DESY Virtual Theory Forum 2020

Report of Contributions

https://indico.desy.de/e/25488

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

QCD axion EFT under the loop

Wednesday 23 September 2020 17:30 (15 minutes)

The low-energy phenomenology of the QCD axion is usually studied in a model-independent way using an effective Lagrangian. However, one-loop processes that exhibit logarithmic divergencies are sensitive to the high-energy completion of each specific model. This is extremely important for some axion searches, like the ones conducted at Kaon facilities such as NA62 that aim to look for the rare decay $K \to \pi + a$. After showing that the rate predicted by the EFT for this process is not applicable to the popular KSVZ and DFSZ axions, we construct a new QCD axion model that successfully maps to the EFT at one loop. As a consequence, we argue that NA62 has the potential to probe untested QCD axion parameter space in the ~ 0.1 eV region.

Primary author: ALONSO ÁLVAREZ, Gonzalo (Heidelberg University)

Co-authors: ERTAS, Fatih (RWTH Aachen University); KAHLHOEFER, Felix (RWTH Aachen University); JAECKEL, Joerg (Heidelberg University); THORMAEHLEN, Lennert (Heidelberg University)

Presenter: ALONSO ÁLVAREZ, Gonzalo (Heidelberg University)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Mistakes on the way to a good idea: Peccei-Quinn Symmetry. A tribute to Roberto Peccei

Thursday 24 September 2020 18:00 (1 hour)

I will talk about the development of the idea now known as Peccei Quinn symmetry, and its consequences.
I will use this work that I did together with Roberto Peccei to illustrate key features of how science progresses.
While the problem we were addressing, and the answer we found for it are quite technical, this will not be a highly technical lecture.
Rather it will be a story about our confusions and the circuitous path to their resolution. It is also an illustration of how the mathematical descriptions of physics, as Heinrich Hertz pointed out in reference to Maxwell's equations, not only provide solutions to the question or problem that led to their development, but can also suggest things that their developers did not even dream about.
This talk will also be a tribute to Roberto, emphasizing his attributes as a scientist, and as a person, that not only were key to this work but that made him a such a successful scientist and leader of scientific institutions throughout his career.

Session Classification: Hertz Lecture by Helen Quinn (SLAC)

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

Model-independent energy budget of cosmological first-order phase transitions

Friday 25 September 2020 14:12 (12 minutes)

We study the energy budget of a first-order cosmological phase transition, which is an important factor in the prediction of the resulting gravitational wave spectrum. Formerly, this analysis was based mostly on simplified models as for example the bag equation of state. Here, we present a model-independent approach that is exact up to the temperature dependence of the speed of sound in the broken phase. For detonations, we find that the only relevant quantities that enter in the hydrodynamic analysis are the speed of sound in the broken phase and a linear combination of the energy and pressure differences between the two phases which we call pseudotrace (normalized to the enthalpy in the broken phase). The pseudotrace quantifies the strength of the phase transition and yields the conventional trace of the energy-momentum tensor for a relativistic plasma (with speed of sound squared of one third). We present results for realistic models where we treat the bubble wall velocity as an external parameter.

Partly based on [2004.06995], partly based on more recent work.

Primary authors: Mr GIESE, Felix (DESY/Hamburg U.); Ms VAN DE VIS, Jorinde (DESY); Dr SCHMITZ, Kai (CERN); KONSTANDIN, Thomas (DESY)

Presenter: Mr GIESE, Felix (DESY/Hamburg U.)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

Track Classification: Cosmology & Astroparticle Physics

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

Massive neutrinos in non-linear LSS

Tuesday 22 September 2020 17:11 (13 minutes)

Current and near future surveys are expected to map out the large-scale structure of the Universe at unprecedented precision. In order to extract information from observational data, a solid theoretical understanding is required, and in recent years considerable efforts has been dedicated to model the weakly non-linear regime using perturbative methods. In this talk, I will describe an algorithm for computing loop corrections to the matter power spectrum that can be applied to a wide range of extended cosmological models, due to its capability of fully capturing time- and scale-dependence of the underlying fluid dynamics. I discuss the application of this framework on massive neutrinos in non-linear LSS, using a hybrid Boltzmann/two-fluid model for the neutrino perturbations. Finally, a comparison with simplified treatments that only take neutrinos into account linearly is presented.

Primary authors: Dr GARNY, Mathias (Technical University of Munich); Mr TAULE, Petter (Technical University of Munich)

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

How tropical are seven-, eight- and nine-particle scattering amplitudes?

Thursday 24 September 2020 14:05 (20 minutes)

Using the symbol bootstrap, loop amplitudes of planar $\mathcal{N} = 4$ SYM theory can be obtained from their alphabet, the list of their singularities. The elements of this alphabet, the letters, coincide with the variables of certain cluster algebras. However, at eight and more particles these cluster algebras become infinite, whereas it is believed that the amplitudes only have finitely many distinct singularities. First discussing the application of cluster algebras to the seven-particle (N)MHV amplitude, I will show how the recently introduced mathematics of tropical geometry gives rise to a selection rule and present the thus obtained finite alphabets for eight and nine particles. Furthermore, I will discuss how infinite mutation sequences in cluster algebras also give rise to the algebraic singularities.

Primary authors: Dr PAPATHANASIOU, Georgios (DESY); HENKE, Niklas (DESY)

Presenter: HENKE, Niklas (DESY)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Precise dark matter relic abundance in decoupled sectors

Tuesday 22 September 2020 14:15 (13 minutes)

Dark matter (DM) as a thermal relic of the primordial plasma is increasingly pressured by direct and indirect searches, while the same production mechanism in a decoupled sector is much less constrained. We extend the standard treatment of the freeze-out process to such scenarios and perform precision calculations of the annihilation cross section required to match the observed DM abundance. We demonstrate that the difference to the canonical value is generally sizeable, and can reach orders of magnitude. Our results directly impact the interpretation of DM searches in hidden sector scenarios.

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

A hybrid simulation of gravitational wave production

Tuesday 22 September 2020 18:03 (12 minutes)

LISA telescope will be specially interesting to probe the scenario of a first order phase transition happening close to the electroweak scale. Recently, it became evident that the main contribution to the GW spectra would come from the sound waves propagating through the plasma. Current estimates of the GW spectra are based on numerical simulations of a scalar field interacting with the plasma or on analytical approximations – the so-called sound shell model. In this work we present a novel set up to calculate the GW spectra from sound waves. We use a hybrid method that uses a 1d simulation (with spherical symmetry) to evolve the velocity and enthalpy profiles of a single bubble after collision and embed it in a 3d realization of multiple bubble collisions, assuming linear superposition of the velocity and enthalpy. Our method has several advantages over 3d simulations in the literature: 1) it does not depend on solving the bubble wall scale (which is energetically negligible in realistic transitions); 2) it correctly captures shock waves persisting after collisions; 3) it enables fast computation of GW spectrum over a wide range of parameter space. We provide a parametrization of the final GW spectrum as a function of the wall velocity and the fluid kinetic energy.

