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A model for multifractality of the slow solar wind

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We focus on low-dimensional dynamics in the inner heliosphere, which is the region of space dominated by the flow of the solar wind. Because of nonlinear behavior of the low-speed streams, we use the Grassberger and Procaccia method that allows calculation of the generalized dimensions from the experimental signal. Therefore, we analyze time series of plasma parameters of the slow solar wind measured in situ by the Helios 2 spacecraft at 0.3 AU from the Sun. We demonstrate that the influence of noise in the data can be efficiently reduced by moving average and singular-value decomposition filters. The resulting spectrum of dimensions shows multifractal structure of the slow solar wind in the inner heliosphere. In order to quantify that multifractality we use a simple analytical model of the dynamical system. Namely, we consider the generalized baker's map with two parameters describing uniform compression and natural invariant measure on the attractor of the system. This map exhibits stretching and folding properties leading to sensitivity to initial conditions. The obtained solar wind singularity spectrum is consistent with that for the multifractal measure on the self-similar weighted baker's map. The values of the parameters fitted demonstrate relatively small dissipation of our dynamical system and show that some cubes that cover the attractor in phase space are visited at least one order of magnitudes more frequently than other cubes. This work has been supported by the State Scientific Research Committee through Grant No. 2 P03B 126 24.