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Explicit Proof of the Tube Concept in Polymer Dynamics MAX KOLB, Laboratoire de Chimie, Ecole Normale Supérieure de Lyon, F-69364 Lyon, France, MONIQUE A.V. AXELOS, Biopolymères, Interactions, Assemblages, INRA, F-44300 Nantes, France — The key to the understanding of the dynamics of strongly entangled polymers is the tube concept and the reptation theory. For the lack of a mathematically unambiguous definition these concepts have been supported mostly by indirect evidence, such as crossover phenomena in various time correlation functions. Here we formulate the tube in a mathematically precise way and use this definition to explicitely calculate the predicted properties of reptation tube. Dynamic Monte Carlo simulations show that for strongly entangled polymers the tube does exist with the expected properties, most notably with a finite tube width. At the same time, slower than predicted early time Rouse dynamics and unexpectedly fast disentanglement effects due to finite chain lengths are responsible that the reptation limit can only be seen clearly for polymers whose contour length well exceeds one hundred tube widths. This is an explanation for the generally observed deviations from the asymptotic scaling predictions, both in experiments and in simulations. Effects such as dynamic tube shortening and tube dilation can be explicitely monitored in the present approach.

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