Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Toward improved heat transfer models for strongly-coupled particle-laden flows[1] SARAH BEETHAM, AARON LATTANZI, JESSE CAPECELATRO, University of Michigan — At sufficient mass loading, gas-solid flows exhibit the development of large-scale, coherent structures (clusters) due to interphase momentum coupling. This behavior is particularly prevalent in the context of circulating fluidized bed reactors, commonly used in the upgrading of feedstock into fuel. In this talk, we demonstrate that heterogeneity caused by particle clustering degrades gas-solid contact and ultimately impedes heat transfer between the phases. Here, we employ high resolution Eulerian-Lagrangian (EL) simulations to quantify the role of clustering on heat transfer. This is accomplished via a two-step approach, in which fully-developed particle clustering is first established under isothermal conditions and then fed into a secondary simulation with prescribed temperature difference between the phases. The secondary simulation develops a thermal length scale in the flow direction as the phases tend to equilibrium, thereby allowing us to quantify the effect of clustering on heat transfer. Additionally, models will be proposed for the unclosed terms appearing in the averaged two-fluid equations that account for solids heterogeneity.

[1]SB gratefully acknowledges support provided by the NSF Graduate Research Fellowship Program and JC would also like to acknowledge the NSF for partial support from award CBET 1846054.

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Date submitted: 23 Jul 2020 Electronic form version 1.4