Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Destabilization of a liquid-gas interface at supercritical pressure[1]
GUILHEM LACAZE, ANTHONY RUIZ, JOSEPH OEFELEIN, Sandia National Laboratories — To improve efficiency, advanced propulsion systems are operated at high pressure. In many cases the pressure exceeds the critical pressure of the fuel and oxidizer, which leads to radical changes in mixing. Even though this transition is understood theoretically, many important questions remain. One is the impact of the strong interfacial density-gradient on destabilization of the shear layer. At these conditions, experimental imaging techniques fail to provide the resolution required for detailed analysis of the flow structures. In this work, we use Large Eddy Simulation to study these structures in a three-dimensional turbulent mixing layer at a Reynolds number of 500,000. A splitter separates streams of liquid oxygen and gaseous hydrogen. In the last decade, similar conditions have been studied using two-dimensional computational domains. This work is the first attempt to simulate a three-dimensional flow at these conditions with this level of resolution. Simulation results provide new insights on the destabilization processes of the liquid interface. Dynamic instabilities leading to turbulence are enhanced by inhomogeneities in density through baroclinic effects and high shear in the interfacial region.

[1]The U. S. Department of Energy, Office of Basic Energy Sciences, Division of Chemical Sciences, Geosciences, and Biosciences supported this work.

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Date submitted: 23 Jul 2014 Electronic form version 1.4