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Fractal contours of scalar in smooth flows MARIJA VUCELJA, Courant Institute of Mathematical Sciences, NYU, GREGORY FALKOVICH, Department of Physics of Complex Systems, Weizmann Institute of Science, 76100 Rehovot, Israel, KONSTANTIN TURITSYN, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, 02139, USA — A passive scalar field was studied under the action of pumping, diffusion and advection by a smooth flow with a Lagrangian chaos. We present theoretical arguments showing that scalar statistics is not conformal invariant and formulate a new effective semi-analytic algorithm to model scalar turbulence. We then carry out massive numerics of scalar turbulence focusing on nodal lines. The distribution of contours over sizes and perimeters is shown to depend neither on the flow realization nor on the resolution (diffusion) scale for scales exceeding this scale. The scalar isolines are found fractal/smooth at the scales larger/smaller than the pumping scale. We characterize the statistics of bending of a long isoline by the driving function of the Loewner map, show that it behaves like diffusion with diffusivity independent of resolution yet, most surprisingly, dependent on the velocity realization and time (beyond the time on which the statistics of the scalar is stabilized).

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