Vita of K. V. Shajesh

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Teaching Experience

2023 - Present: Professor of Practice in the Department of Physics at Southern Illinois University–Carbondale, Carbondale, Illinois, USA.

2018 - 2023: Associate Professor of Practice in the Department of Physics at Southern Illinois University–Carbondale, Carbondale, Illinois, USA.

2013 - 2018: Lecturer in the Department of Physics at Southern Illinois University–Carbondale, Carbondale, Illinois, USA.

2008 - 2010: Physics instructor at Saint Edward's School, Vero Beach, Florida, USA.

2001 - 2008: Teaching assistant in Physics department, University of Oklahoma, USA.

Education and Research Experience

2016 - 2019: I was a co-investigator (among thirteen others) for a FRINATEK (translated from Norwegian as Independent Projects in Mathematics, Science and Technology) project titled "Casimir effect and van der Waals forces in multilayer systems" that has funding approved by the Norwegian Research Council for three years.

2010 - 2013: Postdoctoral Associate at Rutgers University (Newark, New Jersey, USA), Norwegian University of Science and Technology (Trondheim, Norway), and Iowa State University (Ames, Iowa, USA).

2008: Ph.D. in Physics from the University of Oklahoma, USA.

1996 - 2000: Research Scholar at Physical Research Laboratory, Ahmedabad, India.

1994 - 1996: Masters degree (M. Sc.) at Indian Institute of Technology (I.I.T.), Kharagpur, India.

1991 - 1994: Bachelors degree (B. Sc.) at Banaras Hindu University, Varanasi, India.

Research topics and related publications[1] (Total publications = 44)

Casimir force for magnetodielectric media: In Ref. [9] we suggest connections between the spectral distribution of scattering in electromagnetic cavities and the sign of Casimir energy.

Casimir energies of fractal geometries: In Ref. [15] we calculated Casimir energies of self-similar configurations of parallel plates. We used these methods in Ref. [12] to derive the Casimir energies of Sierpinski triangles. We extended these to configurations with concentric δ-function spheres and quasi-periodic planar configurations in Ref. [4].

[1] Citations refer to list of publications.

Semitransparent δ-function plate: In Ref. [20] we derived optical properties of an infinitesimally thin plate by unambiguously deriving the boundary conditions on the electromagnetic fields in the presence of a δ-function plate. We studied Casimir energies of magneto-electric δ-function plates in Ref. [18], and extended these ideas to spherical geometry in Ref. [13].

Casimir energy: A formalism suitable for the study of long-range forces between anisotropically polarizable atoms and dielectrics was developed in Ref. [22]. This formalism was used to study the interaction energies of CO_2 and CH_4 molecules near surfaces in Ref. [16], and to study ice growth at the interface of silica and water in Ref. [14]. We have developed a formalism suitable for studying Maxwell's equations in the presence of a medium that is axially symmetric in Ref. [11]. A perturbative formalism was developed to study torque between phosphorene sheets in Ref. [10, 7]. Casimir energy of concentric spherical configurations were calculated in Ref. [8]. Geometrical dependence of Casimir-Polder repulsion was studied in Refs. [6, 5].

Many-body Green's functions: In Ref. [23] we used multiple scattering formalism to extract irreducible N-body parts of Green's functions and Casimir energies describing the interaction of N objects. We illustrated and applied the technique to various examples. Significance of three-body contributions to Casimir energies has been emphasized in Refs. [21] and [19].

Non-contact gears: In Ref. [30] we have designed non-contact gears consisting of corrugated concentric cylinders. We have calculated the Casimir torque between two such cylinders for the scalar case. In Ref. [31] we have calculated the lateral Casimir force between corrugated parallel plates in the next-to-leading order. This work has been further reported in Ref. [26, 27]. We are currently extending these results for real materials [24]. This will decisively reduce the theoretical error sufficiently for comparison with the experiments, and will have applications in the next generation of nano-machines.

How does Casimir energy fall? In Ref. [36] we have demonstrated that Casimir energy for parallel plates gravitates like conventional mass. In the sequel [35] we have shown that the divergent parts of the Casimir energy of parallel plates serve to renormalize the bare masses of the plates. This work has been extended for arbitrary orientation of plates in Ref. [33]. This work has been further reported in Ref. [34, 28]. These results were recently strengthened in Ref. [17], where the divergent contributions were properly regularized. The results were also shown to be independent of the conformal term in the stress tensor. In Ref. [1] we investigate how Casimir energy falls in κ-deformed space-time.

