Abstract Submitted
for the DPP19 Meeting of
The American Physical Society

Constraining a Uranium Reaction Mechanism Using Stochastic Optimization and Plasma Flow Reactor Measurements[1] MIKHAIL FINKO, DAVIDE CURRELI, University of Illinois at Urbana-Champaign, MAGDI AZER, Illinois Applied Research Institute, BATIKAN KOROGLU, TIMOTHY ROSE, DAVID WEISZ, JONATHAN CROWHURST, HARRY RADOUSKY, Lawrence Livermore National Laboratory — The chemical processes governing the formation of nuclear debris in nuclear fireballs has been the subject of great interest for decades. However, despite years of study, no experimentally validated reaction mechanism has yet been developed for the uranium plasma-chemical system. In this work, we utilize emission measurements from a uranium plasma flow reactor to constrain the reaction rates of a previously unverified uranium reaction mechanism by performing stochastic optimization of the problem parameter space. The plasma flow reactor is particularly suitable for this task due to its inherent correlation between residence time and axial distance. This correlation enables the reactor to be approximated using a 0D kinetic model, drastically reducing the computational complexity of reaction mechanism calibration. This reduction in model complexity allows for a robust optimization of the dozens of uranium reaction channels over the entire parameter space, producing the first experimentally constrained uranium reaction mechanism.

[1]This project was sponsored by the DoD, Defense Threat Reduction Agency, grant HDTRA1-16- 1-0020. This work was performed in part under the auspices of the U.S. DoE by Lawrence Livermore National Laboratory under Contract DE-AC5207NA27344.

Mikhail Finko
University of Illinois at Urbana-Champaign

Date submitted: 03 Jul 2019 Electronic form version 1.4