3} scaling due to the interaction of the dark matter and dark energy fields. We perform a Bayesian model selection analysis using the Affine-Invariant Monte-Carlo Ensemble sampler. To obtain the posterior distribution for the parameters of each model, we use the Joint Lightcurve Analysis (JLA) SNe Ia compilation containing 740 events in the interval $0.01 < z < 1.3$ along with current measurements of baryon acoustic oscillations (BAO). The JLA data are analysed with the SALT2 light-curve fitter and the model selection is then performed by computing the Bayesian evidence of each model and the Bayes factor of the ΛCDM cosmology related to the other models. The results indicate that the combination of JLA and BAO data can distinguish the standard ΛCDM from its alternatives. Moreover, we find that most of the non-standard cosmologies investigated fares better than ΛCDM, while in all analyses the DGP model is practically not supported by the data compared to the standard scenario. Finally, we provide a rank order for the models considered based.

LIMITATION OF GRAVITATIONAL WAVE DETECTOR NIOBÈ SENSITIVITY BY THE FREQUENCY TRACKING NOISE

Carlos Frajuca

The gravity wave detector at the University of Western Australia was based on a bending flap of 0.45 kg tuned near the fundamental resonant frequency of a 1.5-ton resonant-bar of 710 Hz at a temperature of 5 K. The displacement of the bending flap was monitored with a 9.5 GHz superconducting re-entrant cavity transducer. The performance of the transducer is related to the development of a low noise microwave pump oscillator to drive the transducer. This work studies the influence of the frequency tracking noise of Niobè It had a burst sensitivity of h~ 7 x 10-19 with a long term operation from 1993 to early 1998. It had the lowest observed noise temperature. Using the characteristics of the detector, NIOBE should had reached a much better sensitivity that the one measure. It seems that the noise introduced in the system by the frequency tracking device was not taken into account at the time of operation, this noise gives a value of ~ 2.5 x 10-18 m/(Hz)-1/2 , what is the value that limited the detector sensitivity to the one measured at the time of operation.

Photometric redshift determination and quasar selection using an artificial neural network and Bayesian inference

Carolina Queiroz de Abreu Silva

Quasars are valuable sources for several cosmological applications. In particular, they can be used to trace some of the heaviest halos and their high intrinsic luminosities allow them to be detected at high redshifts. This implies that quasars (or active galactic nuclei, in a more general sense) have a huge potential to map the large-scale structure. However, this potential has not yet been fully realized, because instruments which rely on broad-band imaging to pre-select spectroscopic targets usually miss most quasars and, consequently, are not able to properly separate broad-line emitting quasars from other point-like sources (such as stars and low resolution galaxies). In this work, we employ the techniques of neural network and Bayesian inference to investigate the gains on the identification and separation of quasars and stars when narrow-band filters in the optical are employed.

f(R) modified gravity with cosmological constant in the Jordan and Einstein frames

Cesar Daniel Peralta Gonzalez

It is known the equivalence between f(R) modified gravity theories in the Jordan frame to general relativity theories with non-minimally coupled scalar field in the Einstein frame through a conformal transformation. The inverse problem is that, for a given scalar field with known potential in Einstein frame could generate the dynamically equivalent f(R) function in the Jordan frame. We introduce an alternative parametric method to solve the inverse problem, in order to provide an analytic f(R) function with cosmological constant from general relativity with non-minimally coupled scalar field. We compare the results with other methods and numerical approximations to check its validity.

Towards a resolution to the cosmological constant problem via compactifications in a Randall-Sundrum scenario

CESAR MARTINEZ ROBLES

We propose an innovative approach to the cosmological constant problem where we present an alternative solution to one of the most importat problems of modern physics via extra dimensions under a Randall-Sundrum scenario. We also predict the compactification scale, where we could find evidence of the presence of this extra dimension in future experiments.

Simple inhomogeneous cosmological (toy) models

EDDY GIUSEPE CHIRINOS ISIDRO

Based on the Lemaître-Tolman-Bondi (LTB) metric we consider two flat inhomogeneous big-bang models. We aim at clarifying, as far as possible analytically, basic features of the dynamics of the simplest inhomogeneous models and to point out the potential usefulness of exact inhomogeneous solutions as generalizations of the homogeneous configurations of the cosmological standard model. We discuss explicitly partial successes but also potential pitfalls of these simplest models. Although primarily seen as toy models, the relevant free parameters are fixed by best-fit values using the Joint Light-curve Analysis (JLA)-sample data. On the basis of a likelihood analysis we find that a local hump with an extension of almost 2 Gpc provides a better description of the observations than a local void for which we obtain a best-fit scale of about 30 Mpc. Future redshift-drift measurements are discussed as a promising tool to discriminate between inhomogeneous configurations and the ΛCDM model.