Magnetic monopoles: Trying to develop an approximation method to study processes involving magnetic monopoles. A pedagogical report has been compiled in Ref. [37]. More work is in progress.

PT-symmetric quantum electrodynamics: Hamiltonians that are not Hermitian but are PT-symmetric are being investigated in quantum mechanics recently. We are trying to study the field theoretical analog of the same. Published two papers [38, 32].

Euler-Heisenberg Lagrangians and vacuum pair production: Most recently worked on the paper "Vacuum polarization induced coupling between Maxwell and Kalb-Ramond fields," [40] with N. D. Hari Dass. Published three papers [40, 41, 43] on related topics.

Unitary irreducible representations: We have reexamined the character problems of SU(2) and SU(1,1) from the standpoint of a physicist. Published two papers [42, 44] with Debabrata Basu and Subrata Bal.

List of publications

1. E. Harikumar, K. V. Shajesh, Suman Kumar Panja, "How does Casimir energy fall in κ-deformed spacetime?," arXiv:2404.10300 [hep-th].

2. N. Warnakulasooriya, D. H. Gallaba, J. J. Marchetta, D. Wetzel, P. Parashar, K. V. Shajesh, "Magnetostatic interaction energy between a point magnet and a ring magnet," Physics Open **15**, 100140 (2023), arXiv:2209.06393 [cond-mat.mes-hall].

3. R. Narayanan, P. Parashar, K. V. Shajesh and S. Vijayakumar, "Role of long-range van der Waals interaction in the coefficient of static friction," (2022), arXiv:2209.06123 [cond-mat.mes-hall].

4. I. Cavero-Peláez, P. Parashar and K. V. Shajesh, "Quantum Vacuum Energy of Self-Similar Configurations," Universe **7**, no.5, 128 (2021), arXiv:2105.05507 [hep-th].

5. J. J. Marchetta, P. Parashar and K. V. Shajesh, "Geometrical dependence in Casimir-Polder repulsion," Phys. Rev. A **104**, 032209 (2021), arXiv:2020.11870 [quant-ph].

6. J. J. Marchetta, P. Parashar and K. V. Shajesh, "Geometrical dependence in Casimir-Polder repulsion: Anisotropically polarizable atom and anisotropically polarizable annular dielectric," (2020), arXiv:2020.11871 [quant-ph].

7. P. Thiyam, P. Parashar, K. V. Shajesh, O. I. Malyi, M. Boström, K. A. Milton, I. Brevik, J. Forsman and C. Persson, "Charge carrier and medium alteration of the magnitude and the sign of the Casimir-Lifshitz torque," Phys. Rev. B **100**, 205403 (2019), arXiv:2209.08846 [cond-mat.mes-hall].

8. P. Parashar, K. V. Shajesh, K. A. Milton, D. F. Parsons, I. Brevik and M. Boström, "The role of zero point energy in inducing nucleation of ice in a spherical drop of water," Phys. Rev. Research **1**, 033210 (2019), arXiv:1907.04301 [cond-mat.mes-hall].

9. I. Brevik, P. Parashar and K. V. Shajesh, "Remarks on the Casimir force for magnetodielectric media," Phys. Rev. A **98**, 032509 (2018), arXiv:1808.02205 [physics.class-ph].

10. P. Thiyam, P. Parashar, K. V. Shajesh, O. I. Malyi, M. Boström, K. A. Milton, I. Brevik and C. Persson, "Distance-dependent sign-reversal in the Casimir-Lifshitz torque," Phys. Rev. Lett. **120**, 131601 (2018), arXiv:1801.01183 [cond-mat.mes-hall].

11. K. V. Shajesh, P. Parashar and I. Brevik, "Casimir-Polder energy for axially symmetric systems," Ann. Phys. (N. Y.) **387**, 166 (2017), arXiv:1709.08814 [physics.class-ph].

