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Earthquakes are directed to diversity: An arithmetic seismic activity model

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Seismic activity is diverse. If we use the methodology in which an earthquake generation process is decomposed into individual fundamental processes and they are integrated by assembling a detailed physical model in each process, initial conditions and boundary conditions to be determined become an enormous amount.Therefore, it is difficult to describe the earthquake generation process by finding the solution of one deterministic equation system. In the prediction of seismic activity that has been attempted in recent years, stochastic or statistical techniques have been used. In approaches of stochastic processes theory, characteristics of seismic activities are modeled as probability distributions which are estimated theoretically or empirically. One of the sample path of a stochastic process that is modeled corresponds to the value to be observed. Such an approach is effective to represent the statistical properties of the entire seismic activity, but it cannot be applied to analyze a depth nature of the individual sample path. In this study, we mathematically construct a specific sample path corresponding to the observed value. By showing that they satisfy the statistical nature of seismic activity, we propose seismic activity model based on the idea that different from the stochastic processes approach. A model is proposed for seismic activity due to ”number”.

We consider a correspondence between earthquakes and prime numbers. We parameterize occurrence time of earthquakes as the prime numbers and magnitude of earthquakes as the interval of prime numbers. Then we obtain a relationship similar to Gutenberg-Richter law. We call the model obtained by this correspondence as ”arithmetic seismic activity model”. In the ” arithmetic seismic activity model”, earthquake is equivalent to prime number of prime numbers distribution theory. Earthquake prediction is something equivalent to prediction of emergence of prime numbers. Earthquake is captured as a phenomenon that corresponds to changes in the energy level of the field. Using certain quantum system, we consider to model a field of earthquake occurrence. Considering the Hamiltonian of the field of earthquake occurrence, we set earthquake occurrence as an eigenvalue problem for the Hamiltonian. If we can show that the eigenvalue problem is associated with the zeta function, we can expect to explain the similarity between the distribution of the prime and seismic activity. At present, dynamical system can explain seismic field based on this concept is not known. On the other hand, trying to capture the zero distribution of the zeta function of Riemann in the relationship equivalent to the prime number distribution as an eigenvalue problem of the quantum dynamical system, research on the distribution of prime numbers is progressing. Distribution of prime numbers is related to limits of diversity of ”number”. Distribution of prime numbers is likely to be associated with critical phenomena. Earthquake can be interpreted as an critical phenomena. For this reason, it is considered that there is a similarity between the prime numbers and earthquakes.

Keywords: Number theory, Prime number, Gutenberg-Richter relation, Earthquake