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Scale-by-scale measurements of turbulence modification by heavy particles in homogeneous turbulence[1] ROUMAISSA HASSAINI, FILIPPO COLETTI, University of Minnesota — There is substantial evidence that, even at moderate concentrations, particles can significantly alter the turbulent fluctuations, but it is still debated under which conditions these will be excited or inhibited. The issue is complicated by the multiplicity of the influencing parameters, the scarcity of systematic experimental studies, and the difficulty in measuring fluid velocity in a particle-laden flow. We target this question using a facility featuring hundreds of individually controlled jets, in which homogeneous air turbulence with negligible shear and mean flow is generated and laden with microscopic solid particles. We vary the volume fraction by two orders of magnitude and use high-speed laser imaging at multiple resolutions. We combine particle tracking velocimetry (PTV) and particle image velocimetry (PIV) to simultaneously measure the position and trajectory of particles as well as the fluid velocity down to the Kolmogorov scales. We demonstrate the impact of the particles on the turbulent kinetic energy, dissipation rate, and energy spectrum, to an increasing extent with increasing volume fraction. In the considered range of parameters, gravitational settling is found to be a deciding factor as for whether turbulence is increased or reduced at different scales.

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