Grav13

April 15th–19th, 2013, Villa General Belgrano, Argentina

Schedule (as of April 9th, 2013)

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
9:00-9:50	Registration	H.-O. Kreiss	J. A. Valiente K.	J. Pullin	A. Pérez
10:00-10:30	Coffee				
10:30-11:20	G. Vila	O. E. Ortiz	W. Simon	O. Moreschi	E. Gallo
11:30-12:20	M. E. Gabach C.	C. Chirenti	J. Frauendiner	C. Kozameh	F. Canfora
12:20-14:00	Lunch				
14:00-14:30	A. Aceña	M. Ramírez		A. Giacomini	I. Gentile de A.
14:35-15:05	M. Astorino	E. Eiroa	*enjoy*	J. Skakala	P. Anglada
15:05-15:45	Coffee		*your*	Coffee	
15:45-16:15	G. Quiroga	M. Sendra	*free*	J. Magaña	F. Geser
16:20-16:50	A. Ortiz K.	L. Amarilla	*afternoon*	E. Boero	
16:55-17:25	M. Rubio	G. A. Figueroa			

Moorning Talks

Monday 15

Astrophysical black holes and their manifestations
Gabriela S. Vila
Instituto Argentino de Radioastronomía

I will present an overview of the central role of black holes in astrophysics. I will briefly survey the current evidence on the existence of stellar-mass, intermediate-mass, and supermassive black holes, and the essential characteristics of the systems that host these objects. The discussion will be mainly focused on the effects of accretion onto black holes, particularly the launching of relativistic jets and its relation to the acceleration of particles and the emission of high-energy radiation.

Multiple black hole systems
María E. Gabach Clement
FaMAF - IFEG

We analyze the problem of mutiple-black holes configurations in axial symmetry and give a brief overview on previous results studying the equilibrium and the interaction forces between the black holes. Also, we show how certain physical parameters of the system, such as the total mass, the separation distances between the black holes and their angular momenta, charges and horizon areas control the mutual interactions. Finally, we discuss some future directions to better understand the multiple-black hole system.

Tuesday 16

Einstein equations with a combination of Sommerfeld, Diriclet and Neumann boundary conditions
Heinz-Otto Kreiss and J. Winicour

In the harmonic description of general relativity, the Einstein equations reduce to a constrained system of ten quasilinear wave equations for the components of the spacetime metric. Recently [1],[2] we used the theory of pseudo-differential operators to prove that one can construct constraint preserving boundary conditions of Sommerfeld type such that the resulting initial-boundary value problem (IBVP) is well-posed in the generalized sense. Since the theory of pseudo-differential operators is perhaps not as easily accessible for the nonexperts, we show in this note that the decisive estimate can also be obtained by *integration by parts.* It follows that the full quasilinear system can be treated by standard energy estimates to establish that the harmonic IBVP is strongly well-posed in the classical sense [3].

Unfortunately, Sommerfeld conditions are very restrictive because they are dissipative and therefore the geometric interpretation of the necessary boundary data is difficult. If we replace the Sommerfeldt conditions by a suitable combination of Dirichlet and Neumann conditions, then there is hope that we can overcome the difficulty. However, to be sure that there is an energy estimate, the boundary conditions have to be homogeneous. We shall see that this can be achieved by a suitable transformation. We will show that we can solve the Einstein equations for rather complicated combinations of of Dirichlet and Neumann boundary conditions.

References

[1] Kreiss H,-O. and Winicour J.: *Problems which are well-posed in a generalized sense with applications to the Einstein equations*, Class Quantum Grav. **23** (2006) pp. 405-420.

[2] Kreiss H.-O.,Reula O., Sarbach O. and Winicour J.: *Well-posed initial-boundary value problem for the harmonic Einstein equations using energy estimates* Class Quantum Grav. **24** (2007) pp. 5973-5984

[3] Kreiss,H.-O. and Lorenz J.:**Initial-Boundary Value Problems and the Navier-Stokes Equations**, *New York: Academic*, 1989, Reprint *SIAM CLASSICS*, 2004.

