
The Time Machine Factory
[unspeakable,speakable] on Time Travel in Turin
October 14-19, 2012
Future
Past
http://timemachine.polito.it
S C
Orfeu Bertolami (FCUP, Univ. Porto)
Donato Bini (Ist. M. Picone, CNR, ICRA and INFN)
Salvatore Capozziello (Univ. Napoli and INFN)
Sandro Coriasco (Univ. Torino)
Mariateresa Crosta (chair, INAF,OATo)
Fernando de Felice (Univ. Padova)
Mauro Francaviglia (SIGRAV, Univ .Torino)
Marco Genovese (INRiM)
Marco Gramegna (co-chair, INRiM)
Robert T. Janzen (ICRA,Villanova Univ. USA)
Christophe Leponcin-Lafitte (SYRTE, Obs. de Paris)
Matteo Luca Ruggiero (co-chair, Politecnico and INFN)
Oldrich Semerak (ÚTF, Charles Univ., Prague)
Angelo Tartaglia (Politecnico and INFN)
L C
Ummi Abbas (INAF,OATo)
Stefano Bertone (OATo-SYRTE, Obs. de Paris)
Monica Capone (Univ. Torino and INFN)
Tullia Carriero (INAF,OATo)
Sandro Coriasco (Univ. Torino)
Mariateresa Crosta (INAF,OATo)
Marco Gramegna (INRiM)
Roberto Morbidelli (INAf-Oato)
Matteo Luca Ruggiero (Politecnico and INFN)
Enzo Obiso (Phos)
Maria Sarasso (INAF-OATo)
Paolo Traina (INRiM)
POLITECNICO DI TORINO
INRiM ISTITUTO NAZIONALE DI RICERCA METROLOGICA
MUSEO REGIONALE DI SCIENZE NATURALI
MUSEO NAZIONALE DEL CINEMA
MARTINI
IED Torino
PHOS
Sponsors
Gaia DPAC
INTESA SANPAOLO
Patronage
PROVINCIA DI TORINO
REGIONE PIEMONTE
CITTÀ DI TORINO

October 2, 2012, Turin (Italy)

"TM2012 - The Time Machine Factory"
Scientific Conference and Multidiscipinary Events

The Scientific Organizing Committee Chairs of "**The Time Machine Factory**" Event (TM2012) would like to bring to the attention of whom could be interested that Osservatorio Astrofisico di Torino (OATo-INAF), Istituto Nazionale di Ricerca Metrologica (INRIM), and Politecnico di Torino, are organizing a special scientific appointment that will be held at the Natural Science Museum (MRSN) of Turin, Italy:

THE TIME MACHINE FACTORY
[UNSPEAKABLE, SPEAKABLE] ON TIME TRAVEL - IN TURIN

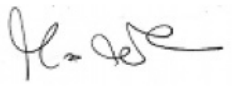
The conference focuses on causality and nonlocality in physics, with emphasis on their relation with time machines. There are three main objectives before this conference: (i) revive the interest in time travel, which is not prohibited by current laws of physics, (ii) provide the opportunity for debating the views of General Relativity and Quantum Mechanics on time travel, and (iii) contribute toward a comprehensive vision for the years to come including anticipations of potential applications.
In order to get a deeper insight into the ultimate nature of time, these issues will be discussed from different viewpoints, encompassing Foundations of General Relativity and Quantum Mechanics, Spacetime Navigation and Quantum Metrology, without neglecting a multidisciplinary vision for a time machine conception. To this end, special events will be organized in collaboration with the Regional Museum of Science in Turin, National Museum of Cinema, PHOS, IED Istituto Europeo di Design and the Blah-Blah Club.

The official Conference website can be visited at the following address: http://timemachine.polito.it

On behalf of the Scientific Organizing Committee, the SOC Chairs remain at full disposal for any further information and invite anyone interested to have a look at the program presented here.

Our warmest regards,

Dr. Mariateresa Crosta

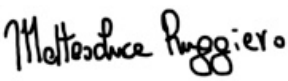


Mariateresa Crosta
crosta@oato.inaf.it
INAF-OATo, via Osservatorio 20, 10025 Pino Torinese (TO), Italy

Dr. Marco Gramegna

Marco Gramegna
m.gramegna@inrim.it
INRIM, Strada delle Cacce 91, 10135 Torino, Italy

Dr. Matteo Luca Ruggiero



Matteo Luca Ruggiero
matteo.ruggiero@polito.it
DISAT-Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

[Enclosed Documents]

THE TIME MACHINE FACTORY
[unspeakable, speakable] on Time Travel - in Turin
Museo Regionale di Scienze Naturali
14-20 Ottobre 2012

Scientific Organizing Committee

Dr. Mariateresa Crosta (chair, INAF-OATo); Dr. Marco Gramegna (co-chair, INRIM); Dr. Matteo Luca Ruggiero (co-chair, DISAT - Politecnico di Torino, INFN); Prof. O. Bertolami (Dep. de Física e Astronomia, Faculdade de Ciências, Univ. Porto); Dr. Donato Bini (Ist. M. Picone - CNR, ICRA, INFN); Prof. Salvatore Capozziello (Università di Napoli, INFN); Dr. Sandro Coriasco (Dip. Matematica, Università di Torino); Prof. Fernando de Felice (Dip. Fisica - Università di Padova); Prof. Mauro Francaviglia (SIGRAV; Università di Torino); Dr. Marco Genovese (INRIM); Prof. Robert T. Janzen (ICRA, Villanova Univ. USA); Dr. Chr. Leponcin-Lafitte (SYRTE, Obs. de Paris); Prof. O. Semerak, (Institute of Theoretical Physics, Charles University, Prague); Prof. Angelo Tartaglia (DISAT - Politecnico, INFN).

Local Organizing Committee

Dr. Ummi Abbas (INAF-OATo); Dr. S. Bertone (OATo-INAF; SYRTE – Obs. De Paris); Dr. Monica Capone (Dip. Matematica - Univiversità di Torino, INFN); Dr. Tullia Carriero (INAF-OATo); Dr. Sandro Coriasco (Dip. Matematica - Università di Torino); Dr. Mariateresa Crosta (INAF-OATo); Dr. Marco Gramegna (INRIM); Dr. Roberto Morbidelli (OATo-INAF); Dr. Matteo Luca Ruggiero (DISAT - Politecnico di Torino, INFN); Dr. Maria Sarasso (INAF-OATo); Dr. Paolo Traina (INRIM); Enzo Obiso (PHOS).

Website and Social Media Profiles

http://timemachine.polito.it
http://www.facebook.com/timemachine2012
http://twitter.com/timemachine2012

Summary description of the initiative

(Aim and Scientific Rationale webpage: http://timemachine.polito.it/home/?q=node/29)

The Time Machine Factory - TM2012 Event is organized by Osservatorio Astrofisico di Torino (OATo-INAF), Istituto Nazionale di Ricerca Metrologica (INRIM), and Politecnico di Torino (POLITO). The cutting edge scientific program consists of five days of meeting to be held at the Museo Regionale di Scienze Naturali of Turin. Internationally renowned experts in theoretical and applied physics will meet with philosophers, to bring perspective into a multidisciplinary approach to the complex fascinating issues defining the deep nature of time and time travel. This

initiative aims to inaugurate a cycle of far reaching conferences interlacing General Relativity and Quantum Mechanics.

The possibility of time travel, both in the past and into the future of a given observer, has left the realm of pure imagination to come into physical plausibility, starting with the seminal works by Chandrasekhar and Carter, followed by that of de Felice, Clarke, Thorne, and Novikov and several others. The early work by de Felice and collaborators showed how physically possible trajectories can be grown under conditions of time reversal in the Kerr metric, in the presence of naked singularities (Gen. Rel . & Gravity, 9155-163, 1978, Gen. Rel & Gravity, Gen. Rel Grav, 16 889, 197810335-341, 1979, The Nuovo Cimento 65B 224-232, 1981, Gen. Rel & Gravity 16139-148, 1984). A strong impetus to the deepening of such studies came also from the findings of K. S. Thorne, Novikov and collaborators, who revealed the possible presence of wormholes (Phys. Rev. D 44 1077, 1991, Phys. Rev. Lett. 61 1446, 1988, Int. J. Mod Phys. D4 557, 1995). The central theme in all of these works was the study of causality and, in particular, the need for an anomalous time behavior able to preserve causality itself in spite of apparent violations. The difficulty of the subject combined with a persistent skepticism about the physical plausibility of this phenomenon repeatedly slowed progress in this area of advanced research.
Despite of all this, recent developments have opened new perspectives for the "realization" of a time machine (Phys. Rev. Lett. 106, 040403, 2011) related to the issue of quantum non-locality (Phys. Rev. 47, 777, 1935, Physics, 1: 195-200, 1964) resulting from entanglement (Proceedings of the Cambridge Philosophical Society, 31, 555-563, 1935; 32, 446-451, 1936; Rev. Mod. Phys. 81, 865-942, 2009) and, in particular, to the phenomenon of teleportation (Nature 390, 575-579, 1997, Phys. Rev. Lett. 80, 1121-1125, 1998). The topological nature of spacetime in the framework of Quantum Mechanics suggests that both causality and locality need to be analyzed at a fundamental level, also by allowing the existence of entities that are more elementary than the spatial dimensions of everyday life. The interplay of these entities influences the very nature of time, and their dynamics could lead to the understanding of the emergence of the arrow of time.
Focusing on these issues would help unveiling the ultimate nature of causality, its role in fundamental physics and in the evolution of the Universe. This would allow for a better comprehension of the "direction" of large scale structure, including complex formation such as that of black holes or hierarchical structures like the Galaxy, with obvious implications on the process of mapping the Universe on local and global scales, which must remain consistent with the theories of General Relativity and Quantum Mechanics.
For this reason, a session of the conference is devoted to the definition of the astronomical reference systems and the transformations of relativistic time necessary for the realization of the next generation of relativistic astrometric maps (the ESA mission Gaia and beyond) and the timings generated by the GPS satellite systems, like Galileo, or those proposed for the ACES mission, inevitably linked to quantum metrology.

