Squeezing, Time Reversal Symmetry, and Chiral Optics

G Leuchs[1]

[1] *Max Planck Institute for the Science of Light, Erlangen, Germany*
Contact Email: gerd.leuchs@mpl.mpg.de

The probably most readily available squeezing of the excitation of a light mode is produced by the Kerr effect. However, the squeezing ellipse is tilted, rendering practical use difficult. A cure was proposed by Kitagawa and Yamamoto [1] already in 1986, turning Kerr squeezing into amplitude squeezing. This method requires a detailed balance between a non-linear phase shift, a linear path length difference and the splitting ratio, a combination, which is not easy to achieve perfectly, and the amount of observable and useful squeezing is limited. To maximize the observable Kerr squeezing, the next step was to increase the dimension to two modes and produce *e.g.* polarization squeezing [2]. The degree of squeezing improved, but the ellipse was again tilted so that the interferometric sensitivity was not improved. Now, a new method is being explored, making full use of the plethora of rotations of the quantum state on the Poincaré sphere, be it by beam splitters or linear phase shifts. The whole range of possible beam splitter rotations is discussed using time-reversal symmetry considerations following G.G. Stokes [3]. A combination of linear and circular birefringent optical elements such as fibers [4] allows one to dream up the new method of making Kerr squeezing more accessible to applications.

References

[1] M Kitagawa and Y Yamamoto, Phys. Rev. A **34**, 3974 (1986)

[2] R Dong, J Heersink, J F Corney, P D Drummond, U L Andersen and G Leuchs, Opt. Lett. **33**, 116 (2008)

[3] G G Stokes, Cambridge and Dublin Math. J. IV, 1 (1849)

[4] P St J Russell, R Beravat and G K L Wong, Philos. Trans. R. Soc. A **375**, 20150440 (2017)