Primary authors: Mr RUBIRA, Henrique (DESY); Dr JINNO, Ryusuke (DESY); KONSTANDIN, Thomas (DESY)

Presenter: Mr RUBIRA, Henrique (DESY)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Resonant backreaction in axion inflation

Tuesday 22 September 2020 15:33 (12 minutes)

Axion inflation entails a coupling of the inflaton field to gauge fields through the Chern-Simons term. This results in a strong gauge field production during inflation, which backreacts on the inflaton equation of motion. We show that this strongly non-linear system generically experiences a resonant enhancement of the gauge field production, resulting in oscillatory features in the inflaton velocity as well as in the gauge field spectrum. The gauge fields source a strongly enhanced scalar power spectrum at small scales, exceeding previous estimates. For appropriate parameter choices, the collapse of these over-dense regions can lead to a large population of (light) primordial black holes with remarkable phenomenological consequences.

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Presenter: WELLING, Yvette (DESY)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Thick Branes in Extra Dimensions and Suppressed Couplings

Friday 25 September 2020 14:48 (12 minutes)

Extra dimensions (ED) have been used as attempts to explain several phenomena in particle physics, such as the hierarchy and flavor problems. The interaction between new mediators in the bulk (vector, scalar of fermion fields) and the Standard Model (SM) particles can be naturally suppressed if one employs a single, flat ED. In this setup, the SM fields are localized in a finite width 'fat'brane, similar to models of Universal Extra Dimensions. A dark matter (DM) candidate is confined to a thin brane at the opposite end of the ED interval. Including brane localized kinetic terms on the fat brane for the mediator fields, the resulting coupling between the SM and these mediators can be several orders of magnitude smaller than the corresponding ones between the mediators and DM. The implications of this scenario is investigated for both vector (dark photon, DP) and scalar mediator fields in the 5-D bulk. The SM particles couple to the DP via their $B-L$ charges while the DP couples to the DM via a dark charge. Both the vector DP couplings and the corresponding Higgs portal couplings with the SM are shown to be naturally small in magnitude with a size dependent on ratio of the 5-D compactification radius and the SM brane thickness. This mechanism is also studied in 6-D. Finally, if a Dirac fermion is present in the bulk, it results (in 4-D) in two towers of Kaluza-Klein Majorana sterile neutrinos, whose mass mixing with the SM neutrinos is also suppressed. The seesaw mechanism is therefore obtained, and sterile neutrino masses of order $\mathcal{O}(1–10)$ TeV naturally explain the small SM neutrino mass.

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

Track Classification: Cosmology & Astroparticle Physics

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

Influence of a magnetic field on beta-processes in supernova matter

Tuesday 22 September 2020 17:37 (13 minutes)

An influence of a magnetic field on beta-processes is investigated under conditions of a core-collapse supernova. For realistic magnetic fields reachable in astrophysical objects we obtain simple analytical expressions for reaction rates of beta-processes as well as the energy and momentum transferred from neutrinos and antineutrinos to the matter. Based on the results of one-dimensional simulations of a supernova explosion, we found that, in the magnetic field with the strength $B \sim 10^{15}$ G, the quantities considered are modified by a few percents only and, as a consequence, the magnetic-field effects can be safely neglected, considering neutrino interaction and propagation in a supernova matter. The analytical results can be also applied for accretion discs formed at a merger of compact objects in close binary systems. The work is supported by the Russian Science Foundation (Grant No. 18-72-10070).

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Harmonic Hybrid Inflation

Thursday 24 September 2020 16:30 (20 minutes)

I will present a mechanism for realising hybrid inflation using two axion fields with a purely non-perturbatively generated scalar potential. I will show that such model generates observationally viable slow-roll inflation for a wide range of initial conditions while accommodating certain Swampland conjectures. I will focus mainly on two possible avenues to embed harmonic hybrid inflation in type IIB string theory, namely with axions from 4-forms in an LVS setup and with axions from 2-forms in the presence of magnetised stacks of branes.

Primary author: Mrs RIGHI, Nicole (DESY)

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Presenter: Mrs RIGHI, Nicole (DESY)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Direct detection of dark matter: Precision predictions in a simplified model framework

Friday 25 September 2020 15:45 (15 minutes)

In my talk, I will present a calculation of the next-to-leading order QCD corrections for the scattering of Dark Matter particles off nucleons in the framework of simplified models with s- and t-channel mediators. These results are matched to the Wilson coefficients and operators of an effective field theory that is generally used for the presentation of experimental results on spin-independent and spin-dependent direct detection rates.

Detailed phenomenological studies illustrate the complementary reach of collider searches for Dark Matter and the direct detection experiments CRESST and XENON. In the case of cancellation effects in the tree-level contributions, one-loop corrections can have a particularly large impact on exclusion limits in the case of combined $s + t$-channel models.

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Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Enlarging the ALP Dark Matter window with axion fragmentation

Tuesday 22 September 2020 15:07 (13 minutes)

Axion-like-particle (ALP) is a well-motivated candidate for dark matter, and it is subject to extensive theoretical and experimental research in recent years. The ALP production mechanisms mostly studied in the literature are misalignment, thermal production in the plasma, and decay of cosmic strings. Recently, a new mechanism, axion fragmentation, has been proposed. It can arise if the axion field has a large initial kinetic energy and rolls through many barriers before it gets trapped in one minimum. Contrary to the misalignment mechanism, the axions produced this way are relativistic, and they cool down later to make cold dark matter. In this talk, after a brief review of axion fragmentation, I will discuss the impact of this new mechanism on the allowed parameter space for ALP dark matter. I will show that axion fragmentation widely opens the parameter space towards higher values fo axion-photon coupling, which can be probed by a whole set of upcoming experiments, including ALPSII, babyIAXO, MADMAX, and many others.

Primary authors: Dr ERÖNCEL, Cem (DESY); SERVANT, Geraldine (DESY and U. hamburg); Mr SØRENSEN, Philip (DESY); SATO, Ryosuke (DESY)

Presenter: Dr ERÖNCEL, Cem (DESY)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Integrability of Massive Feynman Diagrams

Thursday 24 September 2020 15:30 (20 minutes)

Much of the calculational progress in $\mathcal{N} = 4$ Super-Yang-Mills theory has been due to its integrability in the planar limit, which presents itself in form of an infinite-dimensional symmetry of Yangian-type. Recently it has been found that certain classes of ubiquituous massive Feynman diagrams feature a similar dual-conformal Yangian symmetry. I report on this progress and show how this powerful newly-found non-local symmetry can be used to completely constrain the functional dependence of Feynman integrals. Translating the level-one Yangian generators from dual to original momentum space, I introduce a massive generalization of momentum space conformal symmetry. Finally I demonstrate how the Yangian symmetry is realized on off-shell amplitudes of a massive generalization of the so-called Fishnet theory and how this theory emerges in a doubly-scaled Gamma-deformation from $\mathcal{N} = 4$ Super-Yang-Mills theory on the Coulomb branch.