Numerical studies of inequalities relating the size and angular momentum of ordinary objects in GR
Sergio Dain[1] and **Omar E. Ortiz**[1]
[1] FaMAF, Universidad Nacional de Córdoba. IFEG.

In the past there have been studies trying to prove, or finding counterexamples, to some inequalities between magnitudes of bodies, particularly black holes, in General Relativity (GR). Important examples of these inequalities are the Penrose inequality relating the mass of a black hole and the area of its horizon. Another inequality relates the angular momentum with the mass of black holes. Analytical proofs of these inequalities have been found under simplifying conditions.

We present in this work numerical studies carried out with the purpose checking the validity of two conjectures. Both conjectures are stated under the assumption of axial symmetry. The first one states that the area of ordinary bodies in GR is always bigger than the angular momentum (with an appropriate constant factor). The second conjecture states that the "size" is always bigger that an appropriate factor times the angular momentum of the body. We find numerical evidence against the first conjecture and in favor of the second.

Slowly rotating neutron stars with small differential rotation: Equilibrium models and oscillations in the Cowling approximation
C. Chirenti[1], J. Skákala[1] and S. Yoshida[2]
[1] Centro de Matemática, Computação e Cognição, UFABC, Santo André, Brazil [2] Department of Earth Science and Astronomy, University of Tokyo, Tokyo, Japan

Newly born neutron stars can present differential rotation, even if later it should be suppressed by viscosity or a sufficiently strong magnetic field. And in this early stage of its life, a neutron star is expected to have a strong emission of gravitational waves, which could be influenced by the differential rotation. We present here a new formalism for modelling differentially rotating neutron stars: working on the slow rotation approximation and assuming a small degree of differential rotation, we show that it is possible to separate variables in the Einstein field equations. The dragging of inertial frames is determined by solving three decoupled ordinary differential equations. After we establish our equilibrium model, we explore the influence of the differential rotation on the f- and r-modes of oscillation of the neutron star in the Cowling approximation, and we also analyze an effect of the differential rotation on the emission of gravitational radiation from the f-modes. We see that the gravitational radiation from the f-modes is slightly suppressed by introducing differential rotation to the equilibrium stars.

Wednesday 17

Conformal methods and the global analysis of spacetimes
Juan A. Valiente Kroon
School of Mathematical Sciences, Queen Mary, University of London

The purpose of this talk is to provide a survey of conformal methods in General Relativity and their application to the study of global properties of spacetimes. As a demonstration of this approach I will discuss two recent results:

i) a nonlinear stability result for radiation FRW cosmological models;

ii) a local existence result for the Einstein-Yang-Mills spacetimes which are anti-de Sitter like.

These works are in collaboration with C. Luebbe (University College London).

Horizons in 5 dimensions
Tim-Torben Paetz and **Walter Simon**
University of Vienna, Vienna, Austria

The framework is the basic setup of Kaluza-Klein theory, namely a 5-dimensional vacuum with a S^1-isometry, which corresponds to Einstein-Maxwell-dilaton theory in spacetime. I first recall the behavior of Killing horizons and its generators under lift and projection in the S^1-bundle. Then I show that the property of compact surfaces of being (stably) marginally (outer) trapped is preserved under lift and projection provided the appropriate ("Pauli") conformal scaling is used for the spacetime metric. I also discuss recently proven area inequalities for stable axially symmetric 2-dimensional and 3-dimensional marginally outer trapped surfaces. This talk is based on the preprint arXiv:1302.3052.

Exploring the corner: linearised gravitational waves near space-like and null-infinity
F. Beyer, G. Doulis, **J. Frauendiener** and B. Whale
University of Otago, Dunedin, New Zealand

The conformal compactification introduced by Penrose in the late 1960s provides an interesting approach towards the numerical simulation of global properties of space-times. The work by Friedrich has put Penrose's approach onto a firm mathematical footing, giving wellposedness and stability results for several finite initial (boundary) value problems of the (generalized) conformal field equations. In this talk we will discuss the geometrical and analytical foundations of these ideas and we present preliminary results for the evolution of linearized gravitational fields i.e., the zero-rest-mass spin-2 fields on Minkowski space.

