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Czech cryogenic fluid dynamics inspired by Russ Donnelly[1]

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Following nearly five years of work along with Russ in Eugene on cryogenic turbulent convection and quantum grid turbulence, two laboratories in Prague and in Brno have been established to continue experimental research in cryogenic fluid dynamics using all three forms of cryogenic 4He - cold helium gas, normal liquid He I and superfluid He - as excellent multi-purpose working fluids. We review some of our investigations of very high Rayleigh number cryogenic thermal convection and classical and quantum turbulence in liquid helium. In particular, we discuss heat transfer efficiency of turbulent Rayleigh-Benard convection and the role of non-Oberbeck-Boussinesq conditions on possible transition to its ultimate regime; our second sound attenuation experiments probing both steady state and decaying coflow, counterflow and pure superflow of He II through channels of square cross-section including the concept of effective kinematic viscosity. We then introduce visualization experiments of classical and quantum flows of liquid helium using micron-size hydogen/deuterium particles and our recent results on transition to quantum turbulence based on the revisited experiments with a torsionally oscillating disc.

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