L. Sriramkumar

Research Summary:

During the last year, my research work was primarily focused on investigating the following problems in inflationary cosmology:

1. Planck scale corrections to the primordial spectrum
2. Amplification of tachyonic perturbations at super-Hubble scales
3. Generation of features in the primordial spectrum
4. Evolution of perturbations in bouncing universes

and the following issues in black hole physics:

1. Domain of validity of semiclassical gravity around black holes
2. Entropy of black hole and cosmological horizons in brane-world scenarios

I have been studying the issues 2-4 listed above under inflationary cosmology along with my graduate student Rajeev Kumar Jain. Brief description of one of the problems we have been investigating in this context can be found in his report. In what follows, I shall briefly describe the work I have been involved in understanding the domain of validity of semiclassical gravity around black holes.

Semiclassical gravity refers to the theory wherein a quantum matter field evolves in a classical gravitational background, and the backreaction of the quantum field on the gravitational background is assumed to be given by the expectation value of the stress-energy tensor of the quantum field. Such a semiclassical theory is expected to break down when the fluctuations in the backreaction term—viz. the stress-tensor of the matter field—turns out to be 'large'. With such a motivation in mind, we are presently involved in evaluating the noise kernel of the stress-energy tensor of a quantized, conformally coupled and massless scalar field around the $(2+1)$-dimensional Banados-Teitelboim-Zanelli black hole. In particular, we are interested in understanding the dependence of the amplitude of the fluctuations in the stress-energy tensor on the distance from the black hole.

Publications:

1. **L. Sriramkumar** and S. Shankaranarayanan, *Path integral duality and Planck scale corrections to the primordial spectrum in exponential inflation*, JHEP **0612**, 050 (2006).

Preprints:

1. H. K. Jassal and **L. Sriramkumar**, *Entropy of BTZ black strings using the brick wall approach*, gr-qc/0611102.

2. R. K. Jain, P. Chingangbam and **L. Sriramkumar**, *Amplification of tachyonic perturbations at super-Hubble scales*, astro-ph/0703762.

Conferences/Workshops Attended:

1. *Inflation+25: The First 25 Years of Inflationary Cosmology*, Institut d'Astro-physique, Paris, France, June 26–30, 2006.

2. *Field Theoretic Aspects of Gravity V*, Birla Institute of Technology and Science, Goa, December 18–23, 2006.

3. *XXIV Meeting of the Indian Association of General Relativity and Gravitation*, Jamia Millia Islamia, New Delhi, February 5-8, 2007.

Visits to other Institutes:

1. High Energy, Cosmology and Astroparticle Physics Section, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, July 4–18, 2006.

2. Institute of Physics, Bhubaneswar, August 21–24, 2006 and January 14–17, 2007.

3. Inter-University Centre for Astronomy and Astrophysics, Pune, December 24, 2006–January 1, 2007.

Invited Lectures/Seminars:

1. *An introduction to inflation and cosmological perturbation theory*, Seminar at Institute of Physics, Bhubaneswar, August 23, 2006.

2. *Inflation—A window to Planck scale physics*, Seminar at Institute of Physics, Bhubaneswar, August 23, 2006; Invited talk in Field Theoretic Aspects of Gravity V Birla Institute of Technology and Science, Goa, December 18–23, 2006.

3. *The current status of inflationary cosmology*, Colloquium at Institute of Physics, Bhubaneswar, January 15, 2007.

Other Activities:

1. I was the chair for the workshop on *Quantum Gravity* at the *XXIV Meeting of the Indian Association of General Relativity and Gravitation* held at Jamia Millia Islamia, New Delhi during February 5-8, 2007.

2. Taught a full-semester course on *Astrophysics* to physics graduate students at HRI during August–December, 2006.

3. Taught a half-semester course on *Cosmology* to physics graduate students at HRI during January–March, 2007.

4. Guided the following two HRI graduate students on projects:
   • Anindya Dey, January–May 2007, Topic: *Evolution of perturbations in bouncing universes*.
   • Girish P. Kulkarni, January–May 2007, Topic: *Generation of perturbations in the inflationary scenario*.

5. Guided the following student on a project under the Visiting Students' Program: Arindam Chatterjee, B.Sc. Physics, III year, Chennai Mathematical Institute, Chennai, India, May–June 2006. Topic: *Dark energy*.

6. I was incharge of conducting (the Physics part of) the HRI Science Talent Test 2006.