All living organisms utilize light for energy production (e.g. photosynthesis) and detection of the surrounding environment (e.g. vision). Photoreceptor proteins are efficiently used for these activities based on light. Moreover, recently, photoreceptor proteins have been indispensable in life science and medical application, enabling the monitoring and manipulating of cellular activities. For instance, the Nobel Prize in Chemistry 2008 was awarded "for the discovery and development of the green fluorescent protein, GFP". Photoreceptor proteins have a specific structure, and structural changes occur upon light illumination; the so-called 'photoreaction'. Clarifying the photoreaction dynamics is very important, not only for understanding life in more detail but also for the engineering of more useful photoreceptor proteins for science and medical application. However, observation of photoreactions is very difficult because the photoreaction starts on an ultrashort time scale of less than one trillionth of a second ($< 10^{-12}$ sec) and only lasts until milliseconds or seconds for some proteins. To overcome this difficulty, state-of-the-art laser setups were built in the LaserLaB in the Vrije Universiteit Amsterdam. In this thesis, unique photoreaction dynamics of various functional photoreceptor proteins are described.