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Particle-laden turbulence under radiation: toward a novel small-particle solar receiver[1] ARI FRANKEL, ALI MANI, GIANLUCA IACCARINO, Stanford University — In particle-based solar receivers, an array of mirrors focuses sunlight onto a falling curtain of particles in a duct that absorb the light and warm up. The heated particles can be stored for later energy extraction. In this work we consider a design concept in which the particles and air are in a co-flowing configuration, and as the particles are heated they conduct the energy to the surrounding air. The air-particle mixture can then be separated and the heated air used for energy extraction. To assess the viability of this energy concept we have developed a simulation capability to analyze the flow of small particles in a turbulent flow with radiation. The code combines a point-particle direct numerical simulation of the particle-air flow in the low Mach number limit with the discrete ordinates solution of the gray, quasi-steady radiative transfer equation. We will describe the individual solution components and the coupling methodology. We will then demonstrate some results from the replication of a lab-scale experiment of a laser diode array irradiating a transparent channel with a flowing air-particle mixture.

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