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Presenter: Mr MICZAJKA, Julian (Humboldt-Universität zu Berlin)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Beyond the Standard Models with Cosmic Strings

Friday 25 September 2020 14:00 (12 minutes)

A stochastic gravitational-wave (GW) background from cosmic strings spans a broad range of frequencies. By measuring the slope of its spectrum with future GW observatories, we can infer the equation of state of the universe much earlier than the onset of Big-Bang Nucleosynthesis (BBN). In this work, we consider a variety of cosmological scenarios beyond the standard hot-Big-Bang cosmology and examine what are the energy and time scales in the early universe that each GW experiment could be sensitive to. For example, a secondary intermediate inflation era at an energy scale up to 10^{14} GeV could have detectable features even if it lasts only a few e-folds, while generic heavy-unstable particles generating an intermediate matter era could be probed down to a life-time of 10^{-16} seconds, extending the BBN constraint which stops around 0.1 seconds. In precise particle-physics models, this new method can be used to probe oscillating moduli up to a mass of 10^{10} GeV and heavy dark photons with a kinetic mixing as low as 10^{-18}.
Interestingly, the recent stochastic GW background observed by NANOGrav collaboration can be explained by cosmic strings.

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Presenter: Mr SIMAKACHORN, Peera (UHH and DESY)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

Track Classification: Cosmology & Astroparticle Physics

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

Asymptotic dynamics on the worldline for spinning particles

Friday 25 September 2020 17:20 (20 minutes)

The worldline representation of the relativistic spinning particles has been known for a long time. Much of the studies focused on the calculation of effective actions, with less attention to open propagators. In 0811.2067 the formalism has been applied to asymptotic states dressed by soft radiation at next-to-leading power (NLP) in the soft expansion. This led to the definition of the so-called Generalized Wilson Line (GWL), which turned out to be a useful tool to derive factorization theorems at NLP. In this talk I will discuss the extension of the formalism to spinning particles, clarifying the relation between the GWL and the worldline formalism, and stressing the relevance for phenomenology applications.

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Presenter: BONOCORE, Domenico (University of Münster)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Axionlike Particles and Lepton-Flavor Violation

Wednesday 23 September 2020 17:15 (15 minutes)

Axionlike Particles (ALPs) appear in many well-motivated extensions of the Standard Model. Their lepton-flavor violating couplings can be probed in exotic muon and tau decays. When ALPs are produced resonantly, the sensitivity of three-body decays such as $\mu \to 3e$ and $\tau \to 3\mu$ exceeds that of radiative decays like $\mu \to e\gamma$ and $\tau \to \mu\gamma$ by multiple orders of magnitude. The opposite is true for regions, where resonant ALP-production is not possible, therefore searches for both processes are highly complementary. We discuss constraints from various types of experiments on ALPs with a single dominant lepton-flavour violating coupling and loop-induced photon coupling. We also take constraints from non-decay experiments such as muonium-antimuonium oscillations, electron EDM, and $(g-2)_\mu$ into account.

Keywords: Axionlike Particles, Lepton-Flavor Violation, Muon Decays, Tau Decays

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Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Shining Light on the Scotogenic Model: Interplay of Colliders and Cosmology

Tuesday 22 September 2020 16:58 (13 minutes)

In the framework of the scotogenic model, which features radiative generation of neutrino masses, we explore light dark matter scenario. Throughout the paper we chiefly focus on keV-scale dark matter which can be produced either via freeze-in through the decays of the new scalars, or from the decays of next-to-lightest fermionic particle in the spectrum, which is produced through freeze-out. The latter mechanism is required to be suppressed as it typically produces a hot dark matter component. Constraints from BBN are also considered and in combination with the former production mechanism they impose the dark matter to be light. For this scenario we consider signatures at High Luminosity LHC and proposed future hadron and lepton colliders, namely FCC-hh and CLIC, focusing on searches with two leptons and missing energy as a final state. While a potential discovery at High Luminosity LHC is in tension with limits from cosmology, the situation greatly improves for future colliders.

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Presenter: Mr BAUMHOLZER, Sven (Johannes Gutenberg-Universitaet Mainz)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Axion Gegenschein: Dark Countersources of Bright Radio Objects

Tuesday 22 September 2020 14:28 (13 minutes)

I will describe a new scheme for the detection of radio signals from the decay of axions and axion-like particles, called *axion gegenschein*, using next-generation facilities such as SKA. Ambient radiation arriving from astrophysical radio-bright objects drive stimulated decay in the Galactic halo creating a *countersource* with the dimensions and morphological features of each source in the direction precisely opposite to it, smoothed by the velocity dispersion of dark matter. This technique of probing stimulated decay of axions is more sensitive compared to radio observations of dwarf spheroidals, and provides a direct measure of dark matter density along the line of sight.

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Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

One integral to rule them all: an algorithm to compute Feynman integrals

Thursday 24 September 2020 13:45 (20 minutes)

Differential equations are a powerful tool for computing Feynman integrals. Their solution is straightforward if one can find a transformation to a certain 'canonical'form, where the answer is manifestly given in terms of iterated integrals, such as multiple polylogarithms. An algorithmic way to construct the necessary transformation is therefore highly desired, and recent years have seen numerous works in this direction.
In this talk, I will first introduce the relevant set of differential equations for a given scattering problem and then provide a new algorithm for finding the corresponding transformation. To prove the applicability of the new method to multi-variable and large-scale problems, I present the successful application to two-loop five-particle scattering and four-loop heavy-quark integrals, respectively. The latter are relevant for the computation of the cusp-anomalous dimension in QCD and maximally supersymmetric Yang-Mills theory.

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Presenter: Mr DLAPA, Christoph (Max Planck Institute for Physics)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Renormalization and scale evolution of the soft-quark soft function

Wednesday 23 September 2020 15:15 (15 minutes)

Soft functions enter in factorization theorems in soft collinear effective field theory (SCET) and they capture the large distance effects of a process. They are defined as matrix elements of soft fields dressed by Wilson lines. While at leading order in power counting they are described by emissions of soft gauge bosons at sub-leading order one needs to consider emissions of soft fermions too. In this work we consider the soft quark soft function, that enters in the factorization theorem of H $\to \gamma\gamma$. We present here the renormalization of the soft-quark soft function at one loop, derive its two loop anomalous dimension and discuss solutions of its renormalization group equation in momentum space, in Laplace space and in the so called diagonal space, where we show that the soft function evolves multiplicatively.

