Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Influence of compressibility on lifetimes of topologies in turbulent flows SAWAN SINHA, Indian Institute of Technology Delhi , NISHANT PARASHAR, Indian Institute of Technology Delhi INDIA, BALAJI SRINIVASAN, Indian Institute of Technology Madras INDIA — Flow field topologies are categorized based on the nature of eigenvalues of the local velocity gradient tensor. Physically, these topologies are suggestive of the relative importance of the local strain-rate and the rotation rate-tensors. The question that how long a given topology lasts in a turbulent flow field is of fundamental importance in geophysical and astrophysical flows. It has been reported in literature that while in the former, this quest is linked to the process of raindrop formation, in the latter, the question finds its significance in context of star formations. While some earlier attempts have been made to estimate the lifetimes of topologies using surrogate methods like the conditional mean trajectories (CMT), in this work we take a more direct approach and accurately estimate topology lifetimes using well resolved direct numerical simulation data in conjugation with a Lagrangian particle tracker. In particular, we investigate and explain how initial turbulent Mach number and local dilatation rate tends to influence the lifetimes of various topologies in a compressible turbulent flow field. Finally, some modeling implications of these findings are also presented.

Sawan Sinha
Indian Institute of Technology Delhi INDIA

Date submitted: 21 Jul 2019 Electronic form version 1.4