Finally, a complex subject like time travel cannot be dealt with without a multidisciplinary vision: for this reason the conference will devote sessions to the historical, philosophical, and psychological aspects in the perception of time-machine. Events for the public dissemination of Science such as lectures, round tables, concert, movies and photo reportage will be held to provide a parallel view on scientific aspects and collective imagination, in collaboration with, Museo Regionale di Scienze, Museo Nazionale del Cinema, Blah Balh club, PHOS and IED.

The Media coverage will be mandated by national broadcasters and newspapers, as well as the web streaming of seminars and public conferences will be provided.
Conference proceedings are demanded to EPJ – European Physical Journal (Web of Conference) and a commemorative photo exhibition are also planned.

Institutional Sponsorships, Patronages, and Partnerships

(updated list available on the website)

Osservatorio Astrofisico di Torino
Politecnico di Torino
Istituto Nazionale di Ricerca Metrologica
Istituto Nazionale di Astrofisica
Agenzia Spaziale Italiana (ASI) - Gaia DPAC (Data Processing and Analysis Consortium)

Camera di Commercio Industria, Artigianato e Agricoltura di Torino (Chamber of Commerce, Industry, Handicraft and Agriculture)
Intesa-Sanpaolo
Città di Torino
Regione Piemonte
Provincia di Torino
SIGRAV
Museo Regionale di Scienze Naturali (MSRN)
Museo Nazionale del Cinema (National Museum of Cinema)
IED Istituto Europeo di Design
PHOS (Multipurpose Center for Photographic and Visual Arts)
minimum fax
SMAT
Martini&Rossi

Contact points of the principal organizers

Dr. Mariateresa Crosta
OATo-INAF, via Osservatorio 20, 10025 Pino Torinese (TO), Italy
Tel. 0118101922, crosta@oato.inaf.it

Dr. Matteo Luca Ruggiero
DISAT - Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
Tel. 0110907328, matteo.ruggiero@polito.it

Dr. Marco Gramegna
INRiM, Strada delle Cacce 91, 10135 Torino, Italy
Tel. 3393785842, 0113919251, m.gramegna@inrim.it

Locations

@MRSN: Museo Regionale di Scienze Naturali, via Giolitti 36,Torino
http://www.regione.piemonte.it/museoscienzenaturali/

@Cortile del Rettorato, Università degli Studi di Torino, via Po 17, Torino
http://www.visitatorino.com/palazzo_universita.htm
http://www.unito.it

@Politecnico di Torino, corso Duca degli Abruzzi 24, Torino
@Castello del Valentino (Polito), Viale Mattioli 39, Torino
http://www.polito.it

@Museo Nazionale del Cinema – Cinema Massimo, Sala 3, via Verdi 18, Torino
http://www.museonazionaledelcinema.it/

@BLAH-BLAH Club, Via Po 21, Torino
http://www.blah-blah.it/
BlahBalh club will be the evening reference place to meet conference participants.

OPENING CERIMONY

October 14, 2012 @MRSN

18:00 – 19:30

TEA String Quartet *(Genre: Chamber, Classic & Contemporary Music)*

Carlotta Conrado: Violin
Irene Cardo: Violin
Ula Ulijona Zebriunaite: Viola
Claudia Ravetto: Cello

A string time machine

The string quartet. A musical organism which allows for a journey through different ages in music history, like a virtual time machine. Sixteen strings that start from the English baroque with Purcell, at the end of the XVII Century, and travel chronologically through Bach, Haydn, Mendelssohn, Wolf and Pärt, reaching a work by Stefano Pierini, "Kairos", written specially for "The Time Machine Factory", after the scheme of the star chart corresponding to the space-time event of the performance: Turin, October 14th 2012, 6 pm. As to say, the apogee of contemporaneousness: the journey towards the observed present.

Henry Purcell is commonly considered as the greatest English composer before Edward Elgar. The *Chaconne* in G minor for strings is one of the instrumental pieces that he wrote as "Composer-in-ordinary" for the Twenty-four Violins of the King, after 1677. It is a work named after a French dance called "*Chaconne"*, running over a repeated bass line and showing reminiscences of an even earlier musical tradition, both harmonically and formally.
Die Kunst der Fuge, or *The art of fugue*, is a collection of pieces written by **Johann Sebastian Bach** which consists of fourteen *fugues*, called *contrapunctus*, and four *canons*. Bach did not intend this work to be actually performed by a specific group of instruments. They are therefore compositions which have mostly to be considered as a theoretical opus, addressed to musicians initiated in the art of the most sublime counterpoint, and that conceal obscure symbols and meanings described from time to time as "esoteric" as well as "scientific" or "religious". *The Art of Fugue* is normally played by several instrumental solutions which have become traditional with time, from the simple organ performance to the string quartet.
The string quartet as a musical genre is considered to have come into being with **Franz Joseph Haydn**, who developed its formal features and accomplished its perfection codifying schemes and balances among its various parts. He also conceived its traditional formal division in four movements. The quartets belonging to the Opus 20, also known as "*Divertimenti*", were written in 1722, during Haydn's thirty year flourishing period with the Esterhàzy family, as *Kapellmeister*.
Felix Mendelssohn's chamber music reflects his sophisticated and brilliant style, in which virtuosity is never an end in itself. Mendelssohn wrote six complete string quartets, during a period which runs from 1823 to 1847, the year of his death. There are also four separate movements though, written from 1827, which were later joined together in Opus 81 under the title of "Four Pieces for String Quartet", and that can be played either together or separately. Here, the *Scherzo* and the *Allegro leggero* are joined to the *Intermezzo* from Quartet N. 2 in A major Op. 13, which balances the A minor of the opening Scherzo.
Hugo Wolf is celebrated mainly for his important corpus of *Lieder* which were accomplished in nine years that represent his short creative period, before his premature death in a madhouse, aged 43. He did not disdain instrumental chamber music and wrote, besides a Violin Sonata and several piano pieces, two string quartets and the famous *Italian Serenade*, another string quartet in a single movement representing one of the highest moments of his composing technique. In it, the melodic lines typical of his vocal works contract in brilliant and virtuoso writing that strikes the listener.
Summa is a highly evocative piece, originally conceived for an "*a cappella*" choir in 1977 by **Arvo Pärt**, an Estonian composer born in 1935. The lyrics of the work come from the *Credo* of the Catholic liturgy, presented in a syllabic scheme, vaguely hypnotic. In the string quartet version, even without the suggestion of the sung word, several sacred symbolic elements endure: the main thematic group is composed of twelve notes representing the twelve apostles, while the forty-two repetitions emblematize the different generations from Abraham to Jesus.

Kairos, for string quartet, by **Stefano Pierini**, represents an undefined period of time in which something special happens: it is the qualitative time, in opposition to *Kronos*, as quantitative time. Today's star chart, after which the piece has been composed, provides the "temporal quality" of this particular moment, which is infinitesimal when referred to the universe, and at the same time extremely long if compared to some earthly life forms. Becoming music, this moment creates a further form of time: the poetical one.
Courtesy of L.Ripanti

20.30 – 21:30 performing art&science

The Network of Space-time Interlacements

P. Anziché and M. Crosta

"The Network of Space-time Interlacements" develops a relationship among sculpture, architecture and the public, or among objects, space and bodies through the direct use of the artwork as an "interaction" tool. The Network is made of regularly interlaced elastic strings and fabric in which people are invited to enter and simulate physical interactions dictated by the geometry of space-time created by the physical involvement of their own bodies now part of the structure itself. The movements of each person influence the other participants and, together, transform the macroscopic architecture of the network. At the same time, the entanglement breaks the continuity of the network, symbolizing the boundary between "macro" and "micro", where the interplay between general relativity and quantum mechanics could hide new geometries and interactions still to be discovered ("The space-time entaglement. Relativity of space and time: its origin and its mystery " by F. de Felice).
The network creates a structure that follows its users, it provides the conditions for a change in the perception of the surrounding environment, thus stimulating and accommodating different body movements. In this dimension, the experience of each caller becomes that of a participant and, therefore, creating a performance in which the individual movements will determine a multitude of different balances. Physically "belonging" to the exhibition space and actually moving through it materializes what JA Wheeler said "mass tells space-time how to curve, and space-time tells mass how to move".
Therefore, the background lattice is transformed into a force field, attracting as well the "intimate" levels of the spectators who became part of it. The situation that is created is suggestive, playful, and able to involve many people in a highly aesthetic collective action and, at the same time, to return immediately the perception of how the theory of General Relativity "plots" the Universe.
Project by P. Anziché and M. Crosta (OATo) as part of the program for science dissemination and public outreach for the Italian participation in the ESA mission Gaia, funded by the Italian Space Agency ([Intrecci di Rete Spazio-Temporale], INAF-Astrophysical Observatory of Turin, Technical Report no. 158, 26.06.2012). Collaborators: Mario G. Lattanzi, Roberto Morbidelli and Maria Sarasso.