Summary

In this work the main summary points are:

1. Derivation of the renormalisation factor for the soft quark soft function based on the argument of the RG invariance of one of the terms in the amplitude, the T3 term.
2. Present an exact solution to the RGE of the soft quark soft function in momentum space.
3. Build a diagonal space where the soft function evolves locally.
4. Show that the known rapidity regulators in momentum space are inconsistent with the RG invariance of the T3.

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Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Probing baryogengesis using synergy between $n - \bar{n}$ oscillation and collider searches

Tuesday 22 September 2020 17:24 (13 minutes)

Neutron-antineutron ($n - \bar{n}$) oscillation violates baryon number by two units and an observable rate of such a process would strongly advocate physics beyond the Standard Model (BSM). Many prospective future experiments such as ESS and DUNE are planning to search for $n - \bar{n}$ oscillation improving on the current limits. In this talk, we will discuss the impact of the observation of $n - \bar{n}$ oscillation on the washout of baryon number in the early universe. Interestingly, an observation of the relevant new physics mediators at the LHC or future collider searches together with an observation of $n - \bar{n}$ oscillation (or di-nucleon decay) can render many direct baryogenesis mechanisms at high and TeV scale ineffective. In particular, we will focus on a class of UV realisations employing effective trilinear baryon number violating couplings and show that a synergy between the upcoming $n - \bar{n}$ oscillation experiments and direct searches at the colliders will probe many scenarios of baryogenesis.

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Presenter: Dr HATI, Chandan (Technische Universität München, James-Franck-Straße 1, D-85748 Garching, Germany)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Far-from-equilibrium dynamics of axion-like particles with broken shift symmetry

Friday 25 September 2020 14:36 (12 minutes)

Axion-like particles (ALPs) play an important role in cosmology and, among others, are well motivated dark matter candidates. In the presence of a monodromy the discrete shift symmetry of ALPs can be broken, and this talk is devoted to the rich nonlinear dynamics that becomes available in such systems. We consider coherent oscillations of the field, which trigger the resonant amplification of fluctuations, leading to the fragmentation of the field. In many cases the ALP potential contains several local minima and we study how the energy transfer to the fluctuations impacts the transitions between local minima. The production of stochastic gravitational wave background from the dynamics, potentially within reach of future detectors, is also investigated.

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Presenter: Dr CHATRCHYAN, Aleksandr (Heidelberg University, Institute for theoretical physics)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

Track Classification: Cosmology & Astroparticle Physics

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

Probing lepton number violating interactions in rare kaon decays

Wednesday 23 September 2020 16:45 (15 minutes)

We investigate the possibility to probe lepton number violating (LNV) operators in the rare kaon decay $K \to \pi\nu\nu$. Performing the analysis in the Standard Model effective field theory with only light active Majorana neutrinos, we determine the current limits on the corresponding LNV physics scale from the past E949 experiment at BNL as well as the currently operating experiments NA62 at CERN and KOTO at J-PARC. We focus on the specific signature of scalar currents in $K \to \pi\nu\nu$ arising from the LNV nature of the operators and study the effect on the experimental sensitivity, stressing the need for dedicated searches for beyond the SM currents. We find that the rare kaon decays probe high operator scales $\Lambda_{\rm LNV} \approx 15$ to 20 TeV in different quark and neutrino flavours compared to neutrinoless double beta decay. Furthermore, we comment that the observation of LNV in kaon decays can put high-scale leptogenesis under tension.

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Presenter: FRIDELL, Kåre (Technical University of Munich)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Islands in the Randall-Sundrum model

Thursday 24 September 2020 17:10 (20 minutes)

Recent progress in our understanding of the black hole information paradox has lead to a new prescription for calculating entanglement entropies, which involves special subsystems in regions where gravity is dynamical, called *quantum extremal islands*. We present a simple holographic framework where the emergence of these islands can be understood in terms of the standard Ryu-Takayanagi prescription. Our setup describes a boundary CFT coupled to a defect, which are dual to global AdS containing a codimension-one brane. Through the Randall-Sundrum mechanism, an effective description of the brane is given by gravity on an AdS background coupled to two copies of the boundary CFT. We show that the physics of islands here is simply a consequence of the well-understood phase transition of RT surfaces, an island appearing whenever the RT surface crosses the brane.

Primary authors: Dr NEUENFELD, Dominik (Perimeter Institute); Mr CHEN, Hong Zhe (Perimeter Institute); Dr REYES, Ignacio A. (Max Planck Institute, Potsdam); Mr SANDOR, Joshua (Perimeter Institute); Prof. MYERS, Rob (Perimeter Institute)

Presenter: Dr REYES, Ignacio A. (Max Planck Institute, Potsdam)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Audible Axions

Tuesday 22 September 2020 15:20 (13 minutes)

Conventional approaches to probing axions and axion-like particles (ALPs) typically rely on a coupling to photons. However, if this coupling is extremely weak, ALPs become invisible and are effectively decoupled from the Standard Model. We show that such invisible axions, which are viable candidates for dark matter, can produce a stochastic gravitational wave background in the early universe. This signal is generated in models where the invisible axion couples to a dark gauge boson that experiences a tachyonic instability when the axion begins to oscillate. Quantum fluctuations amplified by the exponentially growing gauge boson modes source chiral gravitational waves. We discuss the parameter space where this signal can possibly be detected by pulsar timing arrays or space/ground-based gravitational wave detectors. Further we present preliminary results how the non-perturbative lattice calculations we are carrying out at the moment might change this picture.

Primary author: Mr RATZINGER, Wolfram (Johannes Gutenberg University Mainz)

Presenter: Mr RATZINGER, Wolfram (Johannes Gutenberg University Mainz)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Center 1-from symmetries in higher dimensions

Thursday 24 September 2020 15:50 (20 minutes)

In this talk I will summarize recent results on the fate of center 1-form symmetries in six and eight dimensions. In particular, I will discuss their interplay between other gauged higher-form symmetries causing obstructions to the gauging of the discrete center 1-form symmetries, which would result in non-simply connected non-Abelian gauge groups. In this way we can find previously unknown consistency conditions for quantum theories of gravity. For eight dimensions these have a geometrical interpretation in terms of F-theory on elliptically fibered K3s.

