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Fully-resolved simulation of particle rotation in a turbulent flow[1]
YAYUN WANG, ADAM J. SIERAKOWSKI, Department of Mechanical Engineering, Johns Hopkins University, ANDREA PROSPERETTI[2], Department of Mechanical Engineering, University of Houston — Some results on the statistics of particle rotation induced by hydrodynamic stresses in a weakly turbulent flow, with a Taylor Reynolds number of about 32, are presented. Two particle Reynolds numbers, 80 and 150, and two different particle moments of inertia, are considered.The particle center is held fixed so that the particle statistics can be compared with those of the fluid vorticity in the absence of the particle. It is found that the particle essentially responds only to vortex structures with a scale comparable to, or larger than, its diameter, thus acting as a low-pass filter for the incident turbulent vorticity. An analysis of the flatness of the PDF's of the angular acceleration and angular velocity shows that the former is mildly non-Gaussian, while the latter is very close to Gaussian. The numerical method used, Physalis, is particularly suited for this problem due to the high accuracy with which the couple is calculated.

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