Discussions on noncommutative inflationary cosmology

Everton Murilo Carvalho de Abreu

In this work we will describe some of the main results and discuss new ones based on different formulations of noncommutativity.

Cosmology with tachyonic scalar fields

Fabio Chibana de Castro

Study of the theoretical properties of the tachyonic scalar field and its implications for observational cosmology.

Ideal Fluids in General Relativity and Cosmology

Felipe de Melo Santos

The matter content that permeates the universe is usually described by ideal fluids. Fluid dynamics is here reviewed, and an action for general ideal fluids is studied. It is shown that models of scalar fields minimally coupled, as the canonical scalar field and K-essence field, can mimic certain types of ideal fluids. The definitions of certain unusual fields, called ghosts and tachyons, are presented as part of the analysis of K-essence. At last, dynamical system theory is used to study these fluids on a cosmological background.

Magnetized Neutron Stars

Gibran Henrique de Souza

Here we solve numerically the relativistic Grad-Shafranov equation, that describes the vector potential behavior, for a typical neutron star having as equation of state the matter described by Akmal, Pandharipande and Ravenhall (APR2), and we show the differences on the field line configurations among the different ratio between the field's toroidal and poliodal components.

Effective Field Theory in Large Scale Structure

Henrique Rubira

Gödel and Gödel-type universes in Brans–Dicke theory

Jhonny Andres Agudelo Ruiz

In this paper, conditions for existence of Gödel and Gödel-type solutions in Brans–Dicke (BD) scalar–tensor theory and their main features are studied. The consistency of equations of motion, causality violation and existence of CTCs (closed time-like curves) are investigated. The role which cosmological constant and Mach principle play to achieve the consistency of this model is studied.

Astrophysical sources of galactic cosmic rays: what can we learn from the latest AMS-02 data?

Keanu

Precise measurements made by the AMS-02 experiment in the GeV to TeV energy range show new and unexpected behaviour in cosmic ray fluxes, in particular the raise in the positron fraction and the transition in the spectral index of leptons, protons, Helium and antiprotons. Although cosmic ray electrons and positrons constitute a tiny fraction of cosmic radiation, they can provide important information about the local universe since, given their low mass, their production horizon is severely limited by energy losses. Recent positron data indicate the existence of a nearby source of positrons and electrons, located within few kiloparsecs. It has been proposed that the combined effect of both old and young Supernova Remnants (SNRs) can efficiently accelerate CRs up to the knee. Under this scenario, the spectral hardening of CR hadrons can be naturally interpreted as the transition between the two populations of sources. This recent scenario will be tested in view of the latest SNR catalogue provided by the Fermi-LAT experiment.

Gravitational waves from phase transitions in neutron stars

Leonardo Taynô Tosetto Soethe

Current research in astrophysics, gravitation and elementary particle physics has been seeking for its validation or a deeper understaning of new phenomena in this great laboratory called universe. Each star is experiencing a variety of interactions between elementary particles in extreme thermodynamic and relativistic conditions. To understand the stellar physics, gravitational waves are a singularly important tool. Knowing that stellar events are good candidates for emission of gravitational waves, in this work we calculate the emission of gravitational waves due to phase transitions in hybrid stars (hadronic matter and quark-gluon plasma). We used the MIT-bag-model to quark phase, and GM-1 EoS for hadronic phase. The star's structure was calculated by solving the TOV equation, which considers a relativistic, spherically symmetric, and non-rotating star. We obtained physical quantities related to the phase transition, such as mass, radius, pressure, energy density, baryonic density, and chemical potential. Then, we calculate the change in gravitational energy associated with the phase transition. Finally, we estimate the emitted gravitational signal amplitude, and evaluate how parameters involved affect the gravitational radiation emission spectrum. We also present a comparison of the calculated spectra opposite the sensitivity curves of the gravitational detectors currently in operation or construction.

