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Eulerian and Lagrangian velocity statistics in compressible turbulence on a free surface[1] WALTER GOLDBURG, MAHESH BANDI, University of Pittsburgh, JOHN CRESSMAN, Krasnow Institute, George Mason University — The statistics of velocity differences are analyzed for compressible turbulence on a free surface in both Eulerian and Lagrangian frames. Despite non-applicability of Kolmogorov 1941 theory (K41), prior measurements (J. Cressman et. al., New J. Phys., 6, 2004), have shown Kolmogorov scaling for Eulerian structure functions ($S_n(r) = \langle(\delta v_{||}(r))^n\rangle \sim r^{n/3}$). Here we measure the Eulerian third-order ($S_3(r)$) and Lagrangian second-order ($D_2(\tau)$) structure functions. The Eulerian third-moment is suprisingly consistent with K41 ($S_3(r) = -\frac{4}{5}\bar{\varepsilon}r$)). K41 predicts the lagrangian second-moment should scale linearly with time ($D_2(\tau) = C_0\bar{\varepsilon}\tau$) in the inertial time-scales, however this scaling is not observed. Instead, the Lagrangian second-moment scales as $D_2(\tau) \sim \tau^{1/2}$. Absence of a suitable theory makes it difficult to explain the experimental observations.

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Mahesh Bandi
University of Pittsburgh

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