Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Statistical correction on LIFPA measurement[1] WEI ZHAO, University of South Carolina, FANG YANG, Carnegie Mellon University, GUIREN WANG, University of South Carolina — Laser Induced Fluorescence Photobleaching Anemometer (LIFPA) has been applied for velocity fluctuation measurement in micro electrokinetic turbulence in microfluidics. However, due to the intrinsic drawback of LIFPA, i.e. single-point and 1D measurement, LIFPA cannot distinguish velocity components on each directions and should rely on Taylor's Hypothesis to get spatial series of velocity. Hence, the measurement will have error compared to the actual flow field. Here, the statistical errors of LIFPA measurement, due to 3D flows and Taylor's Hypothesis, are theoretically estimated. We derived the correction formulas based on the work of Ewing and George (2000) and estimated the correction factor of LIFPA in the direction parallel to laser beam. The influences of directional correction factors on both LIFPA and single-wire Hot-Wire Anemometer (HWA) measurements are also investigated and compared. Later, first derivation variance (FDV) of velocity fluctuation by both Taylor's Hypothesis and Local Taylor's Hypothesis (Pinton and Labbe 1994) are compared in microfluidics. It is found the error due to Taylor's Hypothesis is negligible. And the 3D flow influence on the FDV of velocity fluctuations in LIFPA is smaller than in HWA measurement.

[1]The work was supported by NSF under grant no. CAREER CBET-0954977, MRI CBET-1040227, and NSF EPSCoR award, EPS-1317771 respectively.

Guiren Wang
University of South Carolina

Date submitted: 06 Aug 2014 Electronic form version 1.4