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Simultaneous measurements of velocity gradients and rod rotation in 3D turbulence[1] STEFAN KRAMEL, RUI NI, GREG VOTH, Wesleyan University, NICHOLAS OUELLETTE, Yale University — When anisotropic particles are advected in a fluid flow, they rotate in response to the velocity gradient tensor. In 3D turbulent flows, it has previously not been possible to experimentally measure both the motion of anisotropic particles and the velocity gradients simultaneously. We have built a scanning particle tracking velocimetry system in which we illuminate a narrow slab of the volume of interest and scan the illuminated slab through the entire volume, taking sequential images with four high speed cameras. Compared to full volume illumination, this technique enables us to greatly increase the particle concentration because it removes many stereo-matching ambiguities, resulting in a high spatial resolution of the fluid velocity. The trade-off is that the temporal resolution is decreased. We image a low concentration of rods in addition to a high concentration of tracer particles in order to allow extraction of the velocity gradient tensor at the positions of the rods. Rods are found to preferentially align with the direction of the vorticity vector and the intermediate strain-rate eigenvector.

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