Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Hydrodynamic instabilities in swirl-stabilized combustion: experimental assessment and theoretical modelling[1] KILIAN OBERLEITHNER, Technical University Berlin, MICHAEL STÖHR, German Aerospace Center (DLR), Stuttgart, Germany, STEFFEN TERHAAR, OLIVER PASCHEREIT, Technical University Berlin — In gas turbine industry, it is common practice to implement swirling jets and associated vortex breakdown to stabilize the flame and to enhance turbulent mixing. The flow field of such swirl-stabilized combustors features a wide range of flow instabilities that promote the formation of large-scale flow structure. This talk presents recent experimental studies at the Technical University Berlin and the German Aerospace Center (DLR) targeting the impact of these instabilities on the combustion performance. Particular focus is placed on two types of instability: (i) a self-excited helical instability, typically known as the precessing vortex core, which crucially affects mixing and flame anchoring; (ii) the axisymmetric Kelvin-Helmholtz instability, which crucially affects the flame dynamics at thermo-acoustic oscillations. All experimental observations are correlated with analytic flow models utilizing linear hydrodynamic stability theory. This mathematical framework reveals the driving mechanisms that lead to the formation, saturation, and suppression of large-scale flow structures and how these mechanisms interact with the combustion process.

[1]The authors kindly acknowledge the financial support of the German Research Foundation (DFG) and the Research Association for Combustion Engines (FVV).

Kilian Oberleithner
Technical University Berlin

Date submitted: 31 Jul 2014 Electronic form version 1.4