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The Generalized Onsager Model and DSMC Simulations of High-Speed Rotating Flow with Swirling Feed 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 at the end-caps 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 incorporate the angular momentum of the feed gas for a swirling feed for single component gas and binary gas mixture. 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. The equations are restricted to the limit of high Reynolds number and (length/radius) ratio, but there is no limitation on the stratification parameter. The linear operators in the generalized Onsager and generalized Carrier-Maslen equations with swirling feed are still self-adjoint, and so the eigenfunctions form a complete orthogonal basis set. The analytical solutions are compared with direct simulation Monte Carlo (DSMC) simulations. The comparison reveals that the boundary conditions in the simulations and analysis have to be matched with care. When these precautions are taken, there is excellent agreement between analysis and simulations, to within 15%.

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