Weekly CEAFM Seminar: Spring 2018

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Date: **Friday, February 2, 2018**

Time: 3:00 PM (New Time)

Location: Gilman Hall # 132

Speaker: **Prof. William K. George** (Imperial College of London)

Title: ***"Reconsidering K41:***
The Kolmogorov Theory for Small Scale Turbulence"

Abstract

The ideas originally put forth by Kolmogorov in 1941 dominate modern turbulence. It was G.K. Batchelor who introduced them to the western world after WW II and who laid out the multi-length scale view of turbulence that today underlies almost all turbulence theories and experimental interpretations, including turbulence modelling. It was the book by Tennekes and Lumley in 1972 which popularized them. So well-accepted are these ideas now that many newer books don't even bother try to justify what we collectively refer to as K41, some simply saying they have been established by experiment.

Most think the first experimental 'proof' was the Grant et al. in the Vancouver Sound tidal channel. But in fact it was by M.M. Gibson in a jet in the Maryland Hall laboratory of S. Corrsin (Nature 1961) at the Johns Hopkins University. (Gibson to this day does not understand why Corrsin did not co-author the paper, but at that time Corrsin often seemed to leave his name off his students' work usually to their detriment.)

Interestingly the experiments cited in support of K41 are almost entirely experiments in statistically stationary turbulence, so the K41 zeroth hypothesis of local equilibrium of the small scales is satisfied by default. Statistically non-stationary experiments are more often labelled as 'anomalous', and alternative theories explaining them ignored. But the inconsistencies mount. Oran in her Otto Laporte lecture at the APS/DFD meeting several years ago detailed a number of high Reynolds number simulations that were 'non-Kolmogorov' and the experiments of the Vassilicos group at Imperial College using fractal generators have been similarly problematical.

This seminar will examine a number of Kolmogorov's hypotheses and inferences by others from them. Receiving particular attention will by the idea of a universal equilibrium range (Batchelor chap 5), the zeroth law of turbulence ($\varepsilon \propto u^3/L$), whether $\eta K = (\nu^3/\varepsilon)^{1/4}$ is truly the smallest length scale, and finally whether there is ever 'local equilibrium' in a statistically non-stationary flow. Some alternative ideas will be proposed.