PRELIMINARY SCIENTIFIC PROGRAM

(updated new versions available on the website, please check also on real time: http://twitter.com/timemachine2012 or http://www.facebook.com/timemachine2012)

The scientific program consists of five days of workshops, each session preceded by review talks on the main topics.

Key Arguments

Causality in Physics
Theoretical framework: the causality principle and its apparent violations, closed timelike curves, and blackholes.

Physical aspects: paradoxes, spacetime deformations, wormholes, curvature engines, quantum causality, entanglement, teleportation.

The spacetime machine: travelling from "micro" to "macro" event
The beginning of time, holographic principle, causal connections between microscopic and macroscopic properties of time. Entropy and the arrow of time, the emergent properties of gravity.

The cosmic censorship and our Universe, hypotheses on the local and global spacetime structures of the Universe.
The LHC timemachine.

Astronomy and Metrology: the Earth&Sky as a Timemachine
A historical perspective to the concept of time.
From celestial meridian to the operational definition of the unit of time.
The new era of Astrometry: relativistic mapping, synchronization, spacetime positioning and navigation.

Beaming up the spacetime: travelling from science fiction to reality
The many facets of time perception.
Back and forth from science to science-fiction.
"Action!" on timemachines.

Conference talks @MRSN

October 15, 2012, Monday

09:00 – 09:45
F. de Felice (Univ. Padova, Italy)
The Cosmic Time Machines: the issue of causality saving.
Abstract: The occurrence of closed time-like curves nearby naked curvature singularities seems to allow for causality violation. However, if we require that causality should be preserved as a universal law, then there must exist a mechanism which prevents causality violation whenever this is about to occur. Quantum effects have been invoked as an efficient way to reach the goal, but also classical general relativity gives hints that a mechanism to that purpose really exists. A classical behaviour of test particles in the Kerr metric, in fact, prevents causality violation as result of a self-consistency of the solution. That property went unnoticed for the last thirty-four years [M. Calvani, F. de Felice, B. Muchotrzeb and F. Salmistraro "Time machine and geodesic motion in Kerr metric", Gen. Rel. & Gravit. 9 (1978) 155-163.]. Here we reconsider that effect in view of the new interest about the causality problem.

09:45 – 10:30
E. Minguzzi (Univ. Firenze, Italy)
Chronology Violations and the Origin of Time
Abstract: I will explain the connection between closed timelike curves, singularities and cosmological time. I will then propose a causality argument in order to solve the homogeneity and entropy problems of cosmology. The solution is based on the replacement of the spacelike Big Bang boundary with a null boundary behind which stays a chronology violating region. This solution requires a suitable tilting of the light cones near the null boundary and thus is based more on the behavior of the light cones, and hence on causality, than on the scale factor (expansion). The philosophical connection of this picture with Augustine of Hyppo famous discussion on time and creation is commented.

11:00 – 11:45
D. Bini (Ist. M. Picone- CNR, ICRA, INFN, Italy)
Spacetime Splitting, Admissible Coordinates and Causality
Abstract: To confront relativity theory with observation, it is necessary to split spacetime into its temporal and spatial components. The (1+3) timelike threading approach involves restrictions on the gravitational potentials $g_{\mu\nu}$ while the (3+1) spacelike slicing approach involves restrictions on $g^{\mu\nu}$. These latter coordinate conditions protect chronology within any such coordinate patch. While the threading coordinate conditions can be naturally integrated into the structure of Lorentzian geometry and constitute the standard coordinate conditions in general relativity, this circumstance does not extend to the slicing coordinate conditions. We explore the influence of chronology violation on wave motion. In particular, we consider the propagation of radiation parallel to the rotation axis of stationary Gödel-type universes characterized by parameters $\eta > 0$ and $\lambda > 0$ such that for $\eta < 1$ ($\eta > 1$) chronology is protected (violated). We show that in the WKB approximation such waves can freely propagate only when chronology is protected.

11:45 – 12:30
J. Barbour (Univ. Oxford, Great Britain)
The Role of 'Time' in Shape Dynamics
Abstract: Shape Dynamics is a theory of gravity that, modulo some caveats, is dynamically equivalent to general relativity but has a different underlying symmetry: the refoliation invariance of general relativity is traded for invariance with respect to three-dimensional conformal transformations. However, in a spatially closed universe, these must leave the total volume unchanged since otherwise the universe cannot expand. The theory admits two representations, one in which there is no place for an independent time variable and another in which a more or less uniquely determined internal time can be extracted from the dynamics. This time is absolute in the sense that it provides a unique definition of simultaneity and might be preferred by quantum-mechanical requirements. This suggests the intriguing possibility that the quantum mechanics of the universe enforces expansion of the universe when it enters the classical regime.

12:30 – 13:00
M. Genovese (INRiM, Italy)
Entanglement and quantum non-locality: an experimental perspective
Abstract: Quantum Mechanics represents nowadays one of the pillars of modern physics: so far a huge amount of theoretical predictions deriving from this theory has been confirmed by very accurate experimental data, while the theory is at the basis of a large spectrum of researches ranging from solid state physics to cosmology, from bio-physics to particle physics. Furthermore, in the last years the possibility of manipulating single quantum states has fostered the development of promising quantum technologies as quantum information (calculus, communication, etc.), quantum metrology, quantum imaging, ...
Nevertheless, even after a pluri-decennial debate many problems related to the foundations of this theory persist, like non-local effects of entangled states, wave function reduction and the concept of measurement in Quantum Mechanics, the transition from a microscopic probabilistic world to a macroscopic deterministic world described by classical mechanics (macro-objectivation) and so on.
Problems that, beyond their fundamental interest in basic science, now also concern the impact of these developing technologies. In this talk, we will present a short summary of the present discussion concerning some of these problems, in particular on the connection between entanglement and space-time structure, then we will present some recent experimental works in the field, some of them performed at INRIM.

14:10 -14:45
Ognyan Oreshkov (Centre for Quantum Information and Communication Ecole Polytechnique de Bruxelles Université Libre de Bruxelles)
Quantum correlations with no causal order
To be confirmed

14:45 – 15:20
H. T. Elze (Univ. Pisa, Italy)
On classical control of quantum systems
Abstract: Quantum-classical hybrid systems are described in a consistent way - i.e., such that all consistency requirements are fulfilled that have been discussed in the history of this topic, which has alternated between various no-go theorems and only partially successful attempts before. A consistent quantum-classical hybrid theory may be relevant, for example, for practical issues of controlling quantum objects and for the description of measurements. It might allow to study effects of closed timelike curves on quantum objects in analogue models.

15:20 – 16:05
G. M. D'Ariano (Univ. Pavia, Italy)
Signaling from the future falsifies Quantum Theory
Abstract: Something that many physicists and philosopher of physics are still not completely aware of is the simple fact that time-travels are against quantum theory, and any experiment proving information coming from the future would definitely constitute a falsification of the theory. Quantum theory can indeed be derived from six postulates of purely informational nature, of which the first one is "causality", meaning that the probability distribution of any measurement cannot depend on the choice of a following measurement made on the system at the output of the previous one. This is exactly what we technically mean by "no signaling from the future". Therefore a signaling from the future, in the usual sense, would falsify the theory just through this postulate. In my talk, after briefly reviewing the axioms and the mathematical causal structure of the theory, I will show how some recent proposed modification of the theory cannot be logically consistent. The changes to the theory needed to incorporate time-loops are indeed of more radical nature than simply making a "nonlinear" version of it. I will also shortly present a prototype theory that can incorporate time-loops. In the process, I will dispute also about some philosophy of "causality", including a brief discussion of the common historical misconception of "causality as determinism", and the anti-atropocentric motivations of the train of thought against incorporating causality as one of the law of physics (despite the common everyday use in science and common life), and the connection between the Hume's point of view and the Bayes' interpretation of probability.

