Past research

So far I have studied non-perturbative and topological effects of superstring theories. At first I tackled USp matrix model which is a constructive realization of Type I superstring. Itoyama and Matsuo studied Berry's phases of the T-dualized USp matrix model and revealed the geometric structure, partially. I progressed the calculation and found that two kinds of monopoles are included in the model in collaboration with Itoyama and Chen. We obtained monopoles that live in five-dimensional space and nine-dimensional space. These monopoles are described by a chirally projected spin connections of spheres S^4 and S^8. These connections are equal to those of BPST instanton and GKS instanton, respectively. A five-dimensional monopole of this type is called Yang monopole. I also calculated the geometric phases of T-dualized IIB matrix model. In the case of IIB matrix model, I found only nine-dimensional monopoles in our method.

Next I studied the monopole in six-dimensional space-time to realize the Yang monopole in a continuous field theory. To do so, I reviewed the Tchrakian's model with gauge group SO(5) with Hosotani and Nitta. The model consists of a gauge field and a Higgs field. The gauge field belongs to the adjoint representation of SO(5) and the Higgs to the fundamental or vector representation. The model has F^4 terms and no bilinear term. The interpretation of Hamiltonian formalism of this model include difficulty. Somehow we consider the energy in static configurations. The energy is positive definite and we can consider the Bogomolny bound. The energy is bound by a topological charge which is given by the integration of the second Chern class on the spacial infinity S^4. The charge is equivalent to the instanton number. The asymptotic behaviour is described by one abelian three form gauge field and unbroken gauge field in the monopole background. The three form gauge field may couple to membrane.

Recently I have computed the partition function of reduced matrix models with Itoyama and Yoshioka. Reduced matrix models mean models which are given by dimensional reduction of higher dimensional supersymmetric gauge theories with various groups. We rearranged the multiplets of USp matrix model and found that the action is topologically exact. The functional integral was calculated by Moore-Nekrasov-Shatashvili's method. However there are few works about the computation of these integrals with gauge group SO and USp. We have studied easier counterparts to progress the method for SO and USp cases. We calculated the partition functions of matrix models reduced from four-dimensional models.

I also calculated eigenvalues of the scalar Laplacian of toric Sasaki-Einstein manifolds $Y^{p,q}$ with Sakaguchi and Yasui. The calculation showed the AdS/CFT correspondence between $\mathcal{N} = 1$ superconformal theory and supergravity.