Thursday 18

Spherically symmetric vacuum spacetimes in loop quantum gravity
Jorge Pullin
Louisiana State University, USA.

Through a rescaling, we are able to turn the constraint algebra of the canonical formulation of vacuum spherically symmetric gravity into a Lie algebra and complete the Dirac quantization procedure. We solve exactly for the space of physical states. New quantum observables without classical counterpart emerge. The metric can be constructed as an evolving constant of the motion acting on the space of physical states and it turns out to be non-singular. Quantum states can be constructed that approximate the Kruskal extension of the Schwarzschild space-time with the singularity replaced by a region of high curvature and space-time fuzzyness. The new quantum observables and the elimination of the singularity may open new perspectives on the recently discussed issue of "firewalls".

Building a particle model based on the null gauge
Emanuel Gallo and **Osvaldo M. Moreschi**
FaMAF-IFEG; UNC

There are several ways in which one can approach the notion of compact object in general relativity; for example:

* From the notion of isolated systems; through the study of asymptotically flat spacetimes.
* Through the study of local solutions to distributions with support on a timelike world line.

The previous situation motivates the study of extending the particle paradigm to the relativistic regime, in which the gravitational radiation effects are taken into account in the calculation of the equations of motion.

In a previous work we have studied the notion of a particle where the seeds were solutions of linearized gravity calculated from retarded Green's functions of the first order equations in the harmonic gauge.

We here present an approach to the particle paradigm, where no restriction on the weakness of the sources are imposed, nor slow motion is assumed. In particular we present a workable model for the binary system in general relativity. The construction is based on the null gauge and is expected to provide with better results for the regime where back reaction to the motion, due to the emission of gravitational radiation, is important.

Spin and Center of Mass in Asymptotically Flat Spacetimes
Carlos N. Kozameh, Gonzalo D. Quiroga
FaMAF, Universidad Nacional de Córdoba
Instituto de Física Enrique Gaviola (IFEG), CONICET
Ciudad Universitaria, (5000) Córdoba, Argentina

We define the center of mass and spin of an isolated system in General Relativity. The resulting relationships between these variables and the total linear and angular momentum of the gravitational system are remarkably similar to their newtonian counterparts, though no postnewtonian approximation has been taken. We also derive equations of motion linking their time evolution to the emitted gravitational radiation. These equations should be useful when describing highly energetic processes where a considerable fraction of the total mass is emitted as gravitational waves.

Friday 19

Black Hole Models in Loop Quantum Gravity
Alejandro Pérez
Centre de Physique Theorique, Aix-Marseille Universite,
Institut Universitaire de France.

I will review some recent ideas in the construction of a microscopic model for black hole thermodynamics in loop quantum gravity.

On the general definition of angular momentum in General Relativity and the axial symmetry case
E. Gallo and O. M. Moreschi
FaMAF, Universidad Nacional de Córdoba Instituto de Física Enrique Gaviola (IFEG), CONICET Ciudad Universitaria, (5000) Córdoba, Argentina

The subject of the appropriate notion of angular momentum in general relativity is a difficult one and has been tackled by numerous authors. Although there are many works in the subject, different approaches have yielded nonequivalent definitions; most of them suffering from the so called supertranslations ambiguities.

One of the main reasons why it is so difficult to define angular momentum at null infinity comes from the fact that the asymptotic symmetries group is not the 10-dimensional Poincare group, but the infinite dimensional BMS group. And this larger group gives origin to the problem of supertranslations. In the past, one of the authors was able to provide a definition of intrinsic angular momentum based on charge integrals of the Riemman tensor, which have circumvented those problems and provided at the same time with the notion of center of mass at future null infinity. However in this work no conclusive relation with the Komar integral was stated, for the case of rotational symmetry.

In this work we would like to improve on this situation.

After a review of the general problem, we introduce and analyze here the most general notion of intrinsic angular momentum based on charge integrals; which is valid for general asymptotically flat spacetimes, and is free from supertranslations ambiguities, and reduces to the Komar integral in the case of axial symmetry.

