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Contravariant and covariant dumbbells in polymer-diluted viscoelastic turbulence KIYOSI HORIUTI, SHOHEI TAKEU, Tokyo Institute of Technology — We carried out numerical study to reveal the mechanism of drag reduction (DR) in polymer-diluted flows. The polymer chains are modeled as elastic dumbbells. Our aim is to elucidate the effect of non-affinity in the motion of dumbbells on DR, in which their motions do not precisely correspond to macroscopically-imposed deformation. We conduct analysis in forced homogeneous isotropic turbulence by connecting a macroscopic description (DNS) with a mesoscopic Brownian dynamics of dumbbells (BDS). The dumbbell connector vector is convected as either contravariant or covariant vectors. Contravariant dumbbells orient in the stretching direction of the strain and elasticity is incurred on the tubular structures. Covariant dumbbells orient in the direction which maximizes the stretching by the solvent deformation and direct outward perpendicularly on the planar structures. They exert an extra tension on vortex sheet, which leads to attenuation of energy cascade, resulting in a larger DR than in contravariant dumbbells. In the mixture of contravariant and covariant dumbbells, DR is intermediate between those caused in individually released cases. The two dumbbells form a unit in which contravariant dumbbell is transversely aligned with the covariant dumbbell.

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