

ADDRESS

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PERSONAL INFORMATION

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| • Gender: Male | • Date of Birth: October 26, 1985 |
| • Nationality: Indian | • Marital Status: Married |
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PRESENT POSITION

- Assistant Professor, Department of Physics, National Institute of Technology Karnataka Surathkal, India, September 2019–Present.
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ACADEMIC HISTORY (in reverse chronological order)

- Post-Doctoral Fellow, The Inter-University Centre for Astronomy and Astrophysics, Pune, India, August 2017–September 2019.
 - Post-Doctoral Fellow, Department of Physics and Astronomy, Louisiana State University, Baton Rouge, USA, August 2015–August 2017.
 - Ph.D., Indian Institute of Technology Madras, Chennai, India, 2009–2015
 - Junior Research Fellow, Indian Institute of Space Science and Technology, Thiruvananthapuram, India, March–December 2009
 - M.Sc. Physics, Sree Krishna College, Guruvayoor, Thrissur, India, 2006–08
 - B.Sc. Physics, St. Thomas College, Thrissur, India, 2003–06
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RESEARCH INTERESTS

- Inflationary cosmology
 - Generation of non-Gaussianities during inflation
 - Features in the primordial spectrum
 - Quantum to classical transition and measurement problem in cosmology
 - Comparison of inflationary models with the CMB and other cosmological data
 - Extensions and alternatives to inflationary scenario
 - Loop Quantum Cosmology (LQC)
 - Generation of primordial non-Gaussianity in LQC
 - Effect of anisotropies on the evolution of perturbations
 - Comparing predictions of LQC with observations
 - Bouncing scenarios
 - Large Scale Structure (LSS)
 - Structure formation in fuzzy dark matter
 - Imprints of primordial non-Gaussianity on LSS
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Ph. D. THESIS

Thesis topic: Computation and characteristics of inflationary three-point functions

Thesis supervisor: Dr. L. Sriramkumar

Primordial non-Gaussianities and, in particular, the scalar bi-spectrum can provide a powerful handle to arrive at a much smaller class of viable inflationary models. Such an expectation has been corroborated to a substantial extent by the strong constraints that have been arrived at from the Planck data on the three non-Gaussianity parameters, viz. $(f_{\text{NL}}^{\text{loc}}, f_{\text{NL}}^{\text{eq}}, f_{\text{NL}}^{\text{ortho}})$, that are commonly used to characterize the scalar bi-spectrum. While a considerable amount of effort has been dedicated to understanding the generation and imprints of the scalar bi-spectrum, a rather limited amount of attention has been paid to investigating the three-point functions involving the tensor perturbations. My Ph. D. thesis was aimed at the numerical computation of all the three-point functions and their properties in the squeezed limit (where in one wavenumber is much smaller than the other two). In particular, the thesis focused on the following three problems. Firstly [6] (from now on, the reference numbers indicates the number in the list of my publications/preprints), we studied the scalar bi-spectrum for an arbitrary configuration of wavenumbers generated in three models which leads to features in the power spectrum due to deviation from slow roll. We showed, by certain examples, that the consistency relations between the non-Gaussianity parameter, f_{NL} , and the scalar spectral index, n_s , in the squeezed limit holds even away from slow roll. Secondly [8], utilizing Maldacena formalism for calculating three-point functions, we constructed a numerical procedure to evaluate the three-point scalar-tensor cross-correlations as well as the tensor bi-spectrum in single field inflationary models involving the canonical scalar field. We illustrated the robustness of the numerical procedure by comparing with the analytical results for power law inflation, slow roll inflation and Starobinsky model (involving a linear potential with a sudden change in its slope.) We then utilized the code we have developed to evaluate the three-point correlation functions of interest (and the corresponding non-Gaussianity parameters that we introduce) for an arbitrary triangular configuration of the wavenumbers in three different classes of inflationary models which lead to features in the scalar power spectrum, as have been recently considered by the Planck team. We also showed that the contributions to the three-point functions during preheating in inflationary models with a quadratic minimum is small. Finally [9], after writing down the consistency relation obeyed by three-point functions involving tensors in terms of the tensor non-Gaussianity parameter h_{NL} and the two parameters C_{NL}^{R} and C_{NL}^{I} which were earlier introduced by us to characterize the cross-correlations, we showed that these consistency relations are valid away from slow roll.

PUBLICATIONS AND PREPRINTS (in reverse chronological order)

All my papers can be accessed electronically in the following link .

