Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Head-on Quenching of a Non-premixed Flame by an Inert Wall
NIDHEESH BHARADWAJ, CYRUS MADNIA, University at Buffalo (SUNY) —
The quenching characteristics of a nonpremixed flame interacting with a wall have been studied via DNS. The vortex ring is generated by a brief discharge of cold methane fuel into hot air. The ignition of the vortex ring is controlled by adjusting the air temperature. The methane combustion has been modeled using detailed kinetic model GRI3.0. The flame is propelled in the axial direction by the ring induced velocity, and interacts head on with a chemically inert isothermal wall. Two wall conditions are examined, one with and one without a thermal boundary layer. The strength of the flame prior to its interaction with the wall is controlled by varying the distance of the wall from the inlet boundary. The effect of the wall on the heat release rate and the structure of the flame is studied. As the flame approaches the wall the magnitudes of vortex ring induced strain rates acting on the flame increase and the maximum wall heat flux occurs on the centerline. It is found that the increase in the strain rates affects the flame power significantly if there is no thermal boundary layer at the wall. Nondimensional wall heat flux, Peclet number, flame structure and near wall reaction mechanisms have been investigated for front flame quenching. For runs with thermal boundary layer, heat released from HO_2 reactions is found to be the major contributor to heat flux at the wall.

Cyrus Madnia
University at Buffalo (SUNY)

Date submitted: 01 Sep 2005 Electronic form version 1.4