Citation of 2013 (the 1st) Nishina Asia Award

"The Fluid Gravity Correspondence" by Prof. Shiraz Minwalla

Discovery of AdS/CFT correspondence between gravity theory in Anti-de-Sitter space in d+1 space-time dimensions and conformally invariant gauge theory on its d-dimensional boundary has been a major advancement in string theory during the last decades. Under AdS/CFT correspondence strong coupling regime of quantum gauge theory is mapped onto weakly coupled regime of gravity and thus difficult strong coupling dynamics of quantum field theory may possibly be solved by a classical theory of gravitation. Detailed comparison of particle spectra of corresponding gauge and gravity theories has been carried out and provides a very strong evidence for the AdS/CFT correspondence.

When we consider the black hole (brane) sitting inside AdS space, space-time possesses additional parameters corresponding to the velocity (boost) and temperature of the black hole. When these parameters are perturbed and promoted to slowly varying functions (Nambu-Goldstone modes) of the boundary coordinates, perturbed velocity must obey a system of differential equations so that the black hole still obeys Einstein's equation. Professor Minwalla and his collaborators have made a remarkable discovery that these differential equations for black hole perturbations are identical to the equations of fluid dynamics, i.e. Navier Stokes equations, with specific values for fluid parameters. Thus Prof. Minwalla has found that two basic equations of theoretical physics, Einstein's equation of general relativity and Navier Stokes equation of fluid dynamics coincide with each other in the setting of AdS/CFT. This phenomenon is called as the Fluid Gravity Correspondence.

Fluid Gravity Correspondence is an important advancement of AdS/CFT and also may be considered as a rigorous version of membrane paradigm proposed by Thorne and his collaborators some time ago. Fluid Gravity Correspondence is now being vigorously studied by a number of string and black hole physicists.