Abstract Submitted
for the 4CS20 Meeting of
The American Physical Society

Scaling Symmetries and Conservation Laws in Fractional Quantum Mechanics[1] JOEL BEEN, Colorado School of Mines — Continuity equations allow us to write local conservation laws that describe the evolution of physically important quantities, such as mass, energy, and momentum, in terms of fluxes. Because of Noether's theorem, we know that conservation laws are fundamentally connected to symmetry invariance; we find that this still holds in fractional systems. Specifically, we show that scaling symmetries combined with the fractional homotopy and correction operators allow the derivation of conservation laws for fractional evolution equations (FEEs). By choosing scaling families that leave the equation invariant, one may derive constants of motion of a FEE by finding their corresponding densities. These densities characterize quasi-continuity equations which have new source term that directly manifests the nonlocality of space fractional derivatives and shows that fractional derivatives force local conservation laws to become global. The quasi-continuity equation may be computed directly from densities using the fractional homotopy and correction operators. We applied these methods to describe probability transport for the space fractional Schrodinger equation which is important in quantum information processing because it describes the non-locality of connected systems.

[1]Funded by NSF

Joel Been
Colorado School of Mines

Date submitted: 25 Sep 2020 Electronic form version 1.4