Universität Bielefeld Fakultät für Physik

Physikalisches Kolloquium

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Topological and morphological analysis of random fields with applications to compressible turbulence

Turbulence plays an important role in determining the random fluctuations in plasmas. The theory of random functions and techniques of data analysis mostly rely on the assumption that the underlying random field follows Gaussian statistics. This limitation is becoming less and less acceptable as the resolution, sensitivity and physical complexity of experimental and numerical data increase. Observations and simulations of compressible random flows, especially in astrophysical contexts, provide a good example of this difficulty. This work is motivated by the need to compare with observations the results of comprehensive simulations of turbulence in the interstellar medium. The quantitative methods used at present are limited to probability densities and Fourier spectra of random fields, which are insensitive to widespread filamentary structures revealed by observations of interstellar gas. We discuss novel methods of data analysis that are applicable to intermittent, strongly non-Gaussian random fields and are based on recent developments in computational topology and morphology or random fields. Particular aspects include the recovery of a three-dimensional structure of a random field from its two-dimensional cross-section and the effects of magnetic field on interstellar turbulence.

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Ort: Hörsaal 6

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