12. K. V. Shajesh, P. Parashar, I. Cavero-Peláez, J. Kocik and I. Brevik, "Casimir energy of Sierpinski triangles," Phys. Rev. D **96**, 105010 (2017), arXiv:1709.06284 [hep-th].

13. P. Parashar, K. A. Milton, K. V. Shajesh and I. Brevik, "Electromagnetic δ-function sphere," Phys. Rev. D **96**, 085010 (2017), arXiv:1708.01222 [hep-th].

14. M. Boström, O. I. Malyi, P. Parashar, K. V. Shajesh, P. Thiyam, K. A. Milton, C. Persson, D. F. Parsons, I. Brevik, "Lifshitz interaction can promote ice growth at water-silica interfaces," Phys. Rev. B **95**, 155422 (2017), arXiv:1704.01332 [cond-mat].

15. K. V. Shajesh, I. Brevik, I. Cavero-Peláez and P. Parashar, "Casimir energies of self-similar configurations of plates," Phys. Rev. D **94**, 065003 (2016), arXiv:1607.00214 [hep-th].

16. P. Thiyam, P. Parashar, K. V. Shajesh, C. Persson, M. Schaden, I. Brevik, D. F. Parsons, K. A. Milton, O. I. Malyi, M. Boström, "Anisotropic contribution to the van der Waals and the Casimir-Polder energies for CO_2 and CH_4 molecules near surfaces and thin films," Phys. Rev. A **92**, 052704 (2015), arXiv:1506.01673 [cond-mat].

17. K. A. Milton, K. V. Shajesh, S. A. Fulling and P. Parashar, "How does Casimir energy fall? IV. Gravitational interaction of regularized quantum vacuum energy," Phys. Rev. D **89**, 064027 (2014), arXiv:1401.0784 [hep-th].

18. K. A. Milton, P. Parashar, M. Schaden and K. V. Shajesh, "Casimir interaction energies for magneto-electric δ-function plates," IL Nuovo Cimento **36 C**, 193 (2013), arXiv:1302.0313 [hep-th].

19. K. A. Milton, E. Abalo, P. Parashar and K. V. Shajesh, "Three-body Casimir-Polder interactions," IL Nuovo Cimento **36 C**, 183 (2013), arXiv:1301.2484 [quant-ph].

20. P. Parashar, K. A. Milton, K. V. Shajesh and M. Schaden, "Electromagnetic semitransparent δ-function plate: Casimir interaction energy between parallel infinitesimally thin plates," Phys. Rev. D **86**, 085021 (2012), arXiv:1206.0275 [hep-th].

21. K. V. Shajesh and M. Schaden, "Significance of many-body contributions to Casimir energies," Proceedings of the 10th Quantum Field Theory Under the Influence of External Conditions (QFEXT11); Editors: M. Asorey, M. Bordag, E. Elizalde, Int. J. Mod. Phys. Conf. Ser. **14**, 521 (2012), arXiv:1112.1383 [hep-th].

22. K. V. Shajesh and M. Schaden, "Repulsive long-range forces between anisotropic atoms and dielectrics," Phys. Rev. A **85**, 012523 (2012), arXiv:1112.1348 [physics.atom-ph].

23. K. V. Shajesh and M. Schaden, "Many-body contributions to Green's functions and Casimir energies," Phys. Rev. D **83**, 125032 (2011), arXiv:1103.3048 [hep-th].

24. P. Parashar, K. A. Milton, I. Cavero-Peláez and K. V. Shajesh, "Electromagnetic non-contact gears: Prelude," Quantum field theory under the influence of external conditions (QFEXT09), devoted to the centenary of H. B. G. Casimir (pp 48-54), proceedings of the ninth conference, University of Oklahoma, USA, (2010), arXiv:1001.4105 [cond-mat.other].

25. K. A. Milton, P. Parashar, J. Wagner and K. V. Shajesh, "Exact Casimir energies at nonzero temperature: Validity of proximity force approximation and interaction of semitransparent spheres," Doing physics: A festschrift for Thomas Erber, edited by Porter Johnson, Illinois Institute of Technology Press (2010), arXiv:0909.0977 [hep-th].

26. I. Cavero-Peláez, K. A. Milton, P. Parashar and K. V. Shajesh, "Leading- and next-to-leading-order lateral Casimir force on corrugated surfaces," Int. J. Mod. Phys. A **24**, 1757 (2009) arXiv:0810.1787 [hep-th].

