

# Statistics in Neutrino Physics and Methodology in Earth Science: Incompatibility to Marriage

\*Sanshiro Enomoto<sup>1,2</sup>

1. Center for Experimental Nuclear Physics and Astrophysics, University of Washington, 2. Kavli Institute for the physics and mathematics of the universe, University of Tokyo

Geoneutrino observation at KamLAND has brought not only the new method to explore the earth but also an opportunity to meet two independently developed research fields, particle physics and Earth science. In particle physics, where observables are determined by quantum mechanics, it is fundamentally possible and straightforward to describe the observation with probability models, and conclusions are written in statistical statements. Earth science, on the other hand, has to deal with the complexity of the real world, and constructing exact probability models is practically impossible; probability models are often an approximation model or a hypothetical model with some subjectivity, or sometimes a model that is being used without specific attention. Due to this incompatibility, as of 15 years ago when geoneutrino observation came to reality, it was impossible to construct a geoneutrino model from Earth science data, and no logically consistent conclusions were derived. In this presentation, I will introduce the exact and somewhat uncommon statistical methods used in particle physics with an example of geoneutrinos, as well as some recent new outcome and viewpoints from our effort to overcome the incompatibility [1].

[1] N. Takeuchi et al., "Stochastic modeling of 3-D compositional distribution in the crust with Bayesian inference and application to geoneutrino observation in Japan", *Phys. Earth Planet. Inter.* 288 (2019) 37-57

Keywords: statistical methods, neutrinos