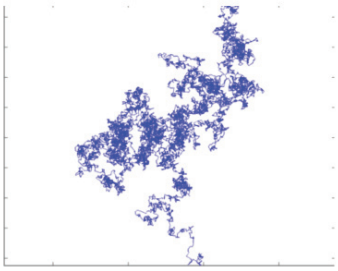
MILLENNIUM NUCLEUS OF NATURAL SCIENCES

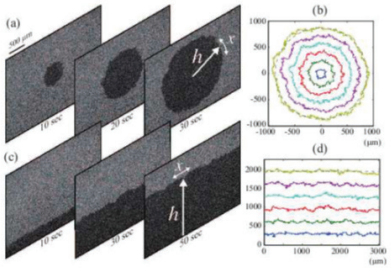
MILLENNIUM NUCLEUS CENTER OF STOCHASTIC MODELS OF COMPLEX AND DISORDERED SYSTEMS

Area of Impact: **Mathematics**
Specialty: **Mathematics**

When we roll the dice, we don't know with certainty the number that will appear face up, we only know the probability of rolling one of the numbers. This behavior is repeated in virtually all areas of life, with a wide range of complexity, from the smallest to the most gigantic scales.

Behaviors determined by chance such as the movement of electrons in certain conductive materials, growth of bacterial colonies, spread of interfaces in liquid crystals, weather conditions, vehicular traffic, social networks or the stock market could only be studied under Probability Theory. The study of these random phenomena, from the most varied disciplines, has created the need to develop new mathematical tools to better understand them, work which we are currently carrying out at the Millennium Nucleus Center of Stochastic Models of Complex and Disordered Systems. Our team consists of researchers from two major universities: the Pontifical Catholic University of Chile and the University of Chile. In addition, we have a wide network of active collaboration with scientists from various universities in Latin America, the US, Canada and France, among others. Moreover, as a way to share, promote and motivate knowledge of mathematics in our society, we are currently developing outreach and educational projects.





MAIN ACHIEVEMENTS

- Random matrices, orthogonal polynomials and Brownian bridges: discovery of explicit formulas describing the typical movement of a curve in random or disordered environments. In addition, exact relationships are established between these models, called Brownian bridges, with certain matrices with random coefficients.
- Time-dependent random walks in random environment: in the context of modeling the random motion of a point in cluttered environments that evolve over time, it is established that fluctuations in the position of the point are Gaussian (Central Limit Theorem).
- Microscopic modeling of the Boltzmann equation: A result that quantifies the proximity of a microscopic particle model and the Boltzmann equation modeling the evolution of systems with many degrees of freedom has been established, with significant improvement of the estimates known to date.

CONTACT INFORMATION

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NÚCLEO MILENIO Modelos Estocásticos de Sistemas Complejos y Desordenados

MILLENNIUM NUCLEUS
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RESEARCHERS

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RESEARCH TOPICS

- **The Kardar-Parisi-Zhang equation and its types of universality.**
- **Midfield particle systems.**
- **Particle systems in spatial interaction.**
- **Random walks in random environments.**
- **Random polymers.**
- **Stochastic differential equations and fundamental solutions.**
- **Stochastic processes convergence towards equilibrium.**
- **Stochastic networks.**

NOTED OUTREACH ACTIVITIES

- **4 workshops on Probability and Stochastic Models for high school students,** as an extension activity of the (National) School Championship of Mathematics CMAT. These workshops took place in Santiago, Talca and Valdivia. The goal of each was to encourage a reflection on the role of randomness in various applied sciences and the way we perceive the world, exemplifying how mathematics allows us to confront chance.

PRODUCTIVITY PUBLICATIONS (2015)
ISI: 13

ACTIVE MILLENNIUM NUCLEUS CENTER
From 2013 to 2016
The Millennium Nucleus Centers can be renewed after 3 years, reaching a maximum of 6 years.

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