Isotropic Scaling Features Measured Locally in the Solar Wind Turbulence with Stationary Background Field

Honghong Wu¹, Chuanyi Tu¹, Xin Wang², Jiansen He¹, Liping Yang³, and Linghua Wang¹

¹Peking University, School of Earth and Space Sciences, department of geophysics, China (honghongwu@pku.edu.cn)
²School of Space and Environment, Beihang University, Beijing, China
³SIGMA Weather Group, State Key Laboratory for Space Weather, National Space Science Center, Chinese Academy of Sciences,Beijing, China

The scaling anisotropy is crucial to interpret the nonlinear interactions in solar wind turbulence. Previous observations provide diverse results and the structure functions analyses are also reported to be an approach to investigate the scaling anisotropy based on a local magnetic field. However, the determination of the sampling angle with respect to the local background magnetic field implicitly assumes that the observed time series are time stationary. If this assumed time-stationarity is compatible with the measurements has not been investigated. Here we utilize the second-order structure function method to study the scaling anisotropy with a time-stationary background field. We analyze 88 fast solar wind intervals each with time durations >=2 days measured by Wind spacecraft in the period 2005-2018. We calculate the local magnetic field as the average of the time series B(t') whose time-stationarity are fulfilled by our criterion $\varphi<10^\circ$ ($\varphi$ is the angle between the two averaged magnetic field after cutting $B(t')$ into two halves). We find for the first time the isotropic scaling feature of the magnetic-trace structure functions with scaling indices -0.63±0.08 and 0.70±0.04 respectively in the local parallel and perpendicular directions. The scaling for the velocity-trace structure functions is also isotropic and the indices are -0.47±0.10 and 0.51±0.09.