1. **V. Sreenath**, I. Agullo and B. Bolliet, *Computation of non-Gaussianity in loop quantum cosmology*, arXiv:1904.01075 [gr-qc].
2. **V. Sreenath**, *Spherical collapse of fuzzy dark matter*, Phys. Rev. D **99**, 043540 (2019) [arXiv:1808.08219 [astro-ph.CO]].
3. I. Agullo, B. Bolliet and **V. Sreenath**, *Non-Gaussianity in Loop Quantum Cosmology*, Phys. Rev. D **97**, 066021 (2018) [arXiv:1712.08148 [gr-qc]].
4. D. Jaffino Stargen, **V. Sreenath** and L. Sriramkumar, *Quantum-to-classical transition and imprints of wavefunction collapse in bouncing universes*, arXiv:1605.07311 [gr-qc].
5. Debika Chowdhury, **V. Sreenath** and L. Sriramkumar, *The scalar-scalar-tensor inflationary three-point function in the axion monodromy model*, JCAP **1611**, 041 (2016) [arXiv:1605.05292 [astro-ph.CO]].
6. Debika Chowdhury, **V. Sreenath** and L. Sriramkumar, *The tensor bi-spectrum in a matter bounce*, JCAP **1511**, 002 (2015) [arXiv:1506.06475 [astro-ph.CO]].
7. **V. Sreenath**, D. K. Hazra and L. Sriramkumar, *On the scalar consistency relation away from slow roll*, JCAP **1502**, 029 (2015) [arXiv:1410.0252 [astro-ph.CO]].
8. **V. Sreenath** and L. Sriramkumar, *Examining the consistency relations describing the three-point functions involving tensors*, JCAP **1410**, 021 (2014) [arXiv:1406.1609 [astro-ph.CO]].
9. **V. Sreenath**, R. Tibrewala and L. Sriramkumar, *Numerical evaluation of the three-point scalar-tensor cross-correlations and the tensor bi-spectrum*, JCAP **1312**, 037 (2013) [arXiv:1309.7169 [astro-ph.CO]].

10. G. Santhosh, **V. Sreenath**, A. Lakshminarayan and R. Narayanan, *Localized zero-energy modes in the Kitaev model with vacancy disorder*, Phys. Rev. B **85**, 054204 (2012) [arXiv:1106.2385 [cond-mat.str-el]].

COMPUTATIONAL SKILLS

I have contributed to the development of the following codes :

- A C code based on the infrastructure provided by CLASS to calculate scalar non-Gaussianity generated in Loop Quantum Cosmology. The code is available at this URL: https://github.com/borisbolliet/class.lqc_public.
- A Fortran code to evaluate inflationary three-point functions involving scalars and tensors for an arbitrary canonical single field inflationary model. The code is available at this URL: <https://github.com/v-sreenath/itpfit>

DATA SCIENCE SKILLS

I have completed the following course in machine learning :

- Machine Learning by Stanford University on Coursera. Certificate earned at Friday, June 7, 2019 5:52 PM GMT.

PARTICIPATION IN WORKSHOPS AND CONFERENCES (in reverse chronological order)

1. *Regional Astronomers Meeting V on Astronomy Research : Opportunities and Challenges*, Department of Physics, Cochin University of Science and Technology, Ernakulam, India, February 08–09, 2019.
2. *The 30th Indian Association of General Relativity and Gravitation meeting*, BITS Pilani Hyderabad campus, Hyderabad, India, January 03–05, 2019.
3. *The 15th Marcel Grossmann meeting*, Sapienza Università di Roma, Rome, Italy, July 01–07, 2018.
4. *Post-Planck Cosmology : Enigma, Challenges and Visions*, The Inter-University Centre for Astronomy and Astrophysics, Pune, India, Oct 09–12, 2017.
5. *Quantifying and Understanding the Galaxy–Halo Connection*, Kavli Institute for Theoretical Physics, Santa Barbara, United States of America, May 15–19, 2017.
6. *APS April meeting 2017*, Washington, DC, United States of America, January 28–31, 2017.
7. *21st International Conference on General Relativity and Gravitation*, Columbia University, New York, United States of America, July 10–15, 2016.
8. *APS April meeting 2016*, Salt Lake City, United States of America, April 16–19, 2016.
9. *Particle Cosmology after Planck*, DESY, Hamburg, Germany, September 23–26, 2014.
10. *Aspects of Cosmology*, Indian Institute of Astrophysics, Bengaluru, India, April 9–11, 2014.
11. *Post Planck Cosmology*, Ecole De Physique de Houches, Les Houches, France, July 8–August 2, 2013.
12. *Twenty-Seventh Meeting of the Indian Association for General Relativity and Gravitation*, Department of Physics, H. N. Bahuguna Garhwal University, Srinagar (Garhwal), Uttarakhand, India, March 7–9, 2013.
13. *Present Observational Constraints on Cosmological Parameters*, Department of Physics and Astrophysics, University of Delhi, Delhi, India, January 28–February 1, 2013.

