中国科学院数学与系统科学研究院应用数学所

偏微分方程及其应用中心

学术报告

报告题目： **Third-order structure function beyond the inertial range in homogeneous isotropic turbulence**

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时　　间： **2024 年 06 月 26 日（星期三）15:00-16:00**

地　　点： 数学院思源楼 615

摘　　要： In 1941, Kolmogorov proposed the 4/5 law for the inertial range in three-dimensional isotropic turbulence, which links measurable third-order structure functions with energy transfer. The inertial-range theories are applied to quantify the direction and magnitude of energy transfer in natural turbulence. However, the applicability of these theories is limited due to the effects of forcing scale and bidirectional energy transfer. Thus, expressions for structure functions beyond the inertial range are required. We derive a forcing-scale-resolving global expression that captures the bidirectional energy transfer. We apply this expression to analyse the drifter data in the Gulf of Mexico and provide evidence for bidirectional energy transfer in ocean turbulence. Also, this new expression implies a conjugate regime to Kolmogorov's theory for

the scales larger than the forcing scale in three-dimensional homogeneous isotropic turbulence. This new regime points out the importance of energy injection even on large scales, which was believed to be described by absolute equilibrium because of zero averaged energy flux across scales and potentially provides a foundation for superresolution. Similar to two-dimensional flow, geostropically balanced flow conserves two quadratic quantities, corresponding to two exact relations of third-order structure functions. However, the scalings provided by these two relations are inconsistent based on simple dimensional analysis.We conjecture that the two scalings bound the actual structure function scalings, which is justified by numerical simulations.