Generalized Hedgehog Ansatz for the Einstein-Skyrme system
F. Canfora[1,2], H. Maeda[1,3]
[1] Centro de Estudios Científicos (CECs), Valdivia, Chile
[2] Universidad Andres Bello, Av. Republica 440, Santiago, Chile
[3] Rikkio University, Tokio, Japan

In this talk a generalization of the hedgehog ansatz both for the non-linear sigma model and for the Skyrme model is proposed. Such generalization allows to reduce the field equations of the Skyrme model (which are non-linear coupled partial diferential equations) to a single scalar master equation even in space-times without spherical symmetry. The key geometrical idea behind this construction is that, even if the Skyrme fields depend in a non-trivial way on the Killing coordinates, still the corresponding energy-momentum tensor can be compatible with the space-time symmetries. Thus, the present ansatz realizes space-time symmetries in a non-trivial way.

Afternoon Talks

Monday 15

Exact hairy black brane solutions in AdS_5
Andrés Aceña[1], Andrés Anabalón[2], and Dumitru Astefanesei[3]
[1]Instituto de Ciencias Básicas, Universidad Nacional de Cuyo, Mendoza, Argentina.
[2]Departamento de Ciencias, Facultad de Artes Liberales y Facultad de Ingeniería y Ciencias, Universidad Adolfo Ibáñez, Viña del Mar, Chile.
[3] Instituto de Física, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile.

In this talk I will present a new general class of *exact, regular* black hole solutions with toroidal horizon topology in 5-dimensional AdS gravity with a self-interacting scalar field. Due to the non-trivial back-reaction of the scalar field, the no-hair theorems can be evaded so that an event horizon can be formed. The scalar field is regular everywhere outside the curvature singularity and it vanishes at the boundary where the potential is finite. Thermodinamical properties and some of the properties of the solutions in the context of AdS/CFT duality will be presented.

Embedding hairy black holes in a magnetic universe
Marco Astorino
Centro de Estusios Cientificos (CECs), Valdivia

Ernst's solution generating technique is adapted to Einstein-Maxwell theory conformally (and minimally) coupled to a scalar field. This integrable system enjoys a SU(2,1) symmetry which enables one to move, by Kinnersley transformations, though the axisymmetric and stationary solution space, building an infinite tower of physically inequivalent solutions.

As a specific application, metrics associated to scalar hairy black holes, such as the ones discovered by Bocharova, Bronnikov, Melnikov and Bekenstein, are embedded in the external magnetic field of the Melvin universe.

Spin and center of mass in axially symmetric Einstein-Maxwell spacetimes
C. N. Kozameh [1] and **G. D. Quiroga**[1]
[1] FaMAF, Universidad Nacional de Córdoba, 5000, Córdoba, Argentina

We give a definition and derive the equations of motion for the center of mass and angular momentum of an axially symmetric, isolated system that emits gravitational and electromagnetic radiation. A central feature of this formulation is the use of Newman-Unti cuts at null infinity that are generated by worldlines of the spacetime. We analyze some consequences of the results and comment on the generalization of this work to general asymptotically flat spacetimes.

Area-Charge inequalities for isoperimetric surfaces
Aceña Andrés E.[1], **Ortiz Klingner Alfredo M.**[1]
[1] ICB, Universidad Nacional de Cuyo, Mendoza, Argentina

We study the Bonnor spacetime from the point of view of geometrical inequalities in General Relativity. We consider the Area-Charge inequality for isoperimetric surfaces. It has been conjectured thet this inequality is not sharp. Bonnor's metric corresponds to an electrically charged spheroid surrounded by electro-vacuum. This model has been used to explore geometrical relations between length, area, mass and charge. In this work we analyze spheroidal surfaces within Bonnor's metric and then we obtain a differential equation that must be satisfied by an isoperimetric surface, along with its boundary conditions

Charge - size inequality for real objects
M. E. Rubio[1], S. Dain[1,2]
[1] FaMAF, Universidad Nacional de Córdoba; Córdoba, Argentina
[2] CONICET

Geometric inequalities have been of interest in General Relativity in recent years. From them, it is possible to relate physical quantities that have a precise geometric meaning–like mass, area, charge and angular momentum–, and thus be able to predict significant consequences on the evolution and stability of some physical systems.

