Exploring the Turbulent Dissipation Regime in the VDTT

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An intrinsic feature of turbulence is its scale hierarchy, famously illustrated by Richardson's energy cascade and formalized by Kolmogorov's phenomenological theory in 1941 (K41). One of the key points of K41 is that the smallest scales (below the Kolmogorov length scale, η) are universal for sufficiently turbulent flows, and depending only on the viscosity and the mean dissipation rate. Nevertheless, little is still known about the dynamics at these scales, mainly due to computational and experimental resolution limitations. Previous experiments have been able to achieve spatial resolutions in the vicinity of η, and our goal is to go further. We do this by performing hot-wire experiments in the Göttingen Variable Density Turbulence Tunnel filled with helium, which is approximately 10 times lighter than air. By varying the density of the gas by setting different pressures and temperatures, we are able to obtain Kolmogorov length scales on the order of the millimeter, and Taylor scale Reynolds numbers between 100 and 300. I will summarize our recent experiments focusing on the dissipation regime, and compare them with prior numerical work.

Figure 1 The Variable Density Turbulence Tunnel, where experiments are performed.