RECENT TALKS (in reverse chronological order)

1. *"Spherical Collapse of fuzzy dark matter"* at Department of Physics, Indian Institute of Technology Madras, Chennai, India, May 29, 2019.
2. *"Inflationary cosmology"* in The Regional Astronomers Meeting V on Astronomy Research: Opportunities and Challenges, Department of Physics, Cochin University of Science and Technology, Ernakulam, India, February 08–09, 2019.

3. *"Spherical Collapse of fuzzy dark matter"* in The 30th Indian Association of General Relativity and Gravitation meeting, BITS Pilani Hyderabad, Hyderabad, India, January 03–05, 2019.
4. *"Spherical Collapse of fuzzy dark matter"* at Virtual Institute of Astroparticle Physics, Paris, France, September 28, 2018.
5. *"Non-Gaussianity in loop quantum cosmology"* in The 15th Marcel Grossmann meeting, Sapienza Università di Roma, Rome, Italy, July 01–07, 2018.
6. *"Primordial non-Gaussianity in loop quantum cosmology"* in Post-Planck Cosmology : Enigma, Challenges and Visions, The Inter-University Centre for Astronomy and Astrophysics, Pune, India, October 09–12, 2017.
7. *"Evolution of perturbations in anisotropic loop quantum cosmology"* in APS April Meeting 2017, Washington, DC, United States of America, January 28–31, 2017.
8. *"Evolution of perturbations through an anisotropic quantum bounce"* seminar at Raman Research Institute, Bengaluru, India, 01 August 2016.
9. *"Evolution of perturbations in anisotropic loop quantum cosmology"* in 21st International Conference on General Relativity and Gravitation, Columbia University, New York, United States of America, July 10–15, 2016.
10. *"The tensor bi-spectrum in a matter bounce"* in APS April Meeting 2016, Salt Lake City, United States of America, April 16–19, 2016.
11. *"Computation and characteristics of inflationary three-point functions"* seminar at Louisiana State University, 26 August 2015.
12. *"Computation and characteristics of inflationary three-point functions"* seminars at The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy on 30 September, 2014, The Institut d'astrophysique de Paris, Paris, France on 09 October, 2014 and The Centre for Cosmology and Particle Physics Phenomenology - CP³ Origins, Odense, Denmark on 13 October, 2014.
13. *"On the consistency relations describing the three-point functions involving tensors"* in Particle Cosmology after Planck, DESY, Hamburg, Germany, September 23–26, 2014.
14. *"Non-Gaussianity parameters for three point scalar-tensor cross correlations and tensor bi-spectrum"* in Post Planck Cosmology, Ecole De Physique de Houches, Les Houches, France, July 8–August 2, 2013.
15. *"Scalar-tensor cross correlations and tensor bi-spectra in models involving deviations from slow roll"* in Twenty-Seventh Meeting of the Indian Association for General Relativity and Gravitation, Department of Physics, H. N. Bahuguna Garhwal University, Srinagar (Garhwal), Uttarakhand, India, March 7–9, 2013.

OUTREACH ACTIVITIES (in reverse chronological order)

1. Two lectures on *"Introduction to Cosmology"*, as part of *"Mini-School on Gravitation and Cosmology"* held at Providence College, Calicut, India, February 07-10, 2019.
Target audience : College students
2. *Story of our universe : Standard model of cosmology*, as part of seminar on *"Space Science and Nano Science"* held at Little Flower College, Guruvayur, India, October 11, 2018.
Target audience : College students

FELLOWSHIPS

- Junior and Senior Research Fellowships, UGC-CSIR NET, India, 2009–2014.
 - Grant for participating in *"Les Houches School of Physics session C Post-Planck cosmology"* held from July 09 – August 02, 2013 from Ecole De Physique des Houches, Les Houches, France.
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