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Measurements of gas temperature in a radiatively heated particle laden turbulent duct flow[1] JI HOON KIM, Stanford Univ, ANDREW BANKO, LAURA VILLAFANE, CHRIS ELKINS, JOHN EATON, Stanford University — Predicting the absorption of radiation through a turbulent, particle laden flow is relevant in atmospheric sciences, turbulent combustion, and in the design of a particle solar receivers. In order to better understand the coupling between the particle phase, the turbulent fluid phase, and the incident radiation, the effects of radiation absorption by disperse inertial particles in a turbulent duct flow was studied experimentally. A fully-developed turbulent duct flow at Reynolds numbers of $O(10^4)$, laden with particles at mass loading ratios of 0.1-0.8, was subject to infrared radiation at varying incident powers. The particle Stokes number based on the Kolmogorov length scale was approximately 12, resulting in a preferentially concentrated particle phase. Measurements of the mean and fluctuating components of the gas phase temperature were made along the wall bisector. Results from mean temperature traverses of the gas phase show that a one-dimensional model can account for much of the mean gas temperature rise. Temperature fluctuations due to preferential concentration are significant and can reach approximately 50% of the mean temperature rise.

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Ji Hoon Kim
Stanford Univ

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