(Dated: September 19, 2009)

Valerio Bozza: L'enigmatico evento di microlensing OB-08-510

Il microlensing si propone come uno dei metodi pi efficienti per la ricerca di pianeti extrasolari di piccola massa. Il progetto MiNDSTEp propone un protocollo decisionale automatico per selezionare gli eventi di microlensing pi promettenti per la rivelazione di pianeti. Grazie a questo protocollo, nell'evento OB-08-510 dell'agosto 2008 stata riconosciuta un'anomalia che sarebbe altrimenti sfuggita. In questo talk ripercorriamo le fasi della scoperta e della controversa analisi, che alla fine ha riservato una sorpresa inaspettata.

Sebastiano Calchi Novati: Microlensing verso M31 al telescopio di Loiano

Il microlensing gravitazionale permette lo studio della componente di materia oscura negli aloni galattici in forma di oggetti compatti (MACHOs). Presento i primi risultati di una campagna osservativa di microlensing in direzione di M31 condotta al telescopio di Loiano (Osservatorio Astronomico di Bologna). In particolare, durante il 2007 abbiamo rilevato 2 nuovi candidati eventi di microlensing. Infine, accenno alla possibilita' di osservare pianeti extra-solari in M31

Monica Capone: Accelrating cosmology in Rastall's theory

In an attempt to look for a viable mechanism leading to a present day accelerated expansion, we investigate the possibility that the observed cosmic speed up may be recovered in the framework of the Rastall's theory, relying on the non - conservativity of the stress - energy tensor, i.e. $T^{\mu}_{\nu;\mu} \neq 0$. We derive the modified Friedmann equations and show that they correspond to Cardassian-like equations. We also show that, under suitable assumptions on the equation of state of the matter term sourcing the gravitational field, it is indeed possible to get an accelerated expansion, in agreement with the Hubble diagram of both Type Ia Supernovae (SNeIa) and Gamma Ray Bursts (GRBs). Unfortunately, to achieve such a result one has to postulate a matter density parameter much larger than the typical $\Omega_M \simeq 0.3$ value inferred from cluster gas mass fraction data. As a further issue, we then discuss the possibility to retrieve the Rastall's theory from a Palatini variational principle approach to $f(R)$ gravity. However, such an attempt turns out to be unsuccessful.

Vincenzo Fabrizio Cardone:

Salvatore Capozziello: Relativistic Orbits and Gravitational Waves from Gravitomagnetic Corrections

Corrections to the relativistic orbits are studied considering higher order approximations induced by gravitomagnetic effects. We discuss in details how such corrections come out taking into account "magnetic" components in the weak field limit of gravitational field and then the theory of orbits is developed starting from the Newtonian one, the lowest order in the approximation. Finally, the orbital structure and the stability conditions are discussed giving numerical examples. Beside the standard periastron corrections of General Relativity, a new nutation effect is due to the c^{-3} corrections. The transition to a chaotic behavior strictly depends on the initial conditions. The orbital phase space portrait and the gravitational wave production are discussed. Results are compared with the forthcoming LISA experiment sensitivity.

Fernando de Felice: Why Dark Matter is Dark

The concepts of space- and time-velocities and their appropriate sum termed world-velocity were recently discussed by de Felice and Preti (arXiv:0709.3002v2 [gr-qc]). They formulate a Generalized Principle of Relativity which states that "any" particle has a world-velocity equal to the Maxwell's constant "c" with respect to "any" observer. The time-velocity of a particle is proportional to its mass hence a massless particle has time-velocity equal to zero. Such a particle has no link with the time dimension and therefore is termed *achronal*. We conjecture that a dark matter

particle has no link with the time dimension and therefore it must be achronal and massless itself. This would cantradict basic cosmological demands hence the non-particle hypothesis for dark matter is strengthen.

Mariafelicia De Laurentis: Classifying and avoiding singularities in the alternative gravity dark energy models

The future finite-time singularities emerging in alternative gravity dark energy models are classified and studied in Jordan and Einstein frames. It is shown that such singularity may occur even in flat spacetime for the specific choice of the effective potential. The conditions for the avoidance of finite-time singularities are presented and discussed. The problem is reduced to the study of a scalar field evolving on an effective potential by using the conformal transformations. Some viable modified gravity models are analyzed in detail and the way to cure singularity is considered by introducing the higher-order curvature corrections. These results maybe relevant for the resolution of the conjectured problem in the relativistic star formation in such modified gravity where finite- time singularity is also manifested.

Giampiero Esposito: NA12 towards 2010

Lorenzo Fatibene: Further Extended Theories of Gravitation

We shall discuss examples of f(R) theories in Palatini formulation with matter couplings depending on the connection. Matter couplings are choosen so that the connection on-shell obeys Ehlers-Pirani-Schild compatibility condition between affine and metric structure of spacetime. SItuations are encountered which are quite different from the standard f(R) theories.

Lorenzo Fatibene: New Cases of Universality Theorem in Gravitational Theories

We present a formulation of f(R) theories in tetrad-affine formulation in terms of the Barberi-Immirzi connection. Each of these models is shown to be equivalent to the corresponding f(R) model in Palatini formulation and hence in vaccum it is equivalent to vacuum Einstein theory with suitable consmological constant.

