

Citation of the 2016 Nishina Asia Award

**Evaluation of Supersymmetry Indices of M2 and M5 Brane Theories**

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Professor Kim has produced very deep and influential papers on several topics in quantum field theory and string theory, bringing new insights to topics which were regarded as very difficult. There are two fundamental objects in string/M theory. They are called M2 and M5 branes. They are objects carrying electric and magnetic charges of the 3-form tensor field of 11 dimensional supergravity. Understanding of the physics of these two objects has been a significant stepping stone in understanding the ultimate theory of string/M theory, which is the unique consistent theory of quantum gravity. Prof. Kim's work has been pivotal in recent progress of our understanding of M2 and M5 brane physics.

Professor Kim has calculated the index function on M2 branes by the localization method of the path integral of the ABJM (Aharony-Bergman-Jafferis-Maldacena) model of M2 branes on  $S^2 \times S^1$ [1]. BPS magnetic monopole operators in these theories are all included and the resulting index function matches exactly with what is obtained from the dual  $AdS_4 \times CP^3$  calculation.

This work had a significant influence in the further development of the subject. It shows Prof. Kim's **originality**, keen and deep insights into the subject, **and** superb analytic skill.

Professor Kim's second major result is the computation of the superconformal index in the 6-dimensional (0,2) (chiral) theory[2]. The (0,2) superconformal field theory on M5 branes is a notoriously difficult theory whose exact nature is not known yet. It is very difficult to approach the problem directly and Prof. Kim's approach via 5-dimensional Yang-Mills theory on  $S^5$  was novel and refreshing.

There exists no known Lagrangian in the (0,2) theory. Nevertheless Prof. Kim and collaborators were able to compute the exact index of this theory

using the method of supersymmetric localization. Thanks to the result we have a detailed understanding of the spectrum of the operators of this theory even in the absence of Lagrangian.

Professor Kim's papers are of very high quality and in particular his results on supersymmetric field theories in 3 and 6 dimensions are outstanding. They are very well suited to the Nishina Asia Award.

## References

- [1] S. Kim "The Complete Superconformal Index for N=6 Chern-Simons Theory", Nucl. Phys. **B821** (2009) 241-284.
- [2] H. Kim and S. Kim, "M5-branes from Gauge Theories on the 5-Sphere", JHEP 1305 (2013) 144.