

Coherent Structures in Fluids are Deformable Topological Defects

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Abstract: Cartan's theory of a global 1-form of Action on a projective variety permits the algebraic evaluation of certain useful geometric and topological objects which can be singular. The projective algebraic methods therefore lend themselves to the development of a theory of coherent structures and defects in which the concept of translational shear dislocations and rotational shear disclinations can be put on equal footing. The topological methods not only lead to a precise definition of coherent structures in fluids, but also produce a non-statistical test for thermodynamic irreversibility on a symplectic manifold of dimension 4, and therefore yield a necessary criteria for turbulence.