Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally Mandal, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Attosecond Science- A Pathway to Quantum World

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Probing quantum systems has always been a challenge since the advent of quantum physics. The fundamental curiosity to observe electronic motion through the quantum world on its inherent temporal scale- attosecond (1 attosecond = 10^{-18} seconds) scale of time, has driven continuous pioneers and discoverers to craft ways/methods for probing it on such ultrafast realms. However, it could be realised only at the dawn of the 21st century. The advancements in the contemporary laser technology made it possible to generate the first attosecond pulses in the year 2001, marking the beginning of a new era- 'Attosecond Science'; also called 'Attoscience'. As the name suggests, this new research area deals with study of electron dynamics in matter on attosecond time scale. The importance of this new science is already recognised by the award of Nobel Prize in Physics for the year 2023 to the pioneers of attosecond pulse generation. Steering the electron through the quantum world using intense ultrafast lasers, we are now capable of observing electron dynamics in real-time. This provides unprecedented control on matter, which was not possible two decades ago. Attosecond science encompasses all research domains across science and engineering streams, where electron dynamics is probed on its intrinsic temporal scale.

In this seminar, I shall take a tour of ultrafast quantum dynamics in molecules and carbon fullerenes; when such systems interact with intense ultrafast laser fields of different polarisations. Using numerical experiments, I shall elucidate some highly nonlinear optical phenomenon and ultrafast processes, such as- high harmonic generation (HHG), charge migration and light-induced quantum correlations, time-resolved observables using the method of pump-probe spectroscopy, molecular photoemission, above-threshold ionisation (ATI) and photoelectron spectrum (PES). I shall explore the origin and underlying physical mechanisms of these ultrafast quantum dynamics in the systems of interest. I shall highlight the importance and applications of such ultrafast processes in the relevant areas and conclude the seminar by elaborating on the future perspectives and goals.

Tuesday, Feb 10th 2026

14:30 Hrs (Tea / Coffee 14:15 Hrs)

Seminar Hall, TIFRH