Physics Colloquium

Michigan Technological University

Thursday, February 16, 2012
at 4:00 pm
Room 139 Fisher

Explorations into the Inertial and Integral Scales of Homogeneous Axisymmetric Turbulence

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Abstract: In isotropic turbulence, a single scalar function fully describes the velocity correlation tensor. The characteristic scales of this correlation function, the Taylor scale and the integral scale, then have an unambiguous interpretation. However, almost all turbulence of practical importance is anisotropic at the largest scales. Here, we focus on the integral scale of the correlation function, which measures the distance over which turbulent fluctuations are correlated. We examine theoretically and experimentally the relationships between correlation functions measured in two directions in anisotropic turbulence that is locally isotropic. We describe a model founded on the isotropy and scale-invariance of the structure functions at small scales, and the similarity of the correlation functions over all scales. The model captures the dominant features of the experimental data. The finding may be of consequence where the integral scale is important. For example, an aircraft flying through the atmosphere, where fluctuations at the large scales are typically anisotropic, might encounter different forces and experience different cooling rates depending on whether it traveled horizontally or vertically.

Biography: Kelken Chang received his Ph.D in Physics from Cornell University in 2011. His dissertation work dealt with experimental generation and theoretical modeling of homogeneous anisotropic turbulent flows, under the supervision of Professor Eberhard Bodenschatz at the Max Planck Institute for Dynamics and Self-Organization in Goettingen, Germany. In October 2011, he joined Professor Raymond Shaw's group as a postdoctoral research associate at Michigan Tech and worked on turbulent Rayleigh-Benard convection.

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