27. I. Cavero-Peláez, K. A. Milton, P. Parashar and K. V. Shajesh, "Lateral Casimir forces on parallel plates and concentric cylinders with corugations," J. Phys. Conf. Ser. **161**, 012008 (2009) arXiv:0810.1786 [hep-th].

28. K. A. Milton, P. Parashar, J. Wagner, K. V. Shajesh, A. Romeo and S. Fulling, "How Does Quantum Vacuum Energy Accelerate?," arXiv:0810.0081 [hep-th].

29. K. V. Shajesh, "Casimir effect: An avatar of the quantum vacuum," Ph. D. Thesis, The University of Oklahoma, 2008, 153 pages. Available under 'Open Access publishing', a service offered by UMI Dissertation Publishing.

30. I. Cavero-Peláez, K. A. Milton, P. Parashar and K. V. Shajesh, "Non-contact gears: II. Casimir torque between concentric corrugated cylinders for the scalar case," Phys. Rev. D **78**, 065019 (2008), arXiv:0805.2777 [hep-th].

31. I. Cavero-Peláez, K. A. Milton, P. Parashar and K. V. Shajesh, "Non-contact gears: I. Next-to-leading order contribution to lateral Casimir force between corrugated parallel plates," Phys. Rev. D **78**, 065018 (2008), arXiv:0805.2776 [hep-th].

32. K. A. Milton, I. Cavero-Peláez, P. Parashar, K. V. Shajesh and J. Wagner, "PT-Symmetric Quantum Electrodynamics–PTQED," arXiv:0712.0045 [hep-th]. Revised version published in Int. J. Theor. Phys. 50, 963 (2011).

33. K. V. Shajesh, K. A. Milton, P. Parashar and J. A. Wagner, "How does Casimir energy fall? III. Inertial forces on vacuum energy," J. Phys. A: Math. Theor. 41, 164058 (2008), arXiv:0711.1206 [hep-th].

34. K. A. Milton, S. A. Fulling, P. Parashar, A. Romeo, K. V. Shajesh and J. A. Wagner, "Gravitational and Inertial Mass of Casimir Energy," J. Phys. A: Math. Theor. 41, 164052 (2008), arXiv:0710.3841 [hep-th].

35. K. A. Milton, P. Parashar, K. V. Shajesh and J. Wagner, "How does Casimir energy fall? II. Gravitational acceleration of quantum vacuum energy," J. Phys. A: Math. Theor. 40, 10935 (2007), arXiv:0705.2611 [hep-th].

36. S. A. Fulling, K. A. Milton, P. Parashar, A. Romeo, K. V. Shajesh and J. Wagner, "How does Casimir energy fall?," Phys. Rev. D **76**, 025004 (2007), arXiv:hep-th/0702091.

37. K. V. Shajesh and K. A. Milton, "Quantum mechanics using Fradkin's representation," arXiv:hep-th/0510103.

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39. K. V. Shajesh, "Eikonal approximation," a study report (Mar 2004).

40. N. D. Hari Dass and K. V. Shajesh, "Vacuum polarization induced coupling between Maxwell and Kalb-Ramond fields," Phys. Rev. D **65**, 085010 (2002) arXiv:hep-th/0107006.

41. K. V. Shajesh, "Effective Lagrangian for the pseudoscalars interacting with photons in the presence of a background electromagnetic field," arXiv:hep-th/0008187.

42. D. Basu, S. Bal and K. V. Shajesh, "The Character of the Exceptional Series of Representations of SU(1,1)," J. Math. Phys. **41**, 461 (2000) arXiv:hep-th/9906066.

43. J. A. Grifols, E. Masso, S. Mohanty and K. V. Shajesh, "Pair production of light pseudoscalar particles in strong inhomogeneous fields by the Schwinger mechanism," Phys. Rev. D **60**, 097701 (1999) [Erratum-ibid. D **65**, 099905 (2002)] arXiv:hep-ph/9906255.

44. S. Bal, K. V. Shajesh and D. Basu, "A Unified Treatment of the Characters of SU(2) and SU(1,1)," J. Math. Phys. **38**, 3209 (1997) arXiv:hep-th/9611236.