Rotational dynamics of anisotropic particles in turbulence

Greg Voth

Department of Physics, Wesleyan University

The rotational dynamics of anisotropic particles advected in a turbulent fluid flow are important in many geophysical flows, particularly icy clouds. Particle rotations are controlled by small scale properties of turbulence that are nearly universal, and so provide a rich system where experiments can be directly compared with theory and simulations. We report the first three-dimensional experimental measurements of the orientation dynamics of rod-like particles as they are advected in a turbulent fluid flow. We also present numerical simulations that show good agreement with the experiments and allow extension to a wide range of particle shapes. Anisotropic tracer particles preferentially sample the flow since their orientations become correlated with the velocity gradient tensor. The rotation rate is heavily influenced by this preferential alignment, and the alignment depends strongly on particle shape.

In collaboration with Shima Parsa, Department of Physics, Wesleyan University, Middletown, Connecticut 06459, USA - Enrico Calzavarini , Laboratoire de Mecanique de Lille CNRS/UMR 8107, Universite Lille 1, 59650 Villeneuve d'Ascq, France - Federico Toschi, Department of Physics, and Dept. of Mathematics & Computer Science, Eindhoven University of Technology, 5600 MB Eindhoven, The Netherlands