Holography and Turbulence

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Abstract:

Holographic duality provides a systematic new approach to studying quantum turbulence in which the dynamics of the quantum liquid are encoded in the dynamics of a black hole horizon in classical gravity. This talk will introduce the basic ideas of holographic duality and then use the gravitational description to numerically construct turbulent flows in a holographic superfluid in two spatial dimensions. The resulting superfluid kinetic energy spectrum obeys the Kolmogorov -5/3 scaling law in the regimes studied. We trace this scaling to a direct energy cascade by injecting energy at long wavelengths and watching it flow to a short-distance scale set by the vortex core size, where dissipation by vortex annihilation and vortex drag becomes efficient. The power of the holographic description lies in the way dissipation is implemented: in the holographic dual, all dynamics are perfectly Lagrangian; dissipation derives from the fact that fluctuations which fall behind the black hole horizon are effectively lost forever. The horizon thus gives us a precise local probe of energy dissipation.

References:

1. A. Adams, P. Chesler, H. Liu, http://arxiv.org/abs/1212.0281
2. http://turbulent.lns.mit.edu/Superfluid/