EFI winter conference on canonical and covariant LQG

Participants, travel dates, titles and abstracts

Emanuele Alesci
Warsaw University
Monday to Saturday

Quantum Reduced Loop Gravity I

Mehdi Assanioussi
Warsaw University

A quantum Ricci operator for LQG
Our purpose is to build a quantum operator in the context of Loop Quantum Gravity corresponding to the 3D Ricci scalar. The construction is based on the concepts of Regge Calculus applied to a graph dual to a spin network, we use the classical expression of curvature as a starting point to define the quantum operator.

Martin Bojowald
Pennsylvania State University
Tuesday to Friday

Off-shell effects in loop quantum gravity
An off-shell anomaly-free realization of the constraint algebra of quantum gravity is crucial for a consistent implementation of cosmological perturbation theory (and many other issues). This talk summarizes recent advances achieved with a large set of different models and techniques. Conclusions will be drawn for the non-existence of deterministic bounces and issues of structure formation

Francesco Cianfrani
University Wroclaw
Monday to Saturday

Quantum Reduced Loop Gravity I

Andrea Dapor
Warsaw University
Sunday to Saturday

QFT on quantum spacetime: a compatible classical framework

We develop a systematic classical framework to accommodate canonical quantization of geometric and matter perturbations on a quantum homogeneous isotropic flat spacetime. The existing approach of standard cosmological perturbations is indeed proved to be good only up to first order in the inhomogeneities, and only if the background is treated classically. To consistently quantize the perturbations \emph{and} the background, a new set of classical phase space variables is required. We show that, in a natural gauge, a set of such Dirac observables exists, and their algebra is of the canonical form. Finally, we compute the physical Hamiltonian that generates the dynamics of such observables with respect to the homogeneous part of a K-G "clock" field T. The results of this work provide a good starting point to understanding and calculating effects that quantum cosmological spacetime in the background has on the quantum perturbations of the metric tensor and of matter fields.

Mikel Fernandez Mendez
Institute for the Structure of Matter (Madrid)
Sunday to Saturday

Uniqueness Quantization Criteria in Cosmological Spacetimes

Michael Gary
University Vienna
Sunday to Saturday

Higher Spin Gravity in 3D and Unitarity

I will introduce and explain the canonical analysis by Brown and Henneaux of gravity in 3D, leading to the AdS3/CFT2 correspondence. After introducing the generalization to higher spin gravity, I will briefly discuss aspects of Unitarity in such theories.

Wojciech Kaminski
Warsaw University
Saturday to Saturday

TBA

Marcin Kisielowski
Warsaw University
Sunday to Saturday

On first-order contributions to the Dipole Cosmology transition amplitude

We present some results of an investigation of the amplitudes contributing to the (Euclidean) Dipole Cosmology transition amplitude at the first order. These amplitudes correspond to spin foams having the boundary graph of Dipole Cosmology, one internal vertex and no edges connecting this vertex with itself. We expect the transition amplitude including contributions from all these spin foams gives the correct Friedmann dynamics in the classical limit.

Jerzy Lewandowski
Warsaw University
Saturday to Saturday

Guillermo Mena Marugan
Institute for the Structure of Matter (Madrid)
Wednesday to Saturday

Hybrid quantization of inflationary universes.

A complete quantization of an approximately homogeneous and isotropic universe with small scalar perturbations is carried out by means of an hybrid approach in Loop Quantum Cosmology. The matter content is provided by a minimally coupled massive scalar field. The homogenous sector of the geometry degrees of freedom is polymerically quantized, while the inhomogeneities are quantized employing Fock techniques. The Fock quantization adopted is a priveleged one,picked out in a unique way by criteria of dynamical unitarity and symmetry invariance in the context of quantum field theory in curved spacetimes. We propose a prescription for the representation of the Hamiltonian constraint as an operator on the kinematical Hilbert space, and show how to characterize its solutions by their data on the minimum volume section in each superselection sector of the theory.

