

Self-similar inverse cascade from higher-form symmetry

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In the conventional turbulence studies, it has been revealed that inverse cascades driven by conserved quantities integrated over the entire space, such as helicity in three spatial dimensions

On the other hand, in terms of the higher-form symmetry, we are getting to know that there are also conserved charges defined by integration over subspaces.

In this talk, I will demonstrate a new mechanism where higher-form symmetries naturally induce a self-similar inverse cascade. Taking axion electrodynamics with non-linear topological interaction as a paradigmatic example, it is shown that the conserved charge associated with its 1-form symmetry drives the system toward large-scale coherent structures through a universal scaling behavior characterized by analytically determined scaling exponents.

Our findings suggest that higher-form symmetries can provide a fundamental organizing principle for understanding non-equilibrium phenomena and the emergence of coherent structures in turbulent systems.

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