



# Physical Research Laboratory, Ahmedabad

## Colloquium 18-11

- Speaker:** Prof. Debabrata Goswami  
Prof. S. Sampath Chair Professor of Chemistry, IIT Kanpur
- Title:** "Femtosecond Laser Induced Spatiotemporal Control and Photothermal Spectroscopy for Remote Sensing and Computing at Nanoscale"
- Time:** Wednesday, 03 October 2018, 16.00 hrs.
- Venue:** Nanosims Lecture Hall, PRL

### Abstract

Femtosecond laser pulses have been shaped in a programable manner for coherent control at molecular level and for several coherent optical processes that have resulted in applications to fast switching, data compression, ultrasensitive detection, computing, etc. Optical and quantum interaction and their detection remain at the forefront of all such efforts. Typically, however, it is not common for ultrashort time to be connected to ultra-small dimension. Use of femtosecond optical tweezers (FOTs) makes this connection possible. We have developed a novel on-the-fly calibration method of FOT that enables in situ control and contactless measure of absolute temperature and viscosity at nanoscale dimensions. Such measurements and control at the nanoscale have been challenging since the present techniques can only provide relative off-line measurements that are of low spatial resolution. Such spatiotemporal control with ultrashort pulses provides the possibility of manipulation at nanoscale that can yield several interesting results that include visualization of colloidal aggregation in real time, computational logical operation in localized zone that is then reset with the subsequent pulse train. We simultaneously apply the high temporal sensitivity of position autocorrelation and equipartition theorem to precisely measure and control in situ temperature and the corresponding microrheological property around the focal volume of the trap at high spatial resolution. The FOTs use a single-beam high repetition rate laser for optical trapping to result in finer temperature gradients in comparison to the continuous-wave laser tweezers. Thermal effects are often treated delirious and most spectroscopy efforts remain in removing them. We have, on the other hand, used highly repetitive femtosecond laser heating to develop time-resolved photothermal lens spectroscopy that provide molecule level sensitivity.

### The Speaker

Debabrata Goswami is currently the Prof. S. Sampath Chair Professor of Chemistry, at IIT Kanpur. He became Professor (Higher Administrative Grade) of Chemistry, The Center for Lasers & Photonics, The Design Program, and The Center of Cognitive Sciences at IIT Kanpur in 2017. An alumnus of IIT Kanpur, Prof. Goswami attended Princeton University, USA with multiple scholarships for his PhD (1994), followed by PDFs at Harvard University (1995) and Brookhaven National Lab (1996). He was a Senior Scientist in the R&D Division of Excel-Quantronix, New York (1997) and subsequently the Director of Laser Laboratories at the Center for Laser Technology, Princeton University (1998). He returned to India at the end of 1998, to join the Physics Faculty of TIFR Mumbai. In 2004, he joined IIT Kanpur to also focus on pedagogy. Over the years, he has also been invited to several reputed Institutes worldwide as a visiting Professor. His research work spans across several interdisciplinary frontiers of science and engineering. Specifically, he is an ultrafast laser spectroscopist who has pioneered the use of coherent control with femtosecond pulse shaping in spatiotemporal control, quantum computing, microscopy, etc. He has received several academic & research accolades, some of which are the Hoechst Advanced Technology Division Industrial Affiliates Fellowship for outstanding academic record in Princeton, the International Senior Research Fellowship award of the Wellcome Trust (UK), the Swarnajayanti Fellowship of the Department of Science and Technology (Govt. of India), Thathachary Science Award (India). He is a Fellow of the Royal Society of Chemistry and the OSA. He is a Senior Member of IEEE & SPIE and He has authored over 200 journal & conference papers.

Tea at 15:30 hrs.

**ALL ARE WELCOME**

