EXTENDED NIJBOER-ZERNIKE DESCRIPTION OF THE HIGH-APERTURE FOCAL FIELD CREATED BY A BEAM WITH ANGULAR MOMENTUM

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KEY WORDS: High numerical aperture beams, angular momentum, optical storage

In some previous publications [1]-[2], the authors have presented a formalism that enables an accurate description of the focal field produced by a high-numerical aperture beam. The analysis is an extension of the original Nijboer-Zernike theory of aberrations and is capable to represent the electric and magnetic field vectors in the focal region of a high-*NA* objective with the aid of a well-converging series expansion in Bessel functions.
In this presentation we first treat, in a concise way, our new approach to calculate the vectorial field distribution in the focal region. The next step is to introduce angular momentum in the incident beam, either by means of the state of polarization (e.g. using circularly polarized light) or by geometrical means using a helically shaped phase plate. The field in focus is calculated and we analyse the energy flow represented by the Poynting vector. As an example, we have plotted in Fig. 1 the field distribution in the focal region for a linearly polarized incident beam with a helical phase structure (2π height). The energy flow shows the presence of angular momentum in the light beam. Other examples will be presented showing the conservation of angular momentum. We will elaborate on the use of angular momentum as a means to increase the density of information in an optical storage system.

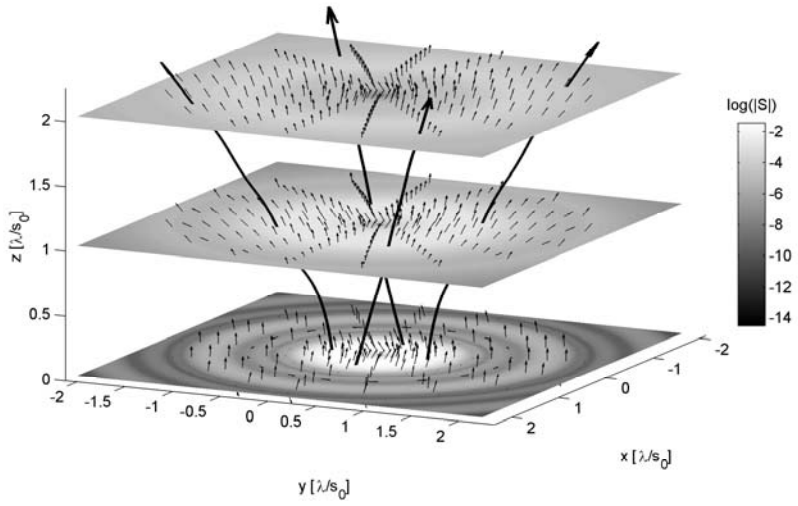

Figure 1: The Pointing vector distribution in the focal region in the presence of a helical structure.

1. A.J.E.M. Janssen, "Extended Nijboer-Zernike approach for the computation of optical point-spread functions", J. Opt. Soc. Am. **A 19**, 849-857 (2002)
2. J.J.M. Braat, P. Dirksen and A.J.E.M. Janssen, "Assessment of an extended Nijboer-Zernike approach for the computation of optical point-spread functions", J. Opt. Soc. Am. **A 19**, 858-870 (2002)