

Curriculum Vitae

P. Nandakumar

Associate Professor
Department of Physics
Birla Institute of Technology and Science, Pilani,
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Areas of Research Interest

Second and third order nonlinear optical properties of composite materials, Influence of metal nanoparticles and dielectric matrix on the nonlinear optical properties of each other, Mesoscopic systems, Ultrafast nonlinear optical spectroscopy and microscopy and application in Biophysics, Biomolecular transport through membranes, Quantum Optics.

General Information

I did my PhD in Physics from Indian Institute of Technology Madras in the year 1999 on the 'Optical properties of semiconductor quantum dots' under the supervision of Prof. Y.V.G.S. Murthy and Prof. C. Vijayan. After my PhD I worked for one year as a CSIR research associate at Indian Institute of Science Bangalore with Prof. P. K. Das. There after I worked at the Weizmann Institute of Science, Israel for two years with Prof. Yehiam Prior on 'coherent control of chemical reactions' using a 30 femto-second laser beam. Next two years was spent at the University of Stuttgart, Germany working with Dr. Andreas Volkmer on 'Coherent Raman Microspectroscopy'. Here we developed a Raman scattering Microscope based on stimulated Raman loss detection, for noninvasive point-by-point vibrational mapping of chemical and biological samples with high sensitivity and without the requirement for labeling of the sample. I joined the department of Physics at BITS Pilani K. K. Birla Goa campus as a faculty member in the year 2005.

My current research interests include nonlinear and quantum optics, optical microscopy and biophysics. I am interested in teaching different fundamental physics courses at undergraduate level apart from teaching advanced courses in Optics.

Personal

- **Name:** P. Nandakumar
- **Date of Birth:** 05 March 1966
- **Nationality:** Indian
- **Sex:** Male
- **Marital Status:** Married
- **Address for Communication**
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Education

Ph. D. (Physics) Indian Institute of Technology, Madras, India, 1999.

Thesis title: ***Semiconductor Quantum Dots in a Polymer Matrix.***

Thesis Advisers: Prof. Y.V.G.S. Murti and Prof. C. Vijayan

M.Tech. (Opto-Electronics & Laser Technology), Cochin University of Science and Technology, Cochin, India, 1993.

Thesis Title: ***Studies on Multimode Squeezed States. Adviser:*** Prof. Babu Joseph

M.Sc. (Physics), University of Calicut, Kerala, India 1988

Employment Record:

✚ **February, 2013 – till date:** Associate. Professor at Physics Department, BITS Pilani, K.K. Birla Goa Campus, Goa 403726.

✚ **August 01, 2007 –January 31, 2013:** Asst. Professor at Physics Department, BITS Pilani, K.K. Birla Goa Campus, Goa 403726.

✚ **April 01, 2005 – July 31, 2007:** Lecturer at Physics group, BITS Pilani, K. K. Birla Goa Campus, Goa 403726.

- ✚ **December 16, 2002 – 15 October 2004:** Research fellow with Dr. A. Volkmer at Coherent Raman Microscopy and Single Molecule Spectroscopy Group, 3rd Institute of Physics, University of Stuttgart, Germany.
- ✚ **October 4, 2000 – December 15, 2002:** Research Fellow with Prof. Y. Prior, Femtosecond Nonlinear Optics Laboratory, Department of Chemical Physics, Weizmann Institute of Science, Rehovot, Israel.
- ✚ **February 1, 2000 – 31 September 2000:** Visiting Research Fellow with Prof. A. Monkman at the University of Durham, UK.
- ✚ **February 15 - 31st December 1999:** Research Associate with Prof. P.K. Das, Nonlinear Optics Laboratory, Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore, India.

