Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad - 500107

Seminar

Intrinsic Luminescence from Protein Charge Transfer states

Rajaram Swaminathan

IIT-G, Guwahati

Origins of blue luminescence first observed by my student Ms. Lopamudra in concentrated aqueous solutions of L-Lysine.HCl could not be explained for a long time. She also observed similar spectra in dilute aqueous solutions of human serum albumin and calf thymus histone protein which are rich in Lys and Glu residues, but not in other proteins that had a minimal population of charged residues. Subsequent investigations on α_3C protein (in which more than 50% of amino acids comprise of Lys and Glu), supported by TDDFT calculations, revealed much later that photoinduced electron transfer from anionic Glu to the polypeptide backbone or polypeptide backbone to cationic Lys or anionic Glu to cationic Lys can give rise to Protein Charge Transfer absorption spectra (ProCharTS) in α_3C protein under the wavelength range 250-800 nm. Aside from charged amino acids, ProCharTS was also shown to be prevalent among phosphorylated amino acids like Tyr, Ser and Thr by Venkatramani's group. Later, our group also showed that this absorption intensity was sensitive to conformational changes in multiple intrinsically disordered proteins and the oligomeric state of Hen egg white lysozyme (HEWL). In this talk, I shall present new results focused on the photochemical characteristics of intrinsic luminescence arising from ProCharTS states in charged amino acids like Lys and Glu; and proteins rich in charged amino acids like IDPs. A consistent red shift in ProCharTS emission wavelength maximum was observed with increase in excitation wavelength. The luminescence was marked by a large Stokes shift (3000-14000 cm^{-1}). The luminescence quantum yields for different amino acids and multiple proteins were low (0.005-0.05), while the luminescence intensity decays revealed a multiexponential profile with mean lifetimes ranging from 1-3 ns. Interestingly, the overlaid luminescence emission spectra of six charged proteins were nearly superimposable with the spectra of Lys and Glu amino acids, hinting at a common origin. Towards the end, I shall dwell on application of ProCharTS to monitor protein aggregation and DNA protein interactions in a label free approach.

Friday, Dec 21st 2018

11:30 AM (Tea/Coffee at 11:00 AM)

Auditorium, TIFR-H