Gauge Field Localization in Models with Large Extra Dimensions

Tokyo Woman's Christian University Norisuke Sakai
E-mail: sakai@lab.twcu.ac.jp

Apart from supersymmetric theories, the most interesting possibilities for unified theories beyond the standard model are models with large extra dimensions, that is, the brane-world scenario. The domain walls are the simplest branes on which realistic models can be constructed. However, localization of gauge fields on domain walls has been notoriously difficult in field theories, although scalar and spinor fields have been successfully localized. An explicit model of Abelian gauge field localized on a domain wall in five-dimensional space-time has been obtained using tensor multiplet [1]. However, it was difficult to extend the idea of tensor multiplet to incorporate the non-Abelian local gauge symmetry. It has been pointed out that the bulk outside of the domain wall has to be in the confining phase, rather than the Higgs phase. Many years ago, a model of (anti-)dielectric Lagrangian has been proposed as a classical representation of the confining vacuum [2]. This can be visualized as a position-dependent gauge coupling, which represents confinement in regions where the gauge coupling tends to infinity. Inspired by these considerations, we propose a mechanism using the position-dependent gauge coupling to localize non-Abelian gauge fields on domain walls in five-dimensional space-time. Low-energy effective theory posseses a massless vector field, and a mass gap. The four-dimensional gauge invariance is maintained intact. We obtain perturbatively the four-dimensional Coulomb law for static sources on the domain wall. BPS domain wall solutions with the localization mechanism are explicitly constructed in the $U(1) \times U(1)$ supersymmetric gauge theory coupling to the non-Abelian gauge fields only through the cubic prepotential, which is consistent with the general principle of supersymmetry in five-dimensional space-time.

This work is done in collaboration with Kazutoshi Ohta and is published in Progess of Theoretical Physics **124**, 71-93 (2010) [arXiv:1004.4078] [3].

References

[1] Y. Isozumi, K. Ohashi and N. Sakai, JHEP **0311** (2003) 061 [arXiv:hep-th/0310130].

[2] J. B. Kogut and L. Susskind, Phys. Rev. D **9** (1974) 3501; R. Fukuda, Phys. Lett. B **73** (1978) 305; Mod. Phys. Lett. A **24** (2009) 251.

[3] K. Ohta and N. Sakai, Prog. Theor. Phys. **124**, 71 (2010) [arXiv:1004.4078 [hep-th]].