

# Sudhakar Panda

## Research Summary:

We studied  $N = 4$  gauged supergravity theory in four dimensions aiming at constructing solutions that may provide a stringy explanation of cosmological problems. We used contracted special orthogonal (CSO) groups for gauging to obtain a non-trivial scalar potential. This gauged theory did not admit stable de Sitter solution. However, we found solutions corresponding to the so-called cosmological scaling solutions. These are interesting solutions which are expected to play a role in explaining the accelerating expansion of the universe. During this study we also established the conditions and proved a mathematical lemma on the existence of invariant metrics on CSO-algebras of rank twelve.

The effective action for gravitational interaction resulting from string theory contains, besides the usual two derivative terms, many higher derivative terms. The entropy of the black holes in this theory, thus, gets contributions from these higher derivative terms as well. A class of these black holes are found to have the same entropy as expected from supersymmetric black holes. This observation requires that the effective action itself should be supersymmetric. Since the effective actions are constructed in a way which does not guarantee manifest supersymmetry, one has to explicitly construct supersymmetric actions involving the higher derivative terms. We have made a lot of progress in this direction for Heterotic string theory and we expect to complete the project soon.

## Publications:

1. M.de Roo, D.B. Westra and Sudhakar Panda, *Gauging CSO groups in  $N = 4$  supergravity*, JHEP **09**, 011, (2006)
2. Sudhakar Panda, *Vacua in  $N = 4$  gauged supergravity*, Mathematical Physics Proc. **12th regional conf. Islamabad**, 190, (2006)

## Preprints:

1. M.de Roo, D.B. Westra and Sudhakar Panda, *Gauging CSO groups in  $N = 4$  supergravity*, hep-th/0606282
2. Sudhakar Panda, *Vacua in  $N = 4$  gauged supergravity*, HRI-P-06-08-004

## Conference/Workshops Attended:

1. ISM-06 (*Indian String meeting, Puri*), India, December 2006,

2. FTAG-V (*Field theoretic aspects of gravity*, Goa, India, December 2006,
3. *From Strings to LHC*, Goa, India, January 2007.

### **Visits to other Institutes:**

1. Centre for Theoretical Physics, Univ. of Groningen, Groningen, The Netherlands, September 2006,
2. TIFR, Mumbai, India, December 2006.

### **Invited Lectures/Seminars:**

1. *Fundamental particles in Nature and how they are held together (six lectures for school students)*, JBNSTS lectures, Aizwal, Mizoram, August 2006.
2. *What is Supersymmetry (two lectures)*, for B.Sc. students, G.C. Govt. college, Silchar, Assam, August 2006.
3. *Supersymmetry: a problem or solution?*, Colloquium, Univ.of Jamia-Millia Islamia, Delhi, August 2006.
4. *Constructing supergravity theory with higher derivative terms*, Invited talk in FTAG-V, Goa, December 2006.
5. *Brief review of String Cosmology*, Workshop, From Strings to LHC, Goa, January 2007.

### **Other Activities:**

1. Dean Administration, April-July, 2006.
2. Convener, Security Committee, 2006-07.
3. Member, Local Works Committee, 2006-07
4. Invited Member, Academic selection committee meeting, April 2006.
5. Participating member, Meeting of Registrars with JS (R&D), DAE, June 2006.
6. External Member, Ph.D defence board, Groningen university, September 2006.
7. Expert member, faculty selection board of Jamia Univ, November 2006.

8. Represented HRI in DAE meeting on panel discussion on suggestions for 6th Pay-commission, March 2007.
9. Taught a course on Quantum Field Theory under HRI Ph.D. course program, January-May 2007.
10. Supervised two students under the summer visiting students program of HRI, May, June and July 2007.