16:30 – 17:00
E. Prati (CNR, Italy)
Timeless physics from an experimental perspective
Abstract: I review from a time measurement perspective some critical experiments such as the quantum teleportation of photons in optical circuits [1], the adiabatic passage of electrons in arrays of individual atoms [2], and single atom clocks for the measurement of time [3,4]. From these experiments, speakable and unspeakable in time physics are discussed. The timeless scenario [5,6] which emerges from the experimental picture is confirmed theoretically by fundamental timelessness of the Hamiltonian formalism employed to define dynamics [7,8]. According to these observations, I discuss how to connect experimental clock metrology, commonly employed to describe dynamics of complex systems with simple equations, with the parametrization of trajectories in the phase space [8]. According to the timeless approach, the inconsistencies of the application of the natural language to the concept of closed timelike curves [9,10] are clarified.

[1] D. Bouwmeester et al., Nature 390, 575-579 (1997)
[2] E. Prati et al, Nature Nanotechnology (online from 1 July 2012)
[3] P. Heavner, et al., Metrologia, 42, 5, 411 (2005)
[4] W. H. Oskay, et al., Phys. Rev. Lett. 97, 020801 (2006)
[5] B. S. De Witt, Quantum Theory of Gravity. I, Phys. Rev. 160, 1113 (1967)
[6] C. Rovelli, Quantum Gravity, Cambridge University Press (2006)
[7] J.B. Barbour, Class. Quantum Gravity 11, 2875 (1994) and Class.Quantum Gravity 11, 2898 (1994)
[8] E. Prati, Journal of Physics: Conference Series 306, 012013 (2011)
[9] D. Deutsch, Phys. Rev. D 44, 3197 (1991)
[10] Todd A. Brun, Jim Harrington, and Mark M. Wilde, Phys. Rev. Lett. 102, 210402 (2009)

17:00 – 17:45 *open lecture*
R. Buccheri (ITD-CNR, Palermo, Italy)
M. Alfano (Conservatorio G. Frescobaldi, Ferrara, Italy)
What Kind of Time for a Time Machine?
Abstract: We claim that the linear, unstructured, parameter t used in the equations of mechanics, in spite of its great amenability in the description of motion, cannot be taken as a precise representation of such a primary concept. Time, as the possible key factor of our cerebral modulation and therefore mediator between us and the world, cannot be

objectified, being the main foundation upon which we build our knowledge of nature through our continuous and inescapable interaction with it. Therefore, any imagined and theoretically possible Time Machine, aimed to get us in the past or in the future, does not have any practical grounds if it is built − as it were − by using the illusory, impersonal, time modeled by the parameter t at the place of our interpersonal lived time th. A th-based Time Machine can only arise, in our opinion, if and when th will be integrated in the body of physics, as repeatedly suggested by Ilya Prigogine. Ongoing joint research in neurophysiology and physics – without neglecting any important contribution coming from anthropology – will surely help to meet such an objective.

17:45 – 18:00 *open lecture*
S. Fiorina: "I think the color" (IED, Turin)
Starting from the point that, for me, we can draw on the color, that is my highest inspiration, and we can draw on it almost like eternal youth, that everybody can reach. In this way the color is timeless and infinite. Just as white light, without which, colors wouldn't exist.
My project, connects the thought of the time, that pass inexorably, almost as it has never existed, with the concept of the color as the only way out for the man's release from the grayness society, in which we are not allowed to admire what remains real.
Therefore, what I am saying, is that we can only imagine that, because they don't know what we can create with our imagination.

With reference to Fiorina Picture presented @TM2012:
Time Machine © Stefano Fiorina, student of the 3rd year IED Course of Photography, Istituto Europeo di Design Torino

18:00 – 18:30 *open lecture*
Vanjia V. Malloy (Courtauld Institute of Art, Great Britain)
Astronomy and Time in Modern Art: Rethinking Alexander Calder's Mobiles
Abstract: John Keats once wrote that 'there is no such thing as time and space' rather, believing that time and space are mental constructs that are subject to a variety of forms and as diverse as the human mind. In the 1920s through the 1930s, modern physics in many ways supported this idea through the various philosophical writings on the Theory of General Relativity to the masses by scientists such as Arthur Eddington, Albert Einstein and Gaston Bachelard. These new concepts of modern physics fundamentally changed our understanding of space, suggesting that space and time are linked through the fourth-dimension and that space can be non-Euclidean. These scientific developments had substantial philosophical implications, which were absorbed by modern artists and resulted in the 1936 Dimensionist Manifesto. Seeking to internalize the developments of modern physics and astronomy within modern art, this manifesto was widely endorsed by the most prominent figures of the avant-garde such as Marcel Duchamp, Jean Arp, Naum Gabo, Joan Miró, László Moholy-Nagy and Wassily Kandinsky. Marking that astronomy was the main source for this cross-disciplinary interest, the Manifesto called for the creation of an absolutely new art: 'cosmic art' in which a total conquest of the art of four-dimensional space-time was achieved. This new concept of the fourth-dimension revolutionized the arts and varied widely in its interpretation by the artistic community, ranging from a purely physical four-dimensional space, to a kinetic concept of space in which space and time are linked, to a metaphysical understanding of space that was associated with the spiritual and eternal. The impact of modern science and astronomy on avant-garde art is currently a developing area of research with the ground breaking work of Linda Henderson's 1983 book Fourth Dimension and Non-Eucleidean Geometry in Modern Art and Gavin Parkinson's 2008 book Surrealism, Art and Modern Physics. By focusing on a case study on the American sculptor Alexander Calder, this paper will explore how his series of Mobiles were conceptually based on this new understanding of time and by the current-day developments in astronomy.

October 16, 2012, Tuesday

09:00 – 09:30
F. Sciarrino (Università La Sapienza, Italy)
Quantum technologies: toward an integrated optical simulator
Abstract

09:30 – 10:15
L. Maccone (Univ. Pavia, Italy)
A Quantum Theory of Time Travel
Abstract: A widely accepted quantum theory of CTCs was proposed by Deutsch. Here we analyze an alternative quantum formulation of CTCs proposed by Bennett and Schumacher and show that it is physically inequivalent to Deutsch's. Because it is based on combining quantum teleportation with post-selection, the predictions / retrodictions of our theory are experimentally testable: we report the results of an experiment demonstrating our theory's resolution of the well-known `grandfather paradox'. We derive the dynamical equations that a chronology-respecting system interacting with a CTC will experience.

10:15 – 10:45
E. Cohen (Weizmann Institute of Science, Israel)
The Future's Subtle Presence within the Present: A Novel Quantum Mechanical Demonstration of Reversed Causality
Underlying the idea of time travel is the Block Universe view, according to which time resembles the spatial dimensions to the extent that past, present and future have the same degree of existence, like the coexistence of different locations in space. A new quantum mechanical experiment is proposed which indicates that a future choice to be made by a human, even before being known to that human herself, can be anticipated by weak quantum measurement. Causal paradoxes are avoided by a special kind of censorship. I discuss the experiment and its implications for the understanding of spacetime.

11:10 – 11:35
J. M. Sparenberg (Université libre de Bruxelles, Belgium)
Could Quantum Decoherence and Measurement be Deterministic Phenomena?
Abstract: The quantum decoherence phenomenon, in particular during a measurement, displays an apparently unavoidable random character. A simple interpretation of that apparent randomness is that the outcome of a quantum measurement is actually deterministically determined by the microscopic state of the measurement apparatus, which can then be seen as a hidden variable. This microscopic state being inaccessible in practice, the outcome of a decoherent process cannot easily be predicted, though it is deterministic in essence. This interpretation of quantum mechanics thus restores determinism and causality at a fundamental level.Some consequences of this interpretation are explored, looking for possible ways to invalidate it. First, its compatibility with Bell's inequalities [1] is checked; it is shown to violate these inequalities and to fully agree with standard quantum mechanics. The price to pay for that is a strong non locality. Being deterministic and non local, this interpretation is shown to violate special relativity and to allow faster-than-light information transfer, at least in principle. Finally, these conjectures are tested on a primitive model of measurement apparatus inspired by Mott [2], the microscopic state of which is controllable.

Ref.: [1] Bell, J. S. (1964). "On the Einstein Podolsky Rosen Paradox". Physics 1: 195-200
[2] Mott, N. F. (1929). "The wave mechanics of alpha-ray tracks". Proceedings of the Royal Society A126: 79-84

11:35-12:20
F. De Martini (Università La Sapienza, Italy)
Quantum Nonlocality and Kaluza-Klein Compactification by Quantum Geometrodynamics
Abstract: By a quantum geometrodynamical theory based on Weyl's conformal geometry the physical origin of quantum nonlocality, epitomized by the violation of Bell's inequalities by spin 1/2 particles within the standard EPR scheme, is fully understood with no recourse to exotic misconceptions. A new ontological status of the wave function interpreted as a Weyl's gauge field emerges within the theory. The theory is further applied to the Kaluza - Klein

space-time compactifica-tion program as the first step towards a novel approach to the Standard Model of the elementary particles.

