SHARP FOCUSING OF BEAMS WITH CIRCULAR-RADIAL POLARIZATION

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INTRODUCTION

The study of hybrid vector beams [1-2] - beams in which not only the polarization direction, but also the phase changes periodically - is very widespread nowadays.

In the works devoted to modeling the sharp focusing of light, the Richards-Wolf formulas are usually used [3], since they allow to make calculations in vector approximation, allowing to calculate all components of the vector of intensity of the electric component of the light field in the coordinates of the exit pupil.

MODELING

We investigate the focusing of a beam with mixed circular-cylindrical polarization of the *m*-th order with the Jones vector:

$$a(\varphi) = -i\sin(m\varphi)$$

$$b(\varphi) = \cos(m\varphi)$$

where ϕ is the azimuthal angle, *m* is the order of the beam.

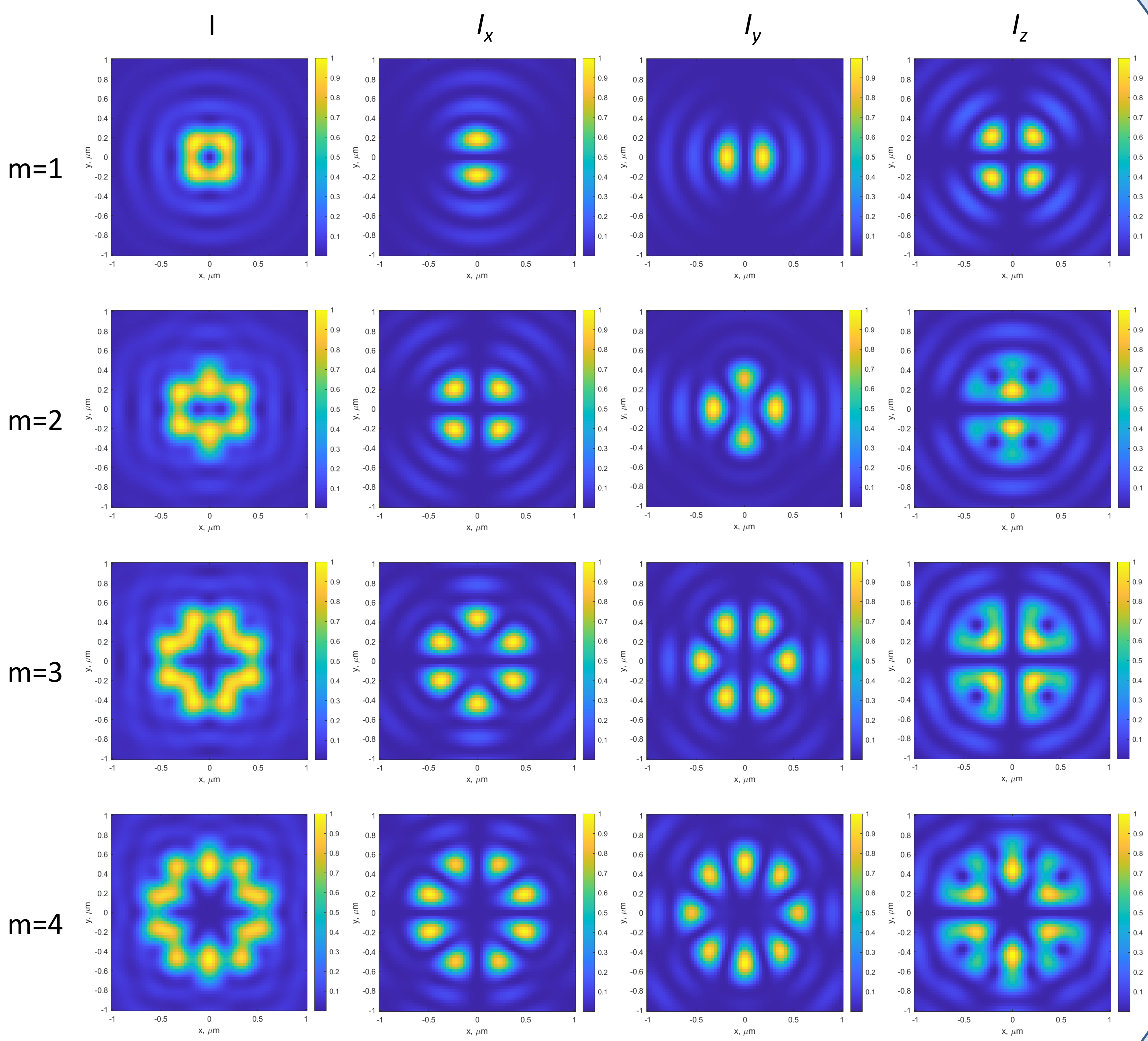
Modeling was performed using Richards-Wolf formulas:

$$\mathbf{E}(\rho,\psi,z) = -\frac{if}{\lambda}\int_0^{\theta_0}\int_0^{2\pi} B(\theta,\varphi)T(\theta)\mathbf{P}(\theta,\varphi)\times$$

$$\times\exp\left\{ik\left[\rho\sin\theta\cos(\varphi-\psi)+z\cos\theta\right]\right\}\sin\theta\, d\theta\, d\varphi,$$

where $\mathbf{E}(\rho,\psi,z)$ -the electric field strength at the focus, $B(\theta,\phi)$ - the electric field amplitude at the exit pupil of the wide aperture optical system, $T(\theta)$ - lens apodization function, f - focal distance, $k = 2\pi/\lambda$ - wave number, θ_0 - maximum polar angle, $\mathbf{P}(\theta,\phi)$ - polarization vector, for electric field strength.

MODELING RESULTS



Distributions of the total intensity I and its individual components I_x, I_y, I_z for orders m = 1,2,3,4

CONCLUSION

It is shown that:

- the intensity distribution in the focus is formed in the form of an irregular ring;
- if the beam order is *m*, the intensity in the focus has 2(*m*+1) local maxima;
- zero intensity is observed in the center of the focal spot;components I_x, I_y have 2*m* local maxima;
- I_z have a ring shape and zero value in the center;
- at negative values of the beam order m, the intensity distributions fully coincide with their positive equivalents.

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