# Research design

I have studied internal spaces preserving supersymmetries in string compactification. In Ref. [1], supersymmetric non-linear sigma models were obtained from $E_8 \times E_8$ heterotic string theory. The 6-dimensional internal space was the intersecting 5-brane which was determined by an 1-dimensional harmonic function. A part of gauge connection was identified with the spin connection with torsion(Hull connection) and then total gauge symmetry was partially broken. This solution broke $E_8$ to the subgroup $E_6$ because the holonomy of the Hull connection was $SU(3)$. In Ref. [1], the associated chiral spectra were compared with those of a $E_8/E_6$ type sigma model. According to Ref. [1], the sigma model $E_8/(E_6 \times SU(2) \times U(1))$ predicts that there are two chiral and one anti-chiral fermions. The prediction was confirmed by explicitly solving the gaugino equation of motion on the intersecting 5-barne backgroud, where gaugino equation of motion of heterotic string theory is written in terms of a special combination of the spin and gauge connections and is called gaugino-Dirac equation. Consequently, two chiral and one anti-chiral fermions were obtained by solving the gaugino-Dirac equation. However, $E_8/SO(10)$ type sigma model is more favourable than $E_8/E_6$ in phenomenological view, which includes three families of quarks and leptons.

To realize $E_8/SO(10)$, I attempted to construct supersymmetric solutions of heterotic supergravity, which admit the holonomy of the Hull connection is $SO(6)$ in Ref. [2]. In this paper, I identified a part of the gauge symmetry with Hull connection and then constructed the supersymmteric solutions which break $E_8$ to $SO(10)$. However, I didn't compare the associated chiral spectra with that of $E_8/SO(10)$ type sigma model. In order to compare, I need to solve the gaugino Dirac equation on the geometry in Ref. [2]. Then, I will compare the spectra with predicted ones from $E_8/SO(10) \times U(1)^3$ sigma model.

Reference

[1] S. Mizoguchi and M. Yata, Prog. Theor. Exp. Phys. **2013**, 53B01 (2013)
[2] K.Hinoue, S.Mizoguchi and Y.Yasui, Phys. Rev. D **90**, 106009 (2014)