12:20-12:50
I. Ciufolini (Univ. Lecce, Italy)
Observational Tests of Relativistic Clock Effects and Time 'Paradoxes'
Abstract to be announced

14:10 – 15:05
A. Ashtekar (Pennsylvania Univ., USA)
From Micro to Macro, Emergence of General Relativistic Time
Abstract: In general relativity we have a dynamical but sharply defined space-time geometry which we use to introduce geometrical notions of time, such as the cosmic or conformal time of cosmology. In quantum gravity we only have a probability amplitude for various geometries, whence these notions cease to be sharp. What is well defined is relational time a la Leibniz. In loop quantum gravity of the early universe one can show in detail how the more familiar general relativistic notions of time arise from the more fundamental ones. The talk will provide a sketch of this theory.

15:05 -15:30
Seth Loyd

16:00 – 16:25
C. Stoica (Institute of Mathematics of the Romanian Academy)
Global and local aspects of causality
Abstract: A new understanding of causality arises naturally in a differential-geometric and topological context. This type of causality exhibits both local and global properties, which have direct application to the interpretation of quantum mechanics. In particular, it offers a simple unitary explanation of the apparent wavefunction collapse, and a local-causal interpretation of entanglement in terms of the wavefunction only, without hidden variables. It also suggests possible directions of exploration of the quantum-to-classical transition and the measurement problem. We analyze the time travel paradoxes from the perspective of this type of causality.

16:25 – 16:50
D. Singh (Univ. Of Regina, Canada)
A New Perspective on Path Integral Quantum Mechanics in Curved Space-Time
Abstract: A fundamentally different approach to path integral quantum mechanics in curved space-time is presented, as compared to the standard approaches currently available in the literature. Within the context of scalar particle propagation in a locally curved background, such as described by Fermi or Riemann normal co-ordinates, this approach requiresuse of a constructed operator to rotate the initial, intermediate, and finalposition ket vectors onto their respective local tangent spaces, defined at each local time step along some arbitrary classical reference worldline. Local time translation is described using a quantum mechanical representation of Lie transport, that while strictly non-unitary in operator form, nevertheless correctly recovers the free-particle Lagrangian in curved space-time, along with new contributions. This propagator yields the prediction that all probability violating terms due to curvature contribute to a quantum violation of the weak equivalence principle, while the remaining terms that conserve probability also correspondingly satisfy the weak equivalence principle, at least to leading-order in the particle's Compton wavelength. Furthermore, this propagator possesses an overall curvature-dependent and gauge-invariant phase factor that can be interpreted as the gravitational Aharonov-Bohm effect and Berry's phase.

October 17, 2012, Wednesday

09:00 – 09:45

M. Francaviglia (President of SIGRAV; Univ. di Torino, INFN, Italy)

Extended Theories of Gravitation: Structure of Space-Time and Fundamental Principles of Physics, following Ehlers-Pirani-Schild

Extended theories of gravitation are naturally singled out by an analysis inspired to the Ehelers-Pirani-Schild framework. In this framework the geometry of spacetimes is described by a Weyl geometry which is enforced by dynamics. Standard General Relativity is just one possible theory within the class of extended theories of gravitation. Also all Palatini f(R) theories are shown to be extended theories of gravitation. This more general setting allows a more general interpretation scheme and more general couplings between gravity and matter. The definitions and constructions of extended theories will be reviewed. A general interpretation scheme will be considered for extended theories and some examples will be considered.

9:45 – 10:30

S. Capozziello (Univ. Napoli, INFN, Italy)

Time Solutions and Symmetries in Extended Gravity Cosmology

We discuss the Hamiltonian dynamics for cosmologies coming from Extended Theories of Gravity. In particular, minisuperspace models are taken into account searching for Noether symmetries. The existence of conserved quantities gives selection rules to recover classical behaviors in cosmic evolution according to the so called Hartle criterion, that allows to select correlated regions in the configuration space of dynamical variables. We show that such a statement works for general classes of Extended Theories of Gravity and is conformally preserved. Furthermore, the presence of Noether symmetries allows a straightforward classification of singularities that represent the points where the symmetry is broken. Examples for nonminimally coupled and higher-order models are discussed.

10:30 – 10:45

B. Vlahovic (North Carolina Central University, Department of Physics, USA)

New Cosmological Model and Its Implications on Observable Data Interpretation

The paradigm of LCDM cosmology works impressively well and with concept of inflation it explains universe after the time of decoupling. GR and standard model can predict with high accuracy decrease in orbital period of binary pulsar and angular power spectrum of CMB. However there are still few concerns. After all efforts there is no detection of dark matter and there are significant problems in theoretical description of dark energy. For that reason underway are numerous attempts for alternative cosmologies that will modify gravity theories (modify Gmn, e.g. brane-worlds, modified action theories, f(R) gravity, tensor gravity, higher dimensional gravity) or modify matter theories (modify Tmn, e.g. inhomogeneous universe, new matter, new interactions, quintessence, Chaplygin gas, k-essence). Experimental data from BAO, CMB, and SNe, and observations of large scale structures allow for some constrains to be placed on cosmological models and parameters. However, because current data are not enough to discriminate between the GR and alternative theories there are ongoing and planned surveys to provide more accurate data and additional tests, such as: LSS observations (galaxy positions, weak lensing, redshift space distortions), Dark Energy Survey (DES), Euclid (an ESA mission to map the geometry of the dark Universe), Evolutionary Map of the Universe (EMU), Westerbork Observation of the Deep Aperitif Northern sky (WODAN). We will consider a variant of cosmological spherical shell model, within FRW formalism. We will compare it with the critical Einstein de Sitter model, which was regarded as providing a good description of universe until its viability become increasingly suspected as observable data improved in 1980's. It was not until late 1990s that it was finally abounded in favor of models by dark energy. We will show that our new topological spherical shell model satisfies cosmological principles and is consistent with all observable data, but that it may require new interpretation for some data. As one of the examples, we will consider the impact of the model on interpretation of the holographic principle. The model allows to explain the established discrepancy [1] between the non-covariant version of the holographic principle and the calculated dimensionless entropy (S/k) for the visible universe, which exceeds the entropy of a black hole. We will consider constrains imposed on the model by the data, as for instance the range for allowed thickness of the shell by the CMB data and gravitational lensing. Dynamics of the shell model will also be discussed and its impact on the interpretation of the commoving radius of the visible universe and CMB data. This work is supported by NSF (HRD-0833184) and NASA (NNX09AV07A).

[1] P.H. Frampton, Holographic Principle and the Surface of Last Scatter, arXiv:1005.2294v5 [physics.gen-ph].

11:25 – 12:10
O. Bertolami (Univ. Porto, Portugal)
Zen and the art of space-time manufacturing
We shall discuss some general features of the so-called emergent properties in biology, neural science and physics and survey on some ideas about the emergence of space-time, of gravity and of our universe.

12:10 – 13:05
V. Gurzadyan (Yerevan State University, Armenia)
On the Cosmological Impact of Randomness and Thermodynamical Time Arrow
Arrows of time – thermodynamical, cosmological, electromagnetic, quantum mechanical, psychological – are basic properties of Nature. The de-correlated initial conditions and no-memory (Markovian) dynamics will be outlined as necessary conditions for the appearance of the thermodynamical arrow, while the quantum measurement can be explained within quantum statistical mechanics as a consequence of thermodynamical arrow. The cosmological impact of the arrow and of the randomness and the means of its evaluation will be discussed as well.

14:30 – 15:15
N. Zanghì (Univ. Genova, Italy)
Why We Don't Remember the Future
Abstract: Drinks can be spilled but not unspilled and heat gets transferred from the hotter to the cooler but not the other way around. Put differently, you can tell whether a movie is shown backward or forward. In brief, natural phenomena are irreversible. Irreversibility may not seem surprising until we notice that the fundamental laws of nature are reversible: every possible process, when run backward, is still in agreement with the laws. So where does irreversibility come from? Richard Feynman, one of the most influential physicists of the second half of 20th century, made the following assessment: "Since we always make the prediction that in a place where we have not looked we shall see stars in a similar condition, or find the same statement about Napoleon, or that we shall see bones like the bones that we have seen before, the success of all those sciences indicates that the world did not come from a fluctuation ... Therefore I think it is necessary to add to the physical laws the hypothesis that in the past the universe was more ordered ... than it is today. I think this is the additional statement that is needed to make sense, and to make an understanding of the irreversibility (R. Feynman, The Character of Physical Law)." My aim is to elaborate, comment, and expand Feynman's assessment (also in the light of some recent proposals in cosmology), as well as to explain why it also provides the key to understand why we remember the past but not the future.

15:15 – 16:00
A. Balbi (Univ. Tor Vergata, Italy)
Cosmology and Time
Abstract: Time plays a crucial role in cosmology. In this talk, I will highlight some of the aspects of the present cosmological model which are more directly related to time, such as: definition of cosmic time; the existence of typical time scales and epochs in an expanding universe; the problem of the initial singularity and the origin of time; the problem of the cosmological arrow of time.

