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Scaling of spectra in grid turbulence with a mean cross-stream temperature gradient CARLA BAHRI, GILAD ARWATZ, MICHAEL E. MUELLER, Princeton University, WILLIAM K. GEORGE, Imperial College London, MARCUS HULTMARK, Princeton University — Scaling of grid turbulence with a constant mean cross-stream temperature gradient is investigated using a combination of theoretical predictions, DNS, and experimental data. Conditions for self-similarity of the governing equations and the scalar spectrum are investigated, which reveals necessary conditions for self-similarity to exist. These conditions provide a theoretical framework for scaling of the temperature spectrum as well as the temperature flux spectrum. One necessary condition, predicted by the theory, is that the characteristic length scale describing the scalar spectrum must vary as $\propto \sqrt{t}$ for a self-similar solution to exist. In order to investigate this, T-NSTAP sensors, specially designed for temperature measurements at high frequencies, were deployed in a heated passive grid turbulence setup together with conventional cold-wires, and complementary DNS calculations were performed to complement and complete the experimental data. These data are used to compare the behavior of different length scales and validate the theoretical predictions.

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