Jakub Mielczarek
Jagiellonian University (Cracow); NCNR (Warsaw)

Asymptotic silence in quantum gravity

The state of asymptotic silence, characterized by causal disconnection of the space points, emerges from various approaches aiming to describe gravitational phenomena in the limit of large curvatures. In particular, such behavior was anticipated by Belinsky, Khalatnikov and Lifshitz (BKL) in their famous conjecture put forward in the early seventies of the last century. While the BKL conjecture is based on purely classical considerations, one can expect that asymptotic silence should have its quantum counterpart at the level of a more fundamental theory of quantum gravity, which is the relevant description of gravitational

phenomena in the limit of large energy densities. Here, we summarize some recent results which give support to such a possibility. More precisely, we discuss occurrence of the asymptotic silence due to polymerization of space at the Planck scale, in the framework of loop quantum cosmology.
In the discussed model, the state of asymptotic silence is realized at the energy density $\rho = \rho_c/2$, where ρ_c is the maximal allowed energy density, being of the order of the Planck energy density. At energy densities $\rho > \rho_c/2$, the universe becomes 4D Euclidean space without causal structure. Therefore, the asymptotic silence appears to be an intermediate state of space between the Lorentzian and Euclidean phases. As we show, the observed signature change may be a result of spontaneous symmetry breaking, and the associated Goldstone boson is a natural candidate for inflation. Finally, we sketch relations with other approaches to quantum gravity such as Causal Dynamical Triangulation and Horava-Lifshitz gravity.

Jacek Puchta
Warsaw University
Sunday to Saturday

Large j behavior of Dipole Cosmology transition amplitudes.

Jorge Pullin
Louisiana State University
Wednesday to Saturday

Exact loop quantization of vacuum spherically symmetric gravity
We consider spherically symmetric vacuum gravity without gauge fixing. We rescale the Hamiltonian constraint so it forms a Lie algebra with the diffeomorphism constraint. We solve exactly for the space of physical states that are annihilated by all the constraints. The space-time metric can be constructed as an operator associated with an evolving constant of motion. The singularity that appears in the classical theory inside black holes is resolved, being replaced by a region of high curvature that tunnels into another region of space-time. New Dirac observables emerge at a quantum level associated with the bulk that may shed light on recent discussions involving black hole "firewalls".

Carlo Rovelli
University Aix-Marseille
Saturday to Sunday

Radiative corrections in covariant LQG

Hanno Sahlmann
University Erlangen-Nuremberg
Sunday to Friday

Frederic Schuller
University Erlangen-Nuremberg
Sunday to Saturday

TBA

Simone Speziale
University Aix-Marseille
Sunday to Friday

Ghost-free massive gravity in Ashtekar variables

A generic self-interacting theory of a massive spin-2 particle is plagued by a severe instability, known as the Boulware-Deser ghost. In the last couple of years, a special potential has been proposed, for which the ghost is absent. This has been argued first perturbatively, then a non-perturbative, yet rather cumbersome canonical analysis was given. I'll show that the theory can be conveniently casted in Ashtekar variables, and the proof of ghost-freeness becomes much more clear and explicit. I'll point out the relation and differences with the non-chiral Plebanski formulation, and a difficulty concerning the interplay between reality conditions (needed in the case of Lorentzian signature) and parity-odd terms. Finally, I'll briefly overview the nonetheless still present difficulties with massive gravity, both theoretical and phenomenological.

Jedrzej Swiezewski
Warsaw University
Sunday to Saturday

Constructing geometrical Dirac observables for GR

Tomasz Trześniewski
University Wroclaw

Francesca Vidotto
University Nijmegen
Monday to Sunday

A New Twist on Spin Connections

I present the torsionless spin-connection of a twisted geometry introduced in arXiv: 1211.2166. The difficulty given by the discontinuity of the triad is addressed by interpolating between triads. The curvature of the resulting spin connection reduces to the Regge curvature in the case of a Regge geometry.

Wolfgang Wieland
University Aix-Marseille
Sunday to Saturday

Hamiltonian spinfoam gravity

My talk presents a Hamiltonian formulation of spinfoam-gravity. We will first review the spinorial framework of loop quantum gravity. This is about kinematics. We will then turn towards dynamics, and derive a continuum action adapted to the simplicial decomposition. The equations of motion admit a Hamiltonian formulation, that will allow us to perform the constraint analysis. We will not find any secondary constraints, but only get restrictions on the Lagrange multipliers enforcing the reality conditions. This comes as a surprise. In the continuum theory, the reality conditions are preserved in time, only if the torsionless condition (a secondary constraint) holds true. Studying an additional conservation law for each spinfoam vertex, we will discuss the issue of torsion and argue that spinfoam gravity may miss an additional constraint. Next, we will canonically quantise. Transition amplitudes match the EPRL (Engle--Pereira--Rovelli--Livine) amplitudes on a spinfoam face. Differences could only come from the additional torsional constraint affecting the vertex amplitude. The talk is based on the references arXiv: 1301.5859 and 1207.6348

Derek Wise
University Erlangen-Nuremberg

Observer Space and Covariant Canonical Gravity

Antonia Zipfel
University Erlangen-Nuremberg
Saturday to Saturday

TBA