Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Simulation of Flows and Heat Transfer in a Supercritical Carbon Dioxide Filled Enclosure BAKHTIER FAROUK, ZHIHENG LEI, Drexel University, ELAINE S. ORAN, NRL — Supercritical fluids are characterized by high compressibilities and large densities. In addition to conduction and convection, thermomechanical conversion of acoustic energy to heat is significant in fluids near their critical point. Supercritical fluids also exhibit a number of specific interesting properties such as non-zero bulk viscosity, low viscosity and low thermal diffusivity - which make them quite different from gases and liquids. In this paper, thermally generated wave induced convection in a supercritical carbon dioxide filled square enclosure is investigated. The top and bottom walls of the enclosure are thermally insulated and the left and right walls are heated (either rapidly or gradually) differentially. Rapid heating causes stronger acoustic waves within the enclosure that enhance mixing and homogenization. The role of the thermally induced acoustic waves in enhancing mixing, and heat transfer in supercritical fluids is examined. The time-dependent flow and temperature fields within the enclosure are obtained by solving a fully compressible form of the Navier-Stokes equations. A flux-corrected transport algorithm is used to discretize the convective terms while the central difference scheme is used to discretize the viscous and the conduction terms. The state relation $p = f(\rho,T)$, the internal energy $i = f(\rho,T)$ and the speed of sound $c = f(\rho,T)$ in supercritical carbon dioxide are obtained from the NIST Standard Reference Database 12. Acknowledgment: NASA grants: NNC04AA22A and NNC04IA09I.

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Date submitted: 03 Aug 2006 Electronic form version 1.4