Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **3306** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Sorkin-Johnston Effective Field Theory

Wednesday, 8 June 2022 14:30 (15 minutes)

Quantum Effective Field Theory (EFT) in curved spacetime is our most advanced and established framework on the path towards a quantum theory of gravity. However, unlike its flat space counterpart, the theory lacks a unique notion of vacuum or energy, which complicates decoupling from ultraviolet (UV) degrees of freedom. Here, we present an EFT quantization procedure based on the Sorkin-Johnston (SJ) vacuum prescription, which sets a unique vacuum state for the UV degrees of freedom based on the infrared (IR) state and geometry. We call this framework SJ-EFT, which achieves *covariance* and *decoupling* at the cost of locality. We then apply this prescription to a system of two coupled oscillators, representing UV and IR modes in a simple toy model for an EFT, and see that the effective action has imaginary non-local contributions (in time), a feature expected for future-included quantum theories. However, the non-local terms in this toy model are exponentially suppressed. More generally, SJ-EFT can provide a playground to explore non-local quantum phenomena that one may expect from a generic theory of quantum gravity.

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Session Classification: W2-2 Fields, Particles, and Strings II (DTP) | Champs, particules et cordes II (DPT)

Track Classification: Technical Sessions / Sessions techniques: Theoretical Physics / Physique théorique (DTP-DPT)