An arithmetic approach for modeling of seismic activity, No.2

*Hiroyuki Fujiwara[1]

1.National Research Institute for Earth Science and Disaster Prevention

An arithmetic seismic activity model is proposed by Fujiwara (2014). In this model, earthquakes are modeled by using prime numbers to express the seismic activity that follows the G-R law. Although the arithmetic seismic activity model has been inferred from phenomenological similarities between seismic activities and the prime number distributions, there may be some mathematical and physical meanings behind the model.
We consider a correspondence between earthquakes and prime numbers. We parameterize occurrence time of earthquakes as prime numbers and magnitude of earthquakes as the interval of prime numbers. Then we obtain a relationship similar to G-R law. We call the model obtained from this correspondence as arithmetic seismic activity model. In the arithmetic seismic activity model, earthquake is equivalent to prime number. Then, earthquake prediction is equivalent to prediction of emergence of prime numbers.
For the prime number distribution, the Riemann explicit formula is known. The Riemann explicit formula is an equation showing the number of primes less than a given number, by using the zeros of the Riemann zeta function. In the arithmetic seismic activity model, the Riemann explicit formula gives a prediction formula of earthquake occurrence.

In this study, for the purpose of giving a physical interpretation to the arithmetic seismic activity model, efforts have been made in the following approach.
(1) By considering the Riemann explicit formula as a trace formula, we explore the mathematical structure behind it.
(2) Using the noncommutative geometry and automorphic representation, we challenge to build a dynamic system that can explain the arithmetic seismic activity model.

With respect to (1), the Selberg trace formula, which links geometry and harmonic analysis on a Riemann surface, is known. A common feature in the trace formula, the sum on the prime elements in the geometric side is equal to the sum on the eigenvalues in the spectrum side. Trace formula can be regarded as an equation linking the two different concepts. It is thought to play an important role in mathematical physical modeling. By paying attention to the similarity between the Selberg trace formula and the Riemann explicit formula and by capturing the Riemann explicit formula as a kind of trace formula, it was conducted a survey of the relevant existing research for mathematical structure behind the Riemann explicit formula.
With respect to (2), as a starting point of the above approach, focusing on the similarity between automorphic forms in the field of number theory and mathematical structure of the conformal field theory in the theoretical physics, we have been conducting research towards the construction of the dynamical system. By configuring the dynamical system based on the automorphic form and its representation in an adele space, we have been conducting preliminary research to capture earthquakes as an eigenvalue problem.
Approach of this study is to construct a bridge linking "prime" as a research subject of number theory and "earthquake" as a physical phenomenon. In the field of number theory, such attempt is known as Langlands program. In recent years, researches to expand the idea of the Langlands program between number theory and theoretical physics has been conducted.
For the prime distribution, historical unsolved problems, such as the Riemann hypothesis, still

exist in number theory. This study is still in the stage of preliminary research towards the resolution of the above-mentioned problems.

References

Hiroyuki Fujiwara (2014): An arithmetic seismic activity model, Zishin, vol. 66, 67-71.

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