Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Orientation of contravariant and covariant polymers and associated energy transfer in elasto-inertial turbulence KIYOSI HORIUTI, AOI SUZUKI, Tokyo Institute of Technology, Japan — It is generally assumed that the polymers in viscoelastic turbulence are advected affinely with the macroscopically-imposed deformation, while de Gennes (1986) hypothesized that stretched polymers may exhibit rigidity. We conduct assessment on this hypothesis in homogeneous isotropic turbulence by connecting mesoscopic Brownian description of elastic dumbbells to macroscopic DNS. The dumbbells are advected either affinely (contravariant) or non-affinely (covariant). We consider the elasto-inertial regime (Valente et al. 2014). Using the approximate solution of the constitutive equation for the polymer stress, we show that when the dumbbells are highly stretched, $-S_{ik}S_{kl}S_{li}$ term (S_{ij} is strain-rate tensor) governs the transfer of solvent energy either to dissipation or to the elastic energy stored in the polymers. In the contravariant polymer, the elastic energy production term $P_e < 0$ and the dissipation production term $P_\varepsilon > 0$. The elastic energy is transferred backwardly into the solvent and dissipation is enhanced. In the covariant polymer, $P_e > 0$ and $P_\varepsilon > 0$. When the dumbbells are aligned with one of eigenvectors of S_{ij}, P_e predominates P_ε, and marked reduction of drag is achieved.

Kiyosi Horiuti
Tokyo Institute of Technology

Date submitted: 31 Jul 2016 Electronic form version 1.4