Primary author: Dr DIERIGL, Markus (UPenn)

Presenter: Dr DIERIGL, Markus (UPenn)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Analytic Structure of all Loop Banana Amplitudes

Thursday 24 September 2020 14:25 (20 minutes)

Using the Gelfand-Kapranov-Zelevinsk\u{\i} system for the primitive cohomology
of an infinite series of complete intersection Calabi-Yau manifolds, whose dimension is the loop order minus one, we completely clarify the analytic structure of all banana amplitudes with arbitrary
masses. In particular, we find that the leading logarithmic structure in the high energy regime, which corresponds
to the point of maximal unipotent monodromy, is determined by a novel $\widehat{\Gamma}$-class evaluation
in the ambient spaces of the mirror, while the imaginary part of the amplitude in this regime is determined
by the $\widehat{\Gamma}$-class of the mirror Calabi-Yau manifold itself. We provide simple closed all loop
formulas for the former as well as for the Frobenius κ-constants, which determine the behaviour of the amplitudes,
when the momentum square equals the sum of the masses squared, in terms of zeta values. We extend our previous work
from three to four loops by providing for the latter case a complete set of (inhomogenous) Picard-Fuchs differential equations
for arbitrary masses. This allows to evaluate the amplitude as well as other master integrals with raised powers
of the propagators in very short time to very high numerical precision for all values of the physical parameters. Using a recent p-adic analysis of the periods we determine the value of the maximal cut
equal mass four-loop amplitude at the attractor points in terms of periods of modular weight two and
four Hecke eigenforms and the quasiperiods of their meromorphic cousins.

Primary authors: Prof. KLEMM, Albrecht (Bethe Center for Theoretical Physics); Mr NEGA, Christoph (Bethe Center for Theoretical Physics); Mr FISCHBACH, Fabian (Bethe Center for Theoretical Physics); Mr BÖNISCH, Kilian (Bethe Center for Theoretical Physics); Mr SAFARI, Reza (Bethe Center for Theoretical Physics)

Presenter: Mr NEGA, Christoph (Bethe Center for Theoretical Physics)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Bounds on axion-like particles from the diffuse supernova flux

Tuesday 22 September 2020 17:50 (13 minutes)

The cumulative emission of Axion-Like Particles (ALPs) from all past core-collapse supernovae (SNe) would lead to a diffuse flux with energies $\mathcal{O}(50)$ MeV. We use this to constrain ALPs featuring couplings to photons and to nucleons. ALPs coupled only to photons are produced in the SN core via the Primakoff process,and then converted into gamma rays in the Galactic magnetic field. We set a bound on the ALP-photon coupling using recent measurements of the diffuse gamma-ray flux observed by the Fermi-LAT telescope. However, if ALPs couple also with nucleons, their production rate in SN can be considerably enhanced due to the ALPs nucleon-nucleon bremsstrahlung process. If ALPs are heavier than keV, the decay into photons becomes significant, leading again to a diffuse gamma-ray flux. Allowing for a (maximal) coupling to nucleons, the limit improves to the level of $10^{-19}\mathrm{GeV}^{-1}$
for $m_a \sim 20\mathrm{MeV}$, which represents the strongest constraint to date.

Primary author: CALORE, Francesca (CNRS, LAPTh)

Co-authors: Dr MIRIZZI, Alessandro (University of Bari); JAECKEL, Joerg (Institut f\"ur theoretische Physik, Universit\"at Heidelberg); GIANNOTTI, Maurizio (Barry University); Mr CARENZA, Pierluca (Università degli Studi di Bari)

Presenter: Mr CARENZA, Pierluca (Università degli Studi di Bari)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Recursive construction of the operator product expansion in curved space

Friday 25 September 2020 17:00 (20 minutes)

I present a formula for the coupling-constant derivative of the coefficients of the operator product expansion (Wilson OPE coefficients) in an arbitrary curved space, as the natural extension of the quantum action principle. Expanding the coefficients themselves in powers of the coupling constants, this formula allows to compute them recursively to arbitrary order. As input, only the OPE coefficients in the free theory are needed, which are easily obtained using Wick's theorem. I illustrate the method by computing some examples, and conjecture on how it can be useful in the context of the AdS/CFT correspondence. Based on arXiv:2007.15668 and work in progress.

Primary author: Dr FRÖB, Markus B. (Universität Leipzig)

Presenter: Dr FRÖB, Markus B. (Universität Leipzig)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Unveiling the Higgs at FCC-hh with new diboson precision measurements.

Wednesday 23 September 2020 14:15 (15 minutes)

The lack of evidence of New Physics coming from direct searches of resonances at the LHC calls for an increase in efforts to devise new observables that can indirectly probe New Physics. Additionally, the future FCC-hh will make available new processes, inaccessible so far due to their low number of events. Studying the high transverse momentum distribution of diboson production processes at FCC-hh is then an interesting path to explore. I will discuss how the diboson processes Wh and Zh, with leptonic decays for W and Z and the Higgs decaying to 2 photons, will allow us to know more about the physics of the Higgs boson in an EFT framework. I will also focus on how doubly differential distributions give us access to higher-dimension operators that, otherwise, would require more specific observables.

Primary author: Mr ROSSIA, Alejo Nahuel (DESY, HU Berlin)

Co-authors: GROJEAN, Christophe (DESY); BISHARA, Fady (DESY); PANICO, Giuliano (Floremce University and INFN Florence); MONTULL, Marc (DESY); Mr ENGLERT, Philipp (DESY Hamburg)

Presenter: Mr ROSSIA, Alejo Nahuel (DESY, HU Berlin)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Asymptotic Safety with Higgs and Flavor Portals

Wednesday 23 September 2020 18:00 (15 minutes)

Standard Model extensions inspired by asymptotic safety generally contain vector-like fermions and singlet matrix scalar fields. Here we study several models where three generations of colorless vector-like fermions allow for portal Yukawa interactions
with leptons, leading to rich phenomenological implications. A novel feature is that the enlarged scalar sector, which also contains a Higgs portal, may spontaneously break lepton flavor universality. We discuss the phenomenology of the BSM sector, covering production at pp and lepton colliders, decay and fermion mixing. Further signatures of the models include lepton flavor violation, displaced vertices, electric dipole moments and anomalous magnetic moments, for which effects from scalar mixing and chiral enhancement are especially relevant. Furthermore, a two-loop renormalization group analysis of the running gauge, Yukawa, and quartic couplings reveals ultraviolet fixed points for which models remain well-behaved and predictive up to the Planck scale.

Primary authors: Ms HORMIGOS-FELIU, Clara (TU Dortmund); Prof. LITIM, Daniel (U Sussex); Prof. HILLER, Gudrun (TU Dortmund); Mr STEUDTNER, Tom (U Sussex)

Presenter: Ms HORMIGOS-FELIU, Clara (TU Dortmund)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

New ways to probe CP-violation and lepton non-universality with rare charm decays

Wednesday 23 September 2020 17:00 (15 minutes)

Rare $|\Delta c| = |\Delta u| = 1$ processes are unique probes of flavour physics in the Standard Model (SM) and beyond and provide an excellent opportunity to analyse CP-violation and search for new physics (NP) due to their strong GIM-suppression in the SM.
Furthermore, a variety of null test observables is available for decays, such as $D \to \pi\ell^+\ell^-$, $\ell = e, \mu$, and provide vital insight into possible NP signals and tests of lepton universality can be performed in charm.
The observation of direct CP-violation in hadronic decays, ΔA_{CP}, draws a connection to semileptonic decays,
like in the case of flavourful, anomaly-free $U(1)'$-extensions, where a NP-interpretation of ΔA_{CP} indicates measurable CP-asymmetries in $c \to u\ell^+\ell^-$ transitions and vice versa.

