Nakanishi, Tomoki Professor

Office: Rm 406 in Math. Bldg.

Telephone: +81 (0)52–789–5575 (ext. 5575)

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

Website: http://www.math.nagoya-u.ac.jp/~nakanisi/

Membership of academic societies:
Japanese Mathematical Society

Research Interest:

- integrable systems
- cluster algebras
- quantum groups

Research Summary:

Since the late 80's I have been working on the mathematical methods and aspects of the integrable quantum systems, such as conformal field theories, S-matrix models, and quantum spin chains. Until 2008, my method was mainly based on the affine Lie algebras and their quantizations (quantum groups). In that method we found various interesting interrelations between integrable systems and representation theory of Lie algebras and quantum groups. To name few key words, the level-rank duality, the Kirillov-Resehtikhin modules, the dilogarithm identities, Q-, T- and Y-systems, q-characters, fermionic formulas, and so on. Many problems were solved (by myself and other researchers) as a result of the development of the representation theory of quantum groups in these twenty years, but some problems were left almost untouched.

Since 2008, I drastically changed the strategy, and started to study these problems from the point of view of *cluster algebras*. The cluster algebras are a new class of commutative algebras introduced by Sergey Fomin and Andrei Zelevinsky around 2000. (So, it is one of mathematics in *this* century!.) The original motivation of the introduction of cluster algebras was to study the structure of the coordinate ring of some algebraic varieties. However, it turns out that a cluster algebra is a key concept to understand some of the unsolved problems mentioned above, and, amazingly and unexpectedly, some of the seemingly untouchable problems were suddenly solved with this new method.

Here I list some of the main results which I obtained with several collaborates. See the next section for the list of references.

- The dilogarithm identities for the quantum affine algebras of simply laced type [1].
- The periodicity of Y-systems and the associated dilogarithm identities for the quantum affine algebras of nonsimply laced type [2].
- The tropicalization method in cluster algebras [2].
- The dilogarithm identities associated with any period of a cluster algebra [3].
- The duality of the c-vectors and the g-vectors [3].
- The relation between the classical and quantum dilogarithm identities [4].
- The determination of the c-vectors and d-vectors of the cluster algebras of finite type [5].
- The periodicity of the sine-Gordon Y-systems and the associated dilogarithm identities [6].

Major Publications:

(Only after 2008. See http://www.math.nagoya-u.ac.jp/ nakanisi/research/publications.html for the compete list)

[1] T. Nakanishi, Dilogarithm identities for conformal field theories and cluster algebras: simply laced case, Nagoya Math. J. **202** (2011) 23–43.

[2] R. Inoue, O. Iyama, B. Keller, A. Kuniba, T. Nakanishi, Periodicities of T and Y-systems, dilogarithm identities, and cluster algebras I: Type B_r, arXiv:1101.1880, to appear in Publ. RIMS.

[3] T. Nakanishi, Periodicities in cluster algebras and dilogarithm identities, in Representations of algebras and related topics (A. Skowronski and K. Yamagata, eds.), EMS Series of Congress Reports, European Mathematical Society, 2011, pp.407-444.

[4] R. M. Kashaev, T. Nakanishi, Classical and Quantum Dilogarithm Identities, SIGMA **7** (2011), 102, 29 pages.

[5] T. Nakanishi, S. Stella, Diagrammatic description of c-vectors and d-vectors of cluster algebras of finite type, arXiv:1210.6299.

[6] T. Nakanishi, S. Stella, Wonder of sine-Gordon Y-systems, arXiv:1212.6853.

Education and Appointments:

1985-1990	Graduate School of Science, Tokyo University
	(Doctor in Science, 1990)
1990–1994	Assistant Professor, Nagoya University
1992–1994	JSPS Fellow for Research Abroad, Harvard University
1994–	Associate Professor, Nagoya Univerisy
2012	Research Member, MSRI, Berkeley

Message to Prospective Students:

You do not have to follow my research interest. On the contrary, it is important to find your research interest for yourself, because in most cases the research in the graduate school will influence decisively the lifetime direction of your research.