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Statistical Research of the Intermittency and Cascade of Solar Wind Turbulence Based on Analysis of PSP Measurements

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The solar wind turbulence intermittency change with the scale from multifractal to monofractal, in the close distance has been available. In the inertial range, the change of the scale exponent with the scale is nonlinearly concave, which characterizes that turbulence intermittency is multifractal; in the kenetic range, the change of the scale exponent with the scale is linear, which characterizes that turbulence intermittency is monofractal. We also found that the closer to the sun, the more obvious the concave of the scale exponent in the inertial range, which indicates that the multifractal characteristics of the magnetic field turbulence intermittency are also more obvious.

Based on the PP98 model function of incompressible MHD turbulent cascade rate, we first compared the cascades εZ and εB=(δB^3)/τ in the distance close to the sun, then found that the two trends were in good agreement. We therefore believe that, to some extent (e.g. in the inertial region), εB=(δB^3)/τ can be used as a proxy of the cascade rate εZ. For the first time, by statistical analysis, we obtained that εB satisfies the following relation with the scale and the heliocentric distance: εB=((τ/τ0)^α)((r/r0)^β). We have given the expression and calculated the parameters: in the inertial range, α is about -0.3+0.6R, β is about -6.6. We also compare the fitting cascade rate line with some cascade or dissipation rate lines in different models. The εB(τ,r) expression given in this work, will help to understand the transport and cascade processes of solar wind turbulence in the inner-heliospheric layer.