



HARVARD UNIVERSITY  
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Cambridge, MA 02138

# Mathematical Picture Language Seminar



**Wednesday, May 20**

**3:00 p.m. Boston time**

**Jefferson 368**

**Carter Gustin**

Tufts

## Quantum Simulation of Renormalized Quantum Field Theory Hamiltonians

**Abstract:** The most accurate ab-initio calculations of hadronic structure have been achieved through lattice QCD, which is classically computationally expensive. Here we propose a scalable approach to computing hadronic mass spectra and constituent particle distributions using quantum computers. We outline the Renormalization Group Procedure for Effective Particles, a renormalization scheme for quantum field theory Hamiltonians to obtain finite observables. Then we describe the Ladder Operator Block Encoding framework, a key ingredient in efficiently calculating mass spectra of quantum field theories on quantum computers. We show explicit resource estimates for quantum simulation of renormalized Yukawa theory and QCD.

**This talk will be posted two days after the seminar at**

**<https://mathpicture.fas.harvard.edu/seminar> and**

**<https://www.youtube.com/@mathematicalpicturelanguag2715/videos>**