Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Flexible Beams in Turbulent Boundary Layers for Piezoelectric Energy Harvesting[1] HUSEYIN DOGUS AKAYDIN, NIELL ELVIN, YIANNIS ANDREOPOULOS, The City College of The City University of New York — Thin flexible cantilever beams with patches of piezoelectric materials or surrogates with strain gages attached have been placed inside turbulent boundary layers to search for the maximum energy output. A turbulent boundary layer (TBL) carries mechanical energy distributed over a range of temporal and spatial scales and their interaction with the immersed piezoelectric beams results in a strain field which generates the electrical charge. This energy harvesting method can be used for developing self-powered flow sensors. In the present experimental work TBLs with Re_θ between 1500 and 7700 were configured in a large scale wind tunnel. The orientation of the beam relative to the incoming flow and its distance to the wall was found to be critical parameters affecting the energy output. "Power maps" generated by testing a beam in TBLs at different free stream velocities and wall distances will be presented. Vibration amplitudes and frequencies at several principal orientations will be compared. The effect of yaw angle, pitch angle, length and natural frequency of the beam will be examined. The role of instantaneous pressure fluctuations and large-scale TBL structures in this rather complex fluid-structure interaction will be discussed in interpreting the electrical output results.

[1]Sponsored by NSF Grant: CBET #1033117.

Huseyin Dogus Akaydin
The City College of The City University of New York

Date submitted: 07 Aug 2012 Electronic form version 1.4