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Direct Numerical Simulation of Multi-Injection Ignition in Low-Temperature Compression Ignition Environments[1] MARTIN RIETH, Sandia National Laboratories, MARC DAY, Lawrence Berkeley National Laboratory, SHUBHANGI BANSUDE, TIANFENG LU, University of Connecticut, CHOLBUM KWEON, JACOB TEMME, Army Research Laboratory, JACQUELINE CHEN, Sandia National Laboratories — Multi-injection strategies in combustion engines are known to be able to reduce pollutant emissions and improve ignition reliability. The latter is especially important in advanced compression ignition engine concepts relying on low-temperature high-efficiency operation or for engines operating at extreme high-altitude conditions. Under low-temperature conditions, fluid from the first injection does not ignite prior to mixing with fluid from the second injection, but provides pre-ignition chemical species and potentially a moderately elevated temperature. Fluid from the second injection mixes with this partially reacted mixture and its ignition is accelerated. However, the exact details of how pre-ignition species accelerate the ignition of the fluid from the second injection are not known. We will explore this with Direct Numerical Simulations (DNS) and, in particular, we will focus on understanding how particular chemical species and reaction pathways are responsible for accelerated ignition, identify the combustion modes and flame topologies present during ignition, and how these are affected by turbulent mixing and entrainment. To this end, we utilize a chemical explosive mode analysis, reaction-diffusion balances and related techniques.

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