16:00 – 16:30
A. Ferretti (Univ.di Torino, Italy)
ALICE's Time Machine
Abstract: According to the Big Bang theory, the Universe was once in an extremely hot and dense state which expanded rapidly. In such a state the normal nuclear matter could not exist: it is believed that a few microsecond after big-bang the matter underwent a phase transition, from a state called Quark-Gluon Plasma (QGP) to a hadron gas. Some of the unexplained features of the Universe (such as matter-antimatter asymmetry and large scale structure) could be explained by the QGP properties. One of the aims of the CERN LHC is to recreate (on a smaller scale) a QGP state, compressing and heating ordinary nuclear matter by means of ultrarelativistic heavy-ion collisions. The ALICE experiment at CERN is dedicated to the study of the medium produced in these collisions, allowing us to catch a fleeting glimpse of the early universe.

16:30 – 16:35 *Poster Session*

M. Kamionka (Astronomical Institute, University of Wroclaw, Poland)

Cosmic acceleration from modified gravity with Palatini formalism

We study new FRW type cosmological models of modified gravity treated on the background of Palatini approach. These models are generalization of Einstein gravity by the presence of a scalar field non- minimally coupled to the curvature. The models employ Starobinsky's term in the Lagrangian and dust matter. Therefore, as a by product, an exhausted cosmological analysis of general relativity amended by quadratic term is presented. We investigate dynamics of our models, confront them with the currently available astrophysical data as well as against "CDM model. We have used the dynamical system methods in order to investigate dynamics of the models. It reveals the presence of a final sudden singularity. Fitting free parameters we have demonstrated by statistical analysis that this class of models is in a very good agreement with the data (including CMB measurements) as well as with the standard "CDM model predictions.

Therefore Bayesian methods of model selection have been employed in order to indicate preferred model.

17:00 – 17:25

A. Raccanelli (JPL NASA and Caltech, USA)

Testing Gravity on Large Scales

Abstract: The strangest feature of our current cosmological model is the observation that the expansion rate of the universe is accelerating. Understanding the cause of cosmic acceleration is one of the great challenges of physics. It has been speculated that the cause of this acceleration is a cosmological constant, or perhaps some novel form of matter; our ignorance is summarized by the simple name for the cause of the observed phenomena: dark energy. Alternatively, it could be explained by the break down of Einsteins gravitation theory (GR) on cosmological scales. Observations of large-scale structure have played an important role in developing our standard cosmological model and will play an essential role in our investigations of the origin of cosmic acceleration. I will illustrate how it is possible to test GR and different models of gravity via Redshift-Space Distortions using forthcoming cosmological galaxy surveys, such as the Subaru Prime Focused Spectrograph (PFS), the Baryon Oscillation Spectroscopic Survey (BOSS), Euclid and the Square Kilometer Array (SKA). However, the theoretical models currently used to interpret the data often rely on simplifications that make them not accurate enough for precise measurements. I will show improvements to the theoretical modelling at very large scales, including wide-angle and general relativistic corrections. I will show that for wide and deep surveys those corrections need to be taken in account if we want to measure the growth rate parameter gamma at a few percent level, and so perform tests on gravity, without introducing systematic errors.

17:25 – 17:50

S. Camera (Universidade Técnica de Lisboa, Instituto Superior Técnico CENTRA - Multidisciplinary Centre for Astrophysics)

Peering into the past: Cosmology as a tool for testing GR

Abstract: In the last few decades, cosmological measurements have reached an unprecedented level of precision, and cosmology is now on the threshold of a new era of observational evidence. In the next future, a vast number of telescopes, satellites and surveys will provide us with accurate, multi-wavelength data that will allow us to investigate the fundaments of our theoretical model of the Universe. Here, I depict, with some useful example, how such a gaze to the deepest cosmos could help in better understanding the laws of gravity and perhaps detecting departures from GR. Specifically, I show recent constraints on well-known alternative gravity theories from some of these next-generation instruments - from Planck to Euclid, the SKA and even space-based gravitational wave detectors.

17:50 – 18:20

L. Fatibene (Univ. Torino, INFN, Italy)

Extended Theories of Gravitation: Observation Protocols and Experimental Tests

Abstract: Within the framework of extended theories of gravitation we shall discuss physical equivalences among different formalisms and classical tests. As suggested by Ehlers-Pirani-Schild framework, the conformal invariance will be preserved and its effect on obser vational protocols discussed. Accordingly, we shall review standard tests showing how Palatini f(R) theories natually passes solar system tests. Observation protocols will be discussed in this wider frame work

October 18, 2012, Thursday

09:00 – 09:30
F. Lobo (Centro de Astronomia e Astrofísica da Universidade de Lisboa, Portugal)
Traversable Wormholes in Modified Theories of Gravity
Abstract: A fundamental ingredient in wormhole physics is the presence of exotic matter, which involves the violation of the null energy condition. Although a plethora of wormhole solutions have been explored in the literature, it is useful to find geometries that minimize the usage of exotic matter. In the context of modified gravity, it has also been shown that the normal matter can be imposed to satisfy the null energy condition, and it is the higher order curvature terms, interpreted as a gravitational fluid, that sustain these non-standard wormhole geometries, fundamentally different from their counterparts in general relativity. In this paper, we review recent work in wormhole physics in the context of modified theories of gravity.

09:30 – 10:00
R. Garattini (INFN Sez. di Milano, Universita' degli Studi di Bergamo)
Self Sustained Traversable Wormholes: from Phantom Energy to Modified Dispersion Relations
Abstract: We explore the possibility that wormhole geometries are sustained by their own quantum fluctuations. More specifically, the energy density of the graviton one-loop contribution to a classical energy in a wormhole background is considered as a self-consistent source for wormholes. In this semi-classical context, we consider different schemes involving phantom energy, non commutative theories and finally Modified Dispersion Relations. We show that all these cases admit the traversability in principle. Only the non commutative case seems to allow the traversability in practice. A comparison with ordinary matter field sources of exotic matter is presented.

10:00 – 10:30
S. Kim (Ewha Womans University, South Korea)
Hawking Temperature of Wormhole Revisited
Abstract: The Hawking temperature is derived from the surface gravity around the event horizon. There are several definitions of the surface gravity. The wormhole temperature depends on the choice of the model. The Killing horizon definition shows the negativeness at the exotic matter, while the flare-out condition shows the positiveness near throat. In this paper, we reviewed the recent definitions of dynamical surface gravity and its Hawking temperature near or at the throat of the wormhole. The Hamilton-Jacobi method is also used in checking the value of the temperature.

11:00 – 11:25
R. Zambujal Ferreira (University of Porto, Portugal)
Time Machines Through Traversable Wormholes in Non-Minimally Coupled Curvature-Matter Theories
We obtain traversable wormhole and time machine solutions in a modified theory of gravity with a non-minimal coupling between matter and curvature.

11:25 – 11:50
R. Slagter (Dept. Phys., Univ. Amsterdam and ASFYON)
Closed Timelike Curves in Warped 5D Spacetimes
Abstract: Cosmic strings occur as topological defects, consisting of confined regions of false vacuum energy in gauge theories with spontaneous symmetry breaking in the early stages of the universe. They could have served as seeds for the formation of the large scale structure of the galaxies and clusters[1] and predict axially symmetric gravitational lensing effects. However, observations of, for example, the cosmic microwave background, would rule out these effects. Apart from their possible astrophysical role, they are fascinating objects in their own right and can give rise to a rich variety of unusual physical phenomena such as the (2+1)-dimensional spinning point particles[2], which could admit closed timelike curves. The appearance of the so called Gott spacetime[3], in which an advanced civilization could produce a closed timelike curve, turns out to induce tachyonic behavio[4]. An uprising of the cosmic string investigations occurred after it was realized that M-theory, the improved version of superstring theory, allows, via brane world scenarios, macroscopic fundamental stings that could play a role very similar to that of cosmic stings. If one investigate the behavior of self gravitating gauge cosmic strings in a warped 5-dimensional spacetime, where the

extra dimension can be as large as 10-3cm, the Gott condition could be fulfilled in order to get closed timelike curves. Moreover, in these warped spacetimes, the behavior of cosmic strings changes dramatically and could resolve the observational conflicts[5,6].

