II-E Studies on Higher-Order Gaussian Light Beams

II-E-1 Simple Generation of Higher-Order Gaussian Beams and the Application to Spectroscopy

SASADA, Hiroyuki
(IMS and Keio Univ.)

Recently optical vortices have attracted considerable attentions because of the phase singularity and the characteristic intensity distribution. In particular, the dark region is very useful to trap and guide cold atoms provided by laser cooling.[1)] Several methods of generating the optical vortices have been reported so far, but their efficiencies are rather low.

Last year we demonstrated a simple and efficient generation of optical vortices using glass plates and an astigmatic mode converter. However, the phase jump introduced by the glass edge is so sharp that the generated beam consists of many higher-order Gaussian modes, and hence has too many vortices.

To overcome these difficulties, we have demonstrated a novel method using an interferometer. A Gaussian beam is first split into two beams by a polarizing beam splitter. Each beam is reflected once by a mirror, then overlapped again with a small misalignment at a beam splitter. A λ/2-wave plate is located in an arm to allow the two beams to interfere. The phase difference between two arms is adjusted so that the two beams have an opposite phase against each other at an output port. The resultant beam is very close to the HG_{10} mode (HG: Hermite-Gaussian). It is further converted into the LG_{01} mode (LG: Laguerre-Gaussian) with an optical vortex by an astigmatic mode converter. This method is also extended to generate the HG_{11}, HG_{21}, LG_{10}, and LG_{11} beams.

Reference

1) T. Kuga, Y. Torii, N. Shiokawa, T. Hirano, Y. Shimizu and H. Sasada, *Phys. Rev. Lett.* **78**, 4713 (1997).