Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Exact results and field-theoretic bounds for randomly advected propagating fronts, and implications for turbulent combustion[1] JACKSON R. MAYO, ALAN R. KERSTEIN, Sandia National Laboratories, Livermore, CA — One of the authors previously conjectured that the wrinkling of propagating fronts by weak random advection increases the bulk propagation rate (turbulent burning velocity) in proportion to the 4/3 power of the advection strength. An exact derivation of this scaling is reported. The analysis shows that the coefficient of this scaling is equal to the energy density of a lower-dimensional Burgers fluid with a white-in-time forcing whose spatial structure is expressed in terms of the spatial autocorrelation of the flow that advects the front. The replica method of field theory has been used to derive an upper bound on the coefficient as a function of the spatial autocorrelation. High precision numerics show that the bound is usefully sharp. Implications for strongly advected fronts (e.g., turbulent flames) are noted.

[1]Sponsored by the US DOE, Ofc. of Basic Energy Sciences, Div. of Chemical Sciences, Geosciences and Biosciences. Sandia is a multiprogram laboratory operated by Sandia Corp., a Lockheed Martin Company, for the US DOE under contract DE-AC04-94AL85000.

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Date submitted: 31 Jul 2007 Electronic form version 1.4