LIGHT-SHEET GENERATION USING BESSEL BEAMS AND THE STED PRINCIPLE

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Light-sheet microscopy is an imaging technique which features enhanced optical sectioning by using a thin, sheet-like illumination of only that part of the object, which is in the plane of focus. By the use of computer-generated holograms, we generate self-reconstructing Bessel beams, which show enhanced propagation stability and penetration depth in scattering media and are thus superior, particularly for imaging in dense biological specimen [1]. However, the pronounced ring system, which facilitates the self-reconstructing property of the scanned Bessel beams, produces a significant image background by exciting out-of-focus fluorophores. By superposing a concentrically aligned, hollow Bessel beam with helical phase, stimulated emission depletion (STED) is used to reduce the background excited in the ring system [2]. Thus, highly focused beams permit to generate light-needles with diameters well below 1 µm with beam length of several tens of micrometers. This allows to improve the light-sheet quality, generating effectively thinner non-diffracting light-sheets. We present first results of such an imaging setup with scanned light-needles and discuss advantages and challenges.

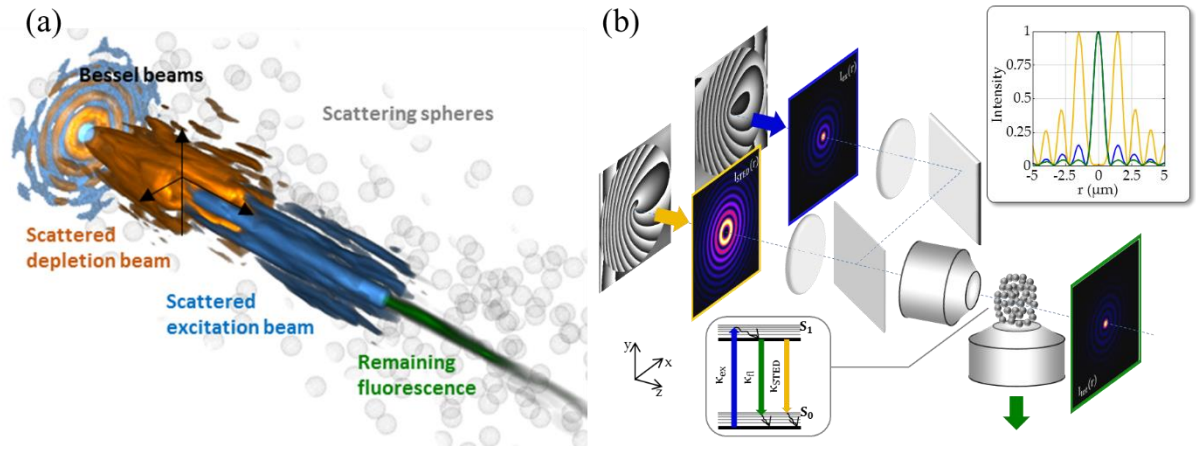

Figure 1: (a) Rendered intensity distribution showing the overlap of the excitation and depletion beam and the resulting beam profile for a static beam. (b) Exemplary phase holograms for the creation of the beam profiles, first experimental results and simulated beam profiles.

REFERENCES:

[1] F. O. Fahrbach, P. Simon, and A. Rohrbach, “Microscopy with self-reconstructing beams,” *Nat. Photonics*, **4**, 780–785 (2010).
[2] C. Gohn-Kreuz and A. Rohrbach, "Light-sheet generation in inhomogeneous media using self-reconstructing beams and the STED-principle," *Opt. Express*, **24**, 5855-5865 (2016).