

Asymptotic Safety meets Particle Physics & Friends

Report of Contributions

Contribution ID: 1

Type: **not specified**

Welcome

Monday 16 December 2024 13:45 (15 minutes)

Presenter: LITIM, Daniel (University of Sussex)

Session Classification: Talks

Contribution ID: 2

Type: **not specified**

Probing Quantum Gravity Effects via Magnetic Conversion of Electromagnetic Waves into Gravitational Waves and Vice Versa?

Monday 16 December 2024 14:00 (45 minutes)

Presenter: RINGWALD, Andreas

Session Classification: Talks

Contribution ID: 3

Type: **not specified**

The cosmological constant problem and the effective potential of a gravity-coupled scalar

Monday 16 December 2024 14:45 (30 minutes)

Presenter: PERCACCI, Roberto

Session Classification: Talks

Contribution ID: 4

Type: **not specified**

Exploring the Majorana Landscape: Planck Safe Models with Majorana Fermions

Monday 16 December 2024 15:45 (45 minutes)

Presenter: SPYCHALA, Kai Jürgen

Session Classification: Talks

Contribution ID: 5

Type: **not specified**

Avoiding quantum gravity-induced chiral symmetry breaking

Monday 16 December 2024 16:30 (30 minutes)

Presenter: PICANCO COSTA, Gabriel

Session Classification: Talks

Contribution ID: 6

Type: **not specified**

Asymptotic Safety and a CPT-Symmetric Universe

Monday 16 December 2024 17:00 (45 minutes)

I will present the idea that the big bang is a type of mirror – in particular a “CPT mirror”. I will review the evidence for this idea, its explanatory power, and its predictions. Recently, we have come to think this idea is closely tied to the asymptotic safety idea, and I will present a new result to this effect (in collaboration with Neil Turok and Vatsalya Vaibhav – to appear soon).

Presenter: BOYLE, Latham (Higgs Centre for Theoretical Physics, University of Edinburgh)

Session Classification: Talks

Contribution ID: 7

Type: **not specified**

Discussion

Monday 16 December 2024 17:45 (15 minutes)

Session Classification: Talks

Contribution ID: 8

Type: **not specified**

A Nonlocal Schwinger Model

Tuesday 17 December 2024 09:30 (45 minutes)

Presenter: HERZOG, Christopher

Session Classification: Talks

Contribution ID: 9

Type: **not specified**

Emergent Symmetries in 2D Dirac Systems

Tuesday 17 December 2024 10:15 (30 minutes)

Presenter: UETRECHT, Max (TU Dortmund University)

Session Classification: Talks

Contribution ID: **10**

Type: **not specified**

Dilaton Physics from Asymptotic Freedom

Tuesday 17 December 2024 11:15 (45 minutes)

Presenter: CRESSWELL-HOGG, Charlie

Session Classification: Talks

Contribution ID: 11

Type: **not specified**

Quantum critical Dirac semimetals and finite-temperature effects

Tuesday 17 December 2024 12:00 (30 minutes)

The chiral Ising-, XY-, and Heisenberg models serve as effective descriptions of Dirac semimetals undergoing a quantum phase transition into a symmetry-broken ordered state. Interestingly, their quantum critical points govern the physical behavior of the system in the vicinity of the transition even at finite temperatures. In this contribution, we explore the chiral models at zero and finite temperature, both in the Dirac phase as well as in the symmetry-broken phases. To that end, we set up a functional renormalization group approach, which allows us to systematically track (1) the phenomenon of pre-condensation, (2) the manifestation of the Mermin-Wagner-Hohenberg theorem due to pseudo-Goldstone fluctuations at finite temperatures, and (3) the quantitative behavior of the system in the quantum critical fan, e.g., by calculating the quasiparticle weight. Our work aims at a more holistic understanding of chiral models near their quantum critical point, including, e.g., the description of non-Dirac-liquid behavior, in analogy to the non-Fermi-liquid behavior in metallic quantum critical points.

