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All-Optical Switching in Bacteriorhodopsin Based on Excited-State Absorption

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Switching light with light is of tremendous importance for both fundamental and applied science. The advent of nano-bio-photonics has led to the design, synthesis and characterization of novel biomolecules that exhibit an efficient nonlinear optical response, which can be utilized for designing all-optical biomolecular switches. Bacteriorhodopsin (bR) protein found in the purple membrane of *Halobacterium halobium* has been the focus of intense research due to its unique properties that can also be tailored by physical, chemical and genetic engineering techniques to suit desired applications. The talk would focus on our recent results on all-optical switching in bR and its mutants, based on excited-state absorption, using the pump-probe technique. We would discuss the all-optical control of various features of the switching characteristics such as switching contrast, switching time, switching pump intensity, switched probe profile and phase, and relative phase-shift. Optimized conditions for all-optical switching that include optimized values of the small-signal absorption coefficient (for cw case), the pump pulse width and concentration for maximum switching contrast (for pulsed case), would be presented. We would discuss the desired optimal spectral and kinetic properties for device applications. We would also discuss the application of all-optical switching to design low power all-optical computing devices, such as, spatial light modulators, logic gates and multiplexers and compare their performance with other natural photoreceptors such as pharaonis phoborhodopsin, proteorhodopsin, photoactive yellow protein and the blue light plant photoreceptor phototropin.