**DSMC simulations of leading edge flat-plate boundary layer flows
at high Mach number** DR. SAHADEV PRADHAN, Department of Chemical Engineering, Indian Institute of Science, Bangalore- 560 012, India. — The flow over
a 2D leading-edge flat plate is studied at Mach number $Ma = (U_{inf}/\sqrt{k_B T_{inf}/m})$ in the range $<Ma <10$, and at Reynolds number number $Re = (L_T U_{inf} rho_{inf})/ mu_{inf}$ equal to 10 using two-dimensional (2D) direct simulation Monte
Carlo (DSMC) simulations to understand the flow phenomena of the leading-edge
flat plate boundary layer at high Mach number. Here, L_T is the characteristic dimension, U_{inf} and T_{inf} are the free stream velocity and temperature, rho_{inf} is the
free stream density, m is the molecular mass, mu_{inf} is the molecular viscosity based
on the free stream temperature T_{inf}, and k_B is the Boltzmann constant. The variation of streamwise velocity, temperature, number-density, and mean free path along
the wall normal direction away from the plate surface is studied. The qualitative
nature of the streamwise velocity at high Mach number is similar to those in the
incompressible limit (parabolic profile). However, there are important differences.
The amplitudes of the streamwise velocity increase as the Mach number increases
and turned into a more flatter profile near the wall. There is significant velocity
and temperature slip ((Pradhan and Kumaran, J. Fluid Mech-2011); (Kumaran and
Pradhan, J. Fluid Mech-2014)) at the surface of the plate, and the slip increases as
the Mach number is increased. It is interesting to note that for the highest Mach
numbers considered here, the streamwise velocity at the wall exceeds the sound
speed, and the flow is supersonic throughout the flow domain.

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