ADOPTION OF VECTOR VORTEX BEAMS TO INCREASE THE LATERAL RESOLUTION IN OPTICAL COHERENCE TOMOGRAPHY

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The capability of engineering the shape of a probe beam is crucial for many microscopy applications. The possibility of penetrating in depth inside the sample is indeed related to the numerical aperture of the objective lens, which also determines the size of the probe, and then the resolution, at the focal spot.

Optical Coherence Tomography is a powerful imaging technique, in which the axial resolution is decoupled from the lateral one and is mainly related to the source spectral features. In principle it is then possible to achieve micrometer axial resolution by keeping an high penetration (1-2 mm) inside the sample, by using a low numerical aperture objective lens. Nevertheless the lateral resolution strongly depends on the focalization inside the sample, and in order to achieve a high lateral resolution it is necessary to decrease the depth of focus and then the penetration inside the sample. Thus the development of extended depth of focus imaging schemes is an active area in OCT research [1,2].

More recently the so called vector beams were introduced [3], where the polarization in the beam transverse plane in space variant. Of particular interest are the vector vortex beams, in which the optical phase at a zero point of intensity is undetermined and the light beam carries orbital angular momentum. Compared with homogeneously polarized beam, vector vortex beams can be focalized in a tighter way but keeping an extended depth of focus [4].

We propose to adopt vector vortex beams in order to increase the lateral resolution in OCT applications, by using a particular device called q-plate [5], which allows to generate helical mode with a wave front elicity controlled by the input polarization. The q-plate is a birefringent liquid crystal plate with a topological charge q at its center [6]. The polarization pattern impressed on the output beam can be easily changed by changing the input beam polarization, and by tuning the liquid crystal orientation by acting on an external electric field.