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Statistics of polymer extensions in turbulent channel flow F. BAGHERI, Linne Flow Centre, KTH Mechanics, Sweden, D. MITRA, NORDITA, Sweden, P. PERLEKAR, Eindhoven University of Technology, The Netherlands, L. BRANDT, Linne Flow Centre, KTH Mechanics, Sweden — We carry out direct numerical simulations of three dimensional channel flow with passive polymer additives. We also calculate, for the first time, the PDF of finite-time Lyapunov exponents and from them the corresponding Cramer's function for the channel flow. We study the statistics of polymer elongation for both the Oldroyd-B model (for Wi less than 1) and the FENE model. We use the location of the minima of the Cramer's function to define the Weissenberg number precisely such that we observe coil-stretch transition at Wi approximately 1. For the Oldroyd-B model we find that the PDF of polymer extensions shows power-law behavior irrespective of the wall-normal coordinate of the polymer molecule, but the range of scaling does depend on the wall-normal coordinate. The exponent of this power-law matches with the earlier theoretical results within error bars. In addition we also find the dependence of the PDF of polymer extension on the wall-normal coordinate, v.i.z, the polymer are more stretched near the wall than at the center of the flow. We further study the orientation of the polymers with respect the channel geometry. Our results show that the polymers close to the wall have a very high probability of being oriented along the stream-wise direction of the flow.

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