Abstract Submitted
for the APR17 Meeting of
The American Physical Society

The generalized Onsager model and DSMC simulations of high-speed rotating flows with product and waste baffles DR. SAHADEV PRADHAN, Department of Chemical Engineering, Indian Institute of Science, Bangalore-560 012, India. — The generalized Onsager model for the radial boundary layer and of the generalized Carrier-Maslen model for the axial boundary layer in a high-speed rotating cylinder ((S. Pradhan & V. Kumaran, J. Fluid Mech., 2011, vol. 686, pp. 109-159); (V. Kumaran & S. Pradhan, J. Fluid Mech., 2014, vol. 753, pp. 307-359)), are extended to a multiply connected domain, created by the product and waste baffles. For a single component gas, the analytical solutions are obtained for the sixth-order generalized Onsager equations for the master potential, and for the fourth-order generalized Carrier-Maslen equation for the velocity potential. In both cases, the equations are linearized in the perturbation to the base flow, which is a solid-body rotation. An explicit expression for the baffle stream function is obtained using the boundary layer solutions. These solutions are compared with direct simulation Monte Carlo (DSMC) simulations and found excellent agreement between the analysis and simulations, to within 15%, provided the wall-slip in both the flow velocity and temperature are incorporated in the analytical solutions.

Dr. Sahadev Pradhan
Department of Chemical Engineering, Indian Institute of Science, Bangalore- 560 012, India.

Date submitted: 01 Oct 2016 Electronic form version 1.4