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Modeling fluid diffusion in cerebral white matter with random walks in complex environments AMICHAI LEVY, GABRIEL CWILICH, SERGEY V. BULDYREV, Department of Physics, Yeshiva University, VAN J. WEEDEN, Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School — Recent studies with diffusion MRI have shown new aspects of geometric order in the brain, including complex path coherence within the cerebral cortex, and organization of cerebral white matter and connectivity across multiple scales. The main assumption of these studies is that water molecules diffuse along myelin sheaths of neuron axons in the white matter and thus the anisotropy of their diffusion tensor observed by MRI can provide information about the direction of the axons connecting different parts of the brain. We model the diffusion of particles confined in the space of between the bundles of cylindrical obstacles representing fibrous structures of various orientations. We have investigated the directional properties of the diffusion, by studying the angular distribution of the end point of the random walks as a function of their length, to understand the scale over which the distribution randomizes. We will show evidence of qualitative change in the behavior of the diffusion for different volume fractions of obstacles. Comparisons with three-dimensional MRI images will be illustrated.

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