In this talk we present a study (from the work 2004.01206) on CP-violating NP linking semileptonic and hadronic rare charm decays and discuss a selection of Z'-models that generate U-spin and isospin breaking which can be probed in patterns of hadronic decays of charm mesons.
Signatures for CP-asymmetries in $D^0 \to \pi^+\pi^-$, $D^0 \to K^+K^-$ and $D^0 \to \pi^0\pi^0$, $D^+ \to \pi^+\pi^0$ as well as potential deviations from the universality limit in $D \to \pi\ell^+\ell^-$ are provided as well.

Primary authors: Prof. HILLER, Gudrun (TU Dortmund); GISBERT, Hector (TU Dortmund); GOLZ, Marcel (TU Dortmund); Mr BAUSE, Rigo (TU Dortmund)

Presenter: Mr BAUSE, Rigo (TU Dortmund)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Axion emissivity from photon conversions in the solar magnetic field

Tuesday 22 September 2020 14:41 (13 minutes)

Axions can be produced in the Sun via the Primakoff process leading to conversions of thermal photons into axions in the flucutuating electric and magnetic fields generated by the charged particles in the stellar plasmas. Currently this flux is searched by the helioscope experiment CAST at CERN. A future generation helioscope experiment, called IAXO, is currently under investigation. Seismic solar models also predict magnetic fields inside the Sun in the radiative and convective zones. The intensity of these fields may also reach $B \sim 3 \times 10^3 T$. At this regard the purpose of our thesis is to characterize the solar axion flux coming from photon conversions into the large-scale solar magnetic fields. We will compare this flux with the Primakoff one and investigate the detection possibility of this additional contribution of the solar axion flux in IAXO detector.
Work in progress with Alessandro Mirizzi, Maurizio Giannotti and Pierluca Carenza.

Primary author: Mrs GUARINI, Ersilia (Physics Department, University of Bari)

Presenter: Mrs GUARINI, Ersilia (Physics Department, University of Bari)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

Gradient effects on false vacuum decay in gauge theory

Friday 25 September 2020 14:24 (12 minutes)

We study false vacuum decay for a gauged complex scalar field in a polynomial potential with nearly degenerate minima. Radiative corrections to the profile of the nucleated bubble as well as the full decay rate are computed in the planar thin-wall approximation using the effective action. This allows to account for the inhomogeneity of the bounce background and the radiative corrections in a self-consistent manner. In contrast to scalar or fermion loops, for gauge fields one must deal with a coupled system that mixes the Goldstone boson and the gauge fields, which considerably complicates the numerical calculation of Green's functions. In addition to the renormalization of couplings, we employ a covariant gradient expansion in order to systematically construct the counterterm for the wave-function renormalization. The result for the full decay rate however does not rely on such an expansion and accounts for all gradient corrections at the chosen truncation of the loop expansion. The ensuing gradient effects are shown to be of the same order of magnitude as non-derivative one-loop corrections.

Primary authors: Prof. GARBRECHT, Björn (Technische Universität München); Dr TAMARIT, Carlos (Technische Universität München); Mr CRUZ, Juan S. (Technical University Munich); Dr AI, Wen-Yuan (Université Catholique de Louvain)

Presenter: Mr CRUZ, Juan S. (Technical University Munich)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

Track Classification: Cosmology & Astroparticle Physics

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

EFTs of axions and gauge bosons in the light of UV models

Wednesday 23 September 2020 17:45 (15 minutes)

I will revisit EFT couplings between an axion and massive gauge bosons. It is known that massive vectors allow for more freedom than massless ones when building an EFT, thanks to the existence of the non-linear realization of (gauge) symmetries. It is also known that such a non-linear realization must sometimes be used even to describe physics at energy scales above the electroweak vev, due to non-decoupling effects. I will discuss the relevance and impact of such considerations on the physics of an axion or ALP, in particular when it is coupled to the SM electroweak gauge bosons. For that, I will consider UV models of spontaneous symmetry breaking with heavy chiral matter, and discuss both Peccei-Quinn anomaly matching and the breakdown of "expected" observational correlations at leading order.

Primary author: BONNEFOY, Quentin (DESY)

Presenter: BONNEFOY, Quentin (DESY)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Constraining the Top EFT

Wednesday 23 September 2020 14:30 (15 minutes)

I will discuss a global analysis of Run II top measurements at the LHC in terms of dimension-6 operators. A distinctive feature of the top sector is the large number of four-fermion operators. This potentially leads to a large number of degeneracies. I will show in detail how those degeneracies can be resolved and how quadratic terms lead to stable limits on each of the Wilson coefficients.

Primary author: Mr BRUGGISSER, Sebastian (ITP Heidelberg)

Presenter: Mr BRUGGISSER, Sebastian (ITP Heidelberg)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

$\Delta F = 1$ effective Hamiltonian in generic extensions of the Standard Model

Wednesday 23 September 2020 15:00 (15 minutes)

In this talk we will discus the flavour violating four-fermion interactions and dipole interaction in models with extra heavy particles whose masses are
equal to or above the electro-weak scale.
We use the Becchi-Rouet-Stora-Tyutin symmetry to constrain tree-level couplings to construct perturbatively unitary theories, for which we calculate one-loop corrections.
We focus on the gauge cancellation and give matching results for four-fermion operators in terms of a reduced set of couplings.
As an illustrative example, we will calculate the $\bar{d}_i d_j \to \bar{\ell}_i \ell_i$ process with one extra charged massive boson.

Primary author: MOLDANAZAROVA, Ulserik (University of Liverpool)

Co-author: GORBAHN, Martin (University of Liverpool)

Presenter: MOLDANAZAROVA, Ulserik (University of Liverpool)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Emergent Strings in 4D N=1: Uniqueness and Obstructions

Thursday 24 September 2020 16:10 (20 minutes)

We revisit infinite distance limits in the Kähler moduli space of F-theory compactifications to 4D with $\mathcal{N} = 1$ supersymmetry. At the classical level, it is known that the existence of certain such limits imposes the structure of a rational or genus-one fibration on the three-dimensional base. As the fiber volume vanishes in the limit, wrapping the D3 brane on it gives rise to an emergent tensionless heterotic or type II string. We argue that this string is unique. Since the limit involves a shrinking cycle, one could expect that any such limit is obstructed in the quantum theory. We demonstrate that such an obstruction is generically present for limits with a finite volume of the three-dimensional base. Relaxing the assumption of finite volume, we exhibit modified limits which survive the leading correction and are not of the decompactification type. Finally, we will discuss whether the weak gravity conjecture survives these corrections.

