NAGAO, Taro Professor

Office: Rm 508 in Math. Bldg.

Telephone: +81 (0)52–789–5392 (ext. 5392)

E-mail: nagao@math.nagoya-u.ac.jp

Website: http://www.math.nagoya-u.ac.jp/~nagao/nagaoeng.html

Membership of academic societies:
The Physical Society of Japan

Research Interest:

- Random matrix theory and its applications
- Semiclassical quantum theory

Research Summary:

I study random matrices from the viewpoints of fundamental theory and various applications. The theory of random matrices (matrices with random number elements) originated in the field of mathematical statistics at the beginning of the twentieth century. Since Wigner introduced random matrices to the research of nuclear physics, the range of their applications has been expanded to many areas, including analytic number theory, combinatorics, elementary particle physics, solid state physics, statistical mechanics and ecology. In particular, the developments in the last two decades can be described as explosive and new discoveries have been reported one after another.

One of the most important problems in random matrix theory is the universality of energy level statistics. It is known that the energy levels of quantum systems are distributed according to universal laws depending on the underlying classical dynamics. If the underlying classical dynamics is chaotic, universal level correlations are observed in agreement with the prediction of random matrix theory. I have investigated the relation between random matrices and semiclassical quantum theory in order to clarify the cause of the universality.

Random matrices can also be applied to the network theory as mathematical models describing the connection pattern of networks. The network theory is a focus of current interest due to the popularization of mobile phones and internet. I wish to contribute to the study of such realistic problems, and as well to obtain inspirations from them to deepen the understanding of the fundamental theory.

Major Publications:

[1] T. Nagao, Correlation functions for multi-matrix models and quaternion determinants, Nucl. Phys. **B602** (2001) 622-637.

[2] T. Nagao, Dynamical correlations for vicious random walk with a wall, Nucl. Phys. **B658** (2003) 373-396.

[3] T. Nagao and T. Sasamoto, Asymmetric simple exclusion process and modified random matrix ensembles, Nucl. Phys. **B699** (2004) 487-502.

[4] T. Nagao, P. Braun, S. Müller, K. Saito, S. Heusler and F. Haake, Semiclassical theory for parametric correlation of energy levels, J. Phys. A: Math. Theor. **40** (2007) 47-63.

[5] P.J. Forrester and T. Nagao, Eigenvalue statistics of the real Ginibre ensemble, Phys. Rev. Lett. **99** (2007) 050603.

[6] T. Nagao and G.J. Rodgers, Spectral density of complex networks with a finite mean degree, J. Phys. A: Math. Theor. **41** (2008) 265002.
[7] G. Akemann and T. Nagao, Random matrix theory for the Hermitian Wilson Dirac operator and the chGUE-GUE transition, J. High Energy Phys. 2011 (2011) 60.
[8] G.J. Rodgers and T. Nagao, Complex Networks, The Oxford Handbook of Random Matrix Theory (ed. by G. Akemann, J. Baik and P.Di Francesco, 2011) Chapter 43.

Awards and Prizes:

- Ryogo Kubo Memorial Prize (2011) "Random matrix theory and its applications to physics"

Education and Appointments:

1994 Doctor (Science), University of Tokyo
1994 Assistant Professor, Osaka University
2004 Associate Professor, Nagoya University
2009 Professor, Nagoya University

Message to Prospective Students:

Possible themes in the master course can be listed as, for example, probability theory, statistical mechanics, chaotic dynamical systems and network theory. These themes are universal and fundamental subjects in mathematical sciences, and deeply related to the theory of random matrices. It is also possible to treat other themes, depending on the wish of the participants.

In the doctor course, I recommend students to take part in the research of novel areas, in which the number of researchers is still relatively small, and to create their own styles of research. I also like to encourage them to find influential and solvable problems by keeping eyes on the newest developments.