

Rajesh Gopakumar

Research Summary:

In the last year, I have continued to build on my attempts to reconstruct the string worldsheet theory dual to free large N Yang-Mills theory. In work with Justin David, we obtained the explicit form of the worldsheet correlators for a special class of field theory correlators. The explicit form exhibited a number of properties expected of worldsheet correlators such as manifest crossing symmetry. The precise form of the answer also shows potentially interesting connections to correlators of the 2d Ising model. In work with O. Aharony, J. David, Z. Komargodsky and S. Razamat, we studied another aspect of the worldsheet correlators which arises in the case of certain free field diagrams. This is the issue of localisation on moduli space of the corresponding worldsheet correlators. We studied how this arises in some detail and found an interesting connection between the localisation on moduli space and the lack of space-time contractions between the corresponding field theory operators. We are continuing to investigate these and other aspects in trying to learn some general lessons about the worldsheet theory.

Another strand of research has been to study black holes in Anti-de Sitter spaces using the gauge-gravity duality. With Suvankar Dutta we tried to see how the membrane paradigm might be realised in the specific context of the AdS/CFT duality for black holes in AdS spaces. We have also been studying the physics of charged black holes in AdS_5 with the hope of quantitatively comparing the thermodynamics of near extremal black holes at weak and strong coupling.

Publications:

1. J. R. David and R. Gopakumar, *From spacetime to worldsheet: Four point correlators* JHEP **0701**, 63 (2007).
2. S. Dutta and R. Gopakumar, *On Euclidean and Noetherian entropies in AdS space* Phys. Rev. D **044007**, (2006).
3. R. Dijkgraaf, R. Gopakumar, H. Ooguri and C. Vafa, *Baby universes and string theory*, Conference Proceedings of Workshop on Einstein's Legacy, Toshiaki Sands. Int. J. Mod. Phys. D.15, 1581, (2006).

Preprints:

1. O. Aharony, J. David, R. Gopakumar, Z. Komargodsky and S. Razamat, *Comments on worldsheet theories dual to free large N gauge theories* (hep-th/0703141, to appear in Phys. Rev. D.).

Conference/Workshops Attended:

1. *MSRI program on "New Topological Structures in Physics"*, Berkeley, USA, May 2006.
2. *Strings 2006*, Beijing, China, June 2006.
3. *Ahrenschoop Symposium*, Berlin, Germany, Sep. 2006.
4. *24th IAGRG Meeting*, Delhi, Feb. 2007.

Visits to other Institutes:

1. Harvard University, USA, Apr. 2006.
2. University of California, Berkeley, May 2006.
3. University of California, Santa Barbara, USA, May 2006.
4. TIFR, Mumbai, Jun. 2006.
5. IISc, Bangalore, Mar. 2007.
6. IISER, Kolkata, Feb., Mar. 2007.

Invited Lectures/Seminars:

1. *From Spacetime to Worldsheet*, Duality Seminar, Harvard University, USA, Apr. 2006.
2. *From Spacetime to Worldsheet*, String Seminar, University of California, Berkeley, USA, May 2006.
3. *From Spacetime to Worldsheet*, String Seminar, University of California, Santa Barbara, USA, May 2006
4. *Strebel Differentials and String Theory*, Talk at Conference on New Developments in Gromov-Witten Theory. MSRI USA, May 2006.
5. *Three Lecture Series* Tea-duality seminars TIFR Mumbai. Jun. 2006.
6. *Strebel Differentials and String Theory*, Joint Mathematics- Physics Colloquium TIFR, Mumbai, Jun. 2006.
7. *From Spacetime to Worldsheet*, Plenary Talk Strings 2006 Beijing, Jun. 2006.

8. *From Spacetime to Worldsheet*, Ahrenshoop Symposium Berlin, Germany Sep. 2006.
9. *New Perspectives on Gravity from Gauge-String Duality* Plenary Talk, IAGRG-24, Jami Millia, Delhi, Feb. 2007.
10. *From Fields to Strings* Physics Colloquium IIScBangalore, Mar. 2007.
11. *Mini course on Extremisation Principles in Physics* IISER Kolkata, Feb., Mar. 2007.

Academic recognition/Awards:

- ICTP Prize, 2006.
- Swarnajayanthi Fellowship, 2006.

Other Activities:

1. Delivered popular lecture on *Spacetime and String Theory* at Techkriti 07, IIT, Kanpur, Feb. 2007.
2. Guided three VSP students, Oct. 2006.
3. Organised with other members of the String group, Informal workshop on String theory, Dec. 2006.
4. Member of various administrative committees.