Primary authors: Dr KLÄWER, Daniel (Mainz University); WIESNER, Max (IFT Madrid); LEE, Seung-Joo (IBS-CTPU); WEIGAND, Timo (CERN)

Presenter: Dr KLÄWER, Daniel (Mainz University)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Plabic Graphs and Symbol Alphabets in $\mathcal{N} = 4$ super-Yang-Mills Theory

Thursday 24 September 2020 14:45 (20 minutes)

A key challenge in the study of scattering amplitudes of $\mathcal{N} = 4$ super-Yang-Mills theory is to understand their analytic structure. Symbols, a central tool in this topic, are known to contain particular cluster coordinates of $Gr(4, n)$ together with certain algebraic functions of cluster coordinates. In my talk, I will present an algorithm for computing symbol alphabets by solving matrix equations of the form $C \cdot Z = 0$ to relate parameterizations of certain $Gr(k, n)$ plabic graphs to functions on $Gr(m, n)$.

Primary author: Mr SCHREIBER, Anders (Brown University)

Co-authors: Prof. VOLOVICH, Anastasia (Brown University); Mr MAGO, Jorge (Brown University); Prof. SPRADLIN, Marcus (Brown University)

Presenter: Mr SCHREIBER, Anders (Brown University)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Landscape instabilities from finite density effects

Tuesday 22 September 2020 14:54 (13 minutes)

We consider finite density effects in models with a metastable ground state. We find that sufficiently dense objects, such as neutron stars, can destabilise the metastable minimum allowing for classical formation of bubbles of a new vacuum. As we show, these bubbles are not necessarily confined to the dense region, but can escape to infinity. This leads to a phase transition in the universe after the formation of stars, and therefore has significant impact on e.g. solutions to the electroweak hierarchy problem based on dynamical selection of the electroweak vacuum. We work out the phenomenological consequences of such density triggered late phase transitions and put new constraints on the parameter space of some benchmark relaxion models.

Primary authors: Prof. WEILER, Andreas (TUM); Dr SERRA, Javi (TUM); Mr SPRINGMANN, Konstantin (Technical University of Munich); Dr BALKIN, Reuven (Technion); Mr STELZL, Stefan (TUM Munich)

Presenter: Mr STELZL, Stefan (TUM Munich)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

How to suppress exponential growth – on the parametric resonance of photons in an axion background

Friday 25 September 2020 16:15 (15 minutes)

Axion–photon interactions can lead to an enhancement of the electromagnetic field by parametric resonance in the presence of a cold axion background, for modes with a frequency close to half the axion mass. In this paper, we study the role of the axion momentum dispersion as well as the effects of a background gravitational potential, which can detune the resonance due to gravitational redshift. We show, by analytical as well as numerical calculations, that the resonance leads to an exponential growth of the photon field only if (a) the axion momentum spread is smaller than the inverse resonance length, and (b) the gravitational detuning distance is longer than the resonance length. For realistic parameter values, both effects strongly suppress the resonance and prevent the exponential growth of the photon field. In particular, the redshift due to the gravitational potential of our galaxy prevents the resonance from developing for photons in the observable frequency range, even assuming that all the dark matter consists of a perfectly cold axion condensate. For axion clumps with masses below $\sim 10^{-13}\, M_\odot$, the momentum spread condition is more restrictive, whereas, for more massive clumps, the redshift condition dominates.

Primary authors: Dr ARZA, Ariel (University of Florida); Dr TODARELLO, Elisa (KIT); Prof. SCHWETZ-MANGOLD, Thomas (KIT)

Presenter: Dr TODARELLO, Elisa (KIT)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

UV Sensitivity of the Axion Mass from Instantons in Partially Broken Gauge Groups

Friday 25 September 2020 16:30 (15 minutes)

We examine the contribution of small instantons to the axion mass in various UV completions of QCD. We show that the reason behind the potential dominance of such contributions is the non-trivial embedding of QCD into the UV theory. The effects from instantons in the partially broken gauge group appear as "fractional instanton"corrections in the effective theory. These will exhibit unusual dependences on the various scales in the problem whenever the index of embedding is non-trivial. We present a full one-instanton calculation of the axion mass in the simplest product group models, carefully keeping track of numerical prefactors. We verify that the small instantons may dominate over the QCD contribution for very high breaking scales and at least three group factors.

Primary authors: Prof. CSÁKI, Csaba (Cornell University); Mr RUHDORFER, Maximilian (Technical University of Munich); Prof. SHIRMAN, Yuri (University of California, Irvine)

Presenter: Mr RUHDORFER, Maximilian (Technical University of Munich)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

On the Phenomenology of the GRSMEFT

Wednesday 23 September 2020 14:45 (15 minutes)

We present collider probes of the GRSMEFT, the most general effective field theory of gravity coupled to the SM of particle physics. In particular, we focus on graviton production in association with a jet, for which we derive the leading new-physics scattering amplitude, the expected cross section, and compare with missing energy searches at the LHC in order to bound the size of the relevant GRSMEFT operator. Along the way, we comment on the expected size of such an operator from matching to simple UV completions.

Primary authors: Prof. WEILER, Andreas (TUM); Mr DICHTL, Maximilian (TUM); Mr RUHDORFER, Maximilian (Technical University of Munich)

Presenter: Mr DICHTL, Maximilian (TUM)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

FlexibleDecay: An automated calculator of scalar decay widths

Wednesday 23 September 2020 15:30 (15 minutes)

We present FlexibleDecay - a tool to calculate decays of scalars in arbitrary BSM models.
BSM effects are taken into account at the leading order - meaning that for loop induced decays all one-loop BSM contributions are automatically included.
In case of scalar and pseudoscalar Higgs boson decays the known higher order SM QED, QCD and EW effects are taken into account where possible.
The code is implemented as an add-on to FlexibleSUSY spectrum-generator generator.

Primary authors: STOECKINGER, Dominik (TU Dresden); Dr KOTLARSKI, Wojciech (TU - Dresden)

Presenter: Dr KOTLARSKI, Wojciech (TU - Dresden)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Relaxing Cosmological Neutrino Mass Bounds with Unstable Neutrinos

Tuesday 22 September 2020 16:45 (13 minutes)

At present, cosmological observations set the most stringent bound on the neutrino mass scale. Within the standard cosmological model (ΛCDM), the Planck collaboration reports $\Sigma m_\nu < 0.12$ eV at 95% CL. This bound, taken at face value, excludes many neutrino mass models. However, unstable neutrinos, with lifetimes shorter than the age of the universe $\tau_\nu < t_U$, represent a particle physics avenue to relax cosmological neutrino mass constrains.