In this work we present a conjecture relating the electrical charge to the size of a real object, inspired on the hoop conjecture valid for black holes. First we discuss briefly some relevant aspects of the hoop conjecture and then we state the analogous conjecture for real objects in general. Physical motivation of that inequality is discussed, as well as define with precision what we understand about the "size" of a three dimensional object. Finally, we restrict to study the case of spherical symmetry, wherein this conjecture is formulated precisely, and we show the first steps to prove it.

Tuesday 16

Quasinormal modes and quasinormal ringing in the Apostolatos-Thorne cylindrical shell model
Reinaldo J. Gleiser, **Marcos A. Ramirez**
IFEG - FaMAF, Universidad Nacional de Córdoba, Argentina

We study the perturbative evolution of the static configurations, quasinormal modes and quasinormal ringing in the Apostolatos-Thorne cylindrical shell model. We consider first an expansion in harmonic modes and show that it provides a complete solution for the characteristic value problem for the finite perturbations of a static configuration. As a consequence of this completeness, we obtain a proof of the stability of static solutions under these types of perturbations. The explicit expressions for the mode expansion are then used to obtain numerical values for some of the quasinormal mode complex frequencies. Some examples involving the numerical evaluation of the integral mode expansions are described and analyzed, and the quasinormal ringing displayed by the solutions is found to be in agreement

with quasinormal modes found previously. Going back to the full relativistic equations of motion, we find their general linear form by expanding them to first order about a static solution. We then show that the resulting set of coupled ordinary and partial differential equations for the dynamical variables of the system can be used to set an initial plus boundary value problem, and prove that there is an associated positive definite constant of the motion that puts absolute bounds on the dynamic variables of the system, establishing the stability of the motion of the shell under arbitrary, finite perturbations. We also show that the problem can be solved numerically, and provide some explicit examples that display the complete agreement between the purely numerical evolution and that obtained using the mode expansion, in particular regarding the quasinormal ringing that results in the evolution of the system. We also discuss the relation of this work to some recent results on the same model that have appeared in the literature.

Strong deflection gravitational lensing: basic aspects and recent progress
E. F. Eiroa[1,2]
[1] Instituto de Astronomía y Física del Espacio, Buenos Aires, Argentina [2] Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina

Compact astrophysical objects like black holes strongly curve the spacetime in their vicinity. If an object with a photon sphere is between a source of electromagnetic radiation and an observer, in addition to the usual primary and secondary images due to small deflections of the light rays, there are two infinite sets of images called relativistic, produced by light passing close to the photon sphere, which undergoes a large deflection. The positions and magnifications of relativistic images can be obtained numerically or analytically. The analytical lensing calculations are performed by using an approximate method called strong deflection limit, which is applied to the study of non-rotating black holes and also to rotating ones. In the latter case, is also of interest to study the deformation of the shadow cast by the black hole, which grows with the rotation parameter. The purpose of this talk is to review the basics and the recent advances on strong deflection gravitational lensing.

Massless braneworld black hole lenses
E. F. Eiroa[1,2] and **C. M. Sendra**[1,2]
[1] Instituto de Astronomía y Física del Espacio, Buenos Aires, Argentina.
[2] Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina.

Black holes distort the spacetime structure in their surroundings. As a consequence, the light rays passing close to them are bent, so black holes can be considered as gravitational lenses. In braneworld cosmological models, the ordinary matter is on a three dimensional space called the brane, which is embedded in a larger space denominated the bulk, where only gravity can propagate. All the properties of black holes, including gravitational lensing effects, will be different due to the presence of extra dimensions. In this work, we study massless black holes as gravitational lenses, in the Randall-Sundrum braneworld scenario. We perform the weak deflection limit (corresponding to a small deflection angle, which can be approximated to first order in $1/r$) to obtain the positions and the magnifications of the primary and secondary images of a point source. Photons passing close to the black hole, experiment one or more loops around it before they emerge to the observer, and will give place to two infinite set of relativistic images of the source. In this case, the deflection angle is obtained by an asymptotical logarithmic approximation called the strong deflection limit, which allows an analytical study of the positions and the magnifications of these images.

