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(A)uroral (K)ilometric (R)adiation as a Self-Organized System

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Abstract

We present results of the processing of short–time AKR (Auroral Kilometric Radiation) bursts recorded onboard Interball–2 mission (POLRAD experiment). POLRAD was a swept–frequency radio–spectrograph working mostly in the frequency range 4 kHz–1 MHz. Sweep duration with a 4 kHz wide filter was 6 s, but for the single frequency step, data integration time was only 6 ms [1].

Preliminary analysis of the distribution of short AKR bursts number in function of their intensity showed for higher intensities a power–law fall (in a log–log scale) characteristic for the Self–Organized Criticality (SOC) systems [2].

We present here results of analysis for a much larger data sample consisting of 241 data sets (vs. 53 cases in [2]). As in the previous paper, for analysis of the power–law part of the distribution, we applied method proposed by Clauset et al., [3] subsequently discussed for power–law–distributed solar data by D'Huys et al., [4]. We found about 80% of scaling parameters values α within the [2.0-3.0] interval with the dominant value ≈ 2.5. We also compared fits to our data of three different distributions: powerlaw, exponential and lognormal. The powerlaw distribution fits data better than the exponential, but for the powerlaw distribution vs. the lognormal our results are not conclusive.

SOC is a rather general concept, and at first we decided to fit the AKR bursts data to a simple analytical model, the logistic–growth model [5], using AKR waveform data from the French MEMO experiment [6]. Results agree well with the expected growth rates for the AKR cyclotron maser instability.

MEMO data are very scarce, but we can see, that data integrated in a 6 ms time window consist in some cases from more than one AKR burst. Such lack of time resolution can lead to the overestimate of the scaling parameter α [7,8].

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