In this talk, based on ArXiv:2007.04994, I will review the cosmological evolution of neutrinos and show how decaying neutrinos can relax cosmological neutrino mass bounds. In addition, I will present a simple extension of the type I seesaw scenario in which neutrino decays can loosen the neutrino mass bounds up to $\Sigma m_\nu \sim 1$ eV, without spoiling the light neutrino mass generation mechanism. I will conclude by highlighting the role that unstable neutrinos can play in light of current and upcoming laboratory and cosmology experiments searching for the neutrino mass scale.

Primary authors: LOPEZ-PAVON, Jacobo (IFIC); ESCUDERO, Miguel (TUM); RIUS, Nuria (IFIC); SANDNER, Stefan (IFIC)

Presenter: ESCUDERO, Miguel (TUM)

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

Track Classification: Cosmology & Astroparticle Physics

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

F-theory on mirror dual Calabi-Yaus

Thursday 24 September 2020 16:50 (20 minutes)

In this work we consider pairs of elliptic Calabi-Yau threefolds, related by mirror symmetry that factorizes between fiber and base.
Extending work of Berglund and Mayr, this allows us to deduce the mirror dual base and fibration structures which we use to build up a dictionary between two different F-theory SUGRA theories: The mirror acts as a quotient on the base while local gauge group factors get exchanged by their communtant in E8.
We use this dictionary to explore Higgs and Coulomb branches in the dual theories by exploiting their inverse interpretations. This allows us to deduce the origin of non-Higgsable U(1)'s and Higgs branches of superconformal field theories with and without non-trivial global structures.

Primary authors: Dr OEHLMANN, Paul-Konstantin (Uppsala University); Prof. TAYLOR, Washington (MIT)

Presenter: Dr OEHLMANN, Paul-Konstantin (Uppsala University)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Impact of the bounds on the direct search of bino-like Dark Matter on naturalness

Friday 25 September 2020 16:00 (15 minutes)

We postulate the WIMP neutralino Dark Matter's interaction with ordinary matter as scattering from the direct detection experiments' nucleon target. Recently, one of the most sensitive direct detection experiments XENON1T submitted an upper bound on the WIMP-Nucleon Spin-Independent elastic cross-section σ_{SI} at $4.1 \times 10^{-47} GeV^2$ for a mass of $30 \frac{GeV}{c^2}$. We imply the last XENON1T results and naturalness constraints to settle a lower bound on Higgsino mass parameter μ.
Results indicated that the lower bound on $|\mu|$ from direct WIMP
searches is only slightly above M_1, especially for $\mu < 0$.
As e consequence, the bino approximation, especially for the negative sign of μ diverges for $|\mu| \rightarrow |M_1|$ where it occurs by increasing M_1 in the lower limit of μ formalism. Instead, we introduce a new approximation, a strong mixture, working in small $|\mu| - |M_1|$ that performs even better for the negative sign of μ.

Primary author: Ms GHAFARI, Ghazal (Bonn University)

Co-author: Prof. DREES, Manuel (Bonn University)

Presenter: Ms GHAFARI, Ghazal (Bonn University)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

Track Classification: Particle Phenomenology

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

Unitary States at the Late Time Boundary of de Sitter

Friday 25 September 2020 18:00 (20 minutes)

In this talk we will focus on free scalar fields of various mass on D-dimensional de sitter, define late time boundary states from their late time behavior, discuss how they are classified in terms of irreducible representations of the symmetry group of de Sitter SO(1,D) by considering their inner products and say a few words about their correlators.

Summary

This talk is based on work arXiv:1912.09885 [hep-th].

Primary authors: SKORDIS, Constantinos (CEICO at the Institute of Physics of the Czech Academy of Sciences); SENGOR, Gizem (CEICO at the Institute of Physics of the Czech Academy of Sciences)

Presenter: SENGOR, Gizem (CEICO at the Institute of Physics of the Czech Academy of Sciences)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

Curvature in Discrete Quantum Gravity

Friday 25 September 2020 17:40 (20 minutes)

Causal Dynamical Triangulation (CDT) is a non-perturbative theory of quantum gravity. It is based on a lattice discretization of general relativity, where the background metric should emerge dynamically. This makes it difficult to construct suitable observables in the model. A recent addition to the list of available CDT observables is the Quantum Ricci Curvature (QRC), which allows one to measure effective average curvature on piecewise flat geometries.

In this talk, I will go over the basics of CDT, and subsequently define the Quantum Ricci Curvature. Furthermore, I will show how it behaves on general triangulated model spaces, and highlight some results in the quantum gravity context. In addition to this, I will explain how to implement the continuum analog of QRC on spaces with isolated singular points of curvature, and how this can provide additional reference points to help us interpret the measurement results of the QRC in a non-perturbative quantum setting.

Primary author: Mr BRUNEKREEF, Joren (Radboud University)

Presenter: Mr BRUNEKREEF, Joren (Radboud University)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

Track Classification: Strings & Mathematical Physics

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

REVIEW TALK - Geometries for scattering amplitudes, and beyond

Thursday 24 September 2020 13:00 (45 minutes)

In recent years it has become clear that geometrical structures underlie various observables in quantum field theories. In this talk I will describe amplituhedra, i.e. geometries encoding scattering amplitudes. These pertain to a broader family of geometries called positive geometries, whose basics I will review. The amplitudes are extracted from the canonical form with logarithmic singularities on the boundaries of these geometries. Afterwards, I will focus on maximally supersymmetric Yang-Mills theory and discuss the amplituhedron and the momentum amplituhedron. Finally, I will discuss some of the questions which remain open in this framework.

Presenter: FERRO, Livia (LMU)

Session Classification: Strings & Mathematical physics session on Zoom and in Main Auditorium.

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

REVIEW TALK: Standard Model

Wednesday 23 September 2020 13:45 (30 minutes)

Presenter: TANCREDI, Lorenzo (CERN TH)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

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

REVIEW TALK: High-intensity probes of dark sector particles

Wednesday 23 September 2020 16:15 (30 minutes)

Presenter: GORI, Stefania (UCSC)

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

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

REVIEW TALK: Dark matter

Friday 25 September 2020 15:15 (30 minutes)

Presenter: VOGL, Stefan

Session Classification: Particle Phenomenology session on Zoom and in Main Auditorium.

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

REVIEW TALK: Gravitational waves from early universe cosmology

Friday 25 September 2020 13:30 (30 minutes)

Presenter: FIGUEROA, Daniel

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium.

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

REVIEW TALK: Recent ideas for dark matter detection

Tuesday 22 September 2020 13:45 (30 minutes)

Presenter: HOCHBERG, Yonit

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium

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

REVIEW TALK: New ideas from the neutrino sector

Tuesday 22 September 2020 16:15 (30 minutes)

Presenter: TORTOLA, Mariam

Session Classification: Cosmology and Astroparticles session on Zoom and in Main Auditorium