1. A. Vilenkin and E. P. S. Shellard, " Cosmic Strings and Other Topological Defects", eds. P. V. Landshoff, D. R. Nelson, D. W. Sciama and S. Weinberg (Cambridge University Press, Cambridge, 1994).
2. S. Deser, R. Jackiw and G. 't Hooft, Phys. Rev. Lett. 68 (1992) 267.
3. J. R. Gott, Phys. Rev. Lett. 66, (1990) 1126.
4. G. 't Hooft, Class. Quantum Grav, 9 (1992) 1335.
5. R. J. Slagter, and D. Masselink, Int. J. Mod. Phys.1250060, to appear in 2012. 6. R. J. Slagter, in proc. XI Conference Marcel Grossmann Meeting on General Relativity, Berlin} ed. R. Ruffini (World Scientific, Singapore, 2006)

11:50 – 12:10

E. Nungesser (KTH, Royal Institute of Technology, Sweden)

Strong Cosmic Censorship in Electrogowdy Spacetimes

A sketch of the proof of Strong cosmic censorship is presented for this case and the interpretation of this reult. A key element of the argument is the observation that by means of a suitable choice of variables the central equations in this problem can be written in a form where they are identical to the central equations for general (i.e. non-polarized) vacuum Gowdy spacetimes. Using this it is seen that the deep results of Ringström on strong cosmic censorship in the vacuum case have implications for the Einstein-Maxwell case. Working out the geometrical meaning of these analytical results leads to the main conclusion.

12:10 – 12:55

S. Finazzi (Univ. di Trento, Italy)

Quantum effects in warp drives

Warp drives are interesting configurations in general relativity that, at least theoretically, provide a way to travel at superluminal speed. Unfortunately, several issues seem to forbid their realization. First, a huge amount of exotic matter is required to build them. Second, when warp drives move faster than light, they become unstable because of quantum effects. In fact, a Hawking-like thermal flux of particles is generated inside the warp-drive bubble. This causes an exponential growth of the energy density measured by freely falling observers on the front wall of the bubble. In Lorentz-violating quantum field theories, this instability is tamed but not removed. In this case a linear growth of the emitted flux is expected.

14:30 – 14:50

T. Ootsuka (Dep. Of Physics , Ochanomizu University, Japan)

New Covariant Hamilton Formulation for Field Theories

Abstract: A novel covariant Hamilton formulation for field theories is proposed in terms of multi-contact geometry which is a generalization of contact geometry. This formulation is naturally derived from our previous work ``new covariant Lagrange formulation using Finsler-Kawaguchi geometry". In this Hamilton formulation, the extended phase manifold is composed of spacetime, field configuration and their conjugate momentum space, and is finite dimensional, which is in contrast to the usual Hamilton formulation of fields. Field theories of (n+1)-dimentional spacetime are described by multi-contact (n+1)-form and (n+1)-vector. The (n+1)-vector generates evolution and configuration of our real "spacetime" in extended phase manifold. Physical quantities are expressed by n-forms and Poisson bracket is defined by a (n+2)-form which is a term from the exterior derivative of the multi-contact structure. The transformation allows the mixing of spacetime coordinates, fields and their momentum coordinates, which makes this formulation very powerful.

14:50 – 15:10

E. Tanaka (Palacky University, Czech Republic, and Univ. Di Torino, Italy)

General Relativity by Kawaguchi Geometry

Abstract: The parameterization free method of Lagrange formulation using multi-vector fields and its higher order equivalents are presented. The classical 1st and 2nd order field theory is constructed on Kawaguchi manifold, where the metric is defined on the space of multi-vectors over a manifold M which corresponds to an extended configuration space, where the local coordinates represents spacetime and field variables without any distinction. On this extended configuration space, a coordinate transformation such that mixes these variables are allowed.
The conventional classical field theory can be derived by choosing a specific parameterization. Einstein's general relativity is considered for application.

15:10 – 15:35
D. Dolce (CoEPP, The University of Melbourne, Australia)
Elementary cycles of time
Abstract: De Broglie introduced undulatory mechanics, together with the concept of elementary particles, in terms of intrinsically "periodic phenomena" associated to every elementary isolated quantum system. However, after nearly 90 years, the physical origin of such undulatory mechanics remains unrevealed. We pro- pose a natural realisation of the de Broglie "periodic phenomenon" in terms of field theory in compact space-time dimensions. In this way we show that, similarly to a vibrating string or a particle in a box, intrinsic periodicity represents a fully-consistent semi-classical quantisation condition, formally matching ordinary relativistic QM, for both the canonical and Feynman formulations. In fact, in undulatory mechanics interaction can be equivalently described in terms of modulation of de Broglie periodicity. In this way it is possible to see, for instance, that the gauge fields turns out to naturally encode the modulation of periodicity associated with peculiar local transformation of reference frame (e.g. zitterbewegung). That is gauge interactions turn out to have a geometry nature surprisingly similar to that of gravitational interaction.

October 19, 2012, Friday

09:00 – 09:45
V. F. Polcaro (IASF, Italy)
The Concept of Time, from Paleolithic to Newtonian Physics
Most probably, the first hunters-gatherers communities of the Paleolithic did not have a precise concept of time, at least from what we can deduce from the last communities of this kind that modern anthropologists found in remote areas of our planet (see, e.g., Sinha et al., 2011). Of course, they had the concept of "before" and "after", but not a notion of time as being independent of the events which are occurring. We do not know when the mankind started to develop a computation of time, obviously linked to the most evident natural cyclical phenomena: the alternation of day and night and the Moon cycle. Following Mashack (1972), though his opinion has been challenged, this basic cultural evolution happened as early as 20,000 years BP. In any case, the need for a computation of time (i.e. for a calendar) became mandatory with the Neolithic revolution and development of the agriculture; these first calendars were obviously in some way connected with the meteorological seasons cycle and thus, more or less precisely, with the Sun cycle. Thus, all the first experiences of time during the development of the civilization were connected with cycles, where what happened before was repeated in the same way after a fixed time interval. Most of the following cultures, all over the world, extrapolated this vision of time, hypothesizing a longer cycle, that modern scholars call in general the "Great Year", lasting some millennia, after which all past events would be repeated in a more or less similar way (see, e.g. Aveni, 1989): this is, for instance, the case of the Maya "Long Count". Starting with the Hebrew culture of the Iron Age, this concept of cyclical time was drastically changed: in the Bible, time is represented as a linear experience, with a beginning and an end, and the human history develops between these two extremes. This concept slightly changed during the course of the Western civilization, were the problem of the nature of time was debated by most of the major philosophers and scholars from everlasting to everlasting, but time was always conceived as an independent variable, inevitably running from past to future up to the revolution of the Einstein's Relativity and the birth of modern physics.
References Aveni A., 1989, Empires of Time: Calendars, Clocks and Cultures. New York: (Basic Books),. Marshack

A., 1972, The Roots of Civilization, New York (McGraw-Hill) Sinha C. et al., 2011, language and Cognition, 3(1): 137-169.

09:45 – 10:30
P. Tavella (INRiM, Italy)
Time scales: the answer to the question "what time is it?
Abstract to be announced

11:00 – 11:45
D. Calonico (INRiM, Italy)
Lasers, Cold Atoms and Atomic Clocks: Realizing the Second Today
Abstract: Atomic physics, high accuracy spectroscopy, laser cooling of atoms are today fundamental for the realization of the Second in the International System of Units. At the conference, the present status of the art of atomic clock making, the recent hystory of frequency metrology and the possible forthcoming redefinition of the unit of time will be illustrated. It will be shown the deep and fruitful link between fundamental physics and modern atomic clocks, in a continuous exchange to improve science the art of measurement.

11:45 – 12:45
M. Lattanzi (OATo-INAF, Italy)
Space-time navigation via Relativistic Astrometry
Abstract to be announced

12:30 – 13:15
A. Possenti (OAC-INAF, Italy)
Probing and Measuring the Space-Time with the Radio Pulsars
Abstract: Radio pulsars are rapidly spinning neutron stars which emit beams of radio waves - detected as pulses - once per rotation of the neutron star. As a consequence of their evolution in a binary system, some members of the radio pulsar family are also ultra stable rotators. Hence, the clock-like nature of their pulsed emission can be regarded as a natural tool for probing the properties of their space-time environment, as well as for establishing a terrestrial time scale entirely based on the regular monitoring of the times of arrival of their radio pulses. The talk will discuss methodologies and perspectives in this field.

14:45 – 15:30
A. Tartaglia (Politecnico di Torino, INFN, Italy)
Is time enough in order to know where you are?
Abstract to be announced

16:00 – 16:45 *open lecture*
G. Torrengo (Univ. Barcelona, Spain)
Keeping track of identity in time-travel
In the recent literature of philosophy of time, we find an argument in support of the hypothesis of the plurality of temporal dimensions (either in a multiverse, or in a 5D manifold) that runs as follows. We have reason to think that backward time-travel is physically possible. If we assume the linearity of time, backward time travel turns out to be in tension with the Autonomy Principle (i.e. absence of global constraints on locally possible configuration of matter); whereas, if we assume that the time traveller by going backwards can shift to different temporal dimension, the Autonomy Principle is safe. Since the Autonomy Principle seems reasonable, we should assume the plurality of the temporal dimension. In my talk, I will argue that whether such as argument is valid depends crucially on how we understand the notion of identity through different temporal dimensions, and cast some doubts on whether — when properly understood — the argument is indeed convincing.

