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Fractional diffusion models of non-local transport DIEGO DEL-CASTILLO-NEGRETE, Oak Ridge National Laboratory — A class of models based on the use of fractional derivative operators is proposed to describe nonlocal transport in magnetically confined plasmas. Fractional operators incorporate in a unified framework non-Fickian transport, non-Markovian (memory) effects, and non-diffusive scaling. Recently, this formalism was applied to study transport in pressure-gradient-driven plasma turbulence [1]. Here we present new results that incorporate finite-size domain effects, boundary conditions, sources, spatially dependent diffusivities, and general asymmetric fractional operators. The model is applied to describe, at a phenomenological level, non-diffusive, non-local transport processes observed in fusion plasmas, including anomalous confinement time scaling, up-hill transport, rapid cold-pulse propagation, and on-axis peaking with off-axis fuelling. [1] D. del-Castillo-Negrete, et al., Phys. Plasmas 11, 3854 (2004); Phys. Rev. Lett. 94,065003 (2005).

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