Um modelo de colapso gravitacional para um fluido anisotrópico com viscosidade e fluxo de calor

Leone Santana de Melo Veneroni

Neste trabalho apresentamos um modelo que pode representar uma estrela compacta radiante em colapso gravitacional com fluxo de calor radial, viscosidade volumar e pressões não isotrópicas. A solução das equações de campo de Einstein descreve a evolução temporal de uma configuração inicial bem comportada, que se mantém satisfazendo todas as condições de energia durante todo o processo de colapso, assegurando a razoabilidade física do modelo.

Influence of diffractive physics on ultrahigh energy extensive air showers

Luan Bonneau Arbeletche

In the present study are revisiting the problem of the inffluence of the diffractive interactions on the develepment of extensive air showers initiated by ultrahigh energy cosmic rays, whose energies can reach up to 100 EeV. Using the extensive air shower Monte Carlo simulation code CORSIKA, we estimate the effect of diffractive physics on the shower development by comparing simulations enabling and disabling such interactions. Our results demonstrate that the diffractive component of the hadronic interactions has a non-negligible influence over shower observables for all the studied models. In particular, it has a significant impact on the muonic component of the showers.

Effects of f(R) modified gravity on spherical collapse: the critical density and the turnaround radius

RAFAEL CHRIST DE CASTRO LOPES

We investigate the spherical collapse model in a class of modified gravity (MG) models, namely the $f(R)$ scenario. We have computed numerically some interesting quantities such as the density contrast δ at the moment of collapse (δ_c), at the moment of turnaround (δ_t), as well as the over-density at virialization, Δ_v. We also illustrate the main differences between MG and the $\Lamda$CDM model. We show that δ_t is more sensitive to MG than either δ_c or Δ_v, evidencing the potential of the turnaround radius as an observable that can reveal differences between these GR and MG. We also compute the turnaround radius in both the context of $\Lamda$CDM and $f(R)$, and argue that by measuring the turnaround radius in large-scale structures we can constrain the parameters of $f(R)$ models.

Detecting activity cycles in Kepler stars

Raissa de Lourdes Freitas Estrela

Observations of various solar-type stars along decades show that these stars can have a periodic variability in their magnetic activity, varying in cycles, just like our Sun. These observations yield a relation between the rotation period P_{rot} and the cycle length P_{cycle}. Two distinct branches for the cycling stars were identified: active (A) and inactive (I), classified according to stellar activity level and number of rotations per cycle. In this work, we determined the magnetic activity cycle for 10 active stars observed by the Kepler telescope. The method adopted here estimates the activity from the excess in the residuals of the transit lightcurves. This excess is obtained by subtracting a spotless model transit from the lightcurve, and then integrating over all the residuals during the transit. The presence of long term periodicity is estimated from the analysis of a Lomb-Scargle periodogram of the complete time series. Finally, by comparing the results obtained for the cycles of these Kepler stars with that of stars presented in the literature, we investigate the rotation-cycle period relation.

Estability orbital of circumbinary planets with high inclinations

Raúl Antonio Henríquez Ortiz

In this work, we have studied the stability of different circumbinary planet orbits with different angles of inclination i_{pl}. The investigation of stability was carried out through simulations with an N-body integration code, performing simulations of circumbinary systems with a planet mass of $m_{pl}=10^{-5}$ and a binary system with two stars of mass $m_{1}=m_{2}=0.5~M_{o}$ ($m_{bin}=1~M_{o}$). We made 3522 numerical simulation of circumbinary planetary orbits, changing the relative distance (kappa) between the binary system and the circumbinary planet, and the angle of planetary orbital inclination: $i_{pl}=60^{o}$, 75^{o} y 90^{o}. For the systems simulated, we found inner orbital critical stabilities of $kappa_{crit}=1.955$, 1.948 y 1.902 respectively. Also, we studied the major resonances of the planet orbit, in which we found instabilities or large variations of the planet’s eccentricity.

Gravitationally Induced Particle Production Versus LCDM

Rose Clívia Santos

We show that a cosmology driven by gravitationally induced particle production of all non-relativistic species existing in the present Universe mimics exactly the observed flat accelerating L CDM cosmology with just one dynamical free parameter. This kind of scenario includes the creation cold dark matter (CCDM) model [Lima, Jesus & Oliveira, JCAP 011(2010)027] as a particular case and also provides a natural reduction of the dark sector since the vacuum component is not needed to accelerate the Universe. The new cosmic scenario is equivalent to LCDM both at the background and perturbative levels and the associated creation process is also in agreement with the universality of the gravitational interaction and equivalence principle. Implicitly, it also suggests that the present day astronomical observations cannot be considered the ultimate proof of cosmic vacum effects in the evolved Universe because L CDM may be only an effective cosmology.

