Name: **MATSUO, Atsushi**

Research field: **Group Theory/Ring Theory/Combinatorics**
Lie Groups/Lie Algebras/Representation Theory

Key words: Vertex algebras, Lie algebras, Finite simple groups,
Nonassociative algebras, Conformal field theory,
Quantum integrable systems

Present reseach. 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, mathematical research often crosses over many areas of mathematics, and my own research is not an exception. 'Lie Groups/Lie Algebras/Representation Theory' and 'Group Theory/Ring Theory/Combinatorics' are the fields closest to mine among others, while 'Differential Geometry,' 'Topology,' 'Complex Analysis/Complex Geometry,' and 'Differential Equations' are also related. Here is a brief list of what I have worked on 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.

Notice for the 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 as well as health and physical strength will support and help one's own consideration

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

Semisimle 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. Listed below are themes of my former students and postdocs.

- Classification of axial algebras
- Modular differential equations
- Geometric realization of classical W-algebras
- Genus of vertex algebras
- Automorphism groups of vertex algebras
- Construction of exceptional W-algebras
- Triangulated tensor categories
- Classification of framed vertex operator algebras
- Construction of 2-local subgroups of the Monster simple group
- Decomposition of the moonshine module
- Mirror symmetry of hypersurfaces
- Classification of superconformal algebras
- Supersymmetry and holonomy groups
- Representation theory of quantum affine algebras