Revealing the building blocks of chaos: Deviations from extensivity

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Researchers have made relatively little progress in developing a predictive theory of far-from-equilibrium, spatially-extended chaotic systems. Even descriptions of the fundamental degrees of freedom and the nature of their interactions — central elements of statistical mechanics — are lacking. Using high-precision studies of the fractal dimension as a function of system length for the complex Ginzburg-Landau equation, we have uncovered deviations from extensivity on a length scale consistent with the chaotic length scale, indicating that this spatiotemporal chaotic system is composed of weakly-interacting building blocks, each containing about two degrees of freedom. Our results also suggest an explanation of some of the ‘windows of periodicity’ found in spatiotemporal systems of moderate size.

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