Plan of my research **Zengo Tsuboi**

I will research solvable models in field theories and statistical mechanics from a point of view of mathematical physics [1]. For example, I will continue to research the following topics.

(1) Baxter Q-operators

Baxter Q-operators were introduced by R. J. Baxter in the early 1970's when he solved the 8-vertex model. Bazhanov, Lukyanov, Zamolodchikov introduced transfer matrices in CFT and defined Baxter Q-operators as traces over infinite dimensional representations of a certain q-oscillator algebra. Their work is attracting interest from various areas in physics and mathematics, such as representation theory of quantum groups, ODE/IM correspondence, Bäcklund transformation in soliton theory (which is important in classical integrable system) and the algebraic Bethe ansatz in solvable lattice models. In view of this situation, Prof. V.Bazhanov (ANU) and I researched on new expressions (Wronskian-type formulae) on T-operators (transfer matrices) based on the Baxter Q-operators from 2003 to 2008. Mathematically, these correspond to quantum affine superalgebra analogues of Weyl character formulae. Or, they can be interpreted as a kind of q-(super)characters. Since we have already published our results on $U_q(\widehat{sl}(2|1))$ (as for eigenvalue formulae, on $U_q(\widehat{gl}(M|N))$), we are constructing Wronskian-type formulae on Q-and T-operators for more general quantum affine superalgebras [2]. I also would like to clarify properties of the Q and T-operators as τ-functions in the soliton theory. This contributes to mathematics (mainly representation theory) from a point of view of physics.

(2) Solvable models related to AdS/CFT correspondence

A paper on Y-system by N. Gromov, V. Kazakov and P. Vieira in January 2009 gave a considerable impact on the AdS/CFT community [cf. Integrability for the Full Spectrum of Planar AdS/CFT, arXiv:0901.3753 [hep-th]]. After a transformation of dependent variables, this Y-system becomes a union of two T-systems (specialized to $sl(2|2)$) in my paper in 1997. Thus we will be able to analyze the solutions of this Y-system if we consider Wronskian-type formulae similar to the ones in my paper in 2009. Now I am collaborating with Prof. Kazakov and Dr. Gromov on problems related to this. I will continue collaboration with them for the time being.

[1] This contains both to apply mathematics to physics (applied mathematics) and to conjecture theorems in mathematics based on methods in physics.

[2] I will give not only eigenvalue formulae but also operator realizations of them based on the representation theory of q-oscillator algebras.