Presenters: TOLOSA SIMEON, Mireia (Ruhr-Universität Bochum); TOLOSA SIMEÓN, Mireia

Session Classification: Talks

Contribution ID: 12

Type: **not specified**

Fixed Points of Quantum Gravity from Dimensional Regularisation

Tuesday 17 December 2024 14:00 (45 minutes)

We investigate β -functions of quantum gravity using dimensional regularisation. In contrast to minimal subtraction, a non-minimal renormalisation scheme is employed which is sensitive to power-law divergences from mass terms or dimensionful couplings. By construction, this setup respects global and gauge symmetries, including diffeomorphisms, and allows for systematic extensions to higher loop orders. We exemplify this approach in the context of four-dimensional quantum gravity. By computing one-loop β -functions, we find a non-trivial fixed point. It shows two real critical exponents and is compatible with Weinberg's asymptotic safety scenario. Moreover, the underlying structure of divergences suggests that gravity becomes, effectively, two-dimensional in the ultraviolet. We discuss the significance of our results as well as further applications and extensions to higher loop orders.

Presenter: Mr KLUTH, Yannick (University of Manchester)

Session Classification: Talks

Contribution ID: 13

Type: **not specified**

Asymptotic Safety within on-shell perturbation theory

Tuesday 17 December 2024 14:45 (45 minutes)

Presenter: FERRERO, Renata

Session Classification: Talks

Contribution ID: 14

Type: **not specified**

Exploring Asymptotically Safe Quantum Gravity on the lattice

Tuesday 17 December 2024 16:00 (45 minutes)

Presenter: SCHIFFER, Marc (Radboud University Nijmegen)

Session Classification: Talks

Contribution ID: 15

Type: **not specified**

Substructures of the Weyl group

Tuesday 17 December 2024 16:45 (45 minutes)

I will introduce the concept of restricted Weyl invariances and discuss their advantages for matter fields in curved space and their disadvantages for quantum gravity.

Presenter: MARTINI, Riccardo (UniBo and INFN - Bologna)

Session Classification: Talks

Contribution ID: **16**

Type: **not specified**

Discussion

Tuesday 17 December 2024 17:30 (30 minutes)

Session Classification: Talks

Contribution ID: 17

Type: **not specified**

A seeded electroweak phase transition

Wednesday 18 December 2024 09:30 (45 minutes)

Presenter: Dr BLASI, Simone (DESY)

Session Classification: Talks

Contribution ID: 18

Type: **not specified**

UV complete local field theory of persistent symmetry breaking in 2+1 dimensions

Wednesday 18 December 2024 10:15 (30 minutes)

Spontaneous symmetry breaking can persist at all temperatures in certain biconical $O(N) \times \mathbb{Z}_2$ vector models when the underlying field theories are ultraviolet complete. So far, the existence of such theories has been established in fractional dimensions for local but nonunitary models or in 2+1 dimensions but for nonlocal models. Here, we study local models at zero and finite temperature directly in 2+1 dimensions employing functional methods. At zero temperature, we establish that our approach describes the quantum critical behaviour with high accuracy for all $N \geq 2$. We then exhibit the mechanism of discrete symmetry breaking from $O(N) \times \mathbb{Z}_2 \rightarrow O(N)$ for increasing temperature near the biconical critical point when N is finite but large. We calculate the corresponding finite-temperature phase diagram and further show that the Hohenberg-Mermin-Wagner theorem is fully respected within this approach, i.e., symmetry breaking only occurs in the \mathbb{Z}_2 sector. Finally, we determine the critical N above which this phenomenon can be observed to be $N_c \approx 15$.

Presenter: HAWASHIN, Bilal (RUB)**Session Classification:** Talks

Contribution ID: 19

Type: **not specified**

BSMPT v3 A Tool for Phase Transitions and Primordial Gravitational Waves in Extended Higgs Sectors

Wednesday 18 December 2024 11:15 (45 minutes)

Strong first-order phase transitions (SFOPT) during the evolution of the Higgs potential in the early universe not only allow for the dynamical generation of the observed matter-antimatter asymmetry, they can also source a stochastic gravitational wave (GW) background possibly detectable with future space-based gravitational waves interferometers. As SFOPTs are phenomenologically incompatible with the Standard Model (SM) Higgs sector, the observation of GWs from SFOPTs provides an exciting interplay between cosmology and particle physics in the search for new physics. With the C++ code BSMPTv3, we present for the first time a tool that performs the whole chain from the particle physics model to the gravitational wave spectrum. Extending the previous versions BSMPTv1 and v2, it traces the phases of beyond-SM (BSM) Higgs potentials and is capable of treating multiple vacuum directions and multi-step phase transitions. During the tracing, it checks for discrete symmetries, flat directions, and electroweak symmetry restoration, and finally reports the transition history. The transition probability from the false to the true vacuum is obtained from the solution of the bounce equation which allows for the calculation of the nucleation, percolation and completion temperatures. The peak amplitude and frequency of the GWs originating from sound waves and turbulence, are evaluated after the calculation of the thermal parameters at the transition temperature, and finally the signal-to-noise ratio at LISA is provided. The code BSMPTv3 is a powerful self-contained tool that comes more than timely and will be of great benefit for investigations of the vacuum structure of the early universe of not only simple but also complicated Higgs potentials involving several vacuum directions, with exciting applications in the search for new physics.

Presenters: VIANA, João (Faculdade de Ciências da Universidade de Lisboa); VIANA, João

Session Classification: Talks

Contribution ID: 20

Type: **not specified**

Planck Safe Phase Transitions in a Complex Singlet Model

Wednesday 18 December 2024 12:00 (30 minutes)

Presenter: BOSSE, Moritz (TU Dortmund)

Session Classification: Talks

Contribution ID: 21

Type: **not specified**

Entanglement in flavored scalar scattering

Wednesday 18 December 2024 14:00 (45 minutes)

Presenter: SESSOLO, Enrico Maria

Session Classification: Talks

Contribution ID: 22

Type: **not specified**

Multiloop calculations (with MaRTIn)

Wednesday 18 December 2024 14:45 (30 minutes)

Presenter: BROD, Joachim (University of Cincinnati)

Session Classification: Talks

Contribution ID: 23

Type: **not specified**

Extended scalar sectors

Wednesday 18 December 2024 15:45 (45 minutes)

Presenter: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Session Classification: Talks

Contribution ID: 24

Type: **not specified**

Physical running in higher derivative gravity

Wednesday 18 December 2024 16:30 (30 minutes)

Running coupling were introduced in quantum field theory in order to preserve perturbativity in scattering amplitudes, despite the appearance of large logs of external momenta. It is commonly believed that these logarithms are directly related to UV divergencies in one-loop perturbation theory, however this is not completely true in higher derivative theories. On one hand, large logs can emerge also from UV finite loop integrals due to IR effects, on the other hand, some UV divergent diagrams do not depend on external momenta. We define a new set of beta functions for quadratic gravity based on the explicit computation of large logs of momenta and discuss their features concerning the asymptotic UV behavior of the theory. In particular, we observe the existence of a unique trajectory of the perturbative RG leading to asymptotic freedom without presence of tachyons.

Presenter: BUCCIO, Diego (SISSA)

Session Classification: Talks

Contribution ID: 25

Type: **not specified**

Spectral Functions of Lorentzian Quantum Gravity

Wednesday 18 December 2024 17:00 (30 minutes)

Presenter: ASSANT, Gabriel

Session Classification: Talks

Contribution ID: 26

Type: **not specified**

Discussion

Wednesday 18 December 2024 17:30 (30 minutes)

Session Classification: Talks

Contribution ID: 27

Type: **not specified**

Vacuum Stability in the Standard Model and Beyond

Thursday 19 December 2024 09:30 (30 minutes)

Presenter: STEUDTNER, Tom

Session Classification: Talks

Contribution ID: 28

Type: **not specified**

Extraction of top quark mass and strong coupling in experiment

Thursday 19 December 2024 10:00 (45 minutes)

Presenter: LIPKA, Katerina (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Talks

Contribution ID: 29

Type: **not specified**

TBD

Thursday 19 December 2024 11:15 (45 minutes)

Presenter: SERVANT, Geraldine (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Talks

Contribution ID: 30

Type: **not specified**

Searching for a dark matter induced galactic axion gradient

Thursday 19 December 2024 12:00 (30 minutes)

An ultra-light axion with CP violating interactions with a dark sector and CP preserving interactions with the visible sector can act as a novel portal between dark matter and the Standard Model. In such theories, dark matter sources an axion field extending over the entire galaxy, the gradient of which can be searched for with precise spin precession experiments. A reinterpretation of existing co-magnetometer data already constrains theories that are consistent with astrophysical bounds, and near-future experiments will begin probing well-motivated models. The required interactions can arise from a confining hidden sector without necessitating fine-tuning of the axion's mass.

Presenter: SMIRNOV, Juri

Session Classification: Talks

Contribution ID: **31**

Type: **not specified**

Discussion and Goodbye

Thursday 19 December 2024 12:30 (30 minutes)

Session Classification: Talks