Apparent shape of a braneworld rotating black hole
Leonardo Amarilla[1] and Ernesto Eiroa[2,1]
[1] Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina
[2] Instituto de Astronomía y Física del Espacio, Buenos Aires, Argentina.

We study the null geodesics of a rotating braneworld black hole in the Randall-Sundrum cosmological scenario. In the Boyer-Lindquist coordinates, the difference between this geometry and the Kerr-Newman one is the possibility of a negative tidal charge term. The shadow cast by this kind of black holes depends on the angular momentum and the tidal charge. For a fixed value of the rotation parameter, the presence of a negative tidal charge enlarges the shadow and reduces its deformation with respect to Kerr spacetime, while for a positive charge, the opposite effect is obtained. We also consider the case in which the combination of the parameters leads to a naked singularity. Finally, we present a discussion of the observational prospects concerning to the Galactic center supermassive black hole.

Thin-shell wormholes with a generalized Chaplygin gas in Einstein-Born-Infeld theory: construction and stability
p E. F. Eiroa[1,2] and **G. Figueroa Aguirre**[1]
[1] Instituto de Astronomía y Física del Espacio, Buenos Aires, Argentina
[2] Departamento de Física, Facultad de Ciencias Exactas y Naturales,Universidad de Buenos Aires, Buenos Aires, Argentina

We construct spherically symmetric wormholes in Born-Infeld electrodynamics coupled to Einstein gravity by using the thin-shell formalism. From a black hole solution, we remove the the inner part of the manifold containing the horizon and paste the resulting geometry with an identical copy of it, in order to build the wormhole. In this form, a new manifold is obtained which has no horizons and the surface where the two parts join corresponds to the throat of the wormhole, where the energy conditions are violated. For this reason, the presence of exotic matter is needed, which in this work is modeled by a generalized Chaplygin gas. We analyze the stability of these objects under radial perturbations, for different values of the Born-Infeld parameter and the charge, and we compare the results with those obtained in a previous work for Maxwell electrodynamics. We show that the stability region in the parameter space reduces and then disappears as the value of the Born-Infeld parameter is modified in the sense of a larger departure from Maxwell theory.

Thursday 18

Exact meron Black Holes in four dimensional SU(2) Einstein-Yang-Mills theory
F. Canfora[1], F. Correa[1], **A. Giacomini**[2], J. Oliva[2]
[1] Centro de Estudios Cientificos (CECs), Valdivia, Chile [2] Facultad de Ciencias Fisicas y Matematicas, Universidad Austral de Chile, Valdivia, Chile

An intrinsically non-Abelian black hole solution for the SU(2) Einstein-Yang-Mills theory in four dimensions is constructed. The gauge field of this solution has the form of a meron whereas the metric is the one of a Reissner-Nordström black hole in which, however, the coefficient of the $1/r^2$ term is not an integration constant. Even if the stress-energy tensor of the Yang-Mills field is spherically symmetric, the field strength of the Yang-Mills field itself is not. A remarkable consequence of this fact, which allows to distinguish the present solution from essentially Abelian configurations, is the Jackiw, Rebbi, Hasenfratz, 't Hooft mechanism according to which excitations of bosonic fields moving in the background of a gauge field with this characteristic behave as Fermionic degrees of freedom.

Spacetimes without event horizons - what happens with the asymptotic quasi-normal modes?
Cecilia Chirenti[1], Alberto Saa[2], **Jozef Skakala**[1]
1. UFABC, Santo Andre, Sao Paulo, Brazil, 2. UNICAMP, Campinas, Sao Paulo, Brazil

We explore the question of what happens with the asymptotically highly damped quasi-normal modes (ℓ fixed, $|\omega_I| \to \infty$) when the underlying spacetime has no event horizons. We consider the characteristic oscillations of a scalar field in a large class of asymptotically flat spherically symmetric static spacetimes without (absolute) horizons, such that the class accommodates the cases that are known to be of some sort of physical interest. The question of the asymptotic quasi-normal modes in such spacetimes is relevant to elucidate the connection between the behavior of the asymptotic quasi-normal modes and the quantum properties of event horizons, as put forward in some recent important conjectures. We prove for a large class of asymptotically flat spacetimes without horizons that the scalar field asymptotically highly damped modes do not exist. This provides in our view additional evidence that there is indeed a close link between the asymptotically highly damped modes and the existence of spacetime horizons (and their properties).

