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Stretching of dumbbells around the Kolmogorov scale in a turbulent shear flow JOERG SCHUMACHER, JAHANSHAH DAVOUDI, Philipps University Marburg (Germany) — We present numerical studies of kinematic stretching of Hookean dumbbells in a turbulent Navier-Stokes flow with a linear mean profile, $\langle u_x \rangle = Sy$. The simulations combine Brownian dynamics of the dumbbells with a high-resolution pseudospectral calculation of the simple shear flow. Scales below the viscous Kolmogorov scale, at which most of the dumbbell dynamics is present, are well resolved. The variation of the constant shear rate S causes a change of the velocity fluctuations on all scales and thus of the intensity of local stretching rate of the advecting flow. The latter is measured by the maximum Lyapunov exponent λ_1 and scales as $\lambda_1 \sim \epsilon^{1/2} \sim S^{3/2}$. As suggested by de Gennes and Tabor, turbulence is found to stop the stretching of Hookean dumbbells when the full nonlinear velocity differences with respect to the bead positions are taken. The growth of anisotropy of stretching with increasing shear rate is confirmed by the joint statistics of the extension R with the azimuthal angle ϕ and the polar angle θ, respectively.

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