Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

**Effects of the fluid flows on enzymatic chemical oscillations** OLEG SHKLYAEV, VICTOR YASHIN, ANNA BALAZS, University of Pittsburgh — Chemical oscillations are ubiquitous in nature and have a variety of promising applications. Usually, oscillating chemical systems are analyzed within the context of a reaction-diffusion framework. Here, we examine how fluid flows carrying the reactants can be utilized to modulate the negative feedback loops and time delays that promote chemical oscillations. We consider a model where a chemical reaction network involves two species, X and Y, which undergo transformations catalyzed by respective enzymes immobilized at the bottom wall of a fluid-filled microchamber. The reactions with the enzymes provide a negative feedback in the chemically oscillating system. In particular, the first enzyme, localized on the first patch, promotes production of chemical X, while the second enzyme, immobilized on the second patch, promotes production of chemical Y, which inhibits the production of chemical X. The separation distance between the enzyme-coated patches sets the time delay required for the transportation of X and Y. The chemical transport is significantly enhanced if convective fluxes accompany the diffusive ones. Therefore, the parameter region where oscillations are present is modified. The findings provide guidance to designing micro-scale chemical reactors with improved functionalities.

Oleg Shklyaev
University of Pittsburgh

Date submitted: 31 Jul 2017 Electronic form version 1.4