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Permutation Entropy Analysis of Geomagnetic Indices Time Series

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The Earth's magnetospheric dynamics displays a very complex nature in response to solar wind changes as widely documented in the scientific literature. This complex dynamics manifests in various physical processes occurring in different regions of the Earth's magnetosphere as clearly revealed by previous analyses on geomagnetic indices (AE-indices, Dst, Sym-H, ..., etc.). One of the most interesting features of the geomagnetic indices as proxies of the Earth's magnetospheric dynamics is the multifractional nature of the time series of such indices. This aspect has been interpreted as the occurrence of intermittence and dynamical phase transition in the Earth's magnetosphere. Here, we investigate the Markovian nature of different geomagnetic indices (AE-indices, Sym-H, Asy-H) and their fluctuations by means of Permutation Entropy Analysis. The results clearly show the non-Markovian and different nature of the distinct sets of geomagnetic indices, pointing towards diverse underlying physical processes. A discussion in connection with the nature of the physical processes responsible of each set of indices and their multifractional character is attempted.