Office: Rm 447 in Sci. Bldg. A
Telephone: +81 (0) 52−789−2417 (ext. 2417)
E-mail: kanno@math.nagoya-u.ac.jp
Membership of academic societies:
JMS (The Mathematical Society of Japan),
JPS (The Physical Society of Japan)

Research Interest:

- Topological gauge/string theory and enumerative geometry
- Supersymmetric gauge theories and integrable system

Research Summary:

I am working on mathematical physics. In particular my recent interest is in topological gauge/string theory and supersymmetric gauge theories. Gauge theory, or the Yang-Mills theory is the most fundamental mathematical framework underlying the Standard Model of Elementary Particles, which is being confirmed by the recent discovery of "Higgs particle" by LHC at CERN. However, the Standard Model still has a few puzzles and does not incorporate gravity. The idea of supersymmetry is expected to resolve some of the puzzles and string theory is the most promising candidate for the unified theory including gravity.

In the study of these theories the quantum dynamics at strong coupling plays a crucial role. This is a difficult problem in general, since we cannot rely on the perturbation theory, which has been successful in the Yang-Mills theory at weak coupling. In such a circumstance exactly solvable models, even if they are toy models, are very valuable, since they will tell us some aspects of quantum dynamics beyond the perturbation theory. They are also called (quantum) integrable system. Exact solvability in quantum filed theory usually follows from infinite dimensional symmetry and/or the idea of dualities which exchanges the weak coupling and the strong coupling regions. Topological gauge/string theory is a typical example. The representation theory of infinite dimensional symmetry and the combinatorics are main mathematical tools for exact solvability. Combined with the idea of the moduli space, exactly solvable models in supersymmetic gauge/string theories sometimes "solve" hard enumerative problems in symplectic/complex geometry, for example through the mirror symmetry.

Major Publications:

[1] H. Kanno, Weil Algebra Structure and Geometrical Meaning of BRST Transformation in Topological Quantum Field Theory, *Z. Phys.* **C43** (1989) 477-484.

[2] T. Inami and H. Kanno, Lie Superalgebraic Approach to Super Toda Lattice and Generalized Super KdV Equations, *Commun. Math. Phys.* **136** (1991) 519-542.

[3] L. Baulieu, H. Kanno and I.M. Singer, Special Quantum Field Theories in Eight and Other Dimensions, *Commun. Math. Phys.* **194** (1998) 149-175.

[4] T. Eguchi and H. Kanno, Topological Strings and Nekrasov's Formulas, *JHEP* **0312** (2003) 006.

[5] H. Awata and H. Kanno, Instanton counting, Macdonald function and the moduli space of D-branes, *JHEP* **0505** (2005) 039.

Education and Appointments:

1989	JSPS post-doctoral fellow at Yukawa Institute, Kyoto
1991	Post-doctoral fellow at ICTP, Trieste
1992	Research fellow of the Nishina memorial foundation at DAMTP, Cambridge Univ.
1993	Assistant professor, Department of Mathematics, Hiroshima university
1995	Lecturer, Department of Mathematics, Hiroshima university
1998	Associate professor, Department of Mathematics, Hiroshima university
2001	Associate professor, Graduate school of Mathematics, Nagoya university
2004	Professor, Graduate school of Mathematics, Nagoya university
2010	Joint appointment at KMI (Kobayashi-Maskawa Institute), Nagoya university

Message to Prospective Students:

The recent topics of Small Group Class (the tutorial seminar) in the master course include the theory of solitons and instantons, the geometry of generalized complex structure and the quantum theory of gauge fields. Though basic knowledge of classical and quantum mechanics is preferable, it is not absolutely required. More important point is that you are full of curiosity.

The theory of integrable systems is one of the main subjects in mathematical physics. A typical method in mathematical physics is to construct the models of physical system of interest and analyze them by making a good use of mathematics. In this sense the exactly solvable models are quite remarkable both in mathematical and physical points of view. They give us valuable lessons on physical phenomena which are hard to access by approximations, while deep mathematical structures, such as symmetry and duality, underlie the integrability of the models. In the study of integrable systems the computation by hand and/or computers is also an important business.

To give you some impression on the theory of integrable systems, let me mention my favorite examples; the first one is the theory of solitons which is closely related to conformal field theory on the Riemann surface. A good reference is the following textbook:

- T. Miwa, M. Jimbo and E. Date ; translated by Miles Reid, Solitons : differential equations, symmetries and infinite dimensional algebras, Cambridge University Press , 2000.

The second example is the Seiberg-Witten theory of $\mathcal{N} = 2$ supersymmetric Yang-Mills theory in four dimensions. You may find several good review articles at “arXiv” : http://arxiv.org/. The followings are examples in early days:

- Adel Bilal, Duality in N=2 SUSY SU(2) Yang-Mills Theory, http://arxiv.org/abs/hep-th/9601007.
- L. Alvarez-Gaume and S.F. Hassan, Introduction to S-Duality in N=2 Supersymmetric Gauge Theory, http://arxiv.org/abs/hep-th/9701069.