Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Statistical and Geometrical Properties of the Scalar Gradient in Homogeneous Isotropic Turbulence MICHAEL GAUDING, JENS HENRIK GOEBBERT, FABIAN HENNIG, NORBERT PETERS, RWTH Aachen University — The mixing of a passive scalar in statistically homogeneous isotropic turbulence is investigated. Here, the scalar gradient plays an important role, since production of small scales and smoothing down by molecular diffusion depend on it. The single-point probability density function (pdf) of the scalar gradient is characterized by long stretched exponential tails. We derive an equation for the probability density function of the scalar gradient from first principles. This equation is not closed due to the highly nonlocal and non-linear character of the equations of motion. We employ a statistical framework to simplify the unclosed terms which also provides insight into the mechanisms of scalar gradient production, diffusion, and dissipation. We further introduce a simple closure for the tails of the scalar gradient pdf. This closure can be motivated by special alignment properties of the scalar gradient with its dissipation tensor. The theory is validated by means of direct numerical simulations with various Schmidt and Reynolds numbers.

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Date submitted: 03 Aug 2012 Electronic form version 1.4