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Ignition and Extinction Dynamics in Turbulent Nonpremixed Cool Flames ALEX G. NOVOSELOV, MICHAEL E. MUELLER, Princeton Univ — Cool flames result from the coupling of low-temperature chemistry with molecular transport. These flames have been experimentally and computationally observed under laminar flow conditions but have not been isolated under turbulent flow conditions. In this work, a skeletal n-heptane chemical mechanism including low-temperature chemistry is used to conduct detailed numerical simulations of nonpremixed cool flames subjected to unsteady, two-dimensional flow initialized from a plane of isotropic turbulence. Like conventional hot flames, under high Damkhler number conditions, these cool flames are found to be adequately described with a steady flamelet model. However, unlike conventional hot flames, cool flames exhibit two limit phenomena: extinction to a non-burning state at large scalar dissipation rate and ignition to a conventional hot flame at small scalar dissipation rate. The latter phenomenon allows for the possibility of ignition and re-extinction in addition to well-known extinction and re-ignition. The detailed simulation databases are analyzed to determine the relative contributions of nonpremixed (aligned with mixture fraction gradient) and premixed (normal to mixture fraction gradient) processes to this ignition and re-extinction phenomenon.

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