Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

**Toward topology-based characterization of small-scale mixing in compressible turbulence** SAWAN SUMAN, SHARATH GIRIMAJI, Texas A&M University — Turbulent mixing rate at small scales of motion (molecular mixing) is governed by the steepness of the scalar-gradient field which in turn is dependent upon the prevailing velocity gradients. Thus motivated, we propose a velocity-gradient topology-based approach for characterizing small-scale mixing in compressible turbulence. We define a mixing efficiency metric that is dependent upon the topology of the solenoidal and dilatational deformation rates of a fluid element. The mixing characteristics of solenoidal and dilatational velocity fluctuations are clearly delineated. We validate this new approach by employing mixing data from direct numerical simulations (DNS) of compressible decaying turbulence with passive scalar. For each velocity-gradient topology, we compare the mixing efficiency predicted by the topology-based model with the corresponding conditional scalar variance obtained from DNS. The new mixing metric accurately distinguishes good and poor mixing topologies and indeed reasonably captures the numerical values. The results clearly demonstrate the viability of the proposed approach for characterizing and predicting mixing in compressible flows.

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Date submitted: 08 Aug 2011 Electronic form version 1.4