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Numerical Simulations of a Reacting Sonic Jet in a Supersonic Cross-flow NITESH ATTAL, PRAVEEN RAMAPRABHU, University of North Carolina at Charlotte — Interaction of a jet with a background cross-flow is a situation common to many engineering systems, including combustors in SCRAMJETS, gas turbines etc. Such an interaction enhances fuel-air mixing through the distortion of coherent structures into counter-rotating vortex pairs that are tilted, stretched and then sundered by the velocity gradient in the cross-flow, eventually leading to turbulent mixing. The ignition process and flame characteristics depend sensitively on the extent and efficiency of this turbulent mixing process. We describe results from detailed 3D numerical simulations of a sonic circular jet of diameter (D=0.5 cm) issuing a mixture of H_2 (Fuel) diluted with 50% N_2 at 300K into a turbulent, Mach 2 cross-flow of air at 1200K. The simulations were performed in a computational domain of 20x16x16 jet diameters using the compressible flow code FLASH [1], with modifications [2] to handle detailed (H_2-O_2) chemistry and temperature-dependent material properties. We discuss the role of shock driven mixing, ignition and flame anchoring on the combustion efficiency of the system.

[1] B. Fryxell et al., Astrophys. J., Suppl. Ser. 131,273(2000)
[2] N. Attal et al., Comput. Fluids(under review)

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