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## On the nonlinear phenomena in the arrival time series of air showers observed at Mt. Chacaltaya

### Abstract content

Several reports indicate the existence of non-random features of arrival time series of air showers observed at sea levels. The non-randomness shows fractal feature and they concluded that a new origin of source or propagation mechanism of cosmic rays are necessary.

We examine these phenomena with using arrival time series of air showers observed at Mt. Chacaltaya in ten years. The location of our array ( 5200m a.s.l. ) is expected to reveal new aspects on them which cannot be observed by sea-level detectors.

Our characteristics of analysis differ from preceding ones on three points, one is using data from much lower energy region (  $> 5 \times 10$  times  $13$ -th eV ), another is using method of analysis not only Grassberger-Procaccia method but also Wayland and Lyapunov exponents estimation methods and the last one is that we can use informations of air shower size.

With these methods, we can select non biased events to observe and also classify observed candidates with fractal feature between chaotic and colored noise ones.

We have performed a time series analysis to search for nonlinear features of arriving UHE cosmic rays and have concluded that all observed ones have features with colored noise only and could not observe real chaotic one. Our result is implying the existence of fractal effect on propagations of these cosmic rays in ISM.

**If this paper is presented for a collaboration, please specify the collaboration**

### Summary

### Reference

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