Observational Constraints on Semi-holographic Universe
Juan Magaña[1], Víctor H. Cárdenas[1], J. R. Villanueva[1]
[1] DFA, Universidad de Valparaíso, Valparaíso, Chile.

In a recent work Zhang and Li (2010) proposed a model for dark energy assuming this component strictly obeys the holographic principle. They performed a dynamical system analysis, finding a scaling solution which is helpful to solve the coincidence problem. However they need explicitly a cosmological constant. In this paper we derive an explicit analytical solution, without Λ, that shows agreement with the Supernovae data. However this solution is not physical because violate all the energy conditions.

Exploring a simple notion of averages for tensor fields in general relativity
E. F. Boero and O. M. Moreschi
FaMAF, Universidad Nacional de Córdoba, Córdoba, Argentina

The Friedmann-Lematre-Robertson-Walker models confronted with observations suggest an accelerating scale factor at this time. Since standard source of energy seems not account for explain this acceleration, an unknow kind of energy has been postulated. In it simplest form this Dark Energy takes the form of a cosmological constant. But many authors have pointed about the need to consider in more details the way in which we arrive to this geometries from the inhomogeneities present in smaller scales. One way to try tackle this, is by means of averages, but averages are also involved in gravitation in other situation. Commonly a notion of averages involves integration, in the context of a system described by tensor fields such as in general relativity, it would think that we should integrate tensor quantities over a space-time volume in order to do averages. This is a rather critical point because integration of tensor quantities have no natural definition in curved spacetimes. In the literature there are numerous works that present inequivalent approaches to the notion of average of tensors in curved spacetimes. In our work, we would like to avoid the introduction of extra structure. For this reason we take a simpler approach and base the notion of average to the problem of averages scalars. This leads us to the need of the introduction of a base of vectors which are used to take components of the corresponding tensors. First, one where we have a mass distribution that at large scale is nearly spherically symmetric and where we use a tetrad adapted to this global symmetry. The second one is found in the study of cosmology where the space-time at largest scales is assumed to be spatially homogeneous and isotropic. In this case we are interested in averages on the past null cone.

On the linear stability of the extreme Kerr black hole under axially symmetric perturbations
Sergio Dain and **Ivan Gentile de Austria**
FaMAF, Universidad Nacional de Córdoba, Córdoba, Argentina

We prove that for axially symmetric linear perturbations of the extreme Kerr black hole there exists a positive definite and conserved energy which control the norm of the solution. This provides a criteria for linear stability in the sense that exponential growing modes can not occur. In the particular case of Minkowski, this energy allows also to control pointwise the solution in a straightforward way.

Inequality between area and angular momentum for objects
P. Anglada[1] and S. Dain[1]
[1] FaMAF, Universidad Nacional de Córdoba, Córdoba, Argentina

In recent works it was proved an inequality between area and angular momentum for axially symmetric black holes. It is natural to ask if it is possible to obtain an inequality valid not only for black holes but also for ordinary objects. We look for a generalisation of this kind of inequality for objects, that means an inequality between a measure of size of the object and its angular momentum. The first attempt is to take the same inequality valid for black holes. Analysing simple cases we obtain arguments, which allows us to infer that the inequality will be false for objects because the area will not be a good measure of the size of an object.

Exact solutions of general relativity, describing dynamically estimated mass and dark matter.
Osvaldo Moreschi, **Federico Geser**
[1] FaMAF, Universidad Nacional de Córdoba, Córdoba, Argentina

In this talk, we will present an exact solution of general relativity equations that correctly adjust observed data from the Coma cluster, corresponding to dynamical estimations of mass, and observations on the shear produced by weak lensing effects. It will be shown that it is possible to satisfy the usual energy conditions using this solution.