ERG 2022

Report of Contributions

https://indico.tpi.uni-jena.de/e/erg2022

Contribution ID: **1** Type: **not specified**

Welcome

Monday 25 July 2022 08:55 (5 minutes)

Contribution ID: **3** Type: **not specified**

Positivity bounds in Effective Field Theories

Monday 25 July 2022 09:00 (45 minutes)

Presenter: MELVILLE, Scott

Contribution ID: **4** Type: **not specified**

From Random Tensors to Tensor Field Theory

Monday 25 July 2022 09:45 (45 minutes)

The latest addition to the family of large N field theories is tensor field theory built on the melonic large N limit of random tensors. This large N limit is richer than the vector large N limit but more amenable to analytic computations that the planar one. In this talk I will present an overview of the main results obtained on tensor field theories over the past several years and comment on their implications for the future.

Presenter: GURAU, Razvan

Contribution ID: **5** Type: **not specified**

Information theory and real space RG

Monday 25 July 2022 11:00 (45 minutes)

Presenter: RINGEL, Zohar

Contribution ID: **6** Type: **not specified**

Functional RG for zero- and one-dimensional Fermi systems

Monday 25 July 2022 11:45 (45 minutes)

I present an overview of our recent applications of funtional RG for zero- and one-dimensional many-fermion systems. The vertex expansion scheme with the two-particle interaction U being the small parameter is used. Equilibrium as well as nonequilibrium situations are considered. Several questions are tackled. Can one describe phase transitions which occur at finite U? If so, what is the role of the self-energy feedback and that of the two-particle vertex? Does the breaking of current conservation in nonequilibrium situations with a frequency dependent self-energy render the corresponding results useless right away? Can one use functional RG to study interacting (topological) insulators? Is it possible to extend functional RG to the realm of pseudo-Hermitian quantum many-body problems?

Presenter: MEDEN, Volker

Contribution ID: **7** Type: **not specified**

SU(2) gauge theory of the pseudogap phase in the two-dimensional Hubbard model

Monday 25 July 2022 14:30 (25 minutes)

We present a SU(2) gauge theory of fluctuating magnetic order in the two-dimensional Hubbard model. The theory is based on a fractionalization of electrons in fermionic chargons and bosonic spinons. The chargons undergo Néel or spiral magnetic order below a density dependent transition temperature T^*. Fluctuations of the spin orientation are described by a non-linear sigma model obtained from a gradient expansion of the spinon action. The spin stiffnesses are computed from a renormalization group improved random phase approximation. Our approximations are applicable for a weak or moderate Hubbard interaction. The spinon fluctuations prevent magnetic long-range order of the electrons at any finite temperature. The phase with magnetic chargon order exhibits many features characterizing the pseudogap regime in high-Tc cuprates: a strong reduction of charge carrier density, a spin gap, Fermi arcs, and electronic nematicity.

Presenter: BONETTI, Pietro Maria

Contribution ID: **8** Type: **not specified**

Renormalization group and probability theory: distribution of the order parameter at criticality

Monday 25 July 2022 14:55 (25 minutes)

Authors: Ivan Balog, Adam Rançon, Bertrand Delamotte; The question of probabilistic interpretation of the renormalization group has been around since the beginning of the subject of the renormalization group in the '70 [1], yet to this day no systematic approach exists for making practical calculations in cases when constituents of the system are strongly correlated, e.g. approaching criticality. Using functional renormalization group and the effective average action formalism [2], we write down a flow equation for the rate function $I(m)$, which determines the scaling function of the critical distribution of the order parameter $P(m)$, $I(m) = -ln(P(m))$. We show that I is a universal function parametrized by $\zeta = \xi/L$ characterizing the approach to criticality. Monte Carlo results for different $\zeta = \xi/L$ collapse closely to the rate functions for different ζ determined from the renormalization group. For all cases when $\zeta > 1$ the shape of the rate function is largely similar, yet not identical, to the shape of the fixed point (dimensionless) effective potential, featuring concavity near the origin. [1] G. Jona-Lasinio: Il Nuovo Cimento, 26, 99 (1975) [2] J. Berges, N. Tetradis, and C. Wetterich, Phys. Rep. 363, 223 (2002).

Presenter: BALOG, Ivan

Contribution ID: **9** Type: **not specified**

The long-range XY model and other examples of exotic BKT scaling

Monday 25 July 2022 15:20 (25 minutes)

The two dimensional classical XY model is characterised by the the presence, in the short-range regime, of a line of RG fixed points, which gives rise to the celebrated Berezinskii - Kosterlitz - Thouless (BKT) phenomenology. We will discuss the deformation of the BKT scaling caused by the inclusion of power-law decaying couplings, yielding a coexistence of spontaneously symmetry broken (SSB) and BKT phases in the phase diagram. Perturbative RG arguments imply that the SSB phenomenology observed in this model is described by a novel form of universality. Finally, in the last part of the talk, we are gonna extend our description of BKT scaling outside of the equilibrium world and consider the BKT scaling generated by the inclusion of non-Hermitian terms in the model Hamiltonian.

Presenter: DEFENU, Nicolo

Contribution ID: **10** Type: **not specified**

Precision calculation with FRG: the planar Bose gas as an example

Monday 25 July 2022 16:15 (20 minutes)

Presenter: DUPUIS, Nicolas

Contribution ID: **11** Type: **not specified**

TU^2FRG - a scalable approach for TUFRG in generic fermionic models

Monday 25 July 2022 16:35 (20 minutes)

Describing the emergence of phases of matter is one of the central challenges in physics. The main complication is the tremendous computational effort required to investigate real materials. Therefore, approximations to enable accurate and fast calculations are of central importance to deepening our understanding of phases of matter. Here, we present a new truncated unity (TU) approach unifying real- and momentum-space TUFRG in a symmetry-preserving fashion, called TU^2FRG. This formalism significantly improves the scaling compared to conventional momentum (TU)FRG when applied to large unit-cell models and models without translational symmetry. To showcase its predictive power, we study the topological edge modes in the superconducting phase of graphene.

Presenter: HAUCK, Jonas

Contribution ID: **12** Type: **not specified**

Functional RG for strongly interacting Hubbard model'

Monday 25 July 2022 16:55 (20 minutes)

Presenter: VILARDI, Demetrio

Contribution ID: **13** Type: **not specified**

Quantum Gravity Amplitudes From First Principles

Monday 25 July 2022 14:55 (25 minutes)

Presenter: KNORR, Benjamin

Contribution ID: **14** Type: **not specified**

Non perturbative strings, asymptotic safety, and the swampland

Presenter: PLATANIA, Alessia

Contribution ID: **15** Type: **not specified**

Invariant Renormalization-Group improvement in General Relativity

Monday 25 July 2022 15:20 (25 minutes)

Renormalization-Group (RG) improvement has been applied to capture the effect of gravitational quantum corrections on cosmological and black-hole spacetimes. In this talk, I will use an algebraically complete set of curvature invariants to establish that (i) RG improvement at the level of the metric (or the equations of motion) is coordinate-dependent, while (ii) RG improvement at the level of curvature invariants (or the action) is coordinate-independent. Spherically-symmetric and axially-symmetric black-hole spacetimes serve as concrete and physically relevant examples.

Presenter: HELD, Aaron

Contribution ID: **16** Type: **not specified**

Gravity-mediated matter scattering amplitudes from the effective action

Monday 25 July 2022 16:15 (20 minutes)

One of the goals of the Asymptotic Safety program for gravity is to compute the effective action at k=0. However, given such an action, what are the concrete physical predictions that we can derive from it? Generically, the renormalization group will generate an infinite number of interactions in the effective action. It is therefore an interesting question which interactions can arise, and how they affect physical observables. In this talk, I will present a classification scheme to parameterize the infinitely many interactions using form factors. These take into account the full momentum-dependence of propagators and vertices. Using 2-to-2 scattering processes involving scalars and photons as a starting point, I will show how to derive the most general scattering amplitudes and cross-sections from the effective action. Taking the low-energy limit, this allows to parameterize the smoking gun signals for quantum gravity in these observables.

Presenter: RIPKEN, Chris

Contribution ID: **17** Type: **not specified**

Towards the phase structure of the complete Lorentzian Barrett-Crane model

The Barrett-Crane spin foam and GFT model is a state-sum model which provides a quantization of first order Lorentzian Palatini gravity. Its complete formulation has only recently been accomplished. It is conjectured that the collective dynamics of the quanta of this model, which correspond to discrete building blocks of spacetime with spacelike, timelike and lightlike components, gives rise to continuum spacetime at criticality via phase transition. In this talk, we discuss how phase transitions for this and related models can be studied using Landau-Ginzburg mean-field theory. To this aim, we restrict the building blocks of the complete model such that the Feynman diagrams are dual to spacelike triangulations. We also include degrees of freedom which may be interpreted as discretized scalar fields on the lattice typically employed in quantum gravity to furnish a matter reference frame. This setting lays the groundwork to study the critical behavior when arbitrary Lorentzian building blocks are incorporated and represents a crucial advance to understand how phase transitions to continuum spacetime can be achieved in this setting. It also paves the way for the analysis of the phase structure of such models via functional renormalization group techniques in the future.

Presenter: PITHIS, Andreas

Contribution ID: **18** Type: **not specified**

Dimensional reduction along the RG flow in combinatorially non-local field theories

Monday 25 July 2022 16:35 (20 minutes)

Combinatorially non-local interactions are at the heart of matrix and tensor theories as well as non-commutative field theory. Interestingly, for theories on a compact domain their renormalization group equations are non-autonomous in the momentum scale. We show that this should be regarded not as an issue but as a feature of such theories leading to a reduction of the effective dimension of the field theory along the renormalization group flow. We illustrate this with the example of a field theory with tensorial symmetry using the functional renormalization group in the cyclic-melonic potential approximation. While this yields a dimensional flow on compact domain, we also find a new phase structure with hints for an asymptotic safe fixed point in the large-volume limit.

