Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Role of intrinsic flame instability in the excitation of combustion chamber instability V'YACHESLAV AKKERMAN, CHUNG K. LAW, Princeton University — While considerable progress was made on understanding the various modes of flame instability at the fundamental level, and substantial empirical information and phenomenological descriptions was also accumulated on combustion instability within combustion chambers such as those of rocket engines, few attempts were made to explore the possible macro-scale excitation of the latter through the micro-scale manifestation of the former. Here we present an initial attempt towards identifying such a possibility and the associated coupling mechanisms. We shall incorporate the flame parameters into the classical theories of liquid-propellant rocket engines, and then implement the rocket dynamics into the analyses of premixed and diffusion flame segments. The analyses are conducted for the various instability modes, including the diffusional-thermal, Darrieus-Landau, and Rayleigh-Taylor (body-force) instabilities for premixed flames, and the Kelvin-Helmholtz and body-force instabilities for diffusion flames. The role of chamber-generated sound on stabilizing the inherent flame instabilities and triggering the parametric instability is also considered.

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Date submitted: 10 Aug 2011 Electronic form version 1.4