

## Dynamic fragmentation theory

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A one-dimensional fragmentation model is proposed. In this model the discrete maps are taken to be the evolution laws of the fragmentation process. For the tent and logistic maps, the asymptotics of the fragment size distribution function in the small-scale fragment region have an exponential-law form in the chaotic regime (Lyapunov exponent  $\lambda_L > 0$ ) and a power-law form in the regular regime ( $\lambda_L < 0$ ). The results of numerical simulation of the process confirm theoretically predicted asymptotics. Dependence of the exponential function increment on  $\lambda_L$  was obtained for the tent map. We also analyze complex dependence of this increment on the map parameter, correlated with the map bifurcation structure, in the logistic map case.

Предложена одномерная модель фрагментации по законам динамических отображений. Установлено для треугольного и логистического отображений, что функция распределения по размерам фрагментов в мелкомасштабной области в хаотическом режиме разрезания (показатель Ляпунова  $\lambda_L > 0$ ) имеет характерную экспоненциальную асимптотику, а в периодическом режиме ( $\lambda_L < 0$ ) — степенную, что подтверждают результаты, полученные при численном моделировании процесса. Для треугольного отображения найдена зависимость инкремента экспоненциальной асимптотики от  $\lambda_L$ . Наблюдается сложная зависимость этого инкремента от параметра отображения, коррелирующая со структурой бифуркационных перестроек отображения, в случае логистического отображения.

### Introduction

Fragmentation is a widespread phenomenon, its examples could be found both in nature and technology. Fragmentation is usually defined as a process driven by external destructive forces, resulting finally in the object fracturing into smaller pieces. Such processes include, e.g., crushing of rocks [1], mineral resource dressing [2], solid body fracturing under external stresses [3], by the impacts [4, 5], by dropping onto a hard surface [6–8] and in colli-

sions with each other [9] (e.g. meteorites [10] and asteroids [11]), breakdown of liquid droplets of mercury [12] and fuel [13], reduction of fibers [14], polymer degradation [15, 16] (due to cutting by high-energy ions or particles, or by mechanical and thermal methods), nuclear breakage into fragments in high-energy collision [17] and also the material cracking and subsequent crushing. The problems of fragmentation process description and correlation between the energy received by a system and the fragment