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 $U_q(\widehat{sl}(2|1))$ and $Y(gl(M|N))$, we are constructing Wronskian-type formulae on Q-and T-operators for more general quantum affine superalgebras. I also would like to clarify properties of the Q and T-operators as τ-functions in the soliton theory. For this purpose, we will use a new construction of Baxter Q-operators based on 'co-derivative' by Kazakov, Leurent and I. Last year, we clarified a relation between Baxter Q-operators and Bäcklund transformations in the soliton theory on the level of the operator. Then this year, we are investigating a relation between our new method and the soliton theory based on fermion operators by the Kyoto school in the '80s. We want to establish a systematic theory on the Baxter Q-operators for any quantum affine algebras. We will also investigate a relation between our new method and a traditional method by Bazhanov, Lukyanov, Zamolodchikov based on oscillator algebras.

This contributes to mathematics (mainly representation theory) from a point of view of physics.

(2) Solvable models related to the AdS/CFT correspondence

There is a model related to centrally extended $su(2|2)$. This model was proposed in relation to the AdS/CFT correspondence. It is related to the one-dimensional Hubbard model and allows q-deformation. This year, we would like to investigate a T-system and Wronskian-type formulae by Baxter Q-operators for this q-deformed model.

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