Lorenzo Fatibene: Loop Quantization for f(R) Theories

We investigate the constraint structure for the extended models presented above, though in the simplier case of Euclidean selfdual formulation. We shall show that in vacuum one obtains LQG with suitable consmological constant, thus extending the universality result at quantum level. This also provides the possibility of using LQG techniques in f(R) models (e.g. one obtains discretization of spacetime) to study quantum effects.

Mauro Francaviglia: Dark Matter, Dark Energy and Dark Metric in the Palatini Formalism

It is nowadays clear that General Relativity cannot be the definitive theory of Gravitation due to several shortcomings that come out both from theoretical and experimental viewpoints. At large scales (astrophysical and cosmological) the attempts to match it with the latest observational data lead to invoke Dark Energy and Dark Matter as the bulk components of the cosmic fluid. Since no final evidence, at fundamental level, exists for such ingredients, it could be useful to reconsider the gravitational sector in order to see if suitable extensions of General Relativity could solve the shortcomings present at infrared scales. On the other hand, the attempts to formulate more general theories than Einstein's one give rise to mathematical difficulties that need workarounds that, in turn, generate problems from the interpretative viewpoint. We present here a completely new approach to the mathematical objects in terms of which a theory of Gravitation may be written in a first-order ('a la Palatini) formalism, and introduce the concept of Dark Metric which could completely bypass the introduction of disturbing concepts as Dark Energy and Dark Matter

Luca Lusanna: Post-Minkowskian Gravity: Dark Matter as a Relativistic Inertial Effect?

We study canonical gravity in asymptotically flat spacetimes in the York canonical basis, where the tidal effects of the gravitational field are identified and separated from the inertial effects. In this basis the trace 3K of the extrinsic curvature of the instantaneous 3-space is the gauge variable describing the inertial effects connected with the freedom in clock synchronization (it does exist in Newtonian gravity where the Euclidean 3-space is absolute). We make the weak field approximation in a family of non-harmonic gauges where the 3-metric is diagonal but 3K free with N scalar particles as matter (with a suitable regularization of the self-energies). We get a formulation of post-Minkowskian gravity (resummation of the post-Newtonian expansions) with gravitational waves with asymptotic background. In the low velocity limit the particles feel the Newton gravitational potential with a v/c correction depending on 3K: like in MOND there is a modification of the motion at low accelerations and 3K can be fitted to the rotation curves of galaxies, showing the possibility that at least part of the dark matter could be a relativistic inertial effect due to the non-Euclidean nature of 3-space near matter.

Luigi Mancini: La connessione fisica tra la massa dei buchi neri delle galassie e lenergia cinetica dei corrispondenti bulge stellari

In questo contributo sara' discussa la relazione tra la massa dei buchi neri supermassicci al centro delle galassie e l'energia cinetica dei moti random dei bulge corrispondenti. Vedremo che questa relazione risulta essere uno strumento utile per studiare l'evoluzione delle galassie dal momento che la massa del buco nero da' una stima dell'eta' e l'energia cinetica e' direttamente connessa con la temperatura del sistema galattico. La nostra relazione verra' infine messa a confronto con altre relazioni e con i risultati di modelli semi-analitici.

Ninfa Radicella:

Paolo Scudellaro:

Mauro Sereno:

Francesco Sorge: On the gravitational scattering of quantum fields

Working in the weak field approximation, we study the scattering of quantum fields from a gravitational source. For definiteness, we consider the electromagnetic radiation field as well as a massive scalar field, both propagating in a slightly curved spacetime and employ the rst-order Born approximation to deduce the scattering cross-sections of the process. We find that the (unpolarized) cross section for the electromagnetic field, coincides (at the tree level) with the classical value, predicted by General Relativity; also our results fairly agree with those obtained by other authors in some previous works. On the other hand, our analysis of the massive scalar field leads to results which are quite different when compared with those presented e.g., in the papers by Golowich *et al.* (1990 *Am. J. Phys.* **58** 688) and by Uno *et al.* (1996 *Phys. Lett. A* **223** 137). Actually, we find that the quantum behaviour deviates from its classical counterpart, showing an *enhancement* in the cross-section as the massive field approaches the *non-relativistic regime*. We critically discuss and compare our results and those of the above Refs., attempting to give a possible physical justification of such a puzzling issue in terms of quantum non locality.

Cosimo Stornaiolo: Spacetime deformations and the backscattering problem

In this talk, I would like to discuss the properties of the spacetime deformations as a way to extend the family of solutions in gravitational theories to the cases without particular symmetries. Application to the inhomogeneous cosmologies will be discussed and I will try to interpret the scalar functions which are usually introduced as an ad hoc device to explain the properties of the universe in terms of the scalar fields introduced by the deformation of the metric, attempting to formulate the backscattering problem in a covariant way.

Angelo Tartaglia: Attività di ricerca del gruppo RELGRAV: Struttura dello spazio tempo, Posizionamento globale relativistico, Gravitomagnetismo sperimentale