

Fiber Optical Parametric Polarizer

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All-optical control of the state-of-polarization (SOP) of light using nonlinear effects in optical fibers has attracted much research interest in recent years [1-3]. These efforts are motivated by telecom applications requiring high-precision polarization control without adding polarization-dependent losses, as in conventional polarizing devices. Nonlinear polarization pulling has already been demonstrated in fibers using counter-propagating waves [1], stimulated Raman or Brillouin scattering [2,3].

In this work, we demonstrate a fiber-optical parametric polarizer (FOPP), i.e., a polarizing device based on parametric amplification in optical fibers [4]. This was achieved for both the signal and idler waves with 25 dB gain over a broad bandwidth using the strong polarization-dependent gain (PDG) of parametric amplifiers [4]. Figure 1 shows the experimental output signal and idler SOPs on the Poincaré sphere by increasing the pump power in a fiber parametric amplifier (See Ref. [5] for details). The experimental values of the degree of polarization (DOP) calculated from the Stokes parameters are indicated above each sphere. The gain spectra are also plotted with the parametric gain and the signal OSNR in insets. The Poincaré sphere represents the three normalized Stokes parameters (S_1, S_2, S_3) in unit radius. As it can be clearly seen in Fig. 1, the DOP of the signal significantly increases with the parametric gain, which means that the signal is simultaneously polarization-pulled and amplified. The best signal DOP is reached for the maximum parametric gain of 25 dB while keeping an optical signal to noise ratio (OSNR) of 22 dB. The idler SOP is also efficiently pulled towards the pump polarization. These results are in excellent agreement with a theoretical approach based on parametric gain [5].

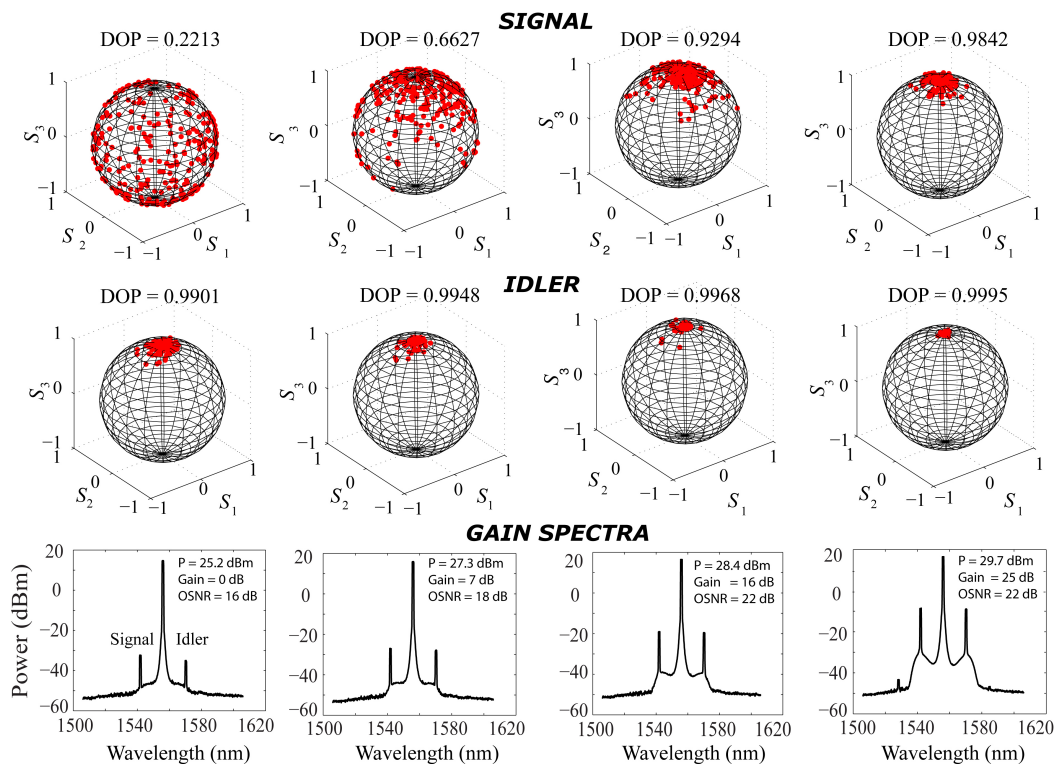


Fig. 1 Output state and degree of polarization of the signal and idler waves measured by a polarimeter and visualized on the Poincaré sphere of unit radius while pump power increases from 25.2 dBm to 29.7 dBm from left to right. The corresponding gain spectra are also shown, with the input pump power P, the parametric gain, and the signal OSNR.

References

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