16:45 – 17:30 *open lecture*
O. Ast (USA)
Archetypes and Architecture of Time: an Artistic Inquiry into the Nature of Time, Space and Information
Abstract: What are the natural phenomena and cognitive structures that underlie the human perception of time? What social constructs have evolved around questioning its nature? How did they arise, and how did they evolve over the ages? I have been exploring the subject of time for almost a decade now, merging my background as a conceptual artist with principles of scientific study. My focus has been on the changing visualizations of time through the evolution of human society, from the earliest depictions of the flowing river, the linear arrow, or the circular uroboros – a snake eating its own tail – to the contemporary paintings of Dali and Magritte, who depict time with modern metaphors of a clock, a train, or the 4th dimension. How have these images influenced scientific, religious and philosophical thought surrounding time? Drawn by now from our collective subconscious, do they naturally bias us towards particular conventional models? And finally, how can an analysis of the visual metaphors of time contribute to the larger dialogue, one that involves scientists, technologists and philosophers, each with their own theories on the subject? This project attempts to answer these questions, and to propose that art is an essential voice in any discussion about time. Can artists and scientists working together bring us closer to an answer to the age-old question – what is time?

17:30 – 17:35 *Poster Session*
Rossetti (Liceo Scientifico G. Bruno, Budrio, Italy)
Millennium Tunneling, an imaginary travel in space and time
Abstract: Imagine that you wake up in a reality that it does not belong to you. This is exactly what happens to Megan Newman, a young American woman, who is not able to recognise anything around herself. It takes quite a lot of time before she understands what has happened. Until that moment she is convinced to be crazy or sick or victim of a complex conspiracy against her. Then, slowly, the truth comes out the labyrinth of her mind. Megan's travel is something that we can only imagine nowadays, but maybe in a not too far future it might turn out to be possible.
Alessandra Rossetti, "Millennium Tunneling", Aracne Editrce, February 2012, ISBN: 978-88-548-4592-3.

SATELLITE EVENTS

Public Lectures

October 14, 2012 @MRSN

19:45

A. Ashtekar, "The Very Early Universe On the Origin of Time and Cosmic Structure"

October 15, 2012 @MRSN

20:30

J. Barbour: "Does Time Exist?"

October 16, 2012 @Rettorato Università di Torino

16:30

Open Session: Intrecci tra Logica e Immaginazione

Introduction by E. Predazzi, S. Capozziello

R. Bucchieri and M. Alfano present ***"Arabeschi"*** di F.de Felice, ed. AKOUSMATA – orizzonti dell'ascolto, Collana "In *cauda cometa*: il calamo di Galileo"

October 16, 2012 @Castello del Valentino, Salone d'Onore

20:30

F.de Felice "The Role of Time in Cosmic Puzzles"

October 17, 2012 @Museo del Cinema – Cinema Massimo 3

20:00 – 21:00

L. Maccone: "Il 'Tempo' nella fisica moderna"

October 19, 2012 @MRSN

18:30

O. Bertolami: **"Torino 2056"**

Round Tables for High Schools

October 20, 2012 @Politecnico di Torino (AulaMagna)

9:30 – 13:00

Coordinator: Prof. A.Vico

Tempo e Spazio-Tempo: Parliamone

Inseguendo la freccia del tempo, regolando i conti con la metrologia, sognando il teletrasporto e confrontandoci con il trascendente.

Oratori:

Prof. Amedeo Balbi, Università di Tor Vergata, Roma

Prof. Andrea De Marchi, Politecnico di Torino

Prof. Andrea Possenti, Osservatorio Astrofisico di Cagliari,

Don Ermis Segatti, Facoltà Teologica dell'Italia Settentrionale, Torino

Prof. Angelo Tartaglia, Politecnico di Torino

Live Music

October 14, 2012 @MRSN

TEA String Quartet

October 19, 2012 @BLAH-BLAH Club

21.30

TITOR *(Genre: alternative rock, post metal, punk hard-core, post hc)*

"ROCK is BACK … FROM 2036: the last chance for humanity "

Sandro Serra: Guitar
Francesco Vittori: Bass
Sabino Pace: Voice
Giuseppe Azzariti: Drums

October 20, 2012 @MRSN (in collaboration with Minimumfax)

22:00

DUB PIGEON *(Genre: electronic, drum 'n bass, dub and urban psychedelia)*

Featuring

"IL TEMPO E' UN BASTARDO" ("A VISIT FROM A GOON SQUAD")

Electro-Visual Improvisation Tribute to Jennifer Egan's "Literary" Time-Machine

J. Egan: 2011 Pulitzer Prize for Fiction and National Book Critics Circle Awards for fiction

Novel: "A visit from a goon squad" ("Il Tempo è un Bastardo", Italian Edition ©Minimumfax)

Ezra (Casino Royale, No.Mad Studio): Synth, Effects
Paolo Spaccamonti: "Shoegaze" Guitar
Deian Martinelli (Deian e l'Orsoglabro): Guitar
Davide Compagnoni (Stearica, Ln Ripley): Drums

TM2012 Movies

October 14, 2012 @BLAH-BLAH Club

21:30

THE GIRL WHO LEAPT THROUGH TIME
(Jap: Toki wo kakeru shōjo; Ita:La Ragazza che Saltava nel Tempo)
Director: Mamoru Hosoda - Japan – 2006

October 17, 2012 @Museo del Cinema – Cinema Massimo, Room 3

20:00

Opening by Stefano Boni of Museo Nazionale del Cinema and by the Time Machine SOC

Public Lecture by L. Maccone: Il Tempo nella Fisica Moderna ("The Time in the modern Physics")

21:00

DONNIE DARKO
Director R. Kelly - USA – 2001

October 17, 2012 @BLAH-BLAH Club

21:30

TIMECRIMES (Los Cronocrímenes)
Nacho Vigalondo - Spain - 2007

October 21, 2012 @BLAH-BLAH Club

20:30

JUKO'S TIME MACHINE

Kai Barry - 2011- USA

2011 – OFFICIAL SELECTION Los Angeles Comedy Festival

2012 – BEST NARRATIVE FEATURE AUDIENCE AWARD Sf IndieFest

http://www.newfangledpictures.com/

22:00

PRIMER

Shane Carruth - 2004 –USA

2004 – GRAND JURY AWARD Sundance Film Festival

http://www.primermovie.com/trailer-Large.html

Photography

October 14-21, 2012 @Everywhere in Space and Time

PHOS and IED-Istituto Europeo di Design

A. La Grotta (Teacher), S. Bascone, L. Cagnotto, G. Daccardi, F. Dal Farra, S. Dipietro, A. Guarini, D. Menarello, G. Meregalli, F. Segato, G. Solia, M. Zolt

The reportage of the event will be done by the students of the three-year post-graduate course in Photography at Istituto Europeo di Design di Torino (IED). A photo exhibition devoted to Time Machine Factory themes will be organized by PHOS. A collection of pictures of Torino done by young photographers in collaboration with PHOS is available at the PhoTos Time Station page.

Courtesy of

ISTITUTO EUROPEO DI DESIGN

Since 1966, the Istituto Europeo di Design has been operating in the fields of Education and Research in the disciplines of Design, Fashion, Visual Communication and Management of creative enterprises. Today it is an International Network with seats in Milano, Roma, Torino, Venezia, Firenze, Cagliari, Como, Madrid, Barcelona and São Paulo in Brazil, that organizes three-year post high school diploma courses, refresher and specialization courses, advanced courses and postgraduate Master degree courses. Partnerships with foremost enterprises is a fundamental issue in Istituto Europeo di Design's education strategy, which characterises the entire training pathway.

IED Turin, operating from 1989, hosts more than 800 students every year, both from Italy and from abroad, and puts into effect a didactic methodology based on the bond between knowing and knowing how to do and the fusion of theorical lessons and practical workshop. The teaching staff, made of professionals and experts in the different areas, grant a direct contact with the most relevant companies on a both local and national level. Every year is characterized by a rich calendar of events that allow to enhance the relations with the territory and to put on show students creative projects, in order to create new relationship with Institutions, media and companies. A Job Placement scheme can ensure an active and constant connection between companies and students, promoting the meeting of offer and demand and the placement of the outbound profiles.

The curriculum of the three-year post-graduate course in Photography ranges from lessons in darkroom and shooting techniques to lessons in photographic technology and history of photography, in order to teach students how to use images both to see and to communicate a story, a thought, an emotion. The role played by photographers is becoming increasingly flexible and integrated with global communication systems. It therefore calls for a critical mind-set and a thorough knowledge of the materials, technologies and procedures involved in photography, together with a deep

understanding of humanistic, cultural and aesthetic issues.
Course coordinator: Enzo Obiso

As part of its program, IED also offers **Specialization Course in Photography**. The course is aimed at anyone who wishes to rapidly acquire specific preparation in the main techniques and languages of contemporary photography.

PHOS

Phos is a cultural center that aims to combine a variety of activities focused on the production, dissemination and use of photography and visual arts. It is dedicated to the development and promotion of photography projects, exhibitions and publishing initiatives, with particular attention to the work of young authors.