Administrative Experience

Head, Department of Physics, Since April, 2008

Assignments handled in Department/Institute

Member, Departmental Research Committee (DRC), since May 2011

Member, Task force on research, Mission 2012

Member, Disciplinary committee 2007-2009

PhD Thesis Supervised

1. Nonlinear optical properties of nanocomposites, M. M. Bijeesh., in progress
2. Studies on biomolecular transport through nuclear membranes, S. Arun Karthick, in progress

Sponsored Research Projects:

1. **Project title:** Photothermal Imaging of Nuclear Transport
Principle investigator(PI): P. Nandakumar
Co-PI: Meenal Kaoushik, Geetha K. Varier
Funding agency: Department of Biotechnology, Govt. of India
Date of completion of the project: 31 Novemebr, 2012.
2. **Project title:** Studies on the optical nonlinearity of gold nanoparticle embedded BaTiO₃ thin films,
Principle investigator(PI): P. Nandakumar
Funding agency: DRDO, Govt. of India

Courses Taught

PHY C131: Physics-1 (Mechanics,waves & optics)
 PHY C132: Physics-2 (Electricity and Magnetism)
 TAG C 211: Measurement Techniques 1 (MT1-Physics)
 PHY C132: Physics-2 (Single session)
 PHY C 353: Optical Physics & Applications (Post-graduate)
 PHY C 391: Instr. Meth. For Analysis (IMA) (Post-graduate)
 PHY C 221: Modern Physics (Post-graduate)
 EA C422: Fiber Optics (Post-graduate – Interdisciplinary)
 BITS G620: Advanced Instrumentation Technique (Pre-Ph.D course)
 PHY CXXX: Nonlinear Optics (Pre-Ph.D course)
 PHY F242: Quantum Mechanics-1

Semester wise break up

Year	Semester1	Semester 2
2006 - 2007	PHY C131: Physics-1 TA C211: Measurement Techniques 1	PHY C 353: Optical Physics & PHY C 391: Instr. Meth. For Analysis
2007 - 20068	PHY C131: Physics-1 TA C211: Measurement Techniques	PHY C 353: Optical Physics & PHY C 391: Instr. Meth. For Analysis
2008 - 2009	PHY C132: Physics-2 TA C211: Measurement Techniques	EA C422: Fiber Optics PHY C 391: Instr. Meth. For Analysis
2009 - 2010	PHY C132: Physics-2 TA C211: Measurement Techniques	EA C422: Fiber Optics PHY C 391: Instr. Meth. For Analysis
2010 - 2011	PHY C 221: Modern Physics PHY F110: Physics Laboratory	ES C242: Strect. & Prop. of Materials PHY C231: Physics Project Lab
2011 - 2012	PHY C 221: Modern Physics PHY F110: Physics Laboratory	ES C242: Strect. & Prop. of Materials PHY C 391: Instr. Meth. For Analysis
2012 - 2013	PHY F111: Mechanics, Oscillations and Waves PHY F110: Physics Laboratory	PHY F242: Quantum Mechanics -1 PHY F244: Modern Physics Lab
2013 - 2014	PHY F213: Optics PHY F110: Physics Laboratory	

List of publications

Conference presentations and publications in proceedings:

1. Photothermal Laser Scanning Microscopy
Arunkarthick Samudram, Bijeesh M. Mangalassery, Geetha K. Varier, Meenal Kowshik, and **P. Nandakumar**, : “Photothermal Laser Scanning Microscopy”, Focus on Microscopy – FOM 2013, 24th to 27th March 2013 in Maastricht, The Netherlands
2. Construction of a simple confocal microscope. MM Bijeesh, C. Arunkartick, Arvind krishanan, Nishith Rastogi, Geetha K. Varier, **P. Nandakumar**, NLS-19, RRCAT, Indore (2010).
3. **P. Nandakumar**, A. Kovalev, A. Volkmer. MicroCARS2009, “*Vibrational imaging based on stimulated Raman scattering microscopy*” Fall school on Raman Scattering and CARS microscopy, Cargese-Corosica, France, October 5-10, 2009
4. **P. Nandakumar**, A. Kovalev, A. Volkmer “*Vibrational imaging based on stimulated Raman scattering microscopy*” 8th European Conference on Nonlinear Optical spectroscopy (ECNOS 2009), ENEA FRASCATI, May 25-27, 2009
5. Gregor Hehl, Alexander Kovalev, **Patincharath Nandakumar**, Andreas Volkmer “*Quantitative detection of cholesterol in stratum corneum model systems by coherent anti-Stokes Raman scattering microspectroscopy*” DPG conference Hamburg 2009
6. **P. Nandakumar** & A. Kovalev & A. Volkmer “*Vibrational imaging based on stimulated Raman scattering microscopy*” Focus on Microscopy 2009 Krakow, Poland, April 5 - April 8, 2009
7. G. Hehl & A. Kovalev & **P. Nandakumar** & A. Volkmer “ *Label-free detection of cholesterol by coherent anti-Stokes Raman scattering microspectroscopy*”, Focus on Microscopy 2009 Krakow, Poland, April 5 - April 8, 2009
8. A. Kovalev, **P. Nandakumar**, A. Muschielok, S. Busch, and A. Volkmer (University of Stuttgart), “*Vibrational microspectroscopy of biological systems based on Coherent Raman Scattering microscopy*” 7th European Conference on Nonlinear Optical spectroscopy (ECNOS 2008) & 1st European Conference of CARS Microscopy MicroCARS2008, May 25-27, 2008 Igls, Austria.

