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Turbulent propagation of premixed flames: the effects of thermal expansion and integral scale FRANCESCO CRETA, University of Rome La Sapienza, MOSHE MATALON, University of Illinois at Urbana-Champaign — We study the propagation of a premixed flame in a turbulent environment within the wrinkled flamelet regime. We adopt a hybrid Navier-Stokes/front capturing technique whereby the flame is assimilated to a surface of vanishing thickness separating burnt and unburned regions and subjected to an incident two-dimensional turbulent flow. Among the many observable phenomena, two separate effects on the turbulent propagation speed are investigated, namely that of the thermal expansion (unburned to burnt gas density ratio) and of turbulence integral scale. Turbulent speed is observed to increase and later plateau as thermal expansion increases, this being due to an increase in flame brush thickness with no perceivable curvature variation. The effect of the integral scale of the incoming turbulent field reveals the existence of a particular intermediate value of such scale at which the flame experiences a maximum propagation speed. The same qualitative tendencies are confirmed by a weakly nonlinear Michelson Sivashinsky (MS) model forced with spatially correlated noise that mimics the incoming turbulent flow. Both effects can be combined, together with the effect of turbulence intensity, in a general scaling law for the turbulent propagation speed valid for hydrodynamically stable flames.

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