Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Large-eddy simulation of swirling reacting flows MARCEL ILIE, University of California San Diego — Turbulent, swirling flows are encountered frequently in various chemical engineering processes. In combustion processes swirling flames are of interest due to the fact that provide enhanced mixing and reduce the pollutants formation. The challenge in understanding turbulent swirling flows stems mainly from the complexity of the flow field which is subject to vortex breakdown, recirculation and flow instability. In general the flow instabilities arise at high swirl numbers and can be used to control the performance of combustors. In the present study a large-eddy simulation (LES) approach with Smagorinsky eddy viscosity subgrid scale model is used to predict the swirling flame. The conserved scalar mixture fraction-based thermo-chemical variables are described using the steady laminar flamelet model. The present study shows that LES together with a laminar flamelet model provides a good prediction of the structure of turbulent swirling flames. Also LES captured very well the complex flame structures involving vortex breakdown which leads to swirl-induced recirculation zones, flow instability, and the occurrence of localized extinction. Also, the present study shows that the formation of an elongated recirculation (bluff-body stabilized) zone is strongly dependent on the swirl number and the ratio of momentum in the swirling annulus and central fuel jet.

Marcel Ilie
University of California San Diego

Date submitted: 15 Dec 2008 Electronic form version 1.4