Cosmological dynamics of f(R,G) theories of gravity

Simony Santos da Costa

We use a dynamical system approach to study the cosmology and analyse the viability of f(R, G) gravity. The method consists of formulating the propagation equa- tions in terms of suitables variables as an autonomous system. The formalism is applied to a class of f(R, G) models and the solutions and their stability are described. We found new accelerating solutions that can be attractors in the phase space, but the existence of a viable matter dominated epoch is excluded, which makes this model cosmologically unacceptable.

OBSERVATION OF PLANETARY WAVE SCALE OSCILLATIONS IN THE LOWER THERMOSPHERE IN THE EQUATORIAL REGION

SOLOMON OTOO LOMOTEY

Thermospheric wind measurements from Fabry-Perot interferometers located at São João do Cariri (7.4°S; 36.5°W) and Cajazeiras (6.9°S; 38.6°W) with both having geomagnetic coordinates (35.8°E; 0.48°N) were investigated for periodicities above 2 days. This was done by using airglow emission of Atomic Oxygen (OI630.0 nm the red line) during the nighttime from 20:00 to 03:00 local time (LT). Lomb–Scargle analysis was used to process the thermospheric winds and temperature. The phases (time of maximum) and amplitudes of these oscillations were estimated by using least square fitting method (LSF). From the result obtained, strong quasi 6-8 days planetary oscillations were observed from the wind measurements 2012 to 2014. A period of 6-days was observed in the meridional and zonal winds, while periods of 8 and 9 days were observed in the intensity and temperature during November 2013. The amplitudes and phases of these oscillations were determined, amplitudes of 30 m/s, 18.6 m/s, 0.88 R and 94.67 K were observed in the meridional and zonal winds, intensity and temperature, respectively. Also the same phase (time of maximum) was observed in the wind measurements.

Modelos Inflacionários e o Reaquecimento Cosmológico

Vinícius Santos Terra

A Teoria de inflação tem como intuito resolver alguns problemas presentes no modelo padrão em Cosmologia. À grosso modo, esta teoria implementa um período de expansão altamente acelerada, resultando num Universo regido pela energia do vácuo. Após isso, deve haver um período de produção de partículas elementares e termalização do Universo, este é o chamado período de Reaquecimento Cosmológico, que foi o principal objeto de estudo deste trabalho. Por fim, serão apresentados os seus estágios mais relevantes e seus respectivos mecanismos.

Detection of cosmic ray nuclei with the AMS-02 experiment in space

Vítor Diório Lordello

Cosmic rays are charged and highly energetic particles that reach the Earth from space. Production mechanisms, acceleration and propagation of these particles are not completely clear and the study of the flux and composition of cosmic rays may help to understand these phenomena. The AMS-02 (Alpha Magnetic Spectrometer) is a cosmic ray detector installed on the International Space Station (ISS) since May 2011 that provides precise and redundant measurements of cosmic ray properties. Different nuclei have different sources: the so called "primaries" like protons, Helium and Carbon, are thought to be produced and accelerated in astrophysical objects such as Supernova remnants, while others, like Lithium and Boron, are called "secundaries" and are produced during the propagation of primaries in the insterstellar medium. In this contribution we will describe the complementary charge identification techniques used in the AMS-02 detector and we will show preliminary results on the cosmic rays composition.

Scalar-tensor extension of the \Lambda CDM model

William Celestino Algoner Jorge

We construct a cosmological scalar-tensor-theory model in which the Brans-Dicke type scalar \Phi enters the effective (Jordan-frame) Hubble rate as a simple modification of the Hubble rate of the \Lambda CDM model. This allows us to quantify differences between the background dynamics of scalar-tensor theories and general relativity (GR) in a transparent and observationally testable manner in terms of one single parameter. Problems of the mapping of the scalar- field degrees of freedom on an e effective fluid description in a GR context are discused. Data from supernovae, the differential age of old galaxies and baryon acoustic oscillations are shown to strongly limit potential deviations from the standard model.