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Turbulence collapses at a threshold particle loading in a dilute particle-gas suspension VISWANATHAN KUMARAN, Indian Institute of Science, PRADEEP MURAMALLA, Indian Institute of Technology Bombay, ANKIT TYAGI, Indian Institute of Science, PARTHA GOSWAMI, Indian Institute of Technology Bombay, INDIAN INSTITUTE OF SCIENCE COLLABORATION, INDIAN INSTITUTE OF TECHNOLOGY BOMBAY COLLABORATION — In order to examine the turbulence attenuation mechanism in a dilute particle-gas suspension, Direct Numerical Simulations (DNS) of a particle-gas suspension are carried out at a Reynolds number of about 3300 based on the average gas velocity and channel width. The particle Reynolds number based on the particle diameter and the flow velocity is about 42 and the Stokes number is in the range $9.5 - 377$. The particle volume fraction is in the range $0 - 3 \times 10^{-3}$, and the particle mass loading is in the range $0 - 12$. As the volume fraction is increased, a discontinuous reduction in the turbulent velocity fluctuations is observed at a critical volume fraction when the volume fraction is increased by 10^{-4}. There is a reduction, by one order of magnitude, in the mean square fluctuating velocities in all directions, in the Reynolds stress and the turbulent energy production rate. Turbulence attenuation is due to a disruption of the turbulence production mechanism, and not due to the increased dissipation due to the particles. The turbulence collapse phenomenon is universal and is observed for different particle Reynolds numbers and for different models for the drag and lift force models, though the critical volume fraction depends on drag law and force model.

Viswanathan Kumaran
Indian Institute of Science

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