【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Mathematical and Physical Sciences)

Title of Project : Stochastic Analysis on Infinite Particle Systems

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Research Project Number : 16H06338 Researcher Number : 20177207
Research Area : Probability Theory
Keyword : Infinite Particle Systems, Stochastic Analysis, Random Matrices, Solvable Models, Stochastic Geometry

【Purpose and Background of the Research】

Infinite particle systems are objects typically appearing in statistic physics, and ensembles of infinite-many particles consisting of finite-number of species. Below we suppose they consist of a single species. We regard infinite particle systems as an element of configuration spaces and denote their equilibrium states as point processes. Their random time evolutions are described by infinite-dim stochastic differential equations with symmetry.

The purpose of the present research is to establish a stochastic analysis of infinite particle systems based on the new theory of infinite dimensional stochastic differential equations with symmetry.

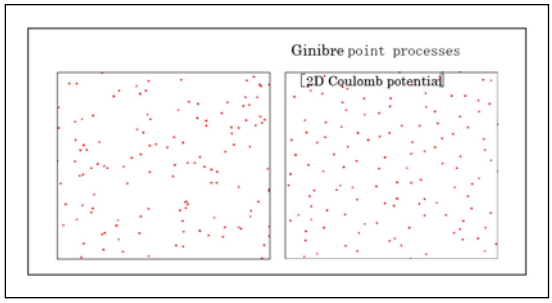
This stochastic analysis can be applied to essentially all Gibbs measures, point processes of eigen values of random matrices, and zero points of random analytic functions, and so on. In particular, stochastic systems with very long range and extremely strong interaction potentials.

We investigate novel and special phenomena arising from long range and strong interactions. In particular, we study phase transition on inverse temperature β and their critical phenomena.

At the same time, we study the algebraic structure of infinite particle systems as solvable models for β =2 in one space dimension.

【Research Methods】

Our team is consisting of one representative, and 6 cooperators, post doctors, students, and others. We will study: 1) New theory of stochastic analysis of infinite particle systems, 2) Universality of stochastic dynamics, 3) Dynamical rigidity 4) Lattice Gasses, 5) Stochastic partial differential equations, 6) Random media.



Poisson/Ginibre

【Expected Research Achievements and Scientific Significance】

We post the typical examples of two dimensional infinite particle systems such as Poisson and Ginibre point processes. The former has no interactions, while the latter has a very long range and extremely strong interaction potentials. In fact, Ginibre is the one of the main objects of our research.

We expect such strong interactions yield novel, unexpected, and interesting phenomena. Existing methods confront difficulty to treat such strong interacting systems, our new theory overcomes this difficulty.

【Publications Relevant to the Project】

・ Infinite-dimensional stochastic differential equations, related to random matrices, Hirofumi Osada, Probability Theory Related Fields (2012) 153:471–509
・ Interacting Brownian motions in infinite dimensions with logarithmic interaction potentials, Hirofumi Osada, The Annals of Probability 2013, Vol. 41, No. 1, 1–49
・ Interacting Brownian motions in infinite dimensions with logarithmic interaction potentials II: Airy random point field, Hirofumi Osada, Stochastic Processes and their Applications 123 (2013) 813–838

【Term of Project】 FY2016-2020

【Budget Allocation】 90,100 Thousand Yen

【Homepage Address and Other Contact Information】

http://www2.math.kyushu-u.ac.jp/~osada/public-2_html/index.html