Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Enhanced convective transport from an isothermal circular cylinder with hydrodynamic slip boundary condition NIDHIL MOHAMED ABDUL REHMAN, RATNESH SHUKLA, Indian Institute of Science, Bangalore — Introduction of a slip in the tangential surface velocity suppresses vorticity production in a typical bluff body flow while simultaneously enhancing vorticity convection downstream and into the wake region. As a result the flow characteristics are altered significantly and the hydrodynamic loads are reduced considerably. In this work we investigate the effect of the hydrodynamic slip on the convective heat transfer from the surface of a heated isothermal circular cylinder placed in the uniform cross flow of a viscous incompressible fluid through numerical simulations. We find that for fixed Reynolds and Prandtl numbers an increase in the Knudsen number or equivalently the hydrodynamic slip length results in a substantial augmentation of the heat transfer coefficient. We establish the dependence of the Nusselt number on the Knudsen, Reynolds and Prandtl numbers over a wide range of these parameters. We find that for given Reynolds and Prandtl numbers the Nusselt number undergoes a sharp transition between the low and high asymptotic limits that correspond to zero (no-slip) and infinite (shear-free perfect slip) Knudsen numbers. We establish that the high asymptotic limit corresponding to the shear-free perfect slip cylinder boundary scales as $Nu \sim Re^{0.5} Pr^{0.5}$.

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Date submitted: 01 Aug 2015 Electronic form version 1.4