Abstract Submitted for the DFD15 Meeting of The American Physical Society

Strongly coupled turbulent gas-particle flows in vertical channels¹ RODNEY O. FOX, Department of Chemical and Biological Engineering, Iowa State University, JESSE CAPECELATRO, Coordinated Science Laboratory, University of Illinois at Urbana-Champaign, OLIVIER DESJARDINS, Sibley School of Mechanical and Aerospace Engineering, Cornell University — Eulerian-Lagrangian (EL) simulations of strongly coupled (high mass loading) gas-particle flows in vertical channels are performed with the purpose of exploring the fundamental physics of fully developed, wall-bounded multiphase turbulence. An adaptive spatial filter is developed that accurately decomposes the total granular energy of the particles into correlated and uncorrelated components at each location in the wall-normal direction of the flow. In this manner, Reynolds- and phase-averaged (PA) two-phase turbulence statistics up to second order are reported for both phases and for three values of the PA mean fluid velocity. As expected due to the high mass loading, in all cases the turbulence production due to mean drag dominates production due to mean shear. A multiphase LRR-IP Reynolds-stress turbulence model is developed to predict the turbulent flow statistics as a function of the wall-normal distance. Using a correlation for the vertical drift velocity developed from the EL data, the turbulence model predictions agree satisfactorily with all of one-point EL statistics for the vertical channel flows, as well as for the homogeneous cluster-induced turbulence (CIT) statistics reported previously.

¹Funded by U.S. National Science Foundation (CBET-1437865)

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Date submitted: 31 Jul 2015

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