Throughout the 20th century it has been widely accepted that, at the end of the day, a light microscope relying on conventional lenses (far-field optics) cannot discern details that are finer than about half the wavelength of light (> 200 nm). However, in the 1990s, it was discovered that overcoming the diffraction barrier is realistic and that fluorescent samples can be resolved virtually down to molecular dimensions. Stefan W. Hell will discuss the simple yet powerful principles that allow neutralizing the resolution-limiting role of far-field optical diffraction1,2. In a nutshell, features residing closer than the diffraction barrier are prepared in different molecular (quantum) states so that they are distinguishable for a brief detection period. As a result, the resolution-limiting role of diffraction is overcome, and the interior of transparent samples, such as living cells and tissues can now be imaged non-invasively at the nanoscale using focused light in 3D.

Stefan W. Hell

FAR-FIELD OPTICAL NANOSCOPY principles and recent advancements

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