RUHR-UNIVERSITÄT BOCHUM
FAKULTÄT FÜR PHYSIK UND ASTRONOMIE

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Morphology and Topology of Random Fields: Application to Compressible Turbulance

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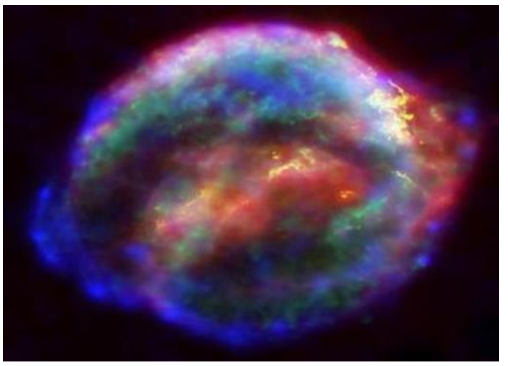

Analysis of turbulent flows relies on theory of random fields which has been developed mostly for Gaussian or related fields such as log-normal ones. However, strong turbulent flows, especially intermittent and compressible ones, are non-Gaussian. Their description in terms of a sequence of higher-order statistical moments is often unsatisfactory both because it is an incomplete description and because the moments are difficult to calculate with sufficient accuracy to make them useful. These problems have become especially acute with the advent of extensive numerical simulations of turbulent flows and the need to compare them with detailed laboratory measurements and astronomical observations. Topological and morphological data analysis offers a range of alternative techniques, including the Minkowski functionals, Betti numbers and persistence diagrams, that can be used to facilitate such a comparison without the assumption of Gaussianity. After describing these tools, we first apply them to synthetic random fields to clarify their significance and interpretation. Focusing upon one particular astrophysical example, we apply topological data analysis to HI observations of the turbulent interstellar medium (ISM) in the Milky Way and to recent magnetohydrodynamic simulations of the random, strongly compressible ISM. These topological techniques are generic and could be applied to any complex, multi-dimensional random field.

Einführung: Prof. Dr. R.-J. Dettmar

Die Fakultät lädt alle Interessierten herzlich ein.