The Reynolds number dependence of classical grid turbulence

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RATION FOR TURBULENCE RESEARCH COLLABORATION — We measured
inertial and dissipation range statistics in the decaying turbulence generated by
a biplanar grid of crossed bars. We did so at Taylor Reynolds numbers between
130 and 1700, reaching higher than any previous study of reasonably homogeneous
and isotropic turbulence. The measurements were made in the Variable Density
Turbulence Tunnel at the Max Planck Institute in Göttingen with both traditional
hot-wire anemometers and the new nano-fabricated NSTAP anemometers devel-
oped at Princeton. We fixed the large-scale conditions of the flow while changing
the Reynolds number only by changing the viscosity of the fluid. To do this, we
used two gases, air and sulfur hexafluoride, and adjusted the pressure of the gases to
between 1 and 15 bar. The data confirm that even when the large-scale conditions
are controlled as the Reynolds number is raised, scaling ranges are not well-defined
unless Extended Self-Similarity is employed.

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