FRACTAL ANALYSIS OF TIME PROFILE OF THE GAMMA RAY BURST REGISTERED BY BATSE

Kotov, Yu. D.; Arkhangelskaja, I. V.; Afonina I. V.; Borodina E. V.
Astrophysics Institute of Moscow State Engineering Physics Institute
kotov@axpk40.mephi.ru

We have analyzed the time profiles of approximately 1300 GRB from 4B revised BATSE catalog using fractal dimension method. The time profiles for all used events were presented as temporal curve (histogram) of counting rate versus time. To define the fractal dimension D the cell algorithm was used in our research: the part of the plane in which an analyzing temporal curve is locate was covers by square cells with side s. Let $N(s)$ is amount of sells, which has at least one common point with this curve. Then we define certain gauge for this curve: $L=N(s)*s^D$. For usual (nonfractal) curve $L \to 0$ for $s \to 0$ but for fractal curve gauge L is nonzero for some value of D. For practical application it is more suitable to plot dependence of $N(s_i)$ as sell size s_i for set of different s. Then $N(s_{min})=a*s_{min}^{-D}$ for some $a>0$, where D is the fractal dimension of this GRB temporal curve.
Fractal indexes of all analyzed GRB are in the range $0.87\pm0.02 < D < 2.20\pm0.03$.
Then all GRB were distributed into three group according their duration defined by T_{90} parameter: short ($<T_{90}> \sim 0.7s$), middle ($<T_{90}> \sim 3s$) and long ($<T_{90}> \sim 0.7s$) duration. The fractal index distributions for GRB divided in these three groups are presented in our article. There are some maxima in fractal index distributions for each of group. The positions of the maxima are different is different groups (exclude maximum at $D=1.50\pm0.02s$ which corresponds to GRB with very smooth time profiles because fractal index in this case is defined by Poisson background fractal index).
To check hypothesis that GRB with different values of the fractal dimension D probably caused by different physical processes the spatial distribution of the GRD with small and large values of D are presented.