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Toward a Mean Velocity Scaling in Variable Property Particle-Laden Channel Flow[1] JACOB WEST, SANJIVA LELE, Stanford University — In a particle-based solar receiver, dense particles in a turbulent duct flow are radiatively heated, in turn heating the surrounding air. When the particle loading and radiation intensity are large enough, there is significant gas expansion, which sets up an accelerating particle-laden flow with substantial density and viscosity variation. Using a suite of heated, particle-laden channel flow simulations, we characterize the turbulent mass, momentum, and energy transport associated with both the particle and fluid phases, as well as the fluctuating particle number density and transmitted radiation fields. In this complex flow, we find that the Van-Driest transformation is not able to collapse the mean velocity profiles, so we examine alternate scalings. The suite of channel flow simulations were conducted at $Re_\tau \approx 235$, using Lagrangian point particles with moderate Stokes number ($St^+ \approx 7.5$) and particle mass loadings ranging from $10\% - 200\%$. Radiation intensities were chosen so that the ratio of radiative heat flux to the sensible heat of the mixture range from $0.4 - 5.8$.

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Jacob West
Stanford University

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