Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Effects of Annular and Rectangular Confinement on the Hydrodynamics of Reacting, Swirling Jets BENJAMIN EMERSON, TIM LIEUWEN, Georgia Tech — In gas turbine combustors, flames are stabilized in the shear layers of swirling jets. In such devices, the flame's dynamics and its unsteady heat release are strongly governed by the fluid dynamics of the swirling jet flow. This unsteady heat release can couple with an acoustic mode of the combustor to cause a troublesome self-excited oscillation known as combustion instability. This coupling often occurs through the fluid dynamics, where the flame is dynamically wrinkled by acoustically excited vortical structures. This study uses linear stability analysis to study the effects of confinement on the fluid dynamics of reacting, swirling jets. Previous studies have explored confinement effects of an outer cylindrical wall. This study investigates other types of confinement. The analysis compares the classical arrangement, with flow through an outer cylindrical wall, to two other arrangements: flows through annular or rectangular confinements. The analysis shows that these confinement changes can have significant impacts on the instability growth rates, frequencies, and mode shapes. For example, changing a cylindrical confinement to a rectangular confinement tends to alter the hydrodynamic mode shape by straightening the nodal lines in the hydrodynamic velocity field.

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Date submitted: 31 Jul 2015 Electronic form version 1.4