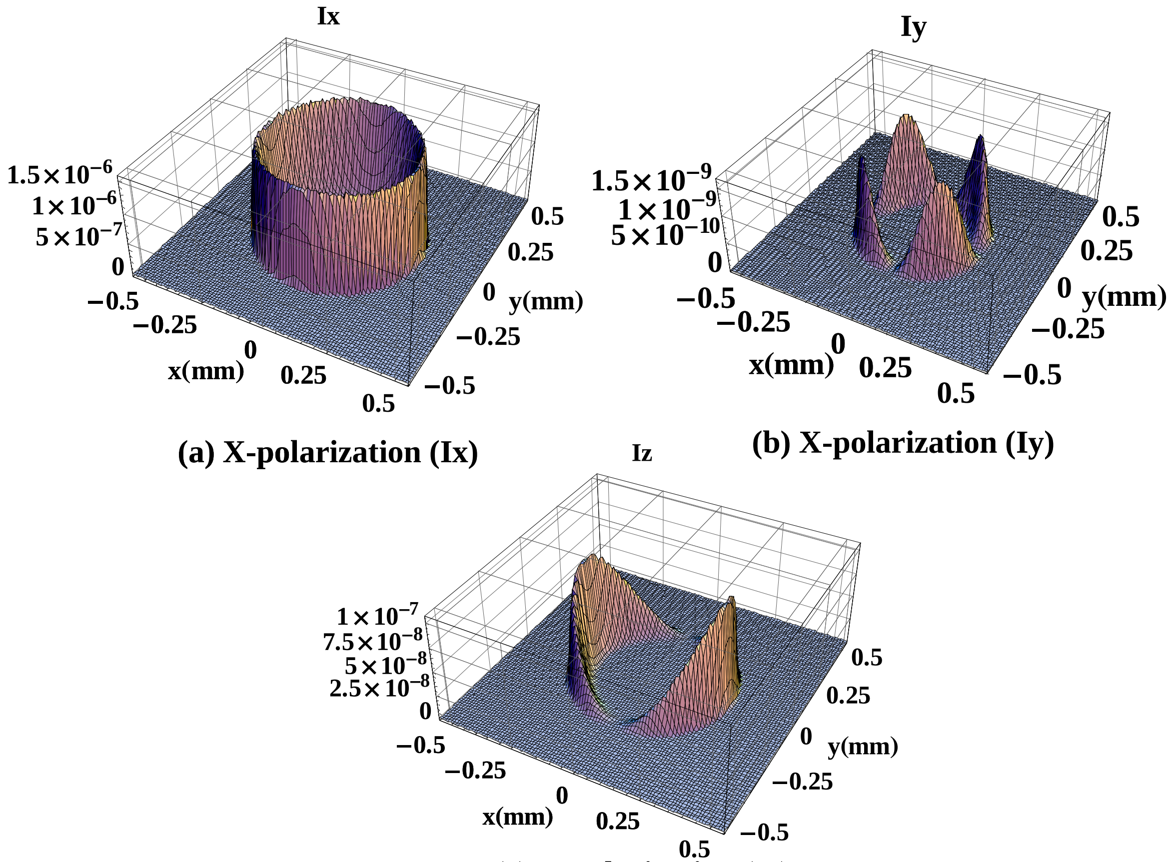
5.3 Contribution of the Longitudinal Field (I_z)

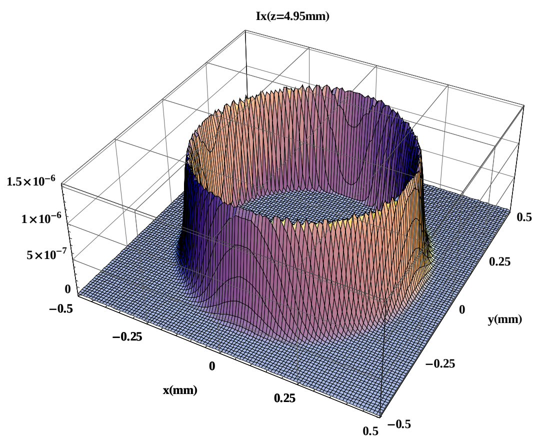
As we can see from Figures 5.5 and 5.6 for γ = 5^0 and f = 35.08 mm, the longitudinal field is about three orders of magnitude smaller than the traverse one for both polarized inputs. However, significant longitudinal contribution for the γ = 0.5^0 and f = 5.08 mm case that the field distribution of x-linearly polarization input nearby the thinnest ring position (Z_b) at z = 5.2 mm is shown in Figure 5.7.



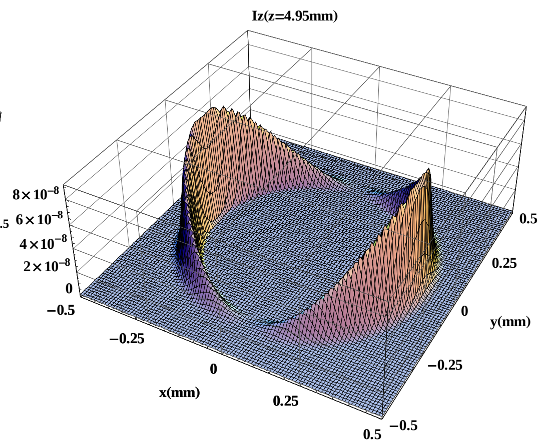
(a) X-polarization (Ix) (b) X-polarization (Iy) (c) X-polarization (Iz)

Fig 5.7 Cross sectional 3D beam profile of x-polarization at z = 5.2 mm for γ = 0.5^0 and f = 5.08 mm: (a) I_x, (b) I_y, and (c) I_z.

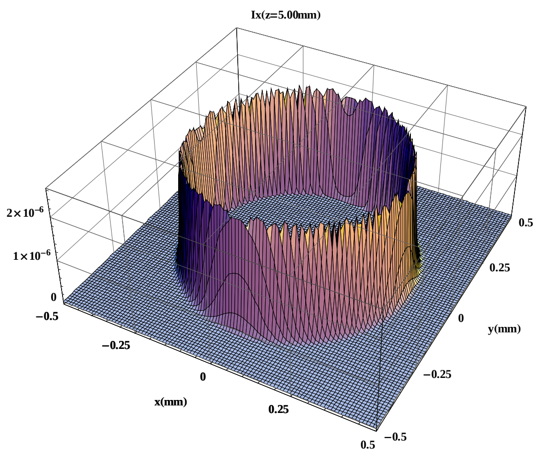
The ratios of the longitudinal field to the transverse one, I_z / I_ρ and I_z / I_x are ~ 10^{-3} for γ = 5^0 and f = 35.08 mm with very smaller I_y / I_x ~ 10^{-7}. However, the longitudinal field (I_z) approaches the traverse field with also relatively small I_y / I_x ~ 10^{-3} if both γ and f are significantly reduced to the case of γ = 0.5^0 and f = 5.08 mm. The higher contribution of the longitudinal field will result in an asymmetric dipole force. In the focal region, we show cross sectional profiles of I_x and I_z at different positions to make sure the weight that longitudinal field obtained in Figure 5.8 (a1)~(b5). We see that the ratios of I_z / I_x at different positions are 0.05 (z = 4.95 mm), 0.06 (z = 5.00 mm), 0.07 (z = 5.10 mm), 0.06 (z = 5.15 mm), and 0.07 (z = 5.20 mm), respectively. Therefore, we know that the weights of longitudinal field are similar to each other at different position in the focal region.



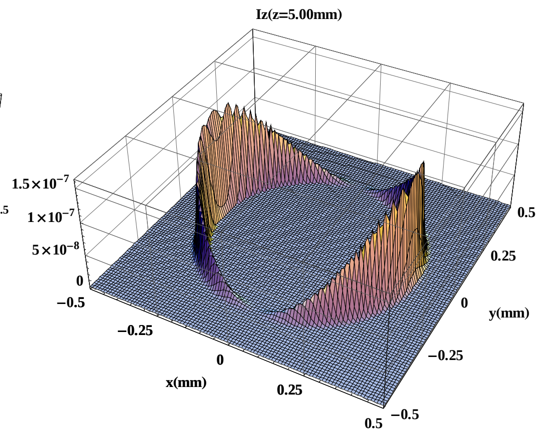
(a1) X polarization (Ix)
(z=4.95 mm)



(b1) X polarization (Iz)
(z=4.95 mm)



(a2) X polarization (Ix)
(z=5.00 mm)



(b2) X polarization (Iz)
(z=5.00 mm)