Polish Particle and Nuclear Theory Summit (2PiNTS) 2024

Report of Contributions

https://indico.ifj.edu.pl/e/2pints2024

Contribution ID: **37** Type: **Talk**

Crossing the desert: Towards predictions for SMEFT coefficients from quantum gravity

The SMEFT provides a general framework to search for new physics beyond the current reach of direct detection. One such form of new physics is quantum gravity. Based on dimensional analysis, one would expect the prediction that the quantum-gravity contribution to the SMEFT coefficients is unmeasurably tiny at LHC scales. In this paper, we test this expectation in a specific framework for quantum gravity, namely the asymptotic safety framework. In this framework, Wilson coefficients can be calculated in relatively straightforward manner, making a connection between quantum gravity and LHC tests of the SMEFT achievable. We work in a toy model of the Standard Model fermion sector to investigate four-fermion couplings. We find three scenarios in this toy model, based on three distinct fixed points of the Renormalization Group flow. In the first scenario, the expectation from dimensional analysis is borne out and Wilson coefficients are Planck-scale suppressed. In the second and third scenarios, the Wilson coefficients are significantly larger than expected by dimensional analysis, due to interacting fixed points which generate an effective new-physics scale that lies between the LHC scale and the Planck scale. We comment on the implications of these results for the testability of asymptotically safe gravity within the SMEFT framework at the LHC.

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Track Classification: Particle Physics [Early Career]

Contribution ID: **38** Type: **Talk**

Freezing-in Cannibal Dark Sectors

Self-Interacting Dark Matter models offer a compelling framework for explaining dark matter production through interactions confined within the dark sector. Introducing a feeble coupling between the dark and visible sectors via a Higgs portal not only opens up new avenues for detection and enriches thermal production dynamics but also provides a potential explanation for the initial dark matter population via the freeze-in mechanism. In this talk, I will examine the freeze-in production of dark matter in scenarios involving self-interactions, focusing on two cases: one with a dark sector consisting solely of unstable dark matter, and another with stable dark matter and an unstable scalar mediator. I will emphasize how variations in dark sector interactions can either tighten or relax cosmological constraints, leading to distinct signatures in long-lived particle searches and indirect detection experiments.

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Track Classification: Particle Physics [Early Career]

Contribution ID: **39** Type: **Talk**

Entropy production and dissipation in spin hydrodynamics

Motivated by the evidence of spin polarization in particles produced by relativistic heavy ion collisions, there is growing interest in the so-called relativistic spin hydrodynamics. In this talk, we will present the outcomes of using first-principle quantum-statistical methods to derive the expression for the entropy production rate in relativistic fluids composed of particles with spin. Based on this, we will discuss our ongoing development of a novel method for deriving various dissipative currents in the system.

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Track Classification: Nuclear Physics [Early Career]

Contribution ID: **40** Type: **Talk**

Functional renormalisation of UV-safe gauge theories coupled to matter

Certain types of large-N gauge theories coupled to matter offer interacting UV fixed points that are under strict perturbative control, beyond the paradigm of asymptotic freedom. In this work, we derive and investigate functional RG equations for the quantum effective potential of the theory to leading order in a derivative expansion. We thereby find the RG flows, fixed points, and scaling dimensions of infinitely many canonically irrelevant interaction monomials to leading order in the small Veneziano parameter. We also find that results can be resummed into closed expressions. Implications for vacuum stability and the size of the conformal window, links with RG studies in the MS bar scheme, and extensions towards larger Veneziano parameters are indicated.

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