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Time-frequency and fractal analyses of the Earth's magnetic field variations appeared during powerful geospace storms took place in September 2017

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According to the non-linear and the system paradigms, many processes generated in open, non-linear, dynamical systems under influence of a powerful source of energy release are appeared to be short-time, ultra-wideband, non-linear and fractal. The Earth – atmosphere – ionosphere – magnetosphere (EAIM) system and the Solar – interplanetary medium – magnetosphere – ionosphere – atmosphere – Earth (SIMMIAE) system are namely such open, non-linear, dynamical ones, and a solar flares causing geospace storms can be considered as one of such powerful sources of energy release. Therefore, being a part of a geospace storm, a magnetic storm is accompanied by many complex processes, which can have complex time-frequency structure and fractal properties. Both this structure and these properties should be detected and investigated in detail.

The purpose of this work is to study the time-frequency structure and the fractal properties of the Earth's magnetic field time-domain variations, which have been registered during powerful geospace storms occurred in September 2017. The corresponding signals were detected by the unique magnetometer-fluxmeter, which is a part of the V. N. Karazin Kharkiv National University Radiophysic Observatory located in the Kharkiv region.

The magnetometric signals corresponding to both D- and H-components of the Earth's magnetic field and registered during two geospace storms took place on September 14 – 16, 2017 and on September 26 – 28, 2017 were investigated in detail. Using the System Spectral Analysis (SSA) method, the set of the time-frequency structures in the existing groups of disturbances was detected. The numerical characteristics describing these structures, namely the duration, the disturbance periods, the fractional bandwidth, the dynamical

fractional bandwidth, the mean signal period were estimated. Using the Correcting Function Method introduced by the authors in this paper, the Generalized Fractal Analysis (GFA) and the Dynamical Fractal Analysis (DynFA) methods were significantly improved. The fractal properties of the signals considered were investigated with usage of the GFA and the DynFA methods. The set of corresponding numerical fractal characteristics were estimated. Some time-frequency structures detected and estimated with the SSA method and investigated with the GFA and the DynFA methods were appeared to be both ultra-wideband and fractal. This fact allows to classify them as the fractal ultra-wideband processes.

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Ionospheric Effects of the August 11, 2018, Solar Eclipse over the People's Republic of China

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Solar eclipse (SE) present rare phenomena of nature. In the course of 2 to 3 hours, the rearrangement of processes acting at the Earth's surface, in the atmosphere, geospace, i.e., in the Earth–atmosphere–ionosphere–magnetosphere system (EAIMS), occurs. The response of this system depends on the solar activity, season, time of day, and on the state of atmospheric and space weather. Therefore, the study of the EAIMS response to SE remains an urgent need. The response is accompanied by controllable dynamic processes, the study of which improves our understanding of the near-Earth environment. The study of the EAIMS response to SE is of fundamental importance to science. Its practical applications include the following. The SE give rise to significant perturbations in the EAIMS, which affect the propagation of radio waves virtually in all frequency bands, and consequently deteriorate the operation of telecommunication, radar, radio astronomy, and radio navigation systems, as well as the instruments for remotely sensing the medium. The SE effects have been studied for over more than about 100 years. Thus far, the following regular effects have been quite well studied: decreases in the electron density, electron and ion temperatures,