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Sommario/riassunto

The rise of optogenetics as a standard technique to non-invasively probe and monitor biological function created an immense interest in the molecular function of photosensory proteins. These photoreceptors are usually protein/pigment complexes that translate light into biological information and have become essential tools in cell biology and neurobiology as their function is genetically encoded and can be conveniently delivered into a given cell. Like for fluorescent proteins that quickly became invaluable as genetically encodable reporters in microscopy and imaging, variants of photosensory proteins with customized sensitivity and functionality are nowadays in high demand. In this ebook we feature reviews and original research on molecular approaches from synthetic biology and molecular spectroscopy to computational molecular modelling that all aspire to elucidate the molecular prerequisites for the photosensory function of the given proteins. The principle property of changing activity of biological function simply by application of light is not only very attractive for cell biology, it also offers unique opportunities for molecular studies as excitation can be controlled with high time precision. Especially in spectroscopy the usually fully reversible photoactivation of photosensory proteins allows researchers to to perform time resolved studies with up to femtosecond resolution. In addition, functional variants can be investigated and quickly screened in common biochemical experiments. The insights that are obtained by the here

presented various yet complementary methods will ultimately allow us write the script for a molecular movie from excitation of the protein by a photon to activation of its biological function. Such deep understanding does not only provide unique insights into the dynamics of protein function, it will also ultimately enable us to rationally design novel optogenetic tools to be used in cell biology and therapy.