Contribution ID: **332**                                                    Type: **talk**

# UV-completion in Particle Theory with Infinite Derivatives: Conformal Invariance, Laboratory and Cosmological Implications

*Monday, 12 July 2021 14:45 (15 minutes)*

We will discuss constructions of string-inspired higher-derivative non-local extension of particle theory which is explicitly ghost-free. Showing quantum loop calculations in the weak perturbation limit we explore the implications on the hierarchy problem and vacuum instability problem in Higgs theory. Then we will discuss the abelian and non-abelian model-building in infinite derivative QFT in 4-D which naturally leads to the predictions of dynamical conformal invariance in the UV at the quantum level due to the vanishing of the \beta-functions above the energy scale of non-locality M. The theory remains finite and perturbative upto infinite energy scales resolving the issue of Landau poles. We move on to the implications of infinite-derivatives in LHC, dark matter, astrophysical and inflationary observables and comment on constraints on the scale M and dimensional transmutation of the scale M. Next we will discuss the strong perturbation limit and show that mass gap that arises due to the interactions in the theory gets diluted in the UV due to the higher-derivatives again reaching a conformal limit in the asymptotic regions both for the scalar field case and Yang-Mills cases. For the Yang-Mills, the gauge theory is confining without fermions and we explore the exact beta-function in the theory. We conclude by summarising the non-locality as a framework UV-completion in particle theory and gravity and the road ahead for its fate with model-building with respect to BSM physics, particularly neutrinos, dark matter and axions.

## Are you are a member of the APS Division of Particles and Fields?

No

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**Session Classification:**  Field and String Theory

**Track Classification:**  Field and String Theory