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Elastic Turbulence

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Abstract

A viscous solvent streamline flow is changed by the addition of a small quantity of long compound molecules, leading to a chaotic flow known as elastic turbulence (ET). ET is attributed to compound stretching, that generates elastic stress and its back reaction on the flow. Its properties area unit analogous to those ascertained in fluid mechanics turbulence, though the formal similarity doesn't imply a similarity in physical mechanisms underlining these two sorts of random motion. Here we have a tendency to review the applied mathematics and spectral properties and also the spacial structure of the rate field, the applied mathematics and spectral properties of pressure fluctuations, and scaling of the friction issue of ET in wall-bounded and boundless flow geometries, as ascertained in experiments and numerical simulations and delineate by theory for a good vary of management parameters and compound concentrations.

A systematic experimental investigation of the onset, development, and statistical and scaling properties of elastic turbulence in a curvilinear micro-channel of a dilute solution of a high molecular weight polymer is presented. By measurements of time series of high spatial resolution flow fields performed over a time 320 times longer than the average relaxation, we show that the transition to elastic turbulence occurs via an imperfect bifurcation. Slightly above the onset of the primary elastic instability, rare events manifested through a local deceleration of the flow are observed.

By measurements of the abstraction distributions and statistics of the second invariant of the speed of strain tensor, we have a tendency to show that the most prediction of the speculation concerning the saturation of root mean sq. of fluctuations of the rate gradients is qualitatively verified though quantitative agreement couldn't be found. A scientific analysis of the statistics of the fluctuations of flow fields in terms of abstraction and temporal correlations, power spectra, and chance distributions is conferred. The scaling properties of structure functions of the increments of the rate gradients square measure mentioned. Our experimental findings entail additional developments of the speculation of elastic turbulence in delimited flow channels.

Keywords: Elastic instabilities • Elastic turbulence • Coil–stretch transition • Elastic waves • Wall dominated elastic turbulence • Inertial effect in elastic turbulence

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