Roma (Rank-Ordered Multifractal Analysis) of Intermittency in Space Plasmas

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For intermittent turbulence, one may visualize the fluctuations to be composed of many types, each being characterized by a particular fractal dimension. Two questions arise: (i) What are the different types of fractal dimensions? And (ii) How are they distributed in the turbulent medium? Recently, a new technique of analyzing intermittent fluctuations has been developed to specifically address these questions (Chang and Wu, 2008). The technique, known as Rank-Ordered Multifractal Analysis (ROMA), retains the spirit of the traditional structure function analysis and combines it with the idea of one-parameter scaling of monofractals.

We shall demonstrate that ROMA maps the complete set of non-self-similar Probability Distribution Functions (PDF) of intermittent fluctuations and at the same time determines the fractal spectrum in terms of the concept of generalized crossover invariant functions, connecting the understanding of intermittent turbulence one-step closer to the concept of the Dynamic Renormalization Group. Examples in numerical simulations and space observations will be provided.