9. Kovalev, **P. Nandakumar**, and A. Volkmer, *Real-Time Monitoring of Biological Processes Inside a Living Cell by Functional CARS Micro-Spectroscopy*, Thirteenth International Conference On Time-Resolved Vibrational Spectroscopy Freising, Germany May 19-25, 2007
10. A. Kovalev, **P. Nandakumar**, A. Muschielok, S. Busch, A. Volkmer, *Vibrational microspectroscopy of biological systems based on CARS microscopy*, Focus on Microscopy-2007.
11. A. Kovalev, **P. Nandakumar**, A. Volkmer, *Real time monitoring of biological processes inside a living cell by functional CARS microspectroscopy*, Focus on Microscopy-2007.
12. A. Kovalev, **P. Nandakumar**, and A. Volkmer, *Local characterization of intra- and extracellular lipids in live cells and tissue by multiplex CARS microspectroscopy*, Focus on Microscopy-2006.
13. P. Nandakumar, A. Kovalev, and A. Volkmer, *CARS microspectroscopy of a stratum corneum model system*, Focus on Microscopy-2005 Jena, Germany.
14. **P. Nandakumar**, A. Kovalev, A. Muschielok and A. Volkmer, *Vibrational imaging and microspectroscopies based on coherent anti-Stokes Raman scattering*, French Israeli Conference on Nonlinear Optics and Quantum Optics FRISNO-8, Ein Bokek, Israel, February 2005
15. **P. Nandakumar**, A. Kovalev, M. Kohler and A. Volkmer, *Multiplex CARS microspectroscopy of a Stratum Corneum model system*, French Israeli Conference on Nonlinear Optics and Quantum Optics FRISNO-8, Ein Bokek, Israel, February 2005.
16. **P. Nandakumar**, A. Kovalev, M. Kohler and A. Volkmer, *Coherent anti-Stokes Raman microspectroscopy Application to the study of a Stratum Corneum model system*, Photonics 2004, Cochin University of Science and Technology, Cochin, December 2004.
17. **P. Nandakumar**, Yuri Paskover, V. Batenkov and Yehiam Prior, *Coherent excitation and monitoring of highly excited vibrational states* Photonics 2004, Cochin University of Science and Technology, Cochin, India, December 2004.
18. **P. Nandakumar**, A. Kovalev and A. Volkmer *Coherent anti-Stokes Raman microspectroscopy: Vibrational imaging and spectroscopy with high sensitivity*. RISBM (Raman and IR Spectroscopy in Biology and Medicine) 2004, Friedrich Schiller University Jena, Germany, February 2004.
19. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan *Studies on semiconductor quantum dots of CdS in a polymer matrix*, pp. 27-32. In

J.P. Raina and P.R. Vaya (eds.) *Photonics-96: Proc. of the International Conference on Fiber Optics and Photonics*, **1**, Tata McGraw-Hill, New Delhi, 1997.

20. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan *Optical properties of PbS quantum dots*, pp.250-254. In R. Kesavamoorthy, A.K. Arora, C. Babu Rao and P. Kalyanasundaram (eds.) *Laser Applications in Material Science and Industry*, Allied Publishers, New Delhi, 1997.
21. C. Vijayan, **P. Nandakumar** and Y.V.G.S. Murti, *Luminescence and related properties of semiconductor quantum dots*, National Seminar on Luminescence and Applications NSLA-2001 (Ed. A. G. Page and M. D. Sastry) pp 89-92.
22. Y.V.G.S. Murti, C. Vijayan and **P. Nandakumar**, *Optical properties of semiconductor quantum dots*, pp.19-25. In S. Selvasekharapandian and P.C. Selvan (eds.), *Proc. of the conference of Luminescence and its Applications*, Allied Publishers, New Delhi, 1996.
23. Anu Krishnan, **P. Nandakumar** and Pushpendu K. Das, *First hyperpolarizabilities of PDEANS by Hyper-Rayleigh scattering : The role of two-photon fluorescence*, National Laser Symposium, Hyderabad, India, December 1999
24. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan. *On the proton exchange mechanism of synthesizing CdS quantum dots in Nafion*. Third National Conference on Solid State Ionics, Itanagar, March 1998.
25. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K.Dhanalakshmi and G. Sundararajan., *Quantum size effects on the optical nonlinearity of CdS quantum dots in Nafion*. Ninth AGM of Materials Research Society of India, Madras, February 1998.
26. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan. *Quantum confinement effects on the photoluminescence of CdS nanoclusters in Nafion*. DAE Solid State Physics Symposium, Kochi, December, 1997
27. **P. Nandakumar**, A.R. Dhobale, Y. Babu, M.D.Sastry, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan. *Photoacoustic spectral studies of CdS semiconductor quantum dots in Nafion matrix*. DAE Solid State Physics Symposium, Bombay, December, 1996.

Publications in refereed Journals

28. Laser Scanning Photothermal Microscopy: Fast Detection and Imaging of Gold Nanoparticles, Arunkarthick Samudram, Bijeesh M. Mangalassery, Geetha K. Varier, Meenal Kowshik, and Nandakumar P 2013 (*Communicated to J. of Microscopy*)

29. M. M. Bijeesh, S. Arunkarthick, Arvind Krishnan, Nishith Rastogi, Geetha K. Varier, Meenal Kowshik and P. Nandakumar. *Construction of simple Confocal Microscope. KIRAN*, 2011, Vol **22 (1)**, 26-28.
30. **P.Nandakumar**, A.Kovalev and A. Volkmer (2009), Vibrational imaging based on stimulated Raman Scattering Microscopy, *New Journal of Physics* **11**, 2009, 033026.
31. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti (2002) *Absorption and photoluminescence studies on CdS quantum dots in Nafion*, *J. Appl. Phys.* **91**, 1509-1514.
32. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, M. Rajalakshmi and A.K. Arora (2001) *Raman spectra of CdS quantum dots in Nafion: Longitudinal optical modes and confined acoustic modes*, *Physica E* **11**, 377-383.
33. A. Krishnan, S.K. Pal, **P. Nandakumar**, A. G. Samuelson, and P. K. Das (2001) *Ferrocenyl donor-organic acceptor complexes for second order nonlinear optics*, *Chemical Physics* **265**, 313-322.
34. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi, G. Sundararajan and K. S. Nair (2001), *Synthesis and XRD characterization of CdS quantum dots in a perfluorinated ionomer (Nafion)*, *Mater. Sci. & Engg. B* **83**, 61-65
35. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti (2000) *Quantum size effects on the third order nonlinear optical susceptibility of CdS quantum dots in Nafion*, *Optics Commun.* **185**, 457-465.
36. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan (1999) *Proton exchange mechanism of synthesizing CdS quantum dots in Nafion*, *Indian J. Pure & Appl. Phys.* **37**, 239-241.
37. Y.V.G.S. Murti, **P. Nandakumar** and C. Vijayan (1999) *Experiments on jailed electrons*, *Physics Education*, October-December, pp 229-235.
38. **P. Nandakumar**, A.R. Dhobale, Y. Babu, M.D. Sastry, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan (1998) *Photoacoustic response of CdS quantum dots in Nafion*, *Solid State Commun.*, **106**, 193-196
39. **P. Nandakumar**, C. Vijayan, Y.V.G.S. Murti, K. Dhanalakshmi and G. Sundararajan (1997), *Preparation and characterization of CdS nanocrystallites in Nafion*, *Bull. Mater. Sci.* **20**, 579-582.