# Katori-Group Seminar
# with Prof. Helmut R. Brand

**Date and Time: 3 March 2023, 13:30-14:30**

**Venue: Room 3309, 3rd floor, Building No.3, Korakuen Campus, Department of Physics, Chuo University**

**Program:** (15 min. talk + 5 min. discussion for each)

**13:30-13:50 Yuya TANAKA**
**Rings-to-Disk Transitions in Complex Eigenvalue Processes**

**13:50-14:10 Ayana EZOE**
**Switching Interacting Particle Systems Modeling Foraging Path Selection by Ants**

**14:10-14:30 Saori MORIMOTO**
**Classifications and Generalizations of Traffic Flow Models in Statistical Mechanics**

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# Abstracts

## Yuya TANAKA

**Rings-to-Disk Transitions in Complex Eigenvalue Processes**

First I show two movies of complex eigenvalue processes of the non-Hermitian matrix-valued Brownian motions starting from two different initial matrices. The first one shows a simple growing of a disk starting from a point source. The second one shows a transition from a single ring to a disk. I am interested in the latter case and studying its generalization as explained in this talk. I briefly review the hydrodynamic equations of eigenvalue processes following the paper by Burda et al. (Nucl. Phys. **B 897** (2015) 421). The solutions of the hydrodynamic equations describe both cases well. We found the initial matrices showing transitions from double rings to a disk of eigenvalue distributions. I report the double-ring solutions of the hydrodynamic equations. Finally I discuss the general case starting from $m$-multiple rings with an arbitrary integer $m$.

## Anaya EZOE

**Switching Interacting Particle Systems Modeling Foraging Path Selection by Ants**

Collective behaviors and swarm intelligence of ants have been extensively studied experimentally, and mathematical modelling is a challenging subject. Recently Nishimori's group experimentally showed that ants perform a situation-dependent switching of the primarily relied cues from the recruit pheromones to the visual ones in the foraging path selection. I use the notion of switching interacting particle systems introduced by den Hollander's group in probability theory in which slow particles and fast particles are switching randomly with a given transition rate. Here I propose a stochastic model on a plane lattice, where the hopping of particles has two modes, slow and fast. The slow mode represents the pheromone-mediated-walk and the fast model represents the visual-cues-mediated-walk of ants. I will show the simulation results of my model.

## Saori Morimoto

**Classifications and Generalizations of Traffic Flow Models in Statistical Mechanics**

One of the most serious issues in modern society is a traffic jam. Starting from a simple cellular automaton (CA) model named Rule-184, a series of improvements of traffic flow models have been reported in statistical mechanics. The main purpose of the improvements was to reproduce the fundamental diagram (the density-flow diagram) obtained by empirical data. Following 'a general stochastic traffic CA model' proposed by Sakai et al. (J. Phys. A: Math. Gen. **39** (2006) 15327), I have programmed in Python my own 'generalized CA model' which includes the quick-start model and the slow-to-start model. In the preset talk, I will explain a variety of models and demonstrate the numerical simulations showing dependence of the obtained fundamental diagrams on the parameters of my model. I expect that the traffic flow models studied so far can be classified into two categories by the following two factors: drivers' individual factor and the eivironmental factor.