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Turbulence modeling with fractional derivatives: Derivation from first principles and initial results BRENDEN EPPS, BENOIT CUSHMAN-ROISIN, Thayer School of Engineering, Dartmouth College — Fluid turbulence is an outstanding unsolved problem in classical physics, despite 120+ years of sustained effort. Given this history, we assert that a new mathematical framework is needed to make a transformative breakthrough. This talk offers one such framework, based upon kinetic theory tied to the statistics of turbulent transport. Starting from the Boltzmann equation and Lvy -stable distributions, we derive a turbulence model that expresses the turbulent stresses in the form of a fractional derivative, where the fractional order is tied to the transport behavior of the flow. Initial results are presented herein, for the cases of Couette-Poiseuille flow and 2D boundary layers. Among other results, our model is able to reproduce the logarithmic Law of the Wall in shear turbulence.

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