Name **MATSUO, Atsushi**

Field : **Group Theory / Combinatorics,**
Lie groups / Lie Algebras / Representation Theory,

Keywords : Infinite-dimensional Lie algebras, Finite simple groups, Vertex operators, Conformal field theory, Quantum integrable systems

Summary of Current Research I am working on symmetries of various mathematical structures. More specifically, I am interested in an infinite-dimensional algebraic structure called a vertex operator algebra and topics in finite groups and Lie algebras related to it. They are closely related to string theory and 2-dimensional conformal field theories in theoretical physics.

Nowadays, researches in mathematics are usually worked over many areas of mathematics, and my own research is not an exception. Lie Groups / Lie Algebras / Representation Theory is the field closest to mine among others, and Group Theory / Combinatorics is probably the next. There are relationships also to Differential Geometry, Topology, Complex Analysis / Complex Geometry, and Differential Equations. Here is a brief list of what I have worked so far:

- Universal formulas related to simple Lie algebra.
- Classification of vertex operator algebras with large symmetries.
- Automorphism groups of vertex operator algebras and the Monster simple group.
- Study of the axioms for vertex algebras.
- q-Difference equations associated with representations of quantum affine algebras.
- Study of integnrable connections with Weyl group symmetries.
- Knizhnik-Zamolodchikov equations and generalized hypergeometric functions.

Requests to Students Roughly speaking, doing research in mathematics is to find a new theorem and to prove it. I would remind the students that broad knowledge, although being useful, may sometimes prevent one from recognizing a new theorem. In my honest opinion, the most important thing is to pursuit the truths by thinking as deep as possible. In doing so, ability of verification, calculation and imagination etc. will support and help one's own consideration, besides the importance of health and physical strength.

I will not require students to fulfil any prerequisites further than standard undergraduate courses in mathematics departments, but if you familiar with one of the following topics, then you can start your research under my supervision by developing it:

Semi-simle Lie algebras, Codes and lattices, Reflection groups and root systems,
Finite simple groups, Riemann surfacs, Modular forms,
Tensor categories and Hopf algebras, Quantum mechanics.

Research areas of my students need not be the same as mine. Below is a list of the themes of my former students and postdocs.

- Construction of exceptional W-algebras.
- Triangulated tensor categories.
- Classification of framed vertex operator algebras.
- Construction of 2-local subgroups of the Monster simple group.
- Decompositions of the Moonshine Module.
- Mirror symmetry of hypersurfaces.
- Representation theory of generalized Kac-Moody algebras.
- Classification of superconformal algebras.
- Supersymmetry and holonomy groups.
- Representation theory of quantum affine algebras.