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Measurements of Deformations of Fibers and Multi-armed Particles in Fluid Flows[1] BARDIA HEJAZI, LEE WALSH, GREG VOTH, Wesleyan University — We measure the deformation of fibers and particles made of 3 and 4 slender arms. The multi-armed particles are triads (3 symmetric arms in a plane) and tetrads (4 symmetric arms separated by the tetrahedral angle) with rigid arms connected near the center of the particle by a weak rubber joint. For fiber-like particles we used two arms joined at the center by a weak joint. The particles are 2cm in diameter and are 3D printed using a soft rubber-like polymer. We show that multi-armed particles deform at lower order of the aspect ratio of the arm in uniform velocity gradients compared to buckling and bending of fibers. We first examine triads in the turbulent flow of a vertical water tunnel and use 4 high-speed cameras to achieve high precision in measuring particle orientations and arm deformations with an uncertainty of roughly 10^{-4} rad. Multi-arm particles deform more readily than fibers, but the measured deformations in the water tunnel are still small and only slightly larger than our measurement uncertainty. We continue our study by measuring the deformation of fibers and tetrads in a Taylor-Couette apparatus. In these experiments we have higher velocity gradients and use a more viscous fluid than water which allows us to measure larger deformations.

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