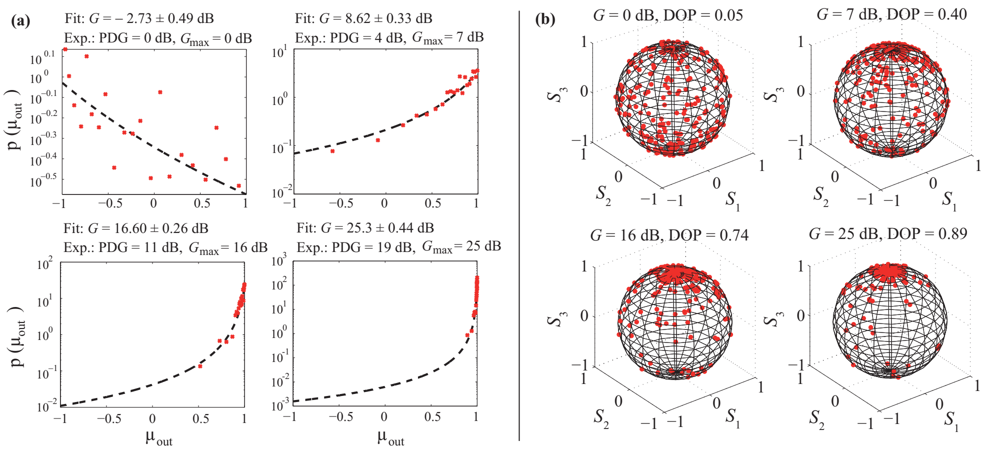


Fig. 3. (a) Probability distribution of signal $S_3$-component. Crosses: experimental data from Fig. 2; Dotted curves: fits by Eq. (5) with $G$ values and standard deviation $\sigma$ compared to the experimental values of PDG and the maximal gain in insets, (b) Signal output state of polarization on the Poincaré sphere calculated from Eq. (3) for the same values of $G$ as the maximal gain in Fig 2. The DOP is indicated in the insets.

alignment of the polarization and the spectra were not sufficiently stable to accurately measure the PDG. In order to confirm this assumption we plotted in Fig. 3(b) the signal SOP on the Poincaré sphere for the same values of $G$ as the maximal gain in Fig. 2 using Eq. (3) for $S_3$ and the corresponding ones for $S_1$ and $S_2$. As can be seen, the signal polarization is pulled towards the $S_3$-axis with increasing $G$. The theoretical results agree well with the experimental results in Fig. 2. However, this also confirms that the PDG in our experiment is actually higher and close to the maximal gain since the orthogonal parametric gain should be theoretically zero.

## 5. Conclusion

In conclusion we have proposed and demonstrated a new technique that achieves all-optical polarization control of light in optical fibers without using polarization-dependent loss, as in conventional polarizer devices. We demonstrated this technique for an initially unpolarized beam by using the strong polarization-dependent gain of a fiber-optical parametric amplifier. Both the signal and idler waves were efficiently repolarized while being parametrically amplified. We have also presented a theoretical prediction for the output PDF of the DOP, assuming an unpolarized input, that agrees well with experimental results.

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