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Measurements of alignment and rotation of anisotropic particles by turbulent fluid flow

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ABSTRACT:

Non-spherical particles in turbulent flows are important in a wide range of problems including ice crystals in clouds, fibers in paper-making, marine plankton, and additives for turbulent drag reduction. We have recently developed experimental methods for precise tracking of the position and orientation of non-spherical particles in intense 3D turbulence. Using 3D printed particles, we can fabricate a wide range of shapes and explore how particle orientation and rotation are affected by particle shape. We find particles are strongly aligned by the turbulence. A simple picture in which particles are aligned by the fluid stretching they experience explains many of the key observations about how particles align and rotate. This same picture sheds new light on some old problems about how vorticity aligns with the strain rate tensor in turbulent flows. It has also allowed us to create a fascinating particle shape which we call a chiral dipole that shows a preferential rotation direction in isotropic turbulent flow.

BIOGRAPHY:

Greg Voth is professor of physics at Wesleyan University, CT, USA. From 1994-2000, he was at Cornell University as a PhD student with Eberhard Bodenschatz using strip detectors to measure accelerations in turbulent flows. From 2000-2002, he was a postdoc with Jerry Gollub at Haverford College studying chaotic mixing and granular flows. His group at Wesleyan has focused on development of new tools for measurements in turbulence and turbulent multi-phase flows with recent work measuring rotations of 3D printed particles in turbulence. His research has been recognized by the Andreas Acrivos dissertation award, a Sloan research fellowship, and an NSF faculty early career development award.