Presenter: THÜRIGEN, Johannes

Contribution ID: **19** Type: **not specified**

Nevanlinna Analytical Continuation

Tuesday 26 July 2022 09:00 (45 minutes)

Simulations of finite temperature quantum systems provide imaginary frequency Green's functions that correspond one-to-one to experimentally measurable real-frequency spectral functions. However, due to the bad conditioning of the continuation transform from imaginary to real frequencies, established methods tend to either wash out spectral features at high frequencies or produce spectral functions with unphysical negative parts. Here, we show that explicitly respecting the analytic 'Nevanlinna' structure of the Green's function leads to intrinsically positive and normalized spectral functions, and we present a continued fraction expansion that yields all possible functions consistent with the analytic structure. Application to synthetic trial data shows that sharp, smooth, and multi-peak data is resolved accurately. Application to the band structure of silicon demonstrates that high energy features are resolved precisely. Continuations in a realistic correlated setup reveal additional features that were previously unresolved. By substantially increasing the resolution of real frequency calculations our work overcomes one of the main limitations of finite-temperature quantum simulations.

Presenter: GULL, Emanuel

Contribution ID: **20** Type: **not specified**

Towards a microscopic understanding of macroscopic properties of strong-interaction matter

Tuesday 26 July 2022 09:45 (45 minutes)

Presenter: BRAUN, Jens

Contribution ID: **21** Type: **not specified**

The Spectral Geometry of de Sitter Space in Asymptotic Safety

Tuesday 26 July 2022 11:00 (30 minutes)

Within the functional renormalization group approach to Background Independent quantum gravity, we explore the scale dependent effective geometry of the de Sitter solution dS4. The investigation employs a novel approach whose essential ingredient is a modified spectral flow of the metric dependent d'Alembertian, or of similar hyperbolic kinetic operators. The corresponding one-parameter family of spectra and eigenfunctions encodes information about the nonperturbative backreaction of the dynamically gravitating vacuum fluctuations on the mean field geometry of the quantum spacetime. Used as a diagnostic tool, the power of the spectral flow method resides in its ability to identify the scale dependent subsets of field modes that supply the degrees of freedom which participate in the effective field theory description of the respective scale. A central result is that the ultraviolet of Quantum Einstein Gravity comprises far less effective degrees of freedom than predicted (incorrectly) by background dependent reasoning. Exploring the quantum spacetime's spatial geometry carried by physical fields, we find that 3-dimensional space disintegrates into a collection of coherent patches which individually can, but in their entirety cannot be described by one of the effective average actions occurring along the renormalization group trajectory.

Presenter: FERRERO, Renata

Contribution ID: **22** Type: **not specified**

Lorentzian quantum gravity and the graviton spectral function

Tuesday 26 July 2022 11:30 (30 minutes)

Presenter: REICHERT, Manuel

Contribution ID: **23** Type: **not specified**

Quantum discontinuity fixed point and renormalization group flow of the SYK model

Tuesday 26 July 2022 14:30 (25 minutes)

We determine the global renormalization group (RG) flow of the Sachdev-Ye-Kitaev (SYK) model. From a controlled truncation of the infinite hierarchy of the exact functional RG flow equations we identify several fixed points: Apart from a stable fixed point, associated with the celebrated non-Fermi liquid state of the model, we find another stable fixed point related to an integer-valence state. These stable fixed points are separated by a discontinuity fixed point with one relevant direction, describing a quantum first-order transition. Most notably, the fermionic spectrum continues to be quantum critical even at the discontinuity fixed point. This rules out a description of the transition in terms of a local effective Ising variable as is established for classical transitions. We propose an entangled quantum state at phase coexistence as a possible physical origin of this critical behavior.

Presenter: KOPIETZ, Peter

Contribution ID: **24** Type: **not specified**

Functional Flows for Complex Actions

Tuesday 26 July 2022 14:30 (25 minutes)

In my talk I will present a general functional renormalisation group framework for the computation of complex actions. Resolving the complex structure of quantum theories, such as QCD or condensed matter systems such as graphene or spin-imbalanced fermionic gases, may shed light on their phase structure. Restrictions on the phase structure come from exploring complex external fields such as a complex magnetic field in spin systems, or, more generally, complex couplings. The latter gives rise to Lee-Yang zeros in the complex (magnetisation) plane. For the explicit computations we consider both flows of the Wilsonian effective action and the 1PI effective action. In the present formulations the flow of the Wilsonian effective action has a general range of applicability and we obtain results for a ϕ^4 theory in d=0,1,2,3,4 dimensions. These results are also compared with that for the 1PI effective action within its range of applicability. Computations are performed using the Discontinious Galerkin Methods. These advanced numerical methods enable us to solve these highly dynamic equations to very high proximity of the ensuing Lee-Yang singularities, and are reminiscent of reaction-diffusion equations (with an RG-kernel).

Presenter: IHSSEN, Frederike

Contribution ID: **25** Type: **not specified**

Analysis of classical liquids using functional renormalization group

Tuesday 26 July 2022 14:55 (25 minutes)

The development of theoretical methods for classical liquids is a longstanding problem in statistical mechanics. Accurate and efficient methods for classical liquids benefit, for instance, analysis of chemical reactions. In this talk, I will present an application of the functional renormalization group to classical liquids. We develop a formulation suitable for a hard-core repulsion and introduce the Kirkwood superposition approximation to truncate the hierarchy of the flow equations in the vertex expansion. In a numerical test on a one-dimensional solvable model, the functional renormalization group shows more accurate results than the integral-equation methods such as the hypernetted chain and the Percus-Yevick equation, which are conventional methods for classical liquids.

Presenter: YOKOTA, Takeru

Contribution ID: **26** Type: **not specified**

Pion-pion scattering from nucleon-meson fluctuations

Tuesday 26 July 2022 14:55 (25 minutes)

I present calculations of the S-wave isospin-zero and isospin-two pion-pion scattering lengths within a nucleon-meson model with parity doubling. Both scattering lengths are computed in various approximations, ranging from a mean-field calculation towards the inclusion of loop corrections by means of the FRG. I thereby elucidate subtleties concerning the truncation of the effective action w.r.t. higher-derivative pion interactions. As the main result, simultaneous agreement for the isospin-zero and isospin-two scattering lengths with experimental data within the LPA'-truncation is found. The isoscalar sigma-mass is dynamically generated by the FRG integration, and is a prediction of the model. It ends being of the order of 500 MeV, i.e., much lower than the value (> 1 GeV) found in mean-field or one-loop treatment of this or related models. Finally, the convergence of the corresponding low-energy expansion of the quantum effective action in terms of pion momenta is discussed.

Presenter: ESER, Juergen

Contribution ID: **27** Type: **not specified**

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Contribution ID: **28** Type: **not specified**

RG flows between Gaussian fixed points

Tuesday 26 July 2022 15:20 (25 minutes)

A scalar theory can have many Gaussian (free) fixed points, corresponding to Lagrangians of the form \phi\box^k\phi. We use the non-perturbative RG to study the flow from the free theory with four derivatives (k = 2) to the free theory with two derivatives (k = 1), in the presence of a shift-invariant interaction.

Presenter: BUCCIO, Diego

Contribution ID: **29** Type: **not specified**

Multiloop flow equations for single-boson exchange fRG

Tuesday 26 July 2022 16:15 (20 minutes)

The recently introduced single-boson exchange (SBE) decomposition [2] of the four-point vertex of interacting fermionic many-body systems is a conceptually and computationally appealing parametrization of the vertex. It relies on the notion of reducibility of vertex diagrams with respect to the bare interaction U, instead of a classification based on two-particle reducibility within the widely-used parquet decomposition. We re-derived the SBE decomposition in a generalized framework (suitable for extensions to, e.g., inhomogeneous systems or real-frequency treatments) following from the parquet equations. We then derived multiloop functional renormalization group (mfRG) flow equations [3] for the ingredients of this SBE decomposition, both in the parquet approximation, where the fully two-particle irreducible vertex is treated as an input, and in the more restrictive SBE approximation, where this role is taken by the fully U-irreducible vertex. Moreover, we give mfRG flow equations for the popular parametrization of the vertex in terms of asymptotic classes [4] of the two-particle reducible vertices. Since the parquet and SBE decompositions are closely related, their mfRG flow equations are very similar in structure. [1] E. Walter, M. Gievers, A. Ge, J. von Delft, F. B. Kugler, aXiv:2201.04878 (2022). [2] F. Krien, A. Valli, M. Capone, PRB 100, 155149 (2019). [3] F. B. Kugler, J. von Delft, Phys. Rev. Lett. 120, 057403 (2018). [4] N. Wentzell, G. Li, A. Tagliavini, C. Taranto, G. Rohringer, K. Held, A. Toschi, S. Andergassen PRB 102, 085106 (2020)

Presenter: GIEVERS, Marcel

Contribution ID: **30** Type: **not specified**

Timelike properties of QCD from functional methods

Tuesday 26 July 2022 16:15 (20 minutes)

We investigate timelike correlation functions in QCD via spectral functional renormalisation group and Dyson-Schwinger equations. Within the spectral formulation, direct access to the full complex structure of the theory is obtained. Studying the propagation of non-holomorphicities through the coupled system of DSEs in Yang-Mills theory, we obtain consistency conditions which constrain the analytic structure of possible solutions. We also present spectral functions in the Phi^4 theory from the spectral renormalization group. Finally, results for QCD transport coefficients are presented, obtained via closed diagrammatic representations in terms of timelike correlation functions.

Presenter: HORAK, Jan

Contribution ID: **31** Type: **not specified**

Critical behaviour at thermal m-axial Lifshitz point and stability of the FFLO superfluid phases

Tuesday 26 July 2022 16:35 (20 minutes)

We apply nonperturbative renormalization group method to critical exponents of m-axial Lifshitz point as a function of dimensionality d, anisotropy m and the number of order parameter components N. Basing on the results we consider the stability of the Fulde-Ferrell-Larkin-Ovchinnikov states in cold atom system.

Presenter: HOMENDA, Mateusz

Contribution ID: **32** Type: **not specified**

Second order chiral phase transition in three flavor quantum chromodynamics?

Tuesday 26 July 2022 16:35 (20 minutes)

We calculate the renormalization group flows of all renormalizable interactions in the three dimensional Ginzburg–Landau potential for the chiral phase transition of three flavor quantum chromodynamics. On the contrary to the common belief we find a fixed point in the system that is able to describe a second order phase transition in the infrared. This shows that longstanding assumptions on the transition order might be false. If the transition is indeed of second order, our results can also be interpreted as indirect evidence that the axial anomaly restores at the transition temperature.

Presenter: FEJOS, Gergely

Contribution ID: **33** Type: **not specified**

Lifetimes of the Fermi polaron and molecule at finite momentum from fRG

Tuesday 26 July 2022 16:55 (20 minutes)

We study theoretically the lifetimes of the attractive and the repulsive Fermi Polaron and the molecule at finite momentum in both two and three dimensions. To this end we developed a new technique that allows for the computation of Green's functions in the whole complex frequency plane using exact analytical continuation within the functional renormalization group. While conventional approaches like the NSCT method cannot determine these lifetimes, we are able to find the momentum dependent lifetime at different interaction strengths of both the attractive and repulsive polaron as well as the molecule. In our talk we discuss our findings and talk about possible experiments which could be conducted.

Presenter: VON MILCZEWSKI, Jonas

Contribution ID: **34** Type: **not specified**

Spectral Functions in Banks-Zaks QCD

Tuesday 26 July 2022 16:55 (20 minutes)

The question of unitarity in perturbatively non-renormalisable field theories such as asymptotically safe quantum gravity is notoriously difficult to answer. A possible way to make progress lies in analysing spectral functions given by the Källén-Lehmann representation of the propagator. For spectral functions of scalar quantities, unitarity requires positive definiteness as well as normalisability. Such properties or even the existence of the Källén-Lehmann representation are however not clear for gauge fields or the graviton. To address these difficulties, we consider QCD in the Banks-Zaks phase which allows studying spectral functions of all elementary fields analytically using perturbative methods. In particular, this gives access to the propagator in the whole complex plane, which is difficult to achieve using conventional ERG methods. We analyse existence properties of spectral functions and test whether they fulfil positive definiteness and normalisability due to unitarity. Implications for spectral functions of conventional QCD or quantum gravity are discussed.

Presenter: KLUTH, Yannick

Contribution ID: **35** Type: **not specified**

Active matter: A treasure trove of novel universality classes

Tuesday 26 July 2022 17:15 (20 minutes)

A hallmark of living organisms is the ability to move around in their environments. In the fluid state, i.e., when the motile agents can exchange neighbours freely, the equations of motion that describes the system are called the Toner-Tu (TT) equations. The TT equations govern active fluids the same way that the Navier-Stokes equations govern simple fluids. Since the inception of the TT equations in 1995, dynamic renormalization group (DRG) analyses on the TT equations have led to the discovery of diverse novel nonequilibrium states of matter (or phases), and novel critical phenomena. In this talk, I will focus on the incompressible limit of the TT equations and elucidate the associated universal behaviour [1–5]. I will also discuss how exact RG may enable us to solve some key open questions in active matter physics. References: [1] Chen L, Lee C F, Maitra A and Toner J 2022 Packed swarms on dirt: two dimensional incompressible flocks with quenched and annealed disorder arXiv:2202.02865 [2] Chen L, Lee C F, Maitra A and Toner J 2022 Incompressible polar active fluids with quenched disorder in dimensions d > 2 arXiv:2203.01892 [3] Chen L, Lee C F and Toner J 2018 Incompressible polar active fluids in the moving phase in dimensions d > 2 New J. Phys. 20 113035 [4] Chen L, Lee C F and Toner J 2016 Mapping two-dimensional polar active fluids to two-dimensional soap and one-dimensional sandblasting Nat. Commun. 7 12215 [5] Chen L, Toner J and Lee C F 2015 Critical phenomenon of the order–disorder transition in incompressible active fluids New J. Phys. 17 042002

Presenter: LEE, Chiu Fan

Contribution ID: **36** Type: **not specified**

Functional renormalisation group for cosmic large-scale structure formation

Tuesday 26 July 2022 17:15 (20 minutes)

The formation of cosmic large-scale structures can be described with a statistical field theory for the dynamics of dark matter. The functional renormalisation group is on the one hand studied using the underlying symmetries of the theory and in particular using an extended version of Galilean invariance. The corresponding generalised Ward identities allow to close and solve the flow equations for two-point correlation functions and relate to the so-called 'sweeping effect' known in fluid turbulence. On the other hand the flow equations are solved using an ansatz that corresponds to time-local effective dynamics for dark matter and can be understood as a vertex and derivative expansion of the effective action.

Presenter: ERSCHFELD, Alaric

Contribution ID: **37** Type: **not specified**

Novel critical phenomena in compressible polar active fluids

Tuesday 26 July 2022 17:35 (20 minutes)

Active matter describes the collective properties of particles that either possess internal energy or harness energy from the environment to actively self-propel. Diverse biological many-body systems, like tissue, or swarms of birds, fish or bacteria, are thus of this type, and many of which can be modelled as polar active fluids. Since these nonequilibrium systems break conservative laws that are intrinsic to thermal systems, such as energy and momentum conservation, diverse novel nonequilibrium phenomena are expected. In this talk, I will describe the use of the functional renormalization group to discover for the first time new universality classes in compressible polar active fluids that correspond to a multicritical point of these active systems. arXiv:2205.01610

Presenter: JENTSCH, Patrick

Contribution ID: **38** Type: **not specified**

Cosmological constant problem and Hubble tension in scale-dependent cosmology

Tuesday 26 July 2022 17:35 (20 minutes)

In this work, a cosmological model based on the scale-dependent scenario of gravity is presented. We argue that the discrepancy between the Planck mass scale and the observed value of the cosmological constant can be largely attenuated if those quantities are understood as a result of effective, and thus scale-dependent, couplings. In the approach where the scale–dependence appears as a correction to the classical ΛCDM evolution, the potential to address the tensions between early and late time measurements of H0 is studied. Our results are compared to the renormalization group flow obtained within the asymptotic safety program, which reveals a stunning agreement. The work is based on JCAP 01 (2020) 021, JCAP 06 (2021) 019, and arXiv:2205.05592.

Presenter: LAPORTE, Cristóbal

Contribution ID: **39** Type: **not specified**

Towards the phase structure of the complete Lorentzian Barrett-Crane model

Tuesday 26 July 2022 17:55 (20 minutes)

The Barrett-Crane spin foam and GFT model is a state-sum model which provides a quantization of first order Lorentzian Palatini gravity. Its complete formulation has only recently been accomplished. It is conjectured that the collective dynamics of the quanta of this model, which correspond to discrete building blocks of spacetime with spacelike, timelike and lightlike components, gives rise to continuum spacetime at criticality via phase transition. In this talk, we discuss how phase transitions for this and related models can be studied using Landau-Ginzburg mean-field theory. To this aim, we restrict the building blocks of the complete model such that the Feynman diagrams are dual to spacelike triangulations. We also include degrees of freedom which may be interpreted as discretized scalar fields on the lattice typically employed in quantum gravity to furnish a matter reference frame. This setting lays the groundwork to study the critical behavior when arbitrary Lorentzian building blocks are incorporated and represents a crucial advance to understand how phase transitions to continuum spacetime can be achieved in this setting. It also paves the way for the analysis of the phase structure of such models via functional renormalization group techniques in the future.

Presenter: PITHIS, Andreas

Contribution ID: **40** Type: **not specified**

Stability of the Yang-Mills theory vacuum and Cosmological Inflation.

Tuesday 26 July 2022 17:55 (20 minutes)

We examine the phenomena of the chromomagnetic gluon condensation in Yang-Mills theory and the problem of stability of the vacuum state. The stability of the vacuum state is analysed in the nonlinear regime. It is shown that an apparent instability of the Yang Mills vacuum is a result of quadratic approximation. In the case of (anti)self-dual fields the interaction of chromomagnetic modes of the quantised field in the direction of zero modes is calculated by using a new method of infrared regularisation as well as by the integration over the collective variables of self-interacting zero modes. The deformation of (anti)self-dual fields is also considered in the nonlinear regime by the integration, in this case, over the collective variables of self-interacting unstable modes. All these vacuum field configurations are stable and indicate that the vacuum is stable and is a superposition of many states. The deep interrelation between elementary particle physics and cosmology manifests itself when one considers the contribution of quantum fluctuations of vacuum fields to the dark energy and the effective cosmological constant. The contribution of zero-point energy exceeds by many orders of magnitude the observational cosmological upper bound on the energy density of the universe. Therefore it seems natural to expect that vacuum fluctuations of the fundamental fields would influence the cosmological evolution in any way. Our aim is to describe a recent investigation of the influence of the Yang-Mills vacuum polarisation and of the chromomagnetic condensation on the evolution of Friedmann cosmology, on inflation and on primordial gravitational waves.

Presenter: SAVVIDY, George

Contribution ID: **41** Type: **not specified**

Operator Product Expansion

Thursday 28 July 2022 09:00 (45 minutes)

With the help of the renormalization group flow equations a la Wilson-Wegner-Polchinski-Wetterich several hitherto conjectural properties and several new properties of the operator product expansion (OPE) have been established in recent times such as 1) its convergence properties 2) its algebraic properties (”associativity”), or 3) a functional master equation for the OPE coefficients. With the help of the master equation, a differential equation for the flow of the conformal data (OPE coefficients and anomalous dimensions) in d-dimensional CFTs under a marginal perturbation can be established. In this talk, I give an
overview over such results.

Presenter: HOLLANDS, Stefan

Contribution ID: **42** Type: **not specified**

Functional Renormalization Group and 2PI Effective Action Formalism

Tuesday 26 July 2022 12:00 (30 minutes)

Presenter: REINOSA, Urko

Contribution ID: **43** Type: **not specified**

Coarse graining to capture ”relevant” information in biological systems

Wednesday 27 July 2022 09:00 (45 minutes)

Biological systems must selectively encode partial information about the environment, as dictated by the capacity constraints at work in all living organisms. For example, we cannot see every feature of the light field that reaches our eyes; temporal resolution is limited by transmission noise and delays, and spatial resolution is limited by the finite number of photoreceptors and output cells in the retina. Classical efficient coding theory describes how sensory systems can maximize information transmission given such capacity constraints, but it treats all input features equally. Not all inputs are, however, of equal value to the organism. Our work quantifies whether and how the brain selectively encodes stimulus features, specifically predictive features, that are most useful for fast and effective movements. We have shown that efficient predictive computation starts at the earliest stages of the visual system, in the retina. We borrow techniques from statistical physics and information theory to assess how we get terrific, predictive vision from these imperfect (lagged and noisy) component parts. In broader terms, we aim to build a more complete theory of efficient encoding in the brain, and along the way have found some intriguing connections between formal notions of coarse graining in biology and physics.

Presenter: PALMER, Stephanie

Contribution ID: **44** Type: **not specified**

Large Deviations in the Climate System: Extreme Events and Metastability

Wednesday 27 July 2022 09:45 (45 minutes)

The climate system is a complex, chaotic system with many degrees of freedom and variability on a vast range of temporal and spatial scales. Attaining a deeper level of understanding of its dynamical processes is a scientific challenge of great urgency, especially given the ongoing climate change and the evolving climate crisis. In statistical physics, complex, many-particle systems are studied successfully using the Large Deviation Theory (LDT). In the spirit of Hasselmann's programme, a great potential exists for applying LDT to problems relevant for climate science. In particular, LDT allows for understanding the fundamental properties of persistent deviations of climatic fields from the long-term averages and for associating them to low-frequency, large scale patterns of variability. This allows one to introduce a notion of typicality with regard to extreme events. These applications are of key importance to improve our understanding of high-impact weather and climate events. We will present several applications to the case of recent heatwaves (2010 Russian Heatwave, 2021 Western North America Heatwave) and cold spells (2010 Mongolian Dzud, 2019 Canadian Cold Spell). Furthermore, taking advantage of the formalism of Graham's quasipotential, LDT provides powerful tools for evaluating the probability of noise-induced transitions between competing metastable states of the climate system and for understanding the multiscale, hierarchical properties of the so-called dynamical landscape. We will show how this framework can be used to better understand the - arguably - most important critical transition of the Earth system, associated with the dichotomy between Snowball and Warm climate. The final transition to the Warm state that occurred about 600 Mya has been key for the eventual emergence of multicellular life in our planet. References: V.M. Galfi, V. Lucarini, Fingerprinting Heatwaves and Cold Spells and Assessing Their Response to Climate Change using Large Deviation Theory, Phys. Rev. Lett. 127, 058701 (2021) V.M. Galfi, V. Lucarini, F. Ragone, J. Wouters, Applications of Large Deviation Theory in Climate Science and Geophysical Fluid Dynamics, Riv. Nuovo Cimento 44, 291–363 (2021) G. Margazoglou, T. Grafke, A. Laio, V. Lucarini, Dynamical Landscape and Multistability of the Earth's Climate, Proc. R. Soc. A 477, 2021001920210019 V. Lucarini, T. Bodai, Global Stability Properties of the Climate: Melancholia States, Invariant Measures, and Phase Transitions, Nonlinearity 33, R59 (2020) V. Lucarini, T. Bodai, Transitions across Melancholia States in a Climate Model: Reconciling the Deterministic and Stochastic Points of View, Phys. Rev. Lett. 122,158701 (2019)

Presenter: LUCARINI, Valerio

Contribution ID: **45** Type: **not specified**

Essential Renormalisation Group

Wednesday 27 July 2022 11:00 (30 minutes)

Presenter: FALLS, Kevin

Contribution ID: **46** Type: **not specified**

Vanishing regulators

Wednesday 27 July 2022 11:30 (30 minutes)

Presenter: ZAMBELLI, Luca

Contribution ID: **47** Type: **not specified**

Glory and misery of the Derivative Expansion: Ten years later

Wednesday 27 July 2022 12:00 (30 minutes)

Presenter: WSCHEBOR, Nicolás

Contribution ID: **48** Type: **not specified**

Sextic tensor field theories

Wednesday 27 July 2022 16:15 (20 minutes)

Tensor models admit a melonic large N limit. In d dimensions, they give rise to a new family of conformal field theories. Such melonic CFTs were studied for tensor models in rank 3 with quartic interactions. However, a non-trivial infrared fixed point with a real spectrum of conformal dimensions was only found for a model with a long-range propagator and a purely imaginary coupling constant. We wish to understand how this depends on the rank of the tensors and on the order of the interactions. I will present here the renormalization group flow of two tensor models with sextic interactions in rank 3 and 5 with either short or long-range propagators. In rank 3, we found non-trivial IR fixed points for both the short-range and the long-range models, with precursors at next-to-leading order in short range. We also found a real spectrum of bilinear operators in both cases. Surprisingly, in rank 5, we only found a non-interacting fixed point.

Presenter: HARRIBEY, Sabine

Contribution ID: **49** Type: **not specified**

Coupling fermions to unimodular gravity

Wednesday 27 July 2022 16:15 (20 minutes)

Presenter: ALKOFER, Reinhard

Contribution ID: **50** Type: **not specified**

Fixed Point Structure of Gradient Flow Exact Renormalization Group for Scalar Field Theories

Wednesday 27 July 2022 16:35 (20 minutes)

Gradient Flow Exact Renormalization Group (GFERG) is a framework to define the Wilson action via a gradient flow equation proposed by Ref.[1]. Because it preserves gauge symmetries obviously, it is a promising approach to study non-perturbative aspects of gauge theories or quantum gravity. On the other hand, some scalar models (such as the CP^N-1 model or the O(N) non-linear sigma model) share similar properties with these theories and have been investigated as their toy models. In this talk, we study the fixed point structure of the GFERG equation associated with a general gradient flow equation for scalar field theories. We show that the fixed point structure is the same as that of the conventional Wilson-Polchinski (WP) equation in general. Furthermore, we discuss that the GFERG equation has a similar RG flow structure around a fixed point to the WP equation. We illustrate these results with the O(N) non-linear sigma model in 4-epsilon dimensions and the Wilson-Fisher fixed point. This talk is based on Ref. [2]. [1] H. Sonoda and H. Suzuki, PTEP2021 No.2, (2021) 023B05 [arXiv:2012.03568 [hep-th]] [2] Y.Abe, Y.Hamada and J.Haruna, [arXiv:2201.04111 [hep-th]]

Presenter: HARUNA, Junichi

Contribution ID: **51** Type: **not specified**

The weak-gravity bound in asymptotically safe gauge-gravity systems

Wednesday 27 July 2022 16:35 (20 minutes)

In this talk I will discuss the weak-gravity bound, which has been discovered in asymptotically safe gravity-matter systems. It limits the maximum strength of the gravitational fluctuations. Specifically, I will discuss the weak-gravity bound in gauge-gravity systems with more than one gauge field, to discover whether systems with 12 gauge fields (like the Standard Model) exhibit such a bound and whether the gravitational fixed point evades it. Furthermore, I will highlight that the existence of the weak-gravity bound in gauge-gravity systems also has important phenomenological consequences: it is key to a proposed mechanism that bounds the spacetime dimensionality from above to four or five dimensions. I will discuss strengthened evidence for this mechanism, which indicates that the predictive power of the asymptotic safety paradigm could extend to parameters of the spacetime geometry. Finally, I will present first steps towards investigating the weak-gravity bound beyond polynomial truncations.

Presenter: SCHIFFER, Marc

Contribution ID: **52** Type: **not specified**

Operator product expansion coefficients from the nonperturbative functional renormalization group

Wednesday 27 July 2022 16:55 (20 minutes)

Using the nonperturbative functional renormalization group (FRG) within the Blaizot-Méndez-Galain-Wschebor approximation, we compute the operator product expansion (OPE) coefficient c112 associated with the operators O1~φ and O2~φ2 in the three-dimensional O(N) universality class and in the Ising universality class (N=1) in dimensions 2≤d≤4. When available, exact results and estimates from the conformal bootstrap and Monte-Carlo simulations compare extremely well to our results, while FRG is able to provide values across the whole range of d and N considered.

Presenter: ROSE, Félix

Contribution ID: **53** Type: **not specified**

Nonvanishing gravitational contribution to matter beta functions for vanishing regulators

Wednesday 27 July 2022 16:55 (20 minutes)

In this talk, I will explore the effect of quantum gravity on matter couplings within a Renormalization Group framework. In particular, I will focus on results obtained from a class of interpolating regulators that allow us to extract certain universal pieces from non-universal quantities. I will discuss an explicit example of how misleading conclusions can be drawn by analyzing the gravitational contributions to beta functions instead of analyzing universal quantities, such as critical exponents, that can be extracted from the beta functions. This could be key to explaining the differences between perturbative studies and Functional Renormalization Group studies.

Presenter: DE BRITO, Gustavo

Contribution ID: **54** Type: **not specified**

Interacting fixed points of fermionic field theories

Wednesday 27 July 2022 17:15 (20 minutes)

Using functional RG for fermions, we study new fixed points of 3d Gross-Neveu theories beyond chiral symmetry. At large N we find that the sextic coupling becomes exactly marginal, leading to a line of UV fixed points. We discuss the generation of mass in these theories, the phase diagram and the Bardeen-Moshe-Bander phenomenon for fermions. Similarities with critical scalar theories are highlighted. We also discuss aspects of four-fermion interactions in four dimensions.

Presenter: CRESSWELL-HOGG, Charlie

Contribution ID: **55** Type: **not specified**

Running Newton Coupling, Scale Identification and Black Hole Thermodynamics

Wednesday 27 July 2022 17:15 (20 minutes)

We discuss the quantum improvement of black hole solutions in the context of asymptotic safety. The Newton coupling in this formulation depends on an energy scale, which must be identified with some length scale in order to study physical consequences to black holes. However, no physical principle has so far been known for the identification. Here we propose that the consistency of the first law of thermodynamics is the principle that should determine physically sensible scale identification, at least close to the horizon. We show that this leads to a natural solution that the Newton coupling should be a function of the horizon area and find a universal formula for the quantum entropy, which agrees with the standard Bekenstein-Hawking entropy for constant Newton coupling, for Kerr black holes and other higher-dimensional black holes. This suggests that the Newton coupling is a function of the area at fixed radius near the horizon, and also away to infinity, where the quantum effects may not be so important.

Presenter: OHTA, Nobuyoshi

Contribution ID: **56** Type: **not specified**

Gross-Neveu SO(3) criticality in spin-orbital liquids: FRG vs higher-order perturbation theory

Wednesday 27 July 2022 17:35 (20 minutes)

The Gross-Neveu SO(3) universality class in three spacetime dimensions describes a quantum critical point between a Dirac semimetal and a long-range-ordered phase in which the fermion spectrum is only partially gapped out. Such a quantum critical point has recently been predicted to be realizable in two-dimensional spin-orbital magnets with strong exchange frustration. Here, I shall report on our efforts to characterize the quantum critical behaviour of the Gross-Neveu-SO(3) universality class using the functional renormalization group in the improved local potential approximation, and compare with our three-loop and second-order large-N results. Time permitting, I shall also discuss some of the qualitative behaviour for general spactime dimension and flavour number, which shows some distinctive features that are absent in the corresponding Gross-Neveu-Ising and -Heisenberg incarnations.

Presenter: RAY, Shouryya

Contribution ID: **57** Type: **not specified**

Formation and evaporation of quantum black holes from the decoupling mechanism

Wednesday 27 July 2022 17:35 (20 minutes)

Quantum counterparts to classical black holes provide an exciting ground for phenomenology of quantum gravity. Within the functional renormalization group approach to quantum gravity, we propose a novel method to account for quantum effects in classical spacetimes. At the core of our construction is the decoupling mechanism: when a physical infrared scale overcomes the effect of the artificial regulator implementing the Wilsonian integration of fluctuating modes, the effective average action freezes out and approximates the standard quantum effective action. Starting from the Einstein-Hilbert truncation, we use the decoupling mechanism to explore the dynamics of quantum black holes in the phases of collapse and evaporation.

Presenter: BORISSOVA, Johanna

Contribution ID: **58** Type: **not specified**

Asymptotic safety of Yang-Mills gauge theory in 5 dimensional spacetime

Tuesday 26 July 2022 15:20 (25 minutes)

The Yang-Mills gauge theory in 5 dimensional spacetime is perturbatively non-renormalizable, but could be asymptotically safe. We study the fixed point structure by using the functional renormalization group.

Presenter: YAMADA, Masatoshi

Contribution ID: **59** Type: **not specified**

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Wednesday 27 July 2022 17:55 (20 minutes)

Contribution ID: **60** Type: **not specified**

Unconventional superconductivity in moiré transition metal dichalcogenides

Thursday 28 July 2022 09:45 (45 minutes)

Presenter: CLASSEN, Laura

Contribution ID: **61** Type: **not specified**

The O(N) models in the vicinity of d=2

Thursday 28 July 2022 11:00 (30 minutes)

Presenter: JAKUBCZYK, Pawel

Contribution ID: **62** Type: **not specified**

Non-equilibrium Properties of Berezinskii-Kosterlitz-Thouless Phase Transitions

Thursday 28 July 2022 11:30 (30 minutes)

Presenter: KENNES, Dante

Contribution ID: **63** Type: **not specified**

Structure functions in shell models of turbulence

Thursday 28 July 2022 12:00 (30 minutes)

Shell models are simplified models of turbulence, describing discrete Fourier modes of velocity coupled via purely local interactions in spectral space. Yet these simple models reproduce all characteristic features of Navier-Stokes turbulence, including intermittency. I will present a FRG analysis of these models, and show that the turbulent regime corresponds to a non-trivial fixed-point. I will explain its specific properties and present the results for the structure functions.

Presenter: CANET, Léonie

Contribution ID: **64** Type: **not specified**

A Generalized fRG Solver for Material Systems

Thursday 28 July 2022 14:30 (25 minutes)

We summarize recent work with Nahom YIrga on the development of a generalized functional Renormalization Group (fRG) approach to condensed matter systems. Our approach combines momentum decoupling (as in standard RG calculations) with frequency decoupling (as in the dynamical mean field theories) and band decoupling (necessary to study the multiband models that apply to various high temperature superconductors and related materials). Importantly, we are able to include both electron-electron interactions and electron-phonon interactions in our solver. We give examples of applications of two- and three-band models for the Cuprate superconductors and of the effects of both Holstein and Su-Schrieffer-Heeger phonons on the phase diagrams of two-dimensional Hubbard models of strongly correlated systems.

Presenter: CAMPBELL, David

Contribution ID: **65** Type: **not specified**

Clock models from second order of the derivarive expansion of the functional renormalization group

Thursday 28 July 2022 14:55 (25 minutes)

Presenter: SÁNCHEZ, Carlos

Contribution ID: **66** Type: **not specified**

The lower critical dimension of phi4 theory from Functional RG

Thursday 28 July 2022 15:20 (25 minutes)

The lower critical dimension d_l is the spatial dimension on which fluctuations destroy the phase transition. In the scalar phi4 theory, this happens due to the proliferation of kinks. This differs for example from the O(N) case where it is a result of Goldstone modes and where $d_l = 2$ is well understood in the RG formalism. We explore whether the Functional Renormalization Group methods can be used to capture those localized excitations and investigate the phase transition just above the lower critical dimension. We have studied the fixed point solutions and discovered that the effective potential develops a boundary layer near its minimum as one approaches the d_l limit, a feature that was not identified in previous works. We explain how the boundary layer determines the critical behavior in the vicinity of the lower critical dimension.

Presenter: FARKAS, Lucija Nora

Contribution ID: **67** Type: **not specified**

Spins, pseudo-Majoranas and the functional RG

Thursday 28 July 2022 16:15 (20 minutes)

Frustrated three-dimensional quantum magnets bear a rich phenomenology but are notoriously hard to treat theoretically. We show how a SO(3) Majorana representation of spin operators, in combination with the functional renormalization group allows for quantitative simulations at finite temperatures. Focusing on Heisenberg magnets, we establish a finite-size scaling approach and extract critical temperatures and -exponents. For the Pyrochlore lattice, we discuss the improvements introduced by two-loop contributions in the flow equations. We also show how the method can be applied so meet some challenges of long-range interacting spin Hamiltonians arising in the context of Rydberg atom array quantum simulators.

Presenter: SBIERSKI, Björn

Contribution ID: **68** Type: **not specified**

Constructing CFTs from AdS flows

Thursday 28 July 2022 16:15 (20 minutes)

Employing the RG flow equations for weakly coupled quantum field theories in AdS, I show how one can apply the AdS/CFT correspondence to obtain flow equations for the dual CFTs. In this duality, loop corrections in the AdS bulk are mapped to 1/N corrections in the CFT. I derive recursion relations for CFT correlation functions which generalize existing results in the large-N limit to all orders in the 1/N expansion, and show how these translate directly into recursion relations for the corresponding Mellin amplitudes.

Presenter: FRÖB, Markus

Contribution ID: **69** Type: **not specified**

Spin functional renormalization group for dimerized quantum spin systems

Thursday 28 July 2022 16:35 (20 minutes)

We investigate dimerized quantum spin systems using the spin functional renormalization group approach proposed by Krieg and Kopietz which directly focuses on the physical spin correlation functions and avoids the representation of the spins in terms of fermionic or bosonic auxiliary operators. Starting from decoupled dimers as initial condition for the renormalization group flow equations, we obtain the spectrum of the triplet excitations as well as the magnetization in the quantum paramagnetic, ferromagnetic, and thermally disordered phases at all temperatures. Moreover, we compute the full phase diagram of a weakly coupled dimerized spin system in three dimensions, including the correct mean field critical exponents at the two quantum critical points.

Presenter: RÜCKRIEGEL, Andreas

Contribution ID: **70** Type: **not specified**

A Rigorous Treatment of the Wetterich Equation

Thursday 28 July 2022 16:35 (20 minutes)

Presenter: ZIEBELL, Jobst

Contribution ID: **71** Type: **not specified**

The low-temperature phase of the O(N) models below two dimensions

Thursday 28 July 2022 16:55 (20 minutes)

We investigate the low-temperature behaviour of the O(N) models for 1<d,N<2. We identify a phase with algebraic correlations similar to the Kosterlitz-Thouless phase but characterized by a universal anomalous dimension. We sketch the region of the (d,N)-plane where the algebraic low-temperature phase is present and calculate the anomalous dimension as a function of (d,N).

Presenter: CHLEBICKI, Andrzej

Contribution ID: **72** Type: **not specified**

Ultraviolet properties of Lifshitz-type field theories

Thursday 28 July 2022 16:55 (20 minutes)

We analyse some aspects of higher derivative Lifshitz-type field theories that exhibit anisotropic scaling laws near the Lifshitz fixed point, with explicit breaking of Lorentz symmetry. Specifically, anisotropic models in 3+1 dimension with dynamical exponent z=3 and with all momentum dependent vertex operators discarded, show restoration of Lorentz symmetry in the infrared region. At the same time, ultraviolet divergences are strongly smoothened and, in particular, models with Liouville-like potential show asymptotic freedom. Generalisation of this picture, that includes fermionic and gauge degrees of freedom, is discussed.

Presenter: ZAPPALA, Dario

Contribution ID: **73** Type: **not specified**

Tetracriticality in O(N) models

Thursday 28 July 2022 17:15 (20 minutes)

We study the tetracritical fixed point in O(N) models with NPRG. Increasing N, we find that the tetracritical FP continues to exist up to N=\infty, which is a different scenario from what we found for the tricritical FP. The FP approaches the WF FP except at a field value. We actually find that higher derivatives of the FP potential at the special point becomes singular in a way that the FP cannot be found with conventional large N analysis.

Presenter: YABUNAKA, Shunsuke

Contribution ID: **74** Type: **not specified**

Asymptotically safe scalar-tensor theories

Thursday 28 July 2022 17:15 (20 minutes)

Presenter: PEREIRA, Antonio

Contribution ID: **75** Type: **not specified**

Benchmarking effective actions and their flow equations in zero dimensions

Thursday 28 July 2022 17:35 (20 minutes)

We can define various quantum effective actions, each of which may have particular utility or convenience, in analogy to the Routhians of classical mechanics. In this talk, we provide an update on efforts to provide pedagogical and explicit illustrations of the construction and subtleties of various effective actions and, in particular, the one-particle-irreducible, average one-particle-irreducible and two-particle-irreducible effective actions. By focussing on zero-dimensional "QFTs", we are able to make concrete one-to-one comparisons in terms of analytic expressions for the effective actions, and the relevant n-point functions and sources, and to benchmark various approaches to the derivation of exact flow equations.

Presenter: MILLINGTON, Peter

Contribution ID: **76** Type: **not specified**

Background Independent Field Quantization with Sequences of Gravity-Coupled Approximants

Thursday 28 July 2022 17:35 (20 minutes)

Presenter: BECKER, Maximilian

Contribution ID: **77** Type: **not specified**

From holographic RG to information flows

Friday 29 July 2022 09:00 (45 minutes)

I will give a brief overview of the holographic RG in the context of the AdS/CFT correspondence, considering both flows to IR fixed points as well as to confining dual field theories. I will highlight recent developments on relating information-theory concepts such as entanglement entropy to geometric objects in dual hyperbolic spaces. Moreover, I will present recent results on the analogy between the RG and deep neural networks, wherein subsequent layers of neurons are analogous to successive steps along the RG. In particular, we quantify the flow of information by explicitly computing the relative entropy or Kullback-Leibler divergence in both the one- and two-dimensional Ising models under decimation RG, as well as in a feedforward neural network as a function of depth. We observe qualitatively identical behavior characterized by the monotonic increase to a parameter-dependent asymptotic value.

Presenter: ERDMENGER, Johanna

Contribution ID: **78** Type: **not specified**

Functional renormalization for the beginning and the present Universe

Friday 29 July 2022 09:45 (45 minutes)

Functional renormalization for quantum gravity with a scalar field computes at the fixed point the scaling solution for the effective scalar potential for the whole range of the scalar field. Similarly, one investigates the scaling solution for the scalar-field-dependent effective Planck mass (coefficient function of the curvature scalar). The solution of the field equations derived from the corresponding effective action determines the cosmology. The region of small scalar field values leads to an inflationary cosmology at the beginning of the Universe. The large field region describes dynamical dark energy in the present Universe, with a cosmological constant that vanishes in the infinite future. Between the two limits the field-dependent couplings of the scaling solution account for the running couplings in the scale invariant standard model of particle physics. No flow away from the scaling solution may be needed.

Presenter: WETTERICH, Christof

Contribution ID: **79** Type: **not specified**

Computational fluid dynamics and the fRG

Friday 29 July 2022 11:00 (30 minutes)

The talk reviews the application of computational fluid dynamics techniques to flow equations, explored in a recent series of paper. Hereby, a detailed explanation of the deep connection between RG flows and convection-diffusion equations is given. These properties, as well as the connection to phase transitions, are made explicit at the example of O(N) theories in various variations. Finally, the extension beyond such simple models and truncations of the effective action will be discussed.

Presenter: WINK, Nicolas

Contribution ID: **80** Type: **not specified**

Luttinger Liquids at the Edge of Quantum Hall Systems

Friday 29 July 2022 11:30 (30 minutes)

We consider the edge transport properties of a generic class of interacting quantum Hall systems on a cylinder, in the infinite volume and zero temperature limit. We prove that the large-scale behavior of the edge correlation functions is effectively described by the multi-channel Luttinger model. In particular, we prove that the edge conductance is universal, and equal to the sum of the chiralities of the non-interacting edge modes. The proof is based on rigorous renormalization group methods, that allow to fully take into account the effect of backscattering at the edge. Universality arises as a consequence of the vanishing of the beta function for the emergent multi-channel Luttinger liquid, combined with lattice Ward identities for the microscopic 2d theory and with the non-renormalization of the chiral anomaly for the emergent QFT. Joint work with Vieri Mastropietro.

Presenter: PORTA, Marcello

Contribution ID: **81** Type: **not specified**

A functional RG perspective on the 2D Hubbard model

Friday 29 July 2022 12:00 (45 minutes)

The Hubbard model is the simplest model of interacting fermions on a lattice and is of similar importance to correlated electron physics as the Ising model is to statistical mechanics. Despite its simplicity, the model exhibits a rich physical behavior and has been proposed as an effective model for electrons moving in the copper-oxygen planes of cuprate high-temperature superconductors. The functional RG stability analysis, originally developed for the 2D Hubbard model describing tight-binding fermions with a local interaction on a square lattice, provided the first conclusive evidence for the existence of d-wave superconductivity with a sizable energy gap at moderate interaction strength. Since then large progress has been achieved in its treatment with various theoretical and numerical methods. We here present recent advancements in the functional RG showing that the flow can be brought to a quantitative level for two-dimensional problems, which opens the route towards the realistic numerical investigations of more general systems.

Presenter: ANDERGASSEN, Sabine

Contribution ID: **82** Type: **not specified**

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Contribution ID: **83** Type: **not specified**

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Contribution ID: **84** Type: **not specified**

Extended symmetries

Monday 25 July 2022 14:30 (25 minutes)

Extended symmetry transformations do not leave the action fully invariant, but change it by a term linear in field expectation values or known composite fields. I will discuss how this leads to a modified version of Noethers theorem with currents that are conserved up to known terms. I will also discuss how an extended version of Galilei boost symmetry allows to close and solve renormalization group equations for cosmological large-scale structure formation in certain regimes.

Presenter: FLOERCHINGER, Stefan

Contribution ID: **85** Type: **not specified**

Universal quantities at high orders of the derivative expansion

Thursday 28 July 2022 14:55 (25 minutes)

In the context of the Functional Renormalization Group, the Derivative Expansion is one of the most employed approximation schemes. In the last decade, this scheme has been pushed up to order $\mathcal{O}(\partial^6)$ for the Ising model universality class and to order $\mathcal{O}(\partial^4)$ for the $O(N)$ models. This allowed us to comprehend better the properties and behaviour of this scheme and enabled the introduction of error bars for the computed quantities. As a consequence, in the last few years not only critical exponents but also universal amplitude ratios were computed with a precision and accuracy comparable with the most precise results in the literature and, in some cases, they are the reference results. In this talk I will discuss these recent results in view of the new developments of the derivative expansion.

Presenter: DE POLSI, Gonzalo

Contribution ID: **86** Type: **not specified**

Fluid dynamic aspects of the exact renormalization group

Thursday 28 July 2022 15:20 (25 minutes)

Presenter: KOENIGSTEIN, Adrian

Contribution ID: **87** Type: **not specified**

Background Effective Action with Nonlinear Massive Gauge Fixing

Monday 25 July 2022 17:20 (1h 15m)

Presenter: GKIATAS, Dimitrios

Session Classification: Poster

Contribution ID: **88** Type: **not specified**

mfRG analysis of the Attractive Hubbard Model

Monday 25 July 2022 17:20 (1h 15m)

Presenter: AL-ERYANI , Aiman

Session Classification: Poster

Contribution ID: **89** Type: **not specified**

FRG analysis of the pseudogap opening in the 2D Hubbard model at finite doping

Monday 25 July 2022 17:20 (1h 15m)

We apply the functional renormalisation group to the two-dimensional Hubbard model to investigate the pseudogap opening. Extending previous applications at half filling [Phys. Rev. Research 2, 033068 (2020)], we here explore the physics in the more relevant finite-doping regime. In particular, we present a systematic analysis of the different contributions to the self-energy by performing a fluctuation diagnostics. Besides the quasiparticle weight, we show results for the correlation-induced shape of the Fermi surface. We identify the (incommensurate) antiferromagnetic fluctuations to be responsible for the pseudogap opening also at finite doping and provide a physical understanding of the observed momentum-selective behavior.

Presenter: BRAUN , Hannes

Session Classification: Poster

Contribution ID: **90** Type: **not specified**

G flows between Gaussian fixed points

A scalar theory can have many Gaussian (free) fixed points, corresponding to Lagrangians of the form \phi\box^k\phi. We use the non-perturbative RG to study the flow from the free theory with four derivatives (k = 2) to the free theory with two derivatives (k = 1), in the presence of a shift-invariant interaction.

Presenter: BUCCIO , Diego

Session Classification: Poster

Contribution ID: **91** Type: **not specified**

Incommensurate 2kF density wave quantum criticality

Monday 25 July 2022 17:20 (1h 15m)

Presenter: DEBBELER, Lukas

Session Classification: Poster

Contribution ID: **92** Type: **not specified**

Holographic RG from Exact RG

Monday 25 July 2022 17:20 (1h 15m)

Holographic RG is the interpretation of the AdS-CFT correspondence as RG evolution of boundary theory. The radial coordinate is interpreted as the scale of the boundary theory. This allows a new physical way of looking at the correspondence. But, the precise regularisation of the boundary theory that allows this interpretation hasn't been looked at. I will show one such regularisation using ERG formalism. I will write down the ERG equation for the scalar, vector and tensor of boundary O(N) theory. I will explicitly redefine the Exact RG evolution operator that corresponds to this equation as the bulk AdS action, thus making the connection precise.

Presenter: DHARANIPRAGADA, Pavan

Session Classification: Poster

Contribution ID: **93** Type: **not specified**

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Session Classification: Poster

Contribution ID: **94** Type: **not specified**

Universal scaling at a pre-thermal dark state

Monday 25 July 2022 17:20 (1h 15m)

Many open quantum systems are well described by an effective non-hermitian Hamiltonian generating a time evolution that allows eigenstates to decay and dissipate to the environment. In this framework, quantum coherent scaling is traditionally tied to the appearance of dark states, where the effect of dissipation becomes negligible. Here we discuss the universal dynamical scaling after a sudden quench of the non-hermitian O(N) model Hamiltonian. While universality is generally spoiled by non-hermiticity, we find that for a given set of internal parameters short-time scaling behaviour is restored with an initial slip exponent different from that of closed quantum systems. This result is tied to the compensation of dissipation by interaction effects at short times leading to a pre-thermal dark state, where coherent many-body dynamics can be observed (arXiv:2112.14180). Separately, for hermitian systems we find a new class of analytical quench solutions by scaling in complex space and time (arXiv:2203.06098).

Presenter: ENSS, Tilman

Session Classification: Poster

Contribution ID: **95** Type: **not specified**

FRG based on the single boson exchange decomposition

Monday 25 July 2022 17:20 (1h 15m)

Presenter: FRABOULET, Kilian

Session Classification: Poster

Contribution ID: **96** Type: **not specified**

EOS of QCD Matter

Monday 25 July 2022 17:20 (1h 15m)

Presenter: GEISSEL, Andreas

Session Classification: Poster

Contribution ID: **97** Type: **not specified**

Multiloop functional renormalization group study of the Fermi polaron problem

Monday 25 July 2022 17:20 (1h 15m)

Imbalanced mixtures of strongly correlated fermions have been investigated both theoretically and experimentally for several decades. A single impurity immersed in a Fermi gas is subject to a transition from a bound molecule of two different fermion species to a so-called 'Fermi polaron'where the impurity forms a quasiparticle with the surrounding fermions [1]. We study the Fermi polaron problem theoretically in three dimensions in an experimentally more realistic setup where there is a finite density of the impurity particles. For this, we apply the recently developed multi-loop functional renormalization group (mfRG) which is an extension of the conventional functional renormalization group equivalent to the diagrammatic parquet formalism [2]. To handle the complexity of the four-point vertex, we make use of a decomposition into processes mediated by single-boson exchanges (SBE) [3]. With this elaborate numerical method, we aim to provide more reliable theoretical predictions such as the lifetime of the polaron. [1] R. Schmidt, T. Enss, Phys. Rev. A 83, 063620 (2011). [2] F. B. Kugler, J. von Delft, Phys. Rev. Lett. 120, 057403 (2018). [3] E. Walter, M. Gievers, A. Ge, J. von Delft, F. B. Kugler, aXiv:2201.04878 (2022).

Presenter: GIEVERS, Marcel

Session Classification: Poster

Contribution ID: **98** Type: **not specified**

Information theoretic regulators for complex systems with multiple notions of scale

Monday 25 July 2022 17:20 (1h 15m)

Presenter: KLINE, Adam

Session Classification: Poster

Contribution ID: **99** Type: **not specified**

Entangled magnetic, charge, and superconducting pairing correlations in the 2-D Hubbard model

Monday 25 July 2022 17:20 (1h 15m)

Presenter: HEINZELMANN, Sarah

Session Classification: Poster

Contribution ID: **100** Type: **not specified**

Truncated-unity FRG approach to minimal models of correlated moiré materials

Monday 25 July 2022 17:20 (1h 15m)

The functional renormalization group is a powerful tool to analyze many-body instabilities in strongly-correlated electron systems. In a simple but handy truncation scheme, i.e. the level-two truncation, it resolves the RG evolution of the two-particle interaction vertex. Thereby it manages to detect the leading instability of the electron system while taking into account all competing interaction channels on equal footing. The truncated unity (TU) variant of the channel decomposed FRG scheme facilitates to decrease the numerical effort of such calculations considerably. Compared to cubic scaling in the conventional patching scheme, it has the advantage of linear scaling in the number of considered exchange momenta. In our work, we put forward a numerically efficient implementation of the TU-FRG and apply it to minimal models for the newly discovered correlated moiré materials. We carefully explore the numerical convergence of our scheme in form factors and momentum resolution to provide the basis for future applications of realistic models of correlated moiré materials.

Presenter: HENKEL, ravn

Session Classification: Poster

Contribution ID: **101** Type: **not specified**

The F-theorem in the melonic limit

Monday 25 July 2022 17:20 (1h 15m)

The F-theorem states that in three dimensions the sphere free energy of a field theory must decrease between ultraviolet and infrared fixed points of the renormalization group flow, and it has been proven for unitary conformal field theories (CFTs). We consider here the long-range bosonic O(N)3 model on a spherical background, at next-to-next-to-leading order of the 1/N expansion. The model displays four large-N fixed points and we test and confirm the F-theorem holds in this case. This is non-trivial as one of the couplings is imaginary, and therefore the model is non-unitary at finite N. Despite this, several tests indicating that the large-N CFTs are in fact unitary have been performed: for instance all the OPE coefficients computed so far in the large-N limit are real, and the spectrum of bilinear operators is real and above unitarity bounds. Our result, namely that the F theorem holds at large N, can be viewed as further indication that such theories are unitary. As an added bonus, we show how conformal partial waves expansions in conformal field theory can be used to resum infinite classes of vacuum diagrams. Non-perturbatively, the jump in the value of the free energy has the interpretation of the inclusion at the ultraviolet fixed point of an extra non-normalizable contribution in the conformal partial wave expansion. This can be seen in perturbation theory as the reversal of the sign of an infinite class of diagrams due to the flow of a coupling constant.

Presenter: LETTERA, Davide

Session Classification: Poster

Contribution ID: **102** Type: **not specified**

The predictive power of asymptotic safety for an ALP model

Monday 25 July 2022 17:20 (1h 15m)

An asymptotically-safe theory of quantum gravity could render a non-perturbative renormalization of general relativity, restoring its predictive power at higher energies. The asymptotic-safety community has been finding indications for that, mainly using the functional renormalization group framework. In this poster, I will explore the predictive power of asymptotically-safe quantum gravity and the interplay between gravity and matter, focusing on a toy model inspired by dark-matter axion-like particles.

Presenter: LINO DOS SANTOS , Rafael Robson

Session Classification: Poster

Contribution ID: **103** Type: **not specified**

SU(4) symmetry in Dirac materials - Application to twisted bilayer graphene

Monday 25 July 2022 17:20 (1h 15m)

Presenter: PARTHENIOS, Nikolaos

Session Classification: Poster

Contribution ID: **104** Type: **not specified**

Functional Renormalization for Multimatrix Models

Monday 25 July 2022 17:20 (1h 15m)

In this poster we report recent progress in understanding the algebraic structure underlying Wetterich Equation for multimatrix models (this sort of model is inspired by noncommutative geometry and contains interactions indexed by the free algebra, i.e. words in the random matrices). The tools can be useful in discretization approaches to quantum gravity and combinatorics of maps. Based on Ann. Henri Poincaré 22 (9) [arXiv 2007.10914] and [arXiv:2111.02858]

Presenter: PEREZ SANCHEZ , Carlos I.

Session Classification: Poster

Contribution ID: **105** Type: **not specified**

UV Conformal Window and Loss of Asymptotic Safety

Monday 25 July 2022 17:20 (1h 15m)

Presenter: RIYAZ, Nahzaan

Session Classification: Poster

Contribution ID: **106** Type: **not specified**

Real-time functional renormalization group for critical dynamics

Monday 25 July 2022 17:20 (1h 15m)

Real-time quantities such as spectral functions and transport coefficients can serve to examine the real-time evolution of a system close to equilibrium, as they encode the possible excitations in the medium and show universal static and dynamic scaling behaviour near a critical point. The functional renormalization group (FRG) formulated on the Schwinger-Keldysh closed-time path provides an excellent calculational tool for such real-time correlations. In this talk I will present a novel approach for the systematic construction of causal regulators for the FRG, which comply with the analytic structure of the propagators, and demonstrate that they can be interpreted as a coupling to a fictitious external heat bath with FRG scale dependent spectral distribution. As particular applications I will discuss the relaxational Models A, B and C according to the classification scheme by Halperin and Hohenberg, and show how they can be implemented in the real-time FRG. With this setup I will then present results which demonstrate the generation of dynamic scaling behaviour in spectral functions obtained from one and two-loop self-consistent truncation schemes. Our results for the different dynamic critical exponents z in both d=2 and 3 spatial dimensions compare favorably with existing results from the literature.

Presenter: ROTH, Johannes

Session Classification: Poster

Contribution ID: **107** Type: **not specified**

Asymptotically safe Einstein-Palatini gravity

Monday 25 July 2022 17:20 (1h 15m)

Presenter: SALEK, Abdol Sabor

Session Classification: Poster

Contribution ID: **108** Type: **not specified**

Towards quantitative precision for non-smooth interaction potentials in FRG flows

Monday 25 July 2022 17:20 (1h 15m)

Presenter: SATTLER, Franz Richard

Session Classification: Poster

Contribution ID: **109** Type: **not specified**

Phase Transitions in Yukawa Models

Monday 25 July 2022 17:20 (1h 15m)

Presenter: SCHMIEDEN, Richard

Session Classification: Poster

Contribution ID: **110** Type: **not specified**

Functional Spin RG for Rydberg Array Spin Hamiltonians

Monday 25 July 2022 17:20 (1h 15m)

Rydberg-Atom arrays are a versatile platform to simulate interesting physics from spin liquids to lattice gauge theories. We develop a one-loop functional renormalization group approach based on Kitaev's pseudo-Majorana spin representation that produces quantitative accurate data for Rydberg type Hamiltonians at finite temperature. By using the convenient symmetries of the Majorana representation, treatment of magnetic fields becomes feasible. The implementation of infinite lattices with long-range interactions and complicated lattice geometries is straightforward.

Presenter: SCHNEIDER, Benedikt

Session Classification: Poster

Contribution ID: **111** Type: **not specified**

Asymptotic freedom and safety in quantum gravity

Monday 25 July 2022 17:20 (1h 15m)

We compute non-perturbative flow equations for the couplings of quantum gravity in fourth order of a derivative expansion. The gauge invariant functional flow equation for arbitrary metrics allows us to extract β-functions for all couplings. In our truncation we find two fixed points. One corresponds to asymptotically free higher derivative gravity, the other is an extension of the asymptotically safe fixed point in the Einstein-Hilbert truncation or extensions thereof. Furthermore we describe the flow trajectories to different fixed points for a subtruncation of Higher derivative gravity. Based on arxiv:2111.04696

Presenter: SEN, Saswato

Session Classification: Poster

Contribution ID: **112** Type: **not specified**

The $(1+1)$-dimensional Gross-Neveu model at non-zero μ, T and finite N

Monday 25 July 2022 17:20 (1h 15m)

We investigate the Gross-Neveu model for a finite number of fermions N. The solution of the Gross-Neveu model is well known in the large-N limit ($N \to \infty$) but unknown for finite N. We approach the finite-N case with a FRG method, more precisely the Wetterich equation. By using the local potential approximation the resulting flow equation for the scale dependent effective potential can be transformed into a non-linear diffusion equation. This equation is solved numerically by applying a finite volume method. No discrete chiral symmetry breaking is observed for any finite number of fermions, arbitrary chemical potentials as long as the temperature is non-zero.

Presenter: STOLL, Jonas

Session Classification: Poster

Contribution ID: **113** Type: **not specified**

From KPZ to Inviscid Burgers universality : a FRG approach

Monday 25 July 2022 17:20 (1h 15m)

In one dimension, the stochastic Burgers'equation, describing a randomly forced viscous fluid, can be obtained from the Kardar-Parisi-Zhang (KPZ) equation for a stochastically growing interface through an exact mapping. Since its introduction, the KPZ equation has been studied broadly, and found to successfully describe the universal dynamics of a wide range of systems out of equilibrium, from classical interfaces to driven dissipative polariton condensates. In 1D, the rough KPZ interface is described by a fully attractive fixed-point corresponding to a finite value of its nonlinear coupling g. In a recent numerical work, a crossover to a different dynamical regime with different scaling exponents has been found from numerical simulations of the stochastic Burgers equation, in the limit of zero viscosity. This limit corresponds in the KPZ equation to the limit of infinite g, which has not been explored so far. In this work, we present a FRG approach to this regime, revealing a new universal behaviour.

Presenter: VERCESI, Francesco

Session Classification: Poster

Contribution ID: **114** Type: **not specified**

Shift-symmetric Horndeski models in the asymptotically safe swampland?

Monday 25 July 2022 17:20 (1h 15m)

Horndeski theories are widely considered extensions of general relativity, intended to explain the dark sector dynamically as well as alleviate the existing cosmological tensions. In this poster, I present a first renormalisation group analysis of the subclass of shift-symmetric kinetic braiding models, which still holds up to observation after GW170817. In particular, I show the four arising fixed points of which only the shifted Gaussian one is deemed reliable. As the investigated couplings are all irrelevant at this fixed point, I conclude that these kind of kinetic braiding models are likely not in the asymptotically safe landscape.

Presenter: WAGNER, Fabian

Session Classification: Poster

Contribution ID: **115** Type: **not specified**

Fluctuation computation of gravitational RG flows on foliated spacetime

Monday 25 July 2022 17:20 (1h 15m)

The exact renormalization group is a powerful tool to explore the renormalization group fixed points in gravity and gravity-matter systems. An important open question in this context is the extension of the formalism to Lorentzian signature computations. One way to incorporate the necessary structures in the presence of a fluctuating spacetime is the Arnowitt-Deser-Misner decomposition of the metric degrees of freedom. In this talk, I will present the first analysis of the resulting fixed point structure at the level of a fluctuation computation, reading off the flow of the gravitational couplings from the graviton two-point function.

Presenter: WANG, Jian

Session Classification: Poster

Contribution ID: **116** Type: **not specified**

Spectral functions from renormalised flow equations

Monday 25 July 2022 17:20 (1h 15m)

We derive renormalized Callan-Symanzik Flowequations in the FRG setup and apply the framework of spectral renormalisation to compute the full, nonperturbative spectral function of a \phi^4 theory in (2+1) dimensions

Presenter: WESSELY, Jonas

Session Classification: Poster

Contribution ID: **117** Type: **not specified**

The $(1+1)$-dimensional Gross-Neveu model at non-zero μ, T and finite N

Monday 25 July 2022 17:20 (1h 15m)

We investigate the Gross-Neveu model for a finite number of fermions N. The solution of the Gross-Neveu model is well known in the large-N limit ($N \to \infty$) but unknown for finite N. We approach the finite-N case with a FRG method, more precisely the Wetterich equation. By using the local potential approximation the resulting flow equation for the scale dependent effective potential can be transformed into a non-linear diffusion equation. This equation is solved numerically by applying a finite volume method. No discrete chiral symmetry breaking is observed for any finite number of fermions, arbitrary chemical potentials as long as the temperature is non-zero.

Presenter: ZORBACH, Niklas

Session Classification: Poster

Contribution ID: **118** Type: **not specified**

A study of a toy model of hydrodynamic turbulence using the NPRG

Monday 25 July 2022 17:20 (1h 15m)

The functional renormalisation group has already been successfully used to study turbulence and it appears as a very natural tool for this problem. However, there remains an unsolved problem related to the calculation of the structure functions in the turbulent state, which is hard to tackle directly from the Navier-Stokes equations. In this work, we study a simpler model: the Sabra shell model. Shell models form a family of toy models that reproduce key properties of hydrodynamic turbulence, and in particular the anomalous exponents of the structure functions. In this work, we present a FRG approach to the Sabra model and the results obtained from this method for the structure functions of this model.

Presenter: FONTAINE, Côme

Session Classification: Poster

Contribution ID: **119** Type: **not specified**

Phonon renormalization and Pomeranchuk instability in the Holstein model

Monday 25 July 2022 17:20 (1h 15m)

The Holstein model with dispersionless Einstein phonons is one of the simplest models describing electron-phonon interactions in condensed matter. A naive extrapolation of perturbation theory in powers of the relevant dimensionless electron-phonon coupling suggests that at zero temperature the model exhibits
a Pomeranchuk instability characterized by a divergent uniform compressibility at a critical value where the dimensionless electron-phonon coupling is of order unity. In this work, we re-examine this problem using modern functional renormalization group (RG) methods. For dimensions d > 3 we find that the RG flow of the Holstein model indeed exhibits a tricritical fixed point
associated with a Pomeranchuk instability. This non-Gaussian fixed point is ultraviolet stable and is closely related to the well-known ultraviolet stable fixed point of phi^3-theory above six dimensions. To realize the Pomeranchuk critical point in the Holstein model at fixed density both the dimensionless electron-phonon coupling and the adiabatic ratio (phonon frequency divided by Fermi Energy) have to be fine-tuned to assume critical values of order unity. On the other hand, for dimensions d=3 or smaller we find that the RG flow of the Holstein model does not have any critical fixed points. This rules out a quantum critical point associated with a Pomeranchuk instability in d=3 or smaller.

Presenters: HANSEN, Max Oberon; CICHUTEK, Niklas

Session Classification: Poster

Contribution ID: **120** Type: **not specified**

Symmetry constraints for Callan-Symanzik flows in chiral models

Monday 25 July 2022 17:20 (1h 15m)

Presenter: TÖPFEL, Sebastian

Session Classification: Poster

Contribution ID: **121** Type: **not specified**

Dilaton Quantum Gravity

Monday 25 July 2022 17:20 (1h 15m)

In this presentation, I will talk about asymptotically safe dilaton gravity. To that end we solve the coupled set of flow equations for the field dependent Newton constant F(phi), cosmological constant or dilaton potential V(phi) and dilaton wave function K(phi), including the physical vanishing cutoff scale. At vanishing dilaton field we recover classical general relativity, while we approach an asymptotically safe regime for large field amplitudes. In addition, the dilaton potential at physical vanishing cutoff scale is essential for the study of the slow-roll-inflation scenario.

Presenter: KOGIOS, Athanasios

Session Classification: Poster

Contribution ID: **122** Type: **not specified**

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Session Classification: Poster

Contribution ID: **123** Type: **not specified**

Non perturbative strings, asymptotic safety, and the swampland

Thursday 28 July 2022 14:30 (25 minutes)

Presenter: PLATANIA, Alessia

Contribution ID: **124** Type: **not specified**

Gauge dependence of Essential Quantum Einstein Gravity

Wednesday 27 July 2022 17:55 (20 minutes)

The Essential Functional Renormalisation Group, applied to quantum gravity, allows the metric to be reparametrised along the RG trajectory, such that only the essential couplings are renormalised. This allows to simplify the study of the properties of the fixed points. It is of interest to investigate the behaviour of the solutions with respect to a change of the gauge fixing parameters. In this work we compute the flow up to the fourth order in derivative expansion using a generic class of gauges for which the kinetic operator becomes nonminimal. To this end we implement the off-diagonal heat kernel technique also known as the Universal RG Machine. We compute the position of the fixed points using Landau and Feynman gauges and discuss the applicability of used approximations.

Presenter: MELICHEV, Oleg

Contribution ID: **125** Type: **not specified**

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Monday 25 July 2022 16:55 (20 minutes)