Turbulence-induced Deflagration-to-Detonation Transition

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The main scientific goal of this project is to gain new insights into the mechanisms of turbulence-induced deflagration-to-detonation transition (tDDT) that are still not clearly understood. We will use high-resolution reactive CDF simulations to model the evolution of initially laminar flames in a developing turbulent flow and analyze the results to identify the conditions that lead to tDDT. A better understanding of tDDT mechanisms is important for the development of detonation-based propulsion systems, where tDDT should be promoted, as well as for deflagration-based propulsion systems where tDDT should be prevented. This research also has significance in other fields, including the prevention and mitigation of accidental industrial gas explosions, and the modeling of Type Ia supernova explosions in astrophysics.