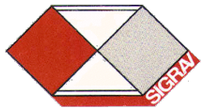

SIGRAV
Società Italiana di Relatività Generale e Fisica della Gravitazione
XVII Congresso SIGRAV "General Relativity and Gravitational Physics"
Torino, 4-7 Settembre 2006

Planary Lectures

M. Bruni (University of Portsmouth),
title to be announced

S. Capozziello (University of Napoli),
Dark Energy and Dark Matter as Curvature Effects

Abstract: Higher order theories of gravity have recently attracted a lot of interest as alternative candidates to explain the observed cosmic acceleration, the flatness of the rotation curves of spiral galaxies and other relevant astrophysical phenomena. Very likely, what we call dark matter and dark energy are nothing else but signals of the breakdown of General Relativity at large scales. Furthermore, PPN-paramete,s deduced from Solar System experiments do not exclude, a priori, the possibility that such theories could give small observable effects also at these scales. We review these results giving the basic ingredients of such an approach.

R. De Pietri (University of Parma),
3D numerical simulation of dynamical instability of compact object in General Relativity

Abstract: The non-axisymmetric dynamical instability of rapidly rotating compact object are a very effective way of generating strongly quadrupolar deformed stellar configuration from axi-symmetric one and may play a significant role in the enhancement of the gravitational wave signal emitted during stellar core collapse.
I present results of simulations in full General Relativity of the dynamical instability against bar-mode deformations of rapidly and differentially rotating neutron stars. Because of the high accuracy and long-term stability of our code we are able to study the BAR-mode dynamical instability of rapidly rotating compact object without the introduction of perturbations in the initial axisymmetric configuration and accurately determine the threshold for the development of the instability as well as the emitted gravitational wave signal. We also find that the instability is non persistent.

S. Ferrara (CERN),
Attractors, Supersimmetry and black holes

A. Giazzotto (INFN Pisa),
Beyond the standard quantum limit: some ideas for a vacuum squeezer

Abstract: Complex problems connected with sensitivity increase, for the next generation of interferometric detectors for gravitational wave, deal with the so called Standard Quantum Limit (SQL). In this talk, the SQL origin and a possible way for circumvent it is presented.

V. Iafolla (IFSI-Roma),
TEPEE/GReAT (General Relativity Accuracy Test in an Einstein Elevator): Separation between the equivalence principle signal and gravity gradient noise

Abstract: The talk reports the advances in the development of an experiment to test the Equivalence Principle (EP) at a level of accuracy equal to EMBED Equation.3 , that is almost two orders of accuracy higher than the results already obtained with lunar laser ranging and ground experiments. Such accuracy requires resolving a very small signal out of the instruments intrinsic noise and the noise associated with the instruments motion. Imperfections in the construction of the differential accelerometer, that detects the differential accelerations due to a possible EP violation, introduce gravity gradient noise that it is possible

to separate from the violation signal only if the apparatus will be spun around an horizontal axis at a known frequency, usually 0.5 Hz. However, the motion also produces a relatively high level of dynamics-related noise. In the test of the Equivalence Principle in an Einstein Elevator (TEPEE/GReAT) under development by our team, the acceleration detector spins about a horizontal axis while free falling for about 25 s inside a co-moving cryogenic capsule released from a stratospheric balloon. After a description of the experiment, various configurations for the differential detector will be shown, able to provide a remarkable separation between the effects of motion and gravity gradients and the EP violation at the spin/signal frequency. Numerical simulations of the detectors dynamics in the presence of relevant perturbations, having assumed realistic errors and construction imperfections, show the merits and demerits of different configurations for the detector. In the talk are also described the latest advances in the development of the detector in terms of i) the electronic set-up to reach the maximum common mode rejection; and ii) the experimental results on prototype instruments showing high sensitivity and common mode rejection factor.

S. Leschiutta (Polytechnic Torino),
title to be announced

J. Lewandowski (University of Warszawa),
title to be announced

A. Marzuoli (University of Pavia),
Quantum Complexity of Chern-Simons Field Theory

S. Matarrese (University of Padova),
title to be announced

V. Moretti (University of Trento),
Some recent rigorous results about QFT on the null boundary of asymptotically flat spacetimes

U. Moschella (University of Como),
Particles and the Cosmological Constant: Lifetime of a de Sitter Particle

F. Nicolò (University of Roma Tor Vergata), *Global Solutions for the Einstein Vacuum Equations and their Asymptotic Behaviour*

G. Palumbo (University of Bologna),
title to be announced

M. Pauri (University of Parma),
Weak objectivity of spacetime: Dis-solution of Einstein's Hole Argument as difference of non-inertial descriptions

M. Roncadelli (INFN Pavia),
Astrophysical and Cosmological Aspects of Dark Matter

Abstract: Viene analizzata in dettaglio l'evidenza osservativa di materia oscura su scala astrofisica (galassie e loro ammassi) e la sua rilevanza cosmologica. Combinando questo risultato con le informazioni fornite dalla cosmologia del big-bang (nucleosintesi primordiale, radiazione cosmica di fondo e supernovae Ia lontane), si discute la natura fisica della materia oscura e lo scenario cosmico che ne emerge.

D. Seminara (University of Firenze),
title to be announced
M. Trigiante (Polytechnic of Torino),
New Superstring compactifications from a Supergravity perspective: flux vacua and dualities

Abstract: Superstring compactifications on internal manifolds in the presence of fluxes have opened new perspectives for string-based phenomenological model-building. The low-energy dynamics of superstring

theory on these backgrounds is, in some limits, encoded in a supergravity theory in which the internal fluxes define local symmetries. We discuss recent results in the study of superstring flux compactifications from a supergravity view-point, emphasizing how the supergravity approach can make highly non trivial duality relations between different microscopic settings manifest.

R. Turolla (University of Padova),
title to be announced

G. Veneziano (CERN),
to be confirmed

A. Vinante (University of Trento),
Development of Wideband Readouts for DUAL Acoustic Gravitational Wave Detectors

Workshop A: Classical and Quantum Theoretical Gravity
Chairmen: M. Carfora, L. Fatibene

G. Esposito (University of Napoli),
Regularized energy-momentum tensor for a Casimir apparatus in Fermi coordinates

Abstract: The energy-momentum tensor of the quantized electromagnetic field between two plane parallel conducting plates in a curved background is derived. We use Fermi coordinates and work to first order in the constant acceleration parameter. A perturbative expansion, to this order, of the Green functions involved and of the energy-momentum tensor is derived by means of the covariant geodesic point splitting procedure. In correspondence to the Green functions satisfying mixed boundary conditions (from gauge invariance) and Ward identities, the energy-momentum tensor is covariantly conserved and satisfies the expected relation between gauge-breaking and ghost parts, while a simple formula for the trace anomaly is obtained to first order in the constant acceleration. A deeper derivation is therefore obtained of the theoretical prediction according to which the Casimir device in a weak gravitational field will experience a tiny repulsive force.

L. Fabbri (University of Bologna),
Spontaneous breaking of conformal invariance in higher order theories of gravitation

Abstract: We study theories of gravitation with higher derivatives. In particular, we focus attention on the conformal (Weyl) gravity, coupled with matter degrees of freedom. Specifically, we consider a triplet of scalar fields and SO(3) non-abelian gauge fields, i.e. the Georgi-Glashow model conformally coupled to Weyl gravity. We show that in asymptotically anti-de-Sitter space-time spontaneous breakdown of conformal symmetry will occur, providing a mechanism for supplying a scale in the theory. Finally, we find that localized soliton solutions correspond to 't Hooft-Polyakov magnetic monopoles. This mechanism allows for the possibility of considering conformally invariant matter-gravity theory, which has shown promising indications concerning the problem of missing matter in galactic rotation curves.

L. Lusanna (INFN Firenze),
The York Map in Tetrad Gravity and the Role of Non-Inertial Frames in the Geometrical View of the Gravitational Field

Abstract: A new parametrization of the 3-metric allows to find explicitly a York map by means of a partial Shanmugadhasan canonical transformation in canonical ADM tetrad gravity and to identify the two pairs of physical tidal degrees of freedom and the 14 gauge variables of the gravitational field. These gauge quantities describe generalized inertial effects . One of them is the trace of the extrinsic curvature of the Cauchy surface: the associated gauge fixing determines the convention for clock synchronization (i.e. the instantaneous 3-space). The main results
i) The explicit form of the Hamilton equations for the two tidal degrees of freedom of the gravitational field in an arbitrary gauge: a deterministic evolution can be defined only in a completely fixed gauge, i.e. in a non-inertial frame with its pattern of inertial forces.
ii) A general solution of the super-momentum constraints, which shows the existence of a generalized Gribov ambiguity associated to the 3-diffeomorphism gauge group. It influences: a) the explicit form of the weak ADM energy and of the super-momentum constraint; b) the determination of the shift functions and then of the lapse one.
iii) The dependence of the Hamilton equations for the two pairs of dynamical gravitational degrees of freedom (the generalized tidal effects) and for the matter, written in a completely fixed 3-orthogonal Schwinger time gauge, upon the gauge variab determining the convention of clock synchronization. Therefore it should be possible (for instance in the weak field limit but with relativistic motion) to try to check whether in Einstein's theory the *dark matter* is a gauge relativistic inertial effect.

R. Giambò (University of Camerino),
Existence of solutions for homogeneous scalar fields in GR: a calculus of variations approach

V. Gili (University of Pavia),

From random Regge triangulations to open strings

Abstract: I will show how Boundary Conformal Field Theory deformation techniques allow for a complete characterization of the coupling between the discrete geometry inherited by uniformization of random Regge triangulations and open string theory, discussing its implications in gauge/gravity correspondence.

D. Malafarina (Polytechnic of Milano),
The dynamical behavior of spherically symmetric thin shells with general equation of state

Abstract: The dynamics of spherical relativistic time-like shells is analyzed under some general assumptions on the equation of state for the matter composing the shell. Solutions describing astrophysical sources of the gravitational field are discussed both for ordinary matter satisfying energy conditions and for exotic matter with positive energy but negative active gravitational mass that can act as a source of dark energy.

L. Modesto (University of),
Black hole singularity in loop quantum gravity

Abstract: In this seminar I summarize the results obtaining studying the black hole singularity problem in the contest of loop quantum gravity. I consider the Kantowski-Sachs space-time and its quantization using ideas from loop quantum gravity theory. The Kantowsi-Sachs metric coincides with the Schwarzschild black hole solution inside the horizon. By studying this model we can obtain information about the black hole singularity and the dynamics across the point $r = 0$ where where the classical singularity is localized. At this point I introduce also the matter and I study the gravitational collapse of a collapsing dust sphere inside the black hole horizon.

M. Ortaggio (University of Trento),
Robinson-Trautman spacetimes in higher dimensions

Abstract: We investigate Robinson-Trautman spacetimes (which admit a hypersurface orthogonal, non-shearing, but expanding geodesic null congruence) in higher dimensional GR. The complete family of solutions to Einstein's equations with an arbitrary cosmological constant (and possibly aligned pure radiation) is presented. Analogies and differences with the well known $D = 4$ case are discussed. While static Schwarzschild-Tangherlini black holes and their generalizations emerge as vacuum solutions of type D, there is no analogue, e.g., of type N spacetimes and of the C-metric within the higher dimensional class.

R. Percacci (SISSA),
The fixed point of higher derivative gravity

G. Valent (LPTHE, Jussieu, Paris),
W-algebras and Bianchi II metrics

Abstract: The geodesic flow of spatially homogeneous Bianchi II metrics is shown to have very special and interesting properties. Among the many possible Ricci-flat or Einstein metrics it is shown that there is a single one with a rich structure of conserved quantities: some linear in the momenta (related to Killing vectors) and some quadratic in the momenta (related to Killing-Stackel tensors). The set of observables is seen to exhibit a finite dimensional W-algebra with respect to the Poisson bracket, a mathematical structure which did not show up, as far as we know, in four dimensional General Relativity, while it was observed in some special two dimensional geometries.

Workshop B: Astrophysics and Cosmology
Chairman: M. Colpi

C. Corda (University of Pisa),
Scalar gravitational waves from scalar-tensor gravity: production and response of interferometers

Abstract: Scalar-tensor gravity admits the existence of scalar modes of gravita- tional waves (SGW). The mechanism of production and the response of in- terferometers to this scalar components of gravitational waves can be stud- ied in three different gauges in the massless case: the transvers-tracelesse (TT) gauge, the so-called Shibata, Nakao and Nakamura (SNN) gauge, and the local Lorentz gauge. The response of interferometers to massless SGWs is invariant in these different gauges. Our work generalizes previ- ous results which, in the study of the coupling between interferometers and massless SGWs, started from the assumption that the wavelength of the SGW is much larger than the distance between the test masses. Furthermore, considering situations motivated by string-dilaton gravity, the effect of a small mass term on the response of the interferometer is taken into account. In this case (massive SGW) we have a longitudinal effect, the response of an arm of an interferometer which is aligned in the wave propagation - direction is computed. The value of the longitudinal response function for non-relativistic massive SGW at high frequencies is very high: this fact opens the doors to the interesting possibility of de- tection of "massive" part of the signal, if advanced pro jects will achieve high sensitivities. Finally, by using previous results and the geometry of the system, the generalized coupling between interferometers (like VIRGO or LIGO) and massless SGWs is studied. The total frequency response function to massless SGWs incoming from arbitrary directions is studied.

M. Daniele (SISSA),
On the environment of short and long gamma ray bursts

L. Gualtieri (University of Roma La Sapienza),
Gravitational wave asteroseismology with strange stars

F. Haardt (University of Insubria),
Gravitational waves from coalescing binary black holes

A. Nagar (Polytechnic of Torino),
Transition from inspiral to plunge in binary black holes systems in the extreme mass ratio

Abstract: using black hole perturbation theory, Effective-One-Body ideas and Pad resummed estimates for the radiation-reaction force, we completely determine the gravitational wave signature for the transition inspiral-plunge-ringdown of a binary (non-spinning) black hole system in the extreme mass ratio. We discuss the features of gravitational waveforms up to the l=4 multipole, energy, angular momentum and linear momentum losses. We focus on the mechanism of excitation of the black hole Quasi.-Normal-Modes and propose analytical methods to well reproduce the smooth transition between the inspiral and the ringdown phase of the gravitational wave signal.

A. Possenti (INAF Cagliari),
On the discovery of rotating radio transients: a new family of neutron stars

M.L. Ruggiero (Polytechnic of Torino),
Rotation effects in binary pulsar systems

Abstract: We study pulsar timing, focusing on the effects induced by rotation of both the pulsar and its binary companion on the observables quantities (gravito-magnetic effects). After reviewing the knows effects, we focus on gravitational lensing in binary systems, and we discuss the influence of different configurations on the detection of gravito-magnetic effects. Furthermore, we evaluate the magnitude of these effects for the binary pulsar systems known so far and, particularly, for the recently discovered system PSR J0737-3039.

R. Salvaterra (University of Insubria),
Cosmic backgrounds from the early universe

R. Schneider (INAF Firenze),
Comic Dawn: the first stars, the first black holes

Workshop C: Experimental Gravity
Chairman: M. Bassan

R. Passaquieti (EGO),
Status of Virgo

Abstract: Virgo, linterferometro italo-francese per la rivelazione di onde gravitazionali, situato nella piana di Cascina (Pi), sta per raggiungere progressivamente la sensibilità di progetto. Saranno presentate le fasi di avanzamento verso questo fondamentale obiettivo, i piani per la raccolta di dati e gli eventuali progetti di futuro sviluppo.

(IFSI/INAF)
Measurement of Newtons gravitational constant G using one axis gravity gradiometer

(IFSI/INAF)
The Italian Spring Accelerometer (ISA) and the BepiColombo